ENVIRONMENTAL PERFORMANCE INDICATORS IN INDUSTRIAL MANAGEMENT SYSTEMS

A portfolio thesis submitted for the degree of Doctor of Engineering

by

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"Environmental Performance Indicators in Industrial Management Systems"

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Abstract

Measuring the Environmental Performance of industry is an essential element in the movement to minimise the impact that industry has on the environment. There has been a significant increase in interest in this area over the last few years, however it is recognised that the available literature still tends towards the conceptual and theoretical and there is little practical advice for a business wishing to undertake environmental performance measurement.

This project has concentrated on the practical development of tools and techniques for measuring environmental performance in a large, complex engineering company, using LucasVarity as an example.

The portfolio discusses the general trends and approaches in environmental performance measurement, explains the specific aspects developed in practice and their results. Finally, the general conclusions for industry are discussed.

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"Environmental Performance Indicators in Industrial Management Systems"

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"Environmental Performance Indicators in Industrial Management Systems"

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How to Read this Portfolio

This Portfolio is structured in three main parts:

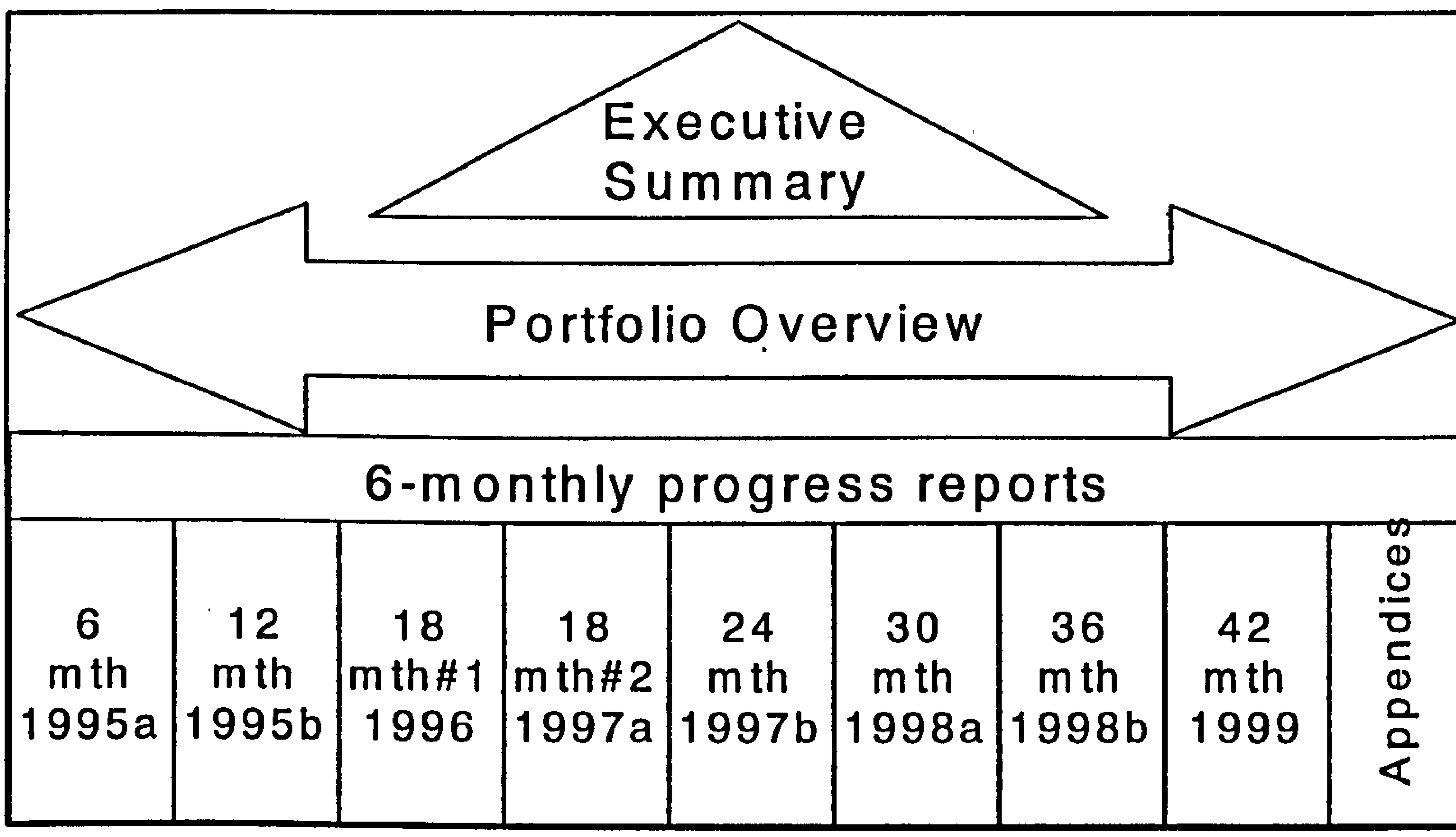
The Executive Summary

The Portfolio Overview

The 6-month reports and Appendices

As described by the diagram below. The triangle and double-arrow symbols will be found on each page of the Executive Summary and Portfolio Overview.

Figure 0.1 Portfolio Structure



The Executive Summary should be read first, in its entirety. It contains background information, the abstract, the objectives and how they have been met, and a diagram explaining the development of Environmental Measures of Performance System elements over the four years of the project. Whilst it makes reference to other documents within the Portfolio, it is suggested that these are not read at this stage.

The Portfolio Overview is a summary of all the issues addressed by the project and the specific work developed by the Research Engineer for LucasVarity, the sponsoring company. The overview will direct the reader to specific areas within the 6-month Reports and Appendices, where issues have previously been covered in detail. The reader is advised to leave the Overview at these points to read the relevant sections in the 6-month reports, if they have a specific interest in the subject described.

The 6-month Reports and Appendices contain the Research Engineer's work over the 4-year project, in chronological order.

The work presented in this portfolio is the Research Engineer's own although often developed in a team environment. Where the work of other team members has had a significant contribution this is noted. Where the work of other researchers is quoted, the author's comments are usually to be found in [*italics*].

Background to LucasVarity and the Research Engineer

LucasVarity is the result of a merger in 1996 between Lucas Industries plc (a UK company) and the smaller Varity Corporation (a North American company) to create an international company of over 47,000 employees. LucasVarity plc designs, manufactures and supplies advanced technology systems, products and services in the world's automotive and aerospace industries. In 1997 it had annual revenues of £4.7 billion, ranking as the 64th largest UK company by market capitalisation. LucasVarity is now one of the top ten automotive suppliers in the world, with 4 main automotive divisions and one aerospace division:

- Light Vehicle Braking Systems, LucasVarity's largest division, supplies braking systems and components to most of the world's major automotive manufacturers, with particular strengths in foundation brakes, actuation, anti-lock braking systems (ABS) and next generation systems such as traction control and vehicle stability control. LucasVarity is the number two worldwide producer of light vehicle braking systems
- Lucas Diesel Systems is one of the world's largest manufacturers of diesel fuel injection systems, serving the car, van, truck, bus, agricultural, industrial and marine sectors. Its product range extends from mechanical rotary fuel pumps, fuel injectors and filters to fully-integrated electronically-controlled systems. LucasVarity is the world's second largest manufacturer of diesel fuel injection systems.
- Lucas Electrical & Electronic Systems is a major supplier of advanced electronic controls, wiring and body electrical systems to the global automotive industry. Among several leading edge technologies it is currently developing are electric power assisted steering (EPAS) and adaptive cruise control (ACC).
- Lucas Aftermarket Operations is a leading provider of comprehensive parts, service, technical and diagnostic support to both vehicle manufacturers and the global independent automotive aftermarket.
- Lucas Aerospace provides the global aerospace industry with high integrity systems in engine controls, electrical power generation and management, flight controls and cargo handling, all backed by a world-wide customer support operation.

At the time of writing this portfolio, LucasVarity is in the process of being taken over by the American company TRW.

The **Research Engineer** (RE) commenced the Eng.D. project, in conjunction with Brunel University and Lucas Industries plc in October 1994. In July 1996, the RE took maternity leave and the Eng.D. project was held in temporary abeyance until September 1997.

At the start of the project the RE was already employed as Technical Manager, with responsibility for environmental projects in the corporate Health, Safety & Environment (HS&E) department. In January 1996, she was promoted to Programme Manager for Environmental and Management Systems programmes. The RE was responsible for the development of all the deliverables explained in this portfolio, with input from, and review by, other members of the HS&E department.

In April 1997, following the merger with Varity, the corporate HS&E department was dissolved and the RE made redundant. Following redundancy she continued the Eng.D. project as a freelance consultant working in close association with LucasVarity.

The RE is a full Member of the Institute of Environmental Management, a registered EARA auditor, a Chartered Engineer and Member of the Institute of Mechanical Engineers.

Executive Summary

1.1 The Issue addressed by the project

The issue addressed by this project was how to measure environmental performance across a Group of companies (125 in 24 countries) and how to design a system that would work, given the size, complexity and culture of the company.

The Research Engineer's thesis was:

> "A robust set of Environmental Performance Indicators can be developed and implemented in a manufacturing industry which will enable:
>
> - situations to be understood
> - informed decisions to be made
> - progress to be described"

1.2 Project Background

Lucas entered the 1990's from a "head-in-the-sand" position, when the traditional management approach to environmental problems had been to deal with any that became an issue (due to direct pressure of legislation, neighbours etc.) but to not go looking for problems that might then need addressing – i.e. it was considered that "unawareness" was a suitable defence for not having addressed an environmental concern. New businesses had been acquired without full knowledge of what environmental liabilities were lurking beneath the surface and there was insufficient corporate knowledge of the practices (good or bad) which were occurring at site-level. There was also poor understanding of what environmental legislation and pressures would come to bear in the future. Management were in denial – they thought that if they did not know about a problem, then it did not exist! (That was until the sand that their heads were stuck in started to show signs of contamination!) In the United States the "Superfund"[1] regulations were starting to bite and clean-up bills for some of Lucas' sites started to run into millions of dollars.

[1] The assessment of liability and the remediation of hazardous waste sites is found in the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA, commonly known as the Superfund Act). CERCLA imposes severe and strict liability as a means to inhibit pollution and to encourage companies to find new and better "best available technologies". It does not have its own cleanup standards but relies on the standards of other regulations. Cleanup funds come from the "Superfund", which was created and is continuously increased by taxes on chemicals and other hazardous waste. The EPA (US Environmental Protection Agency) recovers its costs of cleanup by assessing charges on the responsible parties involved. Responsible parties could include a site's current or past owners and operators, those who generated or transported substances disposed of at the site and even those who arranged transactions. (Epstein 1996)

Suspecting the First Law of Blissful Ignorance: "What you don't know will always hurt you" (Robbins & Finley 1997), management decided that "denial" was no longer an appropriate position and that it was time to understand the Company's environmental performance and take a more proactive approach. Consequently, in November 1991, Lucas Industries set up a corporate Health, Safety and Environment (HS&E) Department. The department built on an existing Health and Safety structure, adding expertise in Total Quality, Manufacturing and Management Systems to bring a new approach and to incorporate environmental issues.

A Policy and Audit system[2] was developed and launched in July 1992 and further work was to be developed and implemented in the following years.

This Engineering Doctorate project, to develop and implement an environmental performance measurement system across the Lucas (later LucasVarity) Group, was born out of the Company's development and implementation of HS&E programmes. Environmental performance measurement started as the outcome of the HS&E auditing programme and developed when "Commitments to Progress" (Lawson 1995b) were reported in 1994. The maturing of the audit programme led to the derivation of HS&E Management Standards in 1995 (Lucas Industries 1995), which were to become the auditing and management performance yardstick, and also the basis for self-assessment.

In 1995 it was decided that more quantitative, objective, "impact" measures were also needed to complement and confirm the semi-quantitative and relatively subjective management systems measures obtained by the audit programme. A set of measures was developed and a pilot study carried out in 1995/96 to investigate whether the required information could be easily gathered and to assess the size of the Company's environmental "impact". The "HS&E Measures of Performance" (MOPs) were implemented worldwide in 1998 and this project ends as the first year's data is being completed and preparations are being made for the future of environmental performance measurement in the Company.

The scope of the project covers all Lucas, later LucasVarity, manufacturing businesses worldwide. The intention being to develop corporate-led initiatives which would be implemented by each business and monitored at the corporate level.

1.3 Overall Goals and Objectives of the 4-year research programme

In the 24-month dissertation (Lawson, 1997b) the project objectives were refined and expanded, and progress against these objectives was described in the subsequent 30-month and 36-month progress reports (Lawson 1998a, 1998b). The objectives, are repeated here with summaries of the progress made up to the end of the project (March 1999).

[2] Explained in more detail in Portfolio Overview, section 2.

Objective 1: To design, develop and implement a workable system for measuring Corporate Environmental Performance in a large diverse business, using LucasVarity plc as an example.

The process described below was designed iteratively, from a simple audit scheme to a sophisticated quantitative system with buy-in from the organisation. A brief résumé follows to give the reader an overview of the work.

- Design and development of a system to measure environmental performance in Lucas Industries started in 1992, when the first **audits** were carried out against the corporate HS&E policy. **Environmental Management Standards** (Lucas Industries 1995, LucasVarity 1997) were developed in 1995 (detailed in 6 and 12-month progress reports – Lawson 1995a, 1995b) describing the management objectives and performance expectations that Lucas corporately wanted its businesses, worldwide, to attain.

- The audit process was then modified to use the Standards rather than the policy as a benchmark, and a new **semi-quantitative rating system** was developed in order to give audited sites an implementation score against the standards, expressed as a percentage. This rating system was also used as a **Self-Assessment system** so that sites could check their own progress between corporate audits (a full description is given in 18-month progress report #1 – Lawson 1996). In 1998 a Corporate Audit highlighted the difference between self-assessment scores and the audit scores obtained by the Corporate HS&E department. This led to the identification of some common weaknesses in process used by the businesses and procedures were developed to redress these discrepancies, notably a **procedure to help businesses identify which activities were contributing to their significant environmental effects** (Objective 6 below builds on this. Also the 36-month progress report has a detailed description – Lawson 1998b). A **verification process** (tabletop audit) was therefore carried out to check the self-assessment scores of one division, with 21 businesses (the Verification process is described in the 42-month report – Lawson 1999).

- A need for **quantitative environmental performance measures** to complement the Management Systems based audit measures, was recognised in 1994. This was due to the generally poor audit scores in the area of performance measurement and internal review. A pilot exercise was carried out with 6 sites in 1995/96 to see if the proposed quantitative performance measurement system was workable (conference paper "A Measure of success?" discusses the context and describes the pilot study – Lawson 1997d in Appendix U). The results of the successful pilot study (described in an internal report – Lawson 1997c in Appendix T) were accepted by the Group HS&E committee, and the study participants alike who agreed that this should be implemented across all the businesses. A change in business management (merger with Varity) delayed the process slightly, modifications were made and the process was introduced worldwide in January 1998.

Subsequently, data has been collected and analysed each quarter to give one year's worth of data. Presentation and analysis of this data can be found in Appendices AA & AH (business names have been changed to protect company confidentiality). This data provides the baseline for future improvement and target setting.

- **Internal reports** were produced for one of the divisions (Lucas Aerospace) after each quarter of data had been received (described in 36-month progress report – Lawson 1998b and Lucas Aerospace Report "Our Environmental Challenge": Appendix AH). In addition, the performance of divisions was compared across the Group. This showed some very large differences in performance which, when investigated, revealed not only real differences in performance, but differences in presentation of data. This was due to misinterpretation of some of the data definitions (described in 36-month progress report– Lawson 1998b and Appendix AC). Having highlighted the problem, a common approach was agreed and the results amended.

- The **practicalities** of collecting and analysing this sort of information from businesses across the world has also been examined and was discussed in the 1998 conference paper (Lawson 1998c). Questions raised during data analysis necessitated further discussions with data providers and a rewrite of the data definitions (described in Portfolio Overview, section 2.6).

Objective 2: To evaluate the effectiveness of the system, the impact of company culture and constraints on the design of the system, and recommend future improvements.

- The system has been effective in raising awareness of environmental issues, particularly among business management. This has been demonstrated by the increasing reference to environmental issues at business meetings, the regular references in company magazines and communications and increasing requests for information from non-environmental specialists. Analysis of the data and preparation of the Lucas Aerospace "Our Environmental Challenge" report (Appendix AH) has demonstrated, not only the company's direct, and indirect, links with global environmental issues, but also gaps in the data which makes it impossible for the Company to gauge the size of its true impact. (A discussion of this report can be found in the Portfolio Overview, section 2.7). Additional information will be requested from businesses in the coming year to address these gaps and improve the robustness and effectiveness of the system and the credibility of the data.

- The impact and constraints of company culture has affected the design of the system and the implementation time-scales. These factors have been summarised in tabular form and form part of the **Environmental Performance Evaluation (EPE) Methodology** explained in the 36-month report (Lawson 1998b, p.15 on and Portfolio Overview, section 3). The effect of culture on the design of the system is dealt with in more detail in the discussion of specific aspects of the project (Portfolio Overview sections 2.1 to 2.7)

Objective 3: To assess whether LucasVarity has the right set of measures to satisfy all its stakeholders and sufficient information to deliver an external environmental report.

- Organisational changes (company merger in 1996, dissolving of the corporate HS&E department in 1997, take-over bid in 1999) have meant that this issue has not been addressed. However, it would still be a valuable exercise, particularly if the company wishes to publish an external environmental report in the future.

Objective 4: To review how Environmental Performance is measured generally in industry, but specifically in large, diverse corporations.

- From discussions with environmental managers in other large, diverse corporations, it is clear that they have similar ways of measuring performance to LucasVarity. Smith and Nephew, GKN (GKN 1998), and ICI (ICI 1997) are all, like LucasVarity, British-based international companies, with many sites around the world. Each have developed in-house systems for measuring performance and, with the exception of ICI, have not felt the need to publish external corporate environmental reports, feeling that it is more productive (in terms of cost and effort) to use the information internally to drive improvement[3]. These companies are not under sufficient pressure to publish externally, they believe there is no competitive advantage and that the stakeholders most in need of this information are internal. Each of these companies has a corporate audit system, self-assessment and a set of quantitative measures that are reported by the businesses to the corporate centre on a regular basis.

Objective 5: To analyse a selection of Environmental Reports (undertaken in 1996/1997) and surveys, evaluate the types of measures now being used and review the latest developments. Also to evaluate the robustness of the systems adopted, i.e. are the metrics interpreted similarly by the users, are they comparable across time, location and organisations, and are they repeatable?

- The Research Engineer's strategy has changed here, since the last two years has seen a plethora of new survey reports (including UNEP/SustainAbility 1997, Bennett & James 1998 for ACCA, PIRC 1998, DETR 1998b, Skillius & Wennberg 1998, and the MEPI project – Wagner and Wehrmeyer 1999) which have analysed Environmental Reports and/or environmental performance indicators. Rather than repeat this work, it was decided to review these surveys. The ACCA report by Bennett and James is reviewed in some detail in the 36-month report (Lawson 1998b, pp 22-36). Other reports are referenced later in the Portfolio Overview document. A database of quantitative measures quoted in these reports and other specific Corporate Environmental Reports has been compiled for reference (see Appendix AI).

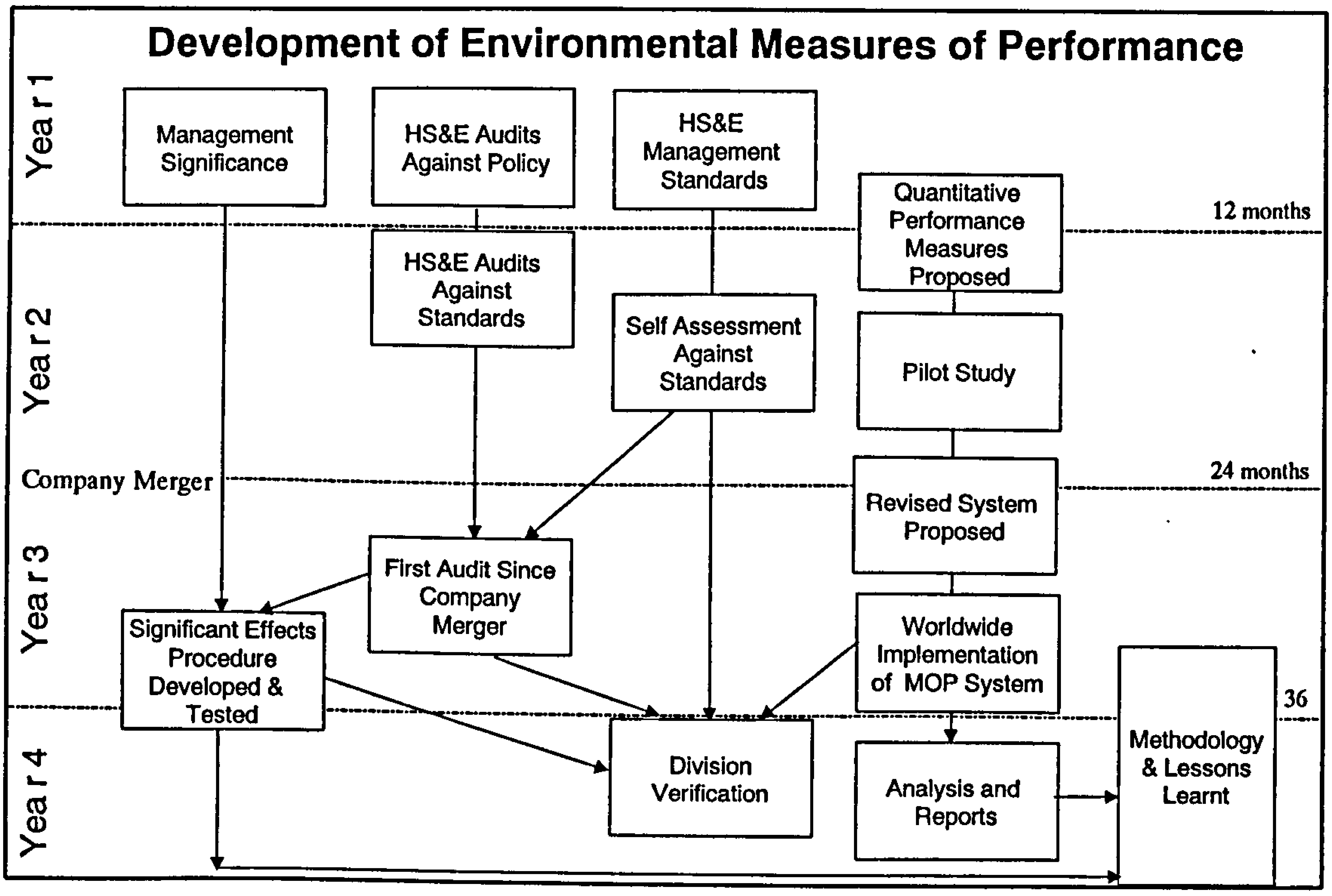
[3] From personal discussions with environmental managers in these businesses.

Objective 6: To develop a decision-making methodology for Environmental Performance Evaluation in LucasVarity. This may also be tested at other companies (if time and opportunities allow).

- A methodology for identifying significant environmental effects and the activities that contribute to them was first developed as a management tool and tested with groups of managers at several Lucas businesses (described in 12 month report: Lawson 1995b). This methodology was structured but still subjective since it relied on the managers to weight the factors influencing an activity's "significance". Since that time, the methodology has been augmented into a step by step procedure that provides a wider range of criteria against which to judge "significance". In this way it is a more robust and repeatable procedure which requires less subjective judgement on the part of the user. This procedure is explained in detail in the 36-month report (Lawson 1998b, pp 9-14 and Appendix AE). The procedure has been used by seven UK Lucas Aerospace businesses, who have expressed positive comments about the process (see Portfolio Overview section 2.5).
- Identification of significant effects (or aspects and impacts – as used in ISO14001) is the first step in understanding the business priorities prior to determining its objectives, targets and necessary measures of performance. An EPE (Environmental Performance Evaluation) Methodology is proposed in the 36-month report (Lawson 1998b, pp 15-20), and the Portfolio Overview (section 3), which includes consideration of cultural factors and business constraints. The elements of the methodology have been synthesised using techniques frequently used in, and familiar to, LucasVarity such as assessment matrices (Lawson 1998b, pp 17-20) (used extensively in Lucas for Risk Assessment and auditing), brainstorming and gap analysis.

The following diagram shows how different elements in this project have developed over the four years. These elements are discussed in more detail in sections 2 and 3 of the Portfolio Overview.

Figure 1.1 Development of Environmental Measures of Performance System Elements.



1.4 Summary of Findings (contributions to knowledge)

Self-Assessment systems

Whilst Self-Assessment is a valuable tool for sites to monitor their own progress, third party audits or other verification are also needed to maintain the standard of assessment across businesses. Calibration is achieved by cross-referencing and triangulation with audit results and other measures (such as quantitative results, compliance records etc.) to ensure that self-assessed results are moderated. It has been demonstrated that, in this way, results remain within an acceptable tolerance, enabling business decisions that take account of both financial and environmental considerations to be made.

Identifying and prioritising significant effects

The "significant effects" methodology is a step by step procedure that provides a wide range of criteria against which to judge "significance". Significance is assessed using a set of criteria which combine the significance of 1) the impact on the environment and 2) the impact on the business. It is a robust procedure which brings more objectivity to the decision-process than was previously the case in LucasVarity. The whole process, plus the use of the matrix as a visual output is considered to be a contribution to knowledge.

Linking environmental performance data with global environmental impacts

Using company environmental performance data to illustrate the business impact on certain environmental issues is a valuable exercise because it has enabled the company to understand its impact on global environmental issues, it has highlighted areas where the performance measurement systems needs refinement and it is known to be a forward thinking approach within engineering companies. The impact indicators used will allow for comparisons to be made across time and businesses.

Industry information requirements

Industry requires practical systems to reflect businesses' need to measure environmental performance. None of the literature researched, leads managers through a thought process that they can buy-in to, customise for their own purposes, and build on. The literature surveyed tends to propose only an end point, the EPE methodology developed by the author is designed to take a business from where they are now to that end-point.

Engineering companies do have an important environmental impact

The work at LucasVarity, clearly indicates that engineering businesses do have important environmental impacts which need to be acknowledged and addressed, and it is possible to implement a useful environmental performance measurement system, even across diverse businesses in many countries.

REFERENCES and BIBLIOGRAPHY

Refer to Portfolio Overview document

Portfolio Overview

The next document in this portfolio is an Overview, which describes all of the subject matter contained in the Portfolio. The five main sections discuss:

1. General aspects and literature referring to the subject area
2. Specific deliverables developed during the project (as outlined in diagram 1.1 on page 11 of this Executive Summary)
3. A Methodology for a company to develop its own environmental performance evaluation system, derived from the work developed for LucasVarity during this engineering doctorate project.
4. Implications for industry in general
5. The possible future of environmental performance measurement in LucasVarity.

Throughout the overview, reference is made to Progress Reports and Appendices in the Portfolio, which contain supporting material, which the reader may wish to examine if they have a particular interest.

Portfolio Overview

Nicolette Lawson

Engineering Doctorate Portfolio 1999

"Environmental Performance Indicators in Industrial Management Systems"

Acknowledgements

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- Prof. James Powell (ex-Lucas professor and co-founder of the EngD programme) for suggesting this course to me: "It will be easy – just write up your work as you're going along" [*Thanks James, you made it sound so easy.*]
- Dr. José Guzman-Bello who first gave me the opportunity to work on environmental issues in Lucas.
- Dr. Mike McKiernan (director HS&E, LucasVarity) for signing the university invoices, allowing me to "practice" on Lucas/LucasVarity and taking my ideas on board.
- All ex-members of the LucasVarity HS&E department for being part of this "experiment"
- Terry Bridgewater (HS&E manager, Lucas Aerospace) for employing me as a consultant, after the demise of the Group HS&E department, and enabling me to develop my ideas, using Lucas Aerospace as a case study.
- Dr. Chris France for reading and editing my work and boosting my ever flagging confidence.
- My parents for allowing me to be what ever I wanted to be.
- My husband, Shane, for making me stick at it (he always wanted to marry a doctor!)
- My daughter, Johanna, for interrupting this project by being born, for getting me up early in the morning, for making me realise there is more to life than work and for extending my future beyond my own lifetime.

Contents

Figures and Tables

Portfolio Overview

This Portfolio Overview describes all the subject matter contained in the Portfolio and signposts the reader to more detailed discussion in the 6-monthly Reports and Appendices. The first section of this report covers the general aspects surrounding environmental performance measurement in industry and refers to the relevant body of literature. Sections 2 to 4 describe the specific aspects developed during the project through to the implications for industry in general.

1 General Aspects and literature

Section 1 of this report introduces the reader to the need for environmental performance measurement in industry, what is driving businesses to do it, why the current methods of measuring business performance are not sufficient, the progress that has been made in measuring and reporting environmental performance in industry, the benefits and problems associated with this type of performance measurement and what guidance is generally available to business.

1.1 Introduction

This project thesis was described in the 18-month progress report (#1, Lawson 1996)

> "A robust set of Environmental Performance Indicators can be developed and implemented in a manufacturing industry which will enable:
>
> - situations to be understood
> - informed decisions to be made
> - progress to be described"

When the project started in 1994 there were no specific external requirements for Lucas to report environmental data. The requirement to supply data for compliance reasons was also very small. However, companies, feeling the increasing pressure to measure their environmental performance started to produce environmental reports based upon their own environmental parameters and effects, but with no external standards or guidelines to work to each company and industry developed their own approach. Now, legislation, such as the UK Integrated Pollution Control 1990, packaging regulations (1996) and Environmental Management Standards such as EMAS, ISO14001 (1996) and ISO14031 (draft 1997), highlight the need for businesses to collect environmental information, either to submit to the authorities directly or to use as a tool to support Environmental Management Systems (EMS) and to drive continual improvement.

1.2 Why does Industry need to measure environmental performance?

In the 24-month dissertation (Lawson 1997, section 3.1), the role of global environmental performance measurement was outlined as a method used to describe man's effect on the earth, as a tool for communication and as a gauge to assess the impacts (positive or negative) of human actions, particularly business activities. The role of general performance measurement in business was described (Brown & Laverick 1994) and seen to be a logical method for reporting businesses environmental performance, particularly for stakeholders. The challenge of Environmental Performance Measurement and its development was covered (BiE and KPMG 1992, Mudie 1995, Houldin 1994), as well as its many potential benefits (Klassen and McLaughlin 1996, Porter and van der Linde 1995, Pope & Lawson 1994, Macgillivray and Zadek 1995).

Measuring environmental performance can provide a more holistic way of looking at business costs, for example, Azzone and Manzini (1993) make a good point about the use of environment-related costs – they tend to integrate a raft of previously unrelated costs (as far as the accountant is concerned) which is more effective in controlling the company's costs than optimising a few chosen areas such as purchase price. The example given is that "production centres could improve their financial performance by using materials that cost less but that are more difficult to be recycled. Hence, the cost of production will decrease, but the total cost for the corporation could increase, due to higher costs of disposal." Indeed, in the light of future product "take-back" legislation this argument becomes more powerful.

McNair et al (1990) state that:

> "Managers need clear, timely and relevant signals from their internal information systems to understand root causes or problems, to initiate corrective action, and to support decisions at all levels of the organisation"

The story of the Toxic Release Inventory demonstrates the positive outcomes that can result from reporting data. Also known as Title III of the 1986 U.S. Superfund Amendments and Reauthorization Act (SARA), it requires companies to report the quantities of 300 listed chemicals emitted into the air or water on a facility basis. Company leaders feared adverse public reactions and some did indeed get negative publicity. But for the majority, gathering the data fostered mutual technical assistance among companies, the transfer of good practices from division to division and increased contact with customers and suppliers (Baram 1990 in Senge et al 1997, p461). The data collected however, is far from accurate. TRI requires the reporting of estimated data and does not mandate that facilities monitor their releases. Variations can occur due to different estimation methodologies employed, such as mass balance, use of published emission factors, engineering calculations or best engineering judgement. In addition, it is known that some facilities may not be fully complying with the reporting requirements either by failing to report at all or by reporting only some of their covered chemicals (EPA 1999). Despite the inherent inaccuracies of the data, the simple act of collecting and reporting data has still had a marked beneficial effect on the behaviour of most reporting companies.

"Since its creation in 1989, BiE's [Business in the Environment's] experience of working with companies on environmental issues suggests that managers continuously ask the same question: how do we compare with other companies? As an awareness raising exercise, the index [of Corporate Environmental Engagement] is intended to encourage environmental comparison between companies [in the FTSE100], and so encourage companies to collectively improve standards of environmental management." (BiE 1996b)

"The overall objective of the Index is to raise awareness of environmental best practice by gauging the level of environmental activity and commitment in the corporate community. The survey will present a clearer understanding of what companies are doing and encourage comparison. BiE hopes that it will also motivate companies to further improve their performance." (BiE 1996a). This has indeed been the case. The second year's report from the BiE showed many companies moving up the ranking table, however, some companies scored lower against the second survey because it included more "qualifying" questions (BiE Seminar 26th June 1998, London).

1.3 What are the drivers behind the measurement and reporting of environmental performance?

External drivers for <u>measuring</u> and improving environmental performance were listed and internal drivers were described in the 24-month dissertation (Lawson 1997, section 3.2). External drivers include legislation (covering processes and increasingly, products), international standards, customer requirements (use of non-hazardous materials, returnable packaging etc.), shareholder concerns (e.g. pollution incidents and bad publicity could affect share price), attracting investment (unresolved environmental liabilities could put off investors), pressure from consumers and the supply chain to provide goods and services at decreasing environmental cost (e.g. more repairable, more fuel efficient, using more recyclable materials, etc.), pressure from environmental groups and associated media influence. Internal drivers include monitoring improvement, management expectations, employee and neighbours' concerns, making business decisions and setting priorities (Bennett and James 1994, Steger 1996).

The drivers for <u>reporting</u> environmental performance are similar, but it is likely that the balance will be more heavily towards the external pressures. Therefore an external environmental report would be seen as a way to address the concerns of external stakeholders.

The Pensions Investment Research Consultants maintain that there is a trend to increased corporate disclosure (PIRC 1998). They cite the Institute of Chartered Accountants views that radical change is needed and that performance measurement systems must be designed to achieve the twin objectives of promoting prosperity and accountability simultaneously: "it is no longer a question of incremental improvement, we must challenge many long held views" (ICAEW 1998). The government is also supporting environmental reporting when they stated that "Company's employing over 200 staff will be expected to report on environmental policies" (John Prescott, Deputy PM, 1998).

1.4 How should business performance be measured?

Financial measures traditionally have dominated the way company performance has been described. Other methods of measuring company performance include qualitative and risk ratings for investment, strategic measures such as growth and market share and production measures such as efficiency and output. None of these measures, however, have adequately described a company's environmental performance. In the 24-month dissertation (Lawson 1997, section 3.3) the dominance and incompleteness of short-term financial measures which are used by business to measure performance are discussed (Brown & Laverick 1994, BiE and KPMG 1992, Gray 1993).

Gray (1993) asserts that "if accountants are score keepers and the score takes no account of environmental matters neither does the economic decision making. Decisions must be environmentally malign."

When discussing the limitations of existing performance measurement systems, Zairi says most arguments centre on the fact that existing financial management systems are incompatible with modern management concepts such as "Just-in-Time" and "Total Quality Management" (Zairi 1996[1]), and the author would include the management of environmental issues.

Criticisms of management accounting systems include:

- Their incompatibility and lack of relevance to the demands of the modern business environment.
- Big distortions and inaccuracies since they focus on product costs and not the process
- Their inability to incorporate change and their remoteness from the process
- Making the visions of best-in-class difficult to achieve since they only focused on short-term results (Zairi 1996).

Gray implies that accountants are ignoring the efforts of specialists trying to measure environmental performance and are effectively ring-fencing their financial systems rather than helping to integrate environmental performance measurements into the central business systems:

[1] Zairi's book on "Benchmarking for Best Practice" is one of the most comprehensive that could be found on this subject and therefore has been quoted frequently.

"The systems at the heart of an organisation, the budgeting and investment and performance appraisal systems ...., have remained largely untouched by the changing environmental agenda. Until they do develop in this way, organisations will face conflicts between environmental *and conventional financial factors - and in those circumstances* the financial will always win over the environmental." (Gray, 1993)

However, very few measures of performance are without problems. Even the economic measures by which whole nations measure their progress are deeply flawed, especially with respect to environmental costs. For instance GDP/GNP does not include factors such as unpaid domestic labour and non-money transactions, distribution of income, different needs and circumstances, leisure time and quality of life. It considers that environmental resources are "free" and that all economic activity is good. GNP favours expensive ways of providing services and short-term decisions rather than long-term provisions (Anderson 1991). But people in all professions still rely on indicators and measures to make decisions and to measure progress, however incomplete or biased they may be.

Handy (1995a pp 220-1) highlights the inadequacy of GDP, when he says:

"if the cars and the highways are so bad that accidents proliferate, then hospital, car-repair and insurance bills increase, and so does the supposed wealth of the country as these transactions find their way into the national accounts. You can spend money polluting the clean air of the countryside with a factory, muck up its rivers and destroy the peace and stillness of the place, and it will all be counted as an increase in wealth because nothing is deducted for the damage. If the firm were fined, or charged, for what they had done, it would, apparently, make us even richer. We are encouraged to be a disposable society by the way we count. The more you throw things away and buy new things instead of having them repaired, the richer society appears."

Zairi (1996) states the need for new performance measures in business include [*authors comments in italics*]:

- "Management approach has moved from manager-centred to customer-centred with emphasis on delivering quality rather than quantity. [*In the environmentally-aware age this means that customers are less likely to want to do business with a company that can produce the goods but does so at the expense of the environment. This is evidenced by the environmental questionnaires and requests for environmental improvement that LucasVarity has received from customers, and the environmental supplier criteria operated by the likes of British Telecom (1994) and B&Q (1995)*].
- Direct physical measures are an effective means to decision making, i.e. proactive rather than reactive

- Measuring the process directly gives better control [*rather than measuring the final product – as with quality any problems need to spotted and corrected as soon as possible and not after the event*]
- Measures can support strategic direction, i.e. measure progress towards goals
- Performance measurement has to fit in with the culture of the organisation [*therefore it must be tailored to fit specific criteria which makes each organisation function in a unique way*]
- Should allow for involvement of individuals and process owners, through continuous measurement and improvement of associated processes."

1.5 What progress has been made on measurement and reporting of environmental performance?

In their comprehensive report on corporate environmental performance measurements and communication, Skillius and Wennberg (1998) [2] uncovered some little-publicised information contained in Agenda 21, the action plan for sustainable development Agenda 21[3], which was adopted at the United Nations Conference on Environment and Development in Rio de Janeiro in June 1992:

> "The business community, including transnational corporations, should recognise that environmental management is one of the highest priorities and a decisive factor in sustainable development". Chapter 30 encourages business and industry to communicate their environmental performance and to report "annually on their environmental records, as well as on their use of energy and natural resources" and "on the implementation of codes of conduct promoting best environmental practice".

"Nearly 80% of companies (based on survey of FTSE 100 companies, 1996) now address the environment in their annual report" (KPMG 1997). Although the quality of the reporting can vary widely.

KPMG (1997) list some of the wider developments in reporting:

- "Several countries have made reporting of environmental information mandatory
- Guidance on environmental issues in financial reporting has been issued by the Institute of Chartered Accountants of England and Wales [*ICAEW*] and the Advisory committee on Business and the Environment [*ACBE*] on good reporting practice.

[2] Skillius and Wennberg wrote such a comprehensive report for the European Environment Agency, that it has been referenced frequently.

[3] Agenda 21 is a very large document (at least 30 chapters) which was seen as a Government document and few companies would have had sought to read it.

- Companies are working on new ways to present environmental information (e.g. Environmental Burden by ICI)
- Environmental reporting is now clearly recognised as an important aspect of corporate communications and is resulting in better information systems."

However, referring to the limitations of environmental reports, Azzone et al (1996) state that:

> "the intrinsic complexity associated with environmental issues means it is difficult to understand all the feasible actions available to a firm for reducing its impact on the environment. Such complexity makes it difficult to accurately assess the real environmental performance achievements made by the firm. Indeed, the effects of the company's products and processes can be expressed only by referring to a number of non-compliance measures (e.g. pollutants, solid wastes, energy consumption and wastewater) requiring distinct measurement units. Underlying the choice of measures will be set of values about the most significant environmental impact; these values are rarely revealed to the reader."

And "little work has been carried out on synthesizing the information into a clear conclusion which enables the stakeholders to make judgements on a company's overall record." (Azzone et al 1996).

Most large companies are measuring some aspects of their environmental performance although the quality and quantity varies greatly (PIRC 1998, BiE 1996b). Small to Medium sized companies are less likely to be measuring their environmental performance because they do not see themselves as having a significant impact or the spare resources to address the issue.[4] Paradoxically, the measurement of environmental performance is easier to implement in small to medium sized enterprises (SMEs) due to their lower level of complexity and lack of "corporate barriers". Indeed, organisations like the Engineering Employers Federation (EEF) are in the process of obtaining funding to help SMEs implement environmental measurement systems.[4]

Skillius and Wennberg (1998) state that it is still predominately large, multinational industrial companies that produce environmental reports. These companies tend to be in the environmental spotlight, such as chemical, oil, gas and power generation industries and the forestry, paper and pulp industries.

Companies, such as LucasVarity, that are new to measuring quantitative environmental performance and/or do not feel direct pressure to report externally, will continue to focus on environmental performance measurement and reporting as an internal exercise for the immediate future. Once these businesses have sufficient data, and a comfortable level of confidence in the data quality and completeness, then there will be less resistance to exposing

[4] From personal discussions with EEF.

that data to the outside world. However, with the existing quality of environmental reporting getting better and better, any newcomers will have a greater entry-level standard to live up to.

1.6 What are the common pitfalls?

One of the first obvious actions to take with data is to look for ways to compare it with other data, e.g. how does it compare historically within the company or how does it compare with competitors (this comparison is often referred to as benchmarking). Comparison with peer groups works well for utilities such as water, power companies (Electricity Association 1998) and commodity industries, such as oil producers, because they provide common services or products, use common materials and resources and produce common impacts. Other companies vary widely, even within one company, such as LucasVarity, the subsidiary companies are not directly comparable since they produce different products with different materials, different processes and different emissions. There are some common quantitative measures that can be collected and compiled, e.g. sales and number of full-time employees, but comparisons are still difficult due to the diversity of products and processes. Tonnes of output would be an alternative comparator and would change the picture, but it is still inadequate since more tonnes might mean more material goes into the product but that cannot be said to be directly proportional to energy, waste or pollution. Standard hours (the amount of labour that goes into a product) might be a better denominator, but that does not take into account differing levels of automation. Only environmental management, or engagement (i.e. the types of systems and processes that are in place to manage environmental issues) is truly common, this is why the LucasVarity audit and self-assessment process and systems like the BiE FTSE100 "Environmental Engagement" survey concentrate on management systems issues. However, their last questionnaire (October 1998) started to collect information about quantitative measures because they recognise that this is where the key to real performance measurement lies.

Implementation can be difficult due to culture and business constraints. The following table takes reasons why mission statements failed to be implemented (Zairi 1996) and compares these to the approach taken at LucasVarity.

Table 1.1: Understanding culture and implementation

Reasons why mission statements failed to be implemented (Zairi 1996)	**Comments and approach taken at LucasVarity** (*by the author*)
"In many cases managers knew what they had to do but did not know how to do it"	*It is for this reason that simple step-by-step guides to implement the mission statement, policy and standards are needed (and were developed for identifying significant effects – see section 2.5).*

"Managers were stretched and not necessarily prepared to handle fundamental challenges in terms of introducing radical changes"	*Again a step-by-step methodology helps to cut down the managers' own time in developing an approach.*
"In many instances, vision and mission tended to be statements on paper only. There was no life, no enthusiasm, no belief and commitment to make things happen"	*Leadership and champions are needed – the most progress has been made in the LucasVarity Divisions that have this commitment. This is illustrated by the appointment of a full time HS&E Manager (plus additional resources) with backing from a senior board director; a steering committee including all the key divisional directors and financial support for environmental projects. Even though appointed HS&E practitioners are in place at each site, they have lacked direction and motivation without this top management commitment.*
"The short term response of board members to economic pressures. This tended to enter into conflict with what the mission tended to drive at."	*It is for this reason that the environmental drive was tied into Total Quality, cost savings and liabilities – so as to integrate it into the corporate strategy.*
"Poor communications, lack of understanding and lack of commitment."	*Communications is vital in order to change behaviour, as is commitment from the top. Within LucasVarity it was found that communications is most effective when it is tailored to, and focuses on, the specific drivers of the particular audience being addressed (see also Eng.D. conference paper: Lawson 1995 in Appendix V).* *This is such an important issue that the last journal (Feb 1999) of the Institute of Environmental Management (IEM 1999a) was devoted entirely to "Environmental Communications"*

"The recession has aggravated levels of cynicism, meaning that managers revert to old reactive habits of fire-fighting when survivability becomes an issue."	*Environmental management, and measurement, (like quality management) has to be embedded into the systems of the business otherwise it will not be maintained. Anything perceived to be an "add-on" would be dropped as soon as other pressures are raised.*

1.7 What are the benefits to business?

The European Green Table report (1997) defines the benefits of environmental performance measurement as follows:

- "Provides the management with concise and quantifiable environmental information
- Improves the basis for companies' environmental policy objective and targets
- Improves the basis for companies' internal and external environmental reporting as well as communication regarding environmental issues
- Enables companies to define their significant environmental aspects and describe and measure their environmental performance.
- Enables companies to focus on and demonstrate continual improvement of environmental performance
- Serves as a useful tool for those aiming at certification to ISO 14001 and EMAS
- Enables companies to complement existing environmental performance scopes by including developments of indicators for Health and Safety
- Improves the basis for internal and external benchmarking"

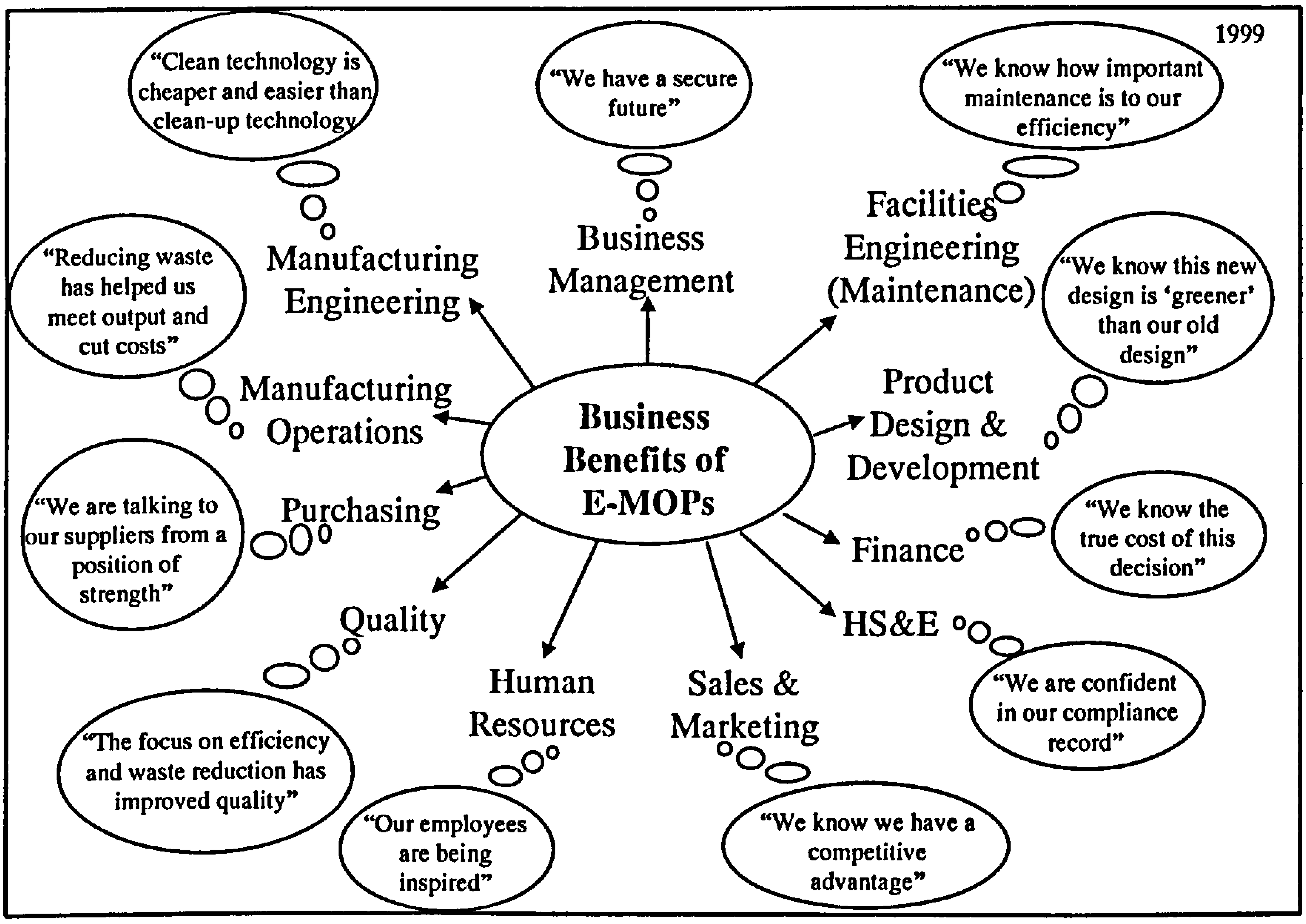
Taichi Kiuchi (M.D., Mitsubishi), speaking at the Global Reporting Initiative Conference (4-5 March 1999, Imperial College, London) stated that sustainability (including environmental) metrics will be to business what the five senses are to human beings. He said that currently business operates with taste (inside the organisation) and touch (that directly outside the organisation), but with no sight (they can't see into the future). In this way business goes forward blindly until it hits something! He likened the current situation to launching a plane off a cliff, without knowing how to fly or land – we need to learn to fly quickly before we hit the ground. Environmental (and sustainable) metrics gives business the sight it needs to be able to look beyond the end of its fingers and the information it needs to be able to fly the plane for as long as possible.

Gathering of environmental information can be the starting point of a "ring of confidence". If information provides knowledge and "knowledge [and its application] is power" then power (and its resulting influence) gives confidence. Confidence in turn encourages people to seek further knowledge. McGonagill & Kleiner put it like this:

> "An organisation that inquires gradually learns enough to influence the other organisations around it. Over time, it gains the credibility, ability and willingness to influence the 'environmental imperative' – helping other companies and governments set their direction. Taking – and living up to – the moral high road allows corporations to influence policy, far more than if they were being adversarial" (McGonagill & Kleiner[5], Chapter 70 in Senge et al 1997, p462)

Just as there are benefits for the company as a whole, environmental measures of performance (E-MOPs) can provide specific benefits for each business function in providing information and systems which allow each person to make more informed decisions within their own spheres of control, which can only enhance the performance of the business as an entity. This idea is illustrated in the following diagram:

Figure 1.1: The Business Benefits of Environmental Measures of Performance



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[5] McGonagill & Kleiner wrote a Chapter called "Corporate Environmentalism" in The Fifth Discipline Fieldbook by Peter Senge and colleagues. The book is subtitled *Strategies and Tools for Building a Learning Organisation* and is one of the best, of few, books available on practical implementation and company culture issues. For this reason, the author has quoted McGonagill and Kleiner's insights extensively.

KPMG (1997) state that the benefits of (external) environmental reporting are [*authors comments in italics*]:

- Stronger internal commitment to improved environmental performance [*internal reporting only can provide a weaker form of commitment because its audience is limited to employees and management. This means that there is less public pressure on the company, targets may be allowed to slip and mistakes could be more easily covered up*].
- The ability to demonstrate progress in environmental management to stakeholders [*other than just employees and managers*] .
- Identifying areas where management systems need to be strengthened [*internal reporting can do this just as well – if the management system encourages honesty*]
- Better public relations and increased employee awareness of the environment policies and goals of the company.

1.8 Why don't all businesses measure environmental performance?

Given the foregoing description of the advantages of measuring environmental performance, why are not all companies doing it?

Rather like Lucas before the 1990's, many companies have some 'floorboards' that they don't want to pry up. McGonagill & Kleiner (1997) describe it thus:

> "Typically, the managers in charge don't feel responsible for causing the problem. It's not their fault, for example, that they own a toxic waste dump site created by a company they purchased, any more than it's the homeowner's fault for unwittingly buying a house with concealed dry rot. Yet they may face the intimidating prospect of uncontrollable costs, or even personal liability, because they own the site. And because they feel that any information about their internal thinking is proprietary, they're reluctant to seek outside opinion. There may also be a 'shoot-the messenger' ethic in place, which discourages any attempt to bring forth the environmental skeleton from the corporate chest. Instead, they blame the bad faith or incompetence of the previous owners." (McGonagill & Kleiner in Senge et al 1997, p460)

McGonagill & Kleiner also go on to say that, if managers continue to deny responsibility for the problem, they never feel fundamentally secure about environmentalism. They are then unable to take advantage of environmental opportunities, or respond to them strategically, because they are too worried about what may be uncovered.

As well as worrying about turning up more problems than they can handle, or afford to rectify, many businesses simply do not see that it is necessary to measure environmental performance. If it is not mandatory and has no obvious business benefit, then it is, at most, a time-consuming distraction. Other businesses may have the desire to measure their environmental performance, but do not have the resources or knowledge of how to go about it.

Engineering companies in particular seem to be slow in realising their environmental impact and the need for measuring environmental performance. Business in the Environment's FTSE100 survey had an overall response rate of 73% (BiE 96b). Of the different sectors "engineering" had the lowest response rate of 57%. This is the sector that LucasVarity falls in to. LucasVarity companies tend to believe that they have a lower environmental impact. This is because they do not use large amounts of chemicals, are not overt polluters and also tend not to have direct consumer pressure as they are suppliers to other companies. It seems likely that other engineering companies could share this view.

KPMG's 1993 International Survey of Environmental Reporting covered 690 companies (KPMG 1993). Of these, no engineering companies had provided quantitative data. This could indicate that most engineering companies had yet to establish the necessary systems to collect the required information, or that they had yet to recognise the need to publish performance data. If LucasVarity can be considered representative of engineering companies, then it may be that they did not consider that their environmental impacts were sufficiently significant to warrant too much effort in this area (as opposed to say the major chemical companies, who clearly have a significant environmental impact).

Despite encouraging developments in environmental achievements and reporting, Wehrmeyer and Tyteca (1998) argue that considerable effort is still needed before environmental performance measures become operational. This is because [*the author's comments are in italics*]:

1) "Not enough standardisation between performance indicators has occurred.
2) Integration of such measures into the wider context in which they should be seen has not happened
3) Efforts to quantify outputs cloud the need for information on environmental impacts (the ecological results of outputs) [*most companies do not have the knowledge and expertise to be able to do this and appropriate guidance has not been available*].
4) Sustainable Development Indicators for firms are insufficiently described, let alone used.
5) Efforts to combine performance measures across environmental media remain largely unsatisfactory [*this is a contentious area which most practitioners have stayed away from. This is because it is difficult to add together, and weight, different environmental impacts. Also, one aggregate performance figure, can result in prejudicial behaviour, since, it is possible to improve the overall figure by addressing one issue only, often at the expense of others*].
6) Very few studies analyse environmental effects over time [*the subject is too young – many companies have not, or have only just, started*]

7) There are a number of areas where firm's impacts are still missing, notably indicators of biodiversity" [*Most businesses would not know where to start. Biodiversity is not generally seen as a direct issue unless a business is setting up a facility on a green field, or environmentally sensitive, site. However, direct impacts such as pollution of local areas, and indirectly, the practices of raw material suppliers and the disposal of waste could have a definite affect on biodiversity. In LucasVarity, measuring biodiversity is recognised as a complex issue, which the business has so far felt unqualified to tackle*].

The argument between the benefits and the barriers is, therefore, still in the balance for many companies. Mandatory reporting would definitely tip the balance, as would more customer pressure. For companies like LucasVarity, the feeling is that the balance will come down on the side of reporting eventually. Therefore, in readiness for that time, the Company is getting its own house in order by starting to collect more and more environmental performance data to use for internal communications and to drive improvement.

1.9 The future climate for environmental performance measurement

In his forward to the Consultation Paper "UK Climate Change Programme", John Prescott (deputy Prime Minister) describes the measures that the government has taken to protect the environment and the targets which have been set to meet the Kyoto Protocol. The UK has agreed to reduce greenhouse gas emissions (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) to 12.5% below 1990 levels over the period 2008-2012. In order to meet this legally binding target, the government have added an extra margin to allow for variations against projections and therefore it proposes a 20% reduction in carbon dioxide emissions by 2010 (DETR 1998a).

In the DETR table (reproduced below) showing projections for 2010, by sector, the Business sector (manufacturing and commercial) is shown to produce the greatest proportion of Carbon (75MtC or 39%) compared to the total of 194MtC and is also listed as the sector with the most possible savings (10MtC out of 29MtC = 34%) (DETR 1998a).

Table 1.2 Projections for greenhouse gas emissions from industry sectors in 2010 (DETR 1998a)

Sector *(MtC = million tonnes of Carbon equivalent)*	**Projections including planned policies and actions for 2010 (MtC)**	**Possible Measures** ***(planned & lower cost measures)*** **(Savings in MtC)**	**Further possible measures (higher cost)** **(Savings in MtC)**
Energy sector (includes energy supplied to end-user)	59	0	5
Business	75	3	7
Transport	42	4	2
Domestic	41	3	4

Agriculture, forestry and land-use	44	0.5	0
Public	9.4	0.5	0.6
TOTAL	**194**	**11**	**18**
Change from 1990 levels (6-gas basket)	-10%	-15%	-24%
Change from 1990 levels (CO_2 only)	-3%	-9%	-20%

The pressure from governments and other agencies for businesses to report their environmental performance will continue to rise (see section 1.14). Businesses that are not currently measuring their environmental performance need to start as soon as possible in order to be able to meet these requirements when they come.

1.10 What would encourage more businesses to measure environmental performance?

Encouragement tends to fall into two categories: the carrot or the stick, or in business parlance; opportunities and threats.

The sticks include customer and stakeholder requirements and mandatory reporting. Many governments e.g. Sweden, Denmark, Norway and the Netherlands (Skillius & Wennberg 1998) are already starting down the path of mandatory reporting (see 1.14) and most people (the prevalent view at a workshop during the GRI conference 4-5 March 1999) would agree that it is the only way to get total participation. Environment Minister Michael Meacher has stated that "a clear majority" believe that compulsion will be needed to achieve a big increase in corporate environmental reporting (ENDS, 1998a).

Carrots include financial incentives (tax benefits, business savings) as well as help, in the guise of guidelines, methodologies, reference data and case studies.

McGonagill & Kleiner (1997) suggest that the first step for non-participating businesses is to admit they do not know all the answers. Then they should conduct an audit, create an inventory of each site, emissions, and processes, collect data and suggest methods for improvement.

> "many managers who take this route [of inquiry] are startled to discover that, in the long run, it is less costly than the containment strategy and, paradoxically, less risky. There are undeniable short-term costs, but these would probably become higher cost burdens later on. There may be unpleasant surprises, but these may spark creative solutions that in fact make the entire enterprise better. Bringing forth data does not mean simply putting it in a report, but testing it against reactions and other knowledge of people within the company." (McGonagill & Kleiner, chapter 70 in Senge et al 1997, p461)

In order to encourage more businesses to measure their environmental performance there needs to be ways of overcoming the four main barriers identified by UNEP and SustainAbility:

1. gathering data,
2. absence of a standard set of indicators,
3. lack of resources, and a
4. lack of management interest. (reported in ENDS 1998b),

All four of these barriers were encountered in LucasVarity. In reality the perception of the height of each barrier is far in excess of the real size of the problem – although this does not necessarily make it easier to overcome.

Gathering data (and analysing it) can be a very time consuming exercise, but getting agreement to do it at all can be the biggest and most time-consuming hurdle (see section 2.6). Starting with data that is already available is always a good tactic (Bennett & James 1998) because that can eliminate most of the excuses. Knowing what the data will be used for is also important – data providers are always more willing if they can see a useful end point to the exercise. Having a standard set of definitions is important, especially in a multi-business company and in the absence of a standard set (as indicated in 2, above), the company will have to define their own (as has been the case in LucasVarity, ICI and BP[6]).

Lack of resources is often cited as an excuse for inactivity whenever any new initiative is announced, but provided the data collection is delegated to the people that have the information anyway, the impact on general resources should be small (as shown by the Lucas pilot study, see report in Appendix T). Where there is an issue is in the design and definition of the system itself and the compilation, analysis and reporting of the data – depending on the size of the company, this can amount to a full-time job. In addition, in the early stages of such a system it is essential that this is done manually, in order to check and correct the mistakes that are inevitable in an exercise that involves so many disparate inputs.

Management commitment, or positive attitude, is essential for any change process (Robbins and Finley 1997, Senge et al 1997) and therefore lack of management interest (barrier 4) can be a big hindrance to the implementation of any environmental measurement programme – but that does not mean that a group of determined individuals can not over come it.

1.11 What are environmental performance indicators (EPIs)?

Bartolomeo (1995) defines environmental performance indicators as "the quantitative and qualitative information that allow the evaluation, from an environmental point of view, of company effectiveness and efficiency in the consumption of resources." Whilst the aim of environmental performance indicators is that of "evaluating company efficiency (economical and environmental) and effectiveness in achieving environmental objectives and allowing:

[6] Information obtained from personal conversations with environmental managers in these businesses.

- the adoption of the most appropriate measures of environmental protection in terms of effectiveness and efficiency;
- the empowerment of environmental policy by a better definition and monitoring of environmental objectives;
- an effective definition of responsibilities and an aid for the implementation of the environmental management systems; and
- the improvement of external and internal communication on environmental achievements and programs."

Whilst Azzone et al (1996, p79) declare that "environmental performance indicators are a vital step towards effective and verifiable reporting to stakeholders and strategy formation."

The definition given by ISO 14031 in 1997 states: "Indicators for EPE are selected by organizations as a means of presenting quantitative or qualitative data or information in a more understandable and useful form. They help to convert relevant data into concise information about management's efforts to influence the organization's environmental performance, the environmental performance of the organization's operations, or the condition of the environment. An organization should select a sufficient number of relevant and understandable indicators to assess its environmental performance" (BSi 1997)

According to Skillius and Wennberg (1998) EPIs can be [*authors comments in italics*]:

- "absolute – basic data e.g. total CO_2 emitted in 1997 [*I would refer to 'absolute' as something that is directly measured such as water or energy consumption. CO_2 tends to be a derived figure based on energy consumption, which I would refer to as 'calculated' rather than absolute – which implies absolute accuracy*.]
- relative – quota of parameters e.g. energy consumption per unit of output [*'relative' is therefore a comparison between two 'absolutes'*]
- compound – combining data from absolute and relative categories, e.g. total CO_2 emitted per unit of production in 1997 [*just another variation on the theme of 'relative'*]
- group – data for related factors, e.g. waste: total solid, hazardous waste, waste incinerated, waste recycled etc.
- indices – constructed to produce a number by using a baseline year, factoring equivalents on a scientific basis or through the use of factors and weighting to produce a single number." [*such as the ICI Burden approach (ICI 1997)*].

However, Skillius and Wennberg (1998) recognise that only two broad types currently occur:

- "Environmental management EPIs, measure the extent to which the company has in place best practice management systems, procedures and practices for compliance with environmental regulations and to achieve wider environmental protection objectives defined by the company and its stakeholders. Categories: compliance; systems and implementation; integration with general business functions; total quality management.

[*termed Management Performance Indicators or MPIs by ISO14031 – these tend to be qualitative or semi-quantitative measures*]

- facilities and operations EPIs, designed to measure the actual environmental performance of company in scientific terms, technical and quantified. Categories: materials use; energy; emissions/effluent (air/water/soil); waste; incidents; local ecological impacts." [*termed Operational Performance Indicators or OPIs by ISO14031 – these tend to be quantitative measures*]

A more detailed discussion about the different types of EPI and their categories is included in the 24-month report (Lawson 1997b), sections 3.6 to 3.9.

PIRC (1998) uses the terms "quantified" and "impact" synonymously. Examples of quantified (impact) EPIs, used by FTSE350 companies, are summarised below (PIRC 1998) together with the sector which scored the highest. The position of the "General Industrial" sector (the sector that includes LucasVarity) is also shown. In all cases, Utilities is the highest scoring sector and General Industrial is the lowest, or second lowest, user of these types of measures. This backs up the premise that engineering companies are lagging behind in the process of measuring environmental performance (see also 1.8).

Table 1.3: Quantified Environmental Performance Indicators usage in FTSE350 companies

No. of Co.'s	%	Measure	Highest Sector	General Industrial
40	17	Waste products`	58% (Utilities)	6% (2nd lowest)
36	16	Energy use • In some cases CO_2	62% (Utilities)	5% (2nd lowest)
33	15	Emissions to air • Most common are SO_2, (contribute to acid rain), NOx and VOCs (smog), HCl (Acid rain).	46% (Utilities)	9% (joint lowest)
29	13	Emissions to water (some COD)	42% (Utilities)	8% (2nd lowest)
23	10	Raw material usage • Including water	42% (Utilities)	1% (lowest)
26	12	Other environmental impacts, (tend to be industry specific) e.g. • Land rehabilitated (after mining) • PCBs in oil (National Grid) • Oil releases (Scottish Power) • Number of diesel vehicles • Water leakage • Noise levels	38% (Utilities)	5% (lowest)

A database of quantitative measures (currently 350 from over 55 companies) collected from the literature relating to this project can be found in Appendix AI. This database will continue to be expanded and used as reference data for the EPE Methodology explained in section 3.

Whilst this section has concentrated on quantitative measures – qualitative measures are also needed to give a balanced picture.

1.12 Quantitative versus Qualitative Measures

Good environmental management systems (the usual focus of qualitative measures) are an indicator of environmental performance (BiE 1996a). However, the presence of an Environmental Management System does not equal good environmental performance, as PIRC (1998) confirms:

> "An Environmental Management System can reduce environmental risk by controlling impacts in a comprehensive and systematic manner, however having a certified system does not necessarily imply good environmental performance, it only indicates that the approach to the environment is organised and should be consistent."

Quantitative measures are the most objective and comparable performance indicators, and most favoured for external reporting (UNEP/SustainAbility 1997, Skillius and Wennberg 1998). However, despite their seemingly straightforward nature, quantitative measures are often the most elusive. This can be due to incomplete records, unwritten (and therefore variable) definitions, dubious quality, mixed units, irregular reporting frequencies, the influence of many external variables and a nervousness, on the part of management, to publish them.

In Lucas, the qualitative measurement of implementing the company policy, and later the company standards, was developed into a semi-quantitative system at the request of directors who wanted to be able to rank the businesses' performance. The allocation of the scores, within a prescribed framework was based on qualitative judgements made by corporate audit teams and through site self-assessment (see 2.2, 2.4). A company-wide quantitative system was implemented in 1998 to complement to qualitative, yet semi-quantitative, nature of the environmental management assessment system. Both qualitative and quantitative measures must be used in tandem to reinforce and support each other. The following diagram is used to explain the balance between these measures at LucasVarity.

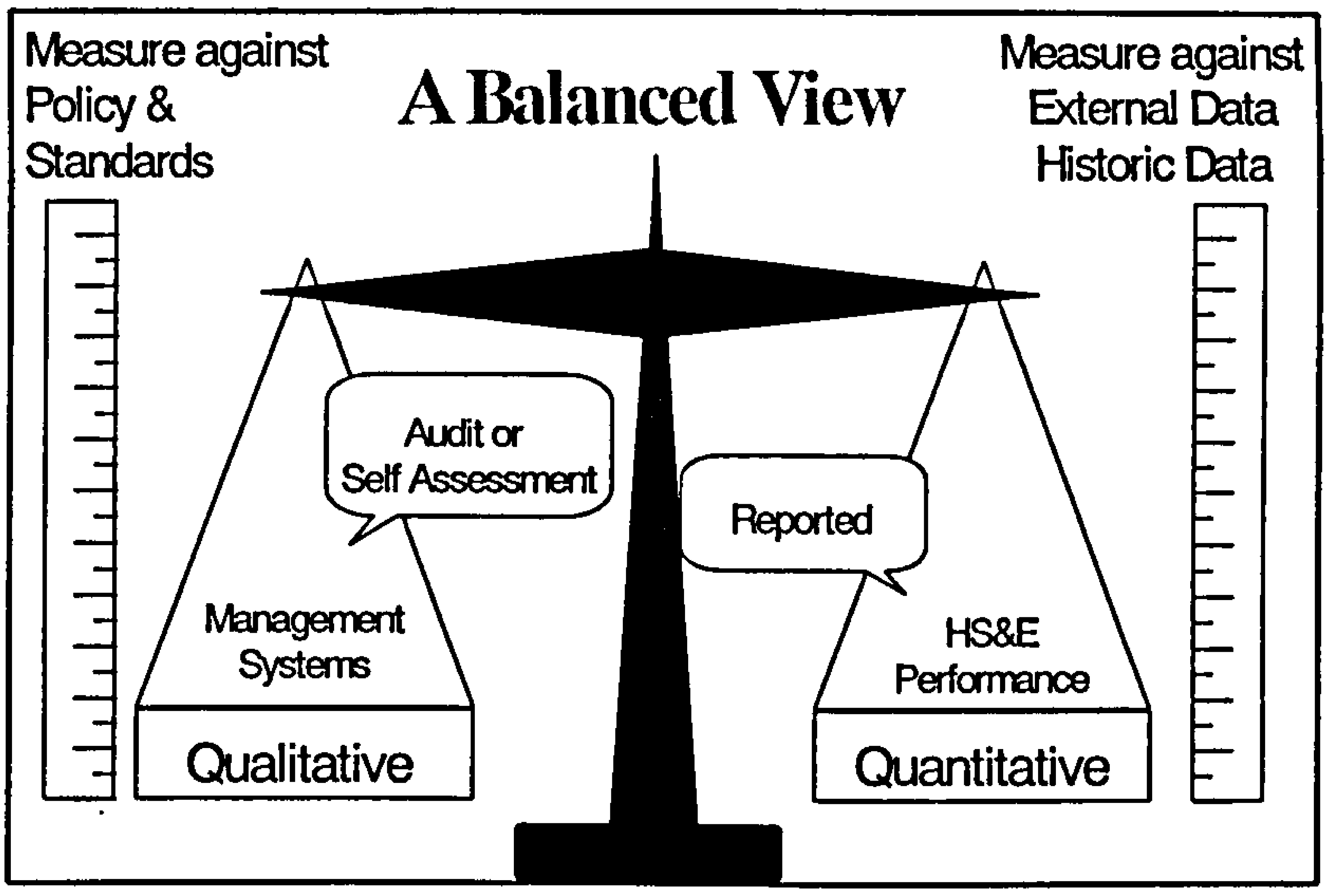


Figure 1.2: Balancing Qualitative and Quantitative measures

1.13 What guidance is there on EPIs and the Process of measuring them?

The various guidance on Environmental Performance Indicators, and the process of measuring environmental performance, described by BiE and KPMG (1992), Azzone and Manzini (1993), Bennett and James (1993, 1994a) and the British Standards Institute's draft BS ISO14031 (1997) are discussed in some detail in the 24-month report (Lawson, 1997b, section 3.5 and 3.10). Since then, a plethora of other reports have emerged offering guidance on reporting of environmental performance (e.g. CERES, Azzone et al 1996, Wehrmeyer and Tyteca 1998, Global Reporting Initiative 1999) or analysing the current trends in environmental reporting (e.g. UNEP/SustainAbility 1997, Bennett and James 1998, PIRC 1998).

Despite this recent interest in the subject most of the papers on the subject are theoretical and inaccessible to industry (i.e. use difficult language, complex ideas and are not published in mainstream publications). In order to be accessible, useful and useable, papers and guidance need to be written in simple language (unlike Wehrmeyer and Tyteca 1998), newcomers need advice on how to gather the information - with real examples (unlike Azzone et al 1996), and the approach should not be too technical (unlike Callens and Tyteca 1995). There still remains very little practical advice on where to start, and how to put environmental performance measurement into practice. Whilst all the methodologies outline <u>what</u> steps to take, what appears to be missing is any advice on <u>how</u> to go about it.

Skillius and Wennberg (1998) back this up:

> "There is currently no consistent, established way of measuring environmental performance and improvements achieved. There is no consistent basis for choosing indicators; the number of indicators; or measuring techniques and definition of standards."

Probably the instructions are just too difficult to write for such a potentially large and diverse audience, but some practical advice and examples could be given, which users could then adapt for their own purposes. Martin Bennett and Peter James, in their ACCA report "Environment under the Spotlight" (Bennett and James 1998) have come close to exploring the practicalities of environmental performance measurement in business, since their report included interviews with business environmental managers and results of questionnaires with practitioners. Their report is probably also one of the most accessible to industry – in that is it written in relatively simple language, is easily available (and reasonably priced) and has the added credibility of ACCA backing.

No method will be perfect for every business, indeed the best systems tend to be tailor-made, or adapted, by companies, for their own needs and using their own people. This creates the ownership and learning needed to ensure that the change will stick (Wille 1992, Robbins & Finley 1997, Senge et al 1997). What is needed though is awareness of the issues, tools and techniques such as those used in Total Quality (Quest 1998), guidance on standard definitions, units and conversion factors, and examples for inspiration (as in Bennett & James 1998, UNEP/SustainAbility 1997, PIRC 1998).

Over the last two years this project has focused on the practicalities of implementing an environmental performance measurement system in a large diverse business and the development of a step-by-step methodology which would lead an engineering business through the process of developing and implementing environmental measures of performance (see section 3 and 36 month report – Lawson 1998b). The approach is based on commonly used tools in industry, such as brainstorming, gap analysis, Failure Modes and Effects Analysis, priority matrices and Boston matrices (Quest 1998) and involves an interactive approach to ensure involvement and buy-in.

Several recent authors have analysed all the current EPI guidelines, reporting formats and ranking systems (Skillius & Wennberg 1998, Wagner & Wehrmeyer 1999), therefore this work has not been repeated. Wagner and Wehrmeyer, based at the University of Surrey, working on the MEPI[7] project have analysed all the current work on environmental performance indicators in their search for suitable practical measures to apply across six different industry sectors in six countries. Their analysis of the strengths and weaknesses of all the currently available initiative and reports are summarised in the table below. Their analysis is comprehensive, therefore it is presented here in its original form, with some additions from the author [*in italics*].

[7] MEPI = Measuring Environmental Performance in Industry: A pan-european project started in April 1998 which seeks to "place on a mature footing" the use of physically based, quantitative environmental performance indicators. Its objectives are to develop EPIs for manufacturing firms, apply these and assess the effectiveness of different policy instruments in improving firms' overall environmental performance. (Ref: MEPI leaflet)

Table 1.4 Major strengths and weaknesses of the initiatives discussed with regard to MEPI (Wagner & Wehrmeyer (1999)

Initiative	Strengths	Weaknesses
ACCA report [Bennett & James 1998]	• Valuable insights into uses and limitations of indicators • Stresses the needs for standardisation, life-cycle thinking and measurement of eco-efficiency and sustainability • Suggests narrower but deeper analysis of core areas of environmental performance	• Does not provide own suggestions for specific environmental performance indicators
CERES [*Valdez principles first published in 1989, CERES reporting format 1997*]	• Stresses needs for standardisation • Suggests to focus on a core set of indicators • Identifies the need for sector-specific EPIs	• Does not provide own suggestions for specific environmental performance indicators
EMAS	• Requires mandatory disclosure of certain environmental information	• Does not prescribe specific indicators
ISO 14031 [*1997*]	• Points to the value and feasibility of management performance indicators and environmental condition indicators • Wide acceptability of approach • Close proximity to EMS	• Too many types of different EPIs i.e. no basic set of key measures • Limited emphasis on standardisation and implementation • Only weakly linked to sustainability
Azzone and Noci, Young and Welford [Azzone et al 1996]	• Eco-balancing approach • Coherent framework to transform absolute to relative indicators	• Eco-balancing is not very widespread in industry (uses predominantly simple mass balances) • Cost • Data comparability • Only weakly linked to sustainability
Bundes-umwelt-ministerium and Umwelt-bundesamt [*1997*]	• Eco-balancing approach • Based on ISO 14031 but more concise	• Strongly oriented towards performance management (eco-controlling approach) • Only weakly linked to sustainability
World Business Council on Sustainable Development (WBCSD) [*1997*]	• Definition of eco-efficiency addresses some aspects of sustainability • Provides a concise set of indicators • Detailed review of possible aggregated indicators	• Uses predominantly economic indicators • Narrower scope as the approach is also mainly oriented towards performance management rather than performance measurement
AIChE	• See WBCSD above	• See WBCSD above
National Round Table on the Environment and the Economy [*NRTEE 1997*]	• Analytically well-grounded aggregated EPIs • Points to limitations of EPIs and need of evolutionary development of EPIs	• Problems of the approach with weighting, aggregation and normalisation • High level of aggregation • Extended discussion process for highly aggregated EPIs
European Environment Agency [*1998*]	• Clustering around key resources (i.e. life cycle view) • Use of physical and financial indicators	• Report proposes no operational indicators • Resource focus which might conflict with the economic valuation of resources

World Resources Institute [*1997*]	• Stresses need for standardisation • Focus on a core set of indicators • Proposal of core areas for environmental performance measurement	• No specification for the form of indicators (e.g. relative, absolute, aggregated)
Storebrand Scudder EVF [*1996*]	• Tries to address and measure sustainability	• High level of aggregation • Requires weighting and aggregation
ICI Environmental Burden Index [*1997*]	• Very detailed approach to a toxic hazard EPI	• Requires agreement on potency factors • Limited application without potency factors • Requires high amounts of detailed data
Callens and Tyteca [*1995*]	• Strong methodological foundation of approach • Approach does not require specific indicators • Easy integration with sustainability	• High level of technical detail which may make it difficult for policy-makers [*and companies*] to "warm" to the methodology
Business in the Environment [*1996*]	• Provides a sub-set of MPIs	• Does not suggest any own physical EPIs

Of the 15 approaches surveyed by Wagner and Wehrmeyer, six did not propose any specific EPIs (ACCA, CERES, EMAS, Bundesumweltministerium, European Environment Agency, Business in the Environment); three were considered to give too little or too narrow information (WBCSD, AIChE, World Resources Institute) and the remaining six were considered to be too complex or technical (ISO14031, Azzone et al, NRTEE, Storebrand, ICI, Callens & Tyteca). This backs up the author's earlier assertions that the current methods tend to give no practical information or are too complicated. It is also notable that the majority of these approaches have been published only in the last few years and none were available in 1994 when this project first started – hence the in-house approach developed in LucasVarity (see section 2).

1.14 Future reporting practice

There can be said to be three categories of environmental disclosures (or reporting) (DTTI, 1993):

- "involuntary disclosure - the disclosure of information about a company's environmental activities without its permission and against its will;
- mandatory disclosure - the disclosure of information about a company's environmental activities that is required by law;
- voluntary disclosure - the disclosure of information on a voluntary basis."

This section refers specifically to voluntary reporting.

Whilst LucasVarity has not published an external corporate environmental report, it is important to remain up to date with the trends so that the company will be prepared when the time comes for either mandatory or voluntary reporting.

Future trends such as normalising, standardising, materials accounting, monetising, auditing (Birchard 1996), consulting stakeholders (IBM 1995) and public surveys (BiE 1996b, KPMG 1993) are discussed in section 3.11 of the 24-month report (Lawson 1997b).

Many companies, especially those that are producing environmental reports, expect that reporting will become mandatory (Brophy and Starkey, 1996). It is certainly on the current government's agenda to make corporate environmental reporting mandatory and there are increasing demands from investors for companies to provide environmental information (Skillius & Wennberg 1998).

In PIRC's (1998) lengthy analysis of "Environmental and Social Reporting" by the FTSE 350 companies, they include a comparison of the key main points required by environmental "standard setters". These are summarised in the table below.

Table 1.5: Main points required in Environmental Reports, by environmental "standard setters"

Organisation: / Main Points	ACBE	BiE	EMAS	ISO14001	PIRC
Corporate Environmental Policy	✓	✓	✓	✓	✓
Board Level responsibility for environmental matters		✓			✓
Policy for dealing with environmental risk	✓				
Group-wide environmental management system		✓	✓	✓	✓
Internal Audit System		✓	✓	✓	
Report to shareholders on progress made	✓	✓			✓
External verification of environmental report			✓		✓

ACBE: *The Advisory Committee on Business and the Environment*
BiE: *Business in the Environment*
EMAS: *Eco-Management and Audit Scheme*
ISO14001: *International Organisation for Standardization (Environmental Management System)*
PIRC: *Pensions and Investment Research Consultants*

PIRC advocates that shareholders should encourage companies to [*comments by the author are in italics*]:

- Make a commitment to achieving excellence by establishing a group-wide environmental policy[8] (reported by 170 companies out of the 350) [*this is the easy bit, the first thing the Lucas HS&E department did when it was set up was to write a policy statement*].

[8] The definition of "policy" has changed over the years and is still viewed by some as two different things. Originally, policy meant simply a statement of intent like an environmental mission statement. Latterly, the meaning of policy has expanded to incorporate specific objectives and targets. Within LucasVarity the policy statement is referred to as the "Policy" and objectives and targets are contained in separate documents which are updated annually in line with prioritised significant activities and performance measures.

- Institute effective internal procedures for the implementation of company environmental policy and for monitoring impacts (reported by 75 companies out of the 350) [*LucasVarity standards system and MOPs (audit, SAS, & quantitative) (see section 2)– an EMS should, but may not, do this effectively / completely.]*

- Establish procedures which will lead to incremental improvements in environmental performance (reported by 46 companies out of the 350) [LucasVarity *MOPs and reporting, the setting of targets and raising of awareness (see section 2). Once improvement can be shown this usually encourages more.]*

- Designate responsibility for the implementation of environmental and corporate responsibility policies to a named board director (reported by 39 companies out of the 350) [*despite this much touted requirement it is not easy to get top Top Management commitment.]*

- Make available to shareholders regular and detailed reports of progress made towards attaining improved environmental standards (60 companies have stand alone reports, 226 mention environmental issues) [*LucasVarity has reported on its HS&E policy and programmes in the last two annual reports, but to date it has not reported any performance data*]

- Establish an independent external review and audit procedure for such policies (21 environmental reports verified) [*The LucasVarity audit programme has been verified by an external body (ERM) and found to be a robust methodology, well executed by experienced auditors, but not carried out frequently enough (since the disbanding of the corporate HS&E department)].*

Quantitative performance information is not mentioned in this summary by PIRC, although it would be a sensible addition to the other main points.

A Structure of the integrated framework for reporting EPIs is proposed by Azzone et al (1996) and summarised by the following diagram.

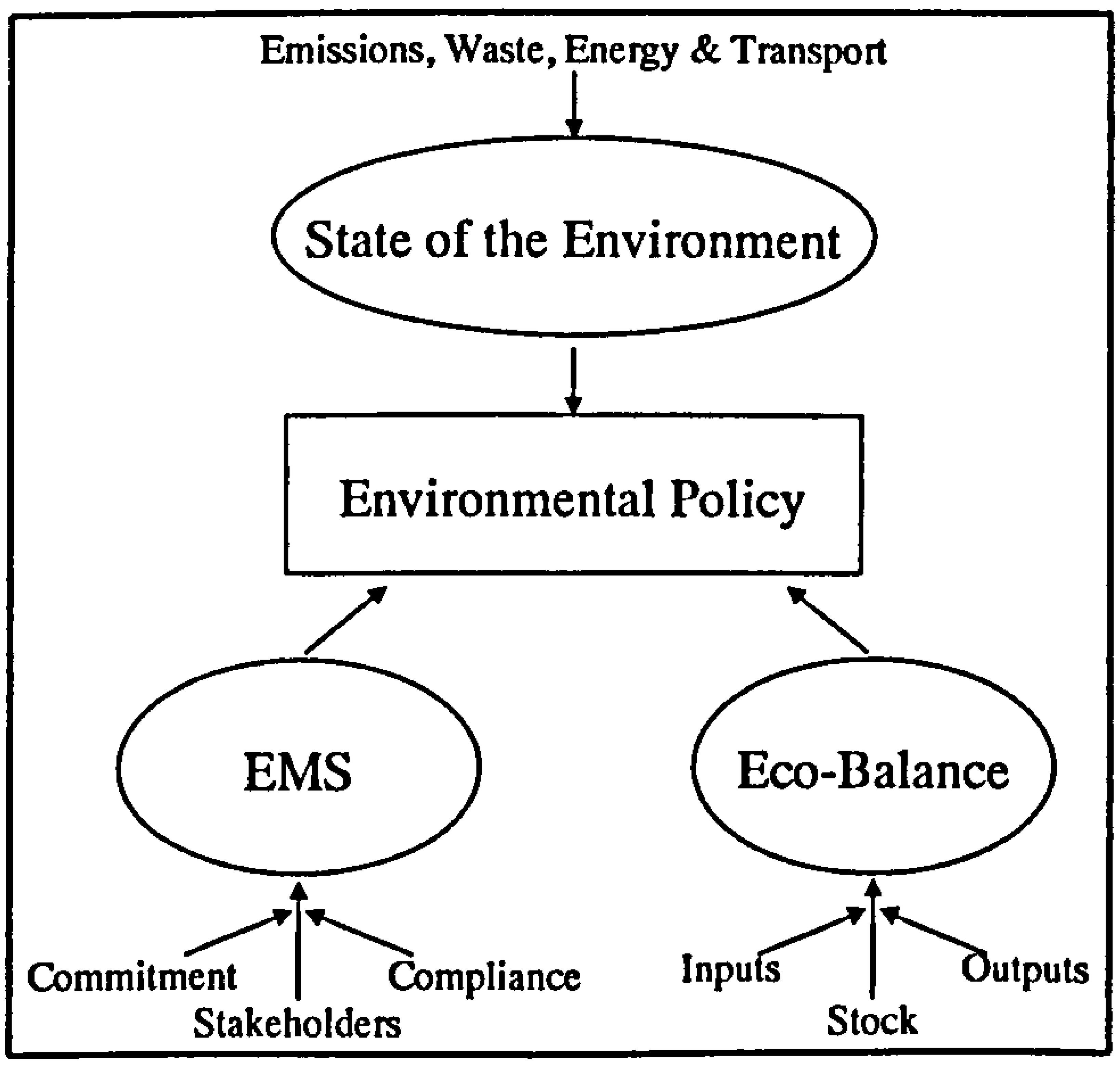


Figure 1.3: Structure of the integrated framework for reporting (Azzone et al 1996)

The Environmental Policy shows the company's aims and objectives over short and long time periods.

The State of the Environment shows the company's contribution to current national and European environmental problems (compared to the Dobris Assessment – European Environment Agency 1995) [*but this is based on*

1990/1991 data, and far from complete (see section 4.4. for more discussion on this point)].

The EMS indicators are used to show companies' ability to manage their environmental problems in an effective manner.

Eco-balance is intended to assess the quantitatively measured outcome of company activities. The eco-balance is the "ultimate indicator" ("the facts", based on physical data) which shows the success or failure of the EMS and policy.

But how does one gather the information necessary to present such a report?

Azzone et al (1996) suggest that the key factors can be expressed in either qualitative or quantitative terms. The quantitative indicators being either financial or physical (non-financial). [*The author agrees with this simple categorisation of measurements, whilst emphasising that quantitative measures should be expressed in both financial and physical (non-financial) terms wherever possible. This enables triangulation of results to be carried out (see section 2.6) and will appeal to a wider range of stakeholders.*]

UNEP/SustainAbility's 1997 Benchmarking Survey has 12 recommendations (p28) for Corporate Environmental Reports (CERs). These are detailed in the table below.

Table 1.6: UNEP/SustainAbility 1997 12 Recommendations for CERs

Recommendation	***Author's comments***
1. Account for the triple bottom line: report on economic, environmental and social commitments, targets and performance.	*Lead provided by The Body Shop, BP, BT (but little advice given)* *LucasVarity does not have sufficient information to attempt this.*
2. Spotlight the real issues, impacts and priorities Critical issues are usually linked to core business.	*Often businesses are not brave enough to spotlight the real issues, i.e. automotive businesses would have to refer to the car's contribution to global warming, congestion, air pollution, accidents and deaths on the road, and a need for reducing dependence on cars. LucasVarity is not currently brave enough to address these issues head-on, although some effort is being made to tackle environmental issues at the product design stage.*
3. Think SMART and verify ensure targets are Specific, Measurable, Attainable, Relevant, Trackable	*It is worth applying this test, it is a good definition, which is not rigorously applied currently. Non specific or measurable targets can be easily "redefined" if they are not met.* *This is not strictly applied within LucasVarity.*
4. Integrate your reporting Integrate the key elements of financial, environmental and social reporting	*The report acknowledges that there are benefits in keeping reporting streams separate from the financial mainstream, whilst they are being developed. (Most companies are still at this stage).*

5. Link your CER with your annual report As metrics evolve, and integration improves	*This implies some currently non-reporting companies may forego the separate CER stage and just report in the Annual Report. LucasVarity has already reported a minimal amount in the annual report. It is not known whether Management would want to publish environmental data in the Annual report.*
6. Focus on financial market issues Appeal to lenders, insurance companies and investors	*Businesses need these financial stakeholders to specify what they want. [Many financial institutions have been involved in the development of the Global Reporting Initiative described later in this section].*
7. Quantify and monetise Leading players are working on how to monetise the relevant areas of performance, risk and opportunity.	*LucasVarity collects quantities for energy, water, waste disposal, effluent, VOCs, clean-ups. Some of the divisions also collect costs relating to these measures. However, these are direct, visible, costs only, no attempt has been made to identify the hidden costs, other than the use of a rough 1:10 ratio. (see pilot study report (Lawson 1997c) in Appendix T)*
8. Communicate, communicate, communicate Stakeholder dialogue is the next step after reporting.	*Lucas Aerospace feeds back information to data providers and writes internal reports for managers and employees. The results of quantitative measures are not communicated externally although this may become more of a realistic option in years to come, when the system is more robust and some data trends have been collected.*
9. Use the internet – but don't go paperless Internet is fine, but not everyone has access.	*Even in LucasVarity the intranet is not yet fully developed so reporting is manual. However, whilst in the development phase a manual process is necessary to pick up all the rogue data, feed it back to the data providers and make improvements.* *The internet, as an alternative to a paper report, would allow the build up the reported information, facilitating easy updates and enabling people to delve into areas of interest.*
10. Help develop – and use – sustainability indicators	*This is beyond the scope of this project, but it is the next important step.*
11. Engage – and re-engage – stakeholders	*Internally LucasVarity want to engage stakeholders in order to change behaviour and realise improvements. Engagement with external stakeholders will come later.*
12. Review the need for new mandatory reporting requirements	*The company needs to be aware that some countries, in which it operates, may soon require mandatory reporting. The company can then learn from this experience internally.*

The current leader in standardised corporate reporting on environmental performance is CERES (Coalition for Environmentally Responsible Economies) (CERES 1997a). 46 companies are CERES endorsers including well known multinationals such as Baxter, The Body Shop, Coca-Cola, General Motors, ITT and Polaroid. The 10 CERES principles cover:

1. Protection of the biosphere (eliminating damaging releases to air, water or earth and safeguarding habitats and biodiversity).

2. Sustainable Use of Natural Resources (making sustainable use of renewable natural resources such as water, soils and forests, and conserving non-renewable resources).
3. Reduction and Disposal of waste (reducing and where possible eliminating waste and handling and disposing of waste safely and responsibly).
4. Energy Conservation (using less and improving efficiency of internal operations, goods and services, and making efforts to use environmentally safe and sustainable energy sources).
5. Risk Reduction (minimising environmental, health & safety risks to employees and local communities, operating safe technologies, facilities and operating procedures and being prepared for emergencies)
6. Safe Products and Services (reducing and where possible eliminating use, manufacture or sale of products and services that cause environmental damage or health and safety hazards, and informing customers of environmental impacts of products and services whilst trying to correct unsafe use).
7. Environmental Restoration (correcting conditions caused that endanger health, safety or the environment, redressing injuries to persons and damage to environment, and restoring the environment).
8. Informing the public (informing those who may be affected by conditions caused by company, seeking advice and counsel through dialogue with communities near facilities and not taking action against employees for reporting dangerous incidents or conditions).
9. Management commitment (to implementation of principles and ensuring board of directors and CEO are fully informed and fully responsible.)
10. Audits and reports (conducting annual self-evaluation of progress in implementing principles and completing an annual CERES report to be made available to the public).

Whilst these principles are laudable, there are obvious questions surrounding just how far some companies are willing to "endeavour" towards these goals and how often they will use "where possible" and "feasible" as get-out clauses. Comparing different CERES endorsers such as The Body Shop, whose whole ethos is based on environmental responsibility, with General Motors whose products are seen as responsible for many environmental problems, shows just how wide the gulf is.

In their 1997 Annual Report, CERES announced "The ambitious vision behind CERES' Global Reporting Initiative (GRI) is to bring together the numerous initiatives on corporate environmental reporting that have developed independently around the world, and to help shape them into one set of coherent, consistent global standards." (CERES 1997a)

On March 4th 1999, the Global Reporting Initiative (GRI) (convened by CERES and incorporating the participation of corporations, non-governmental organisations, consultants, accountancy organisations, business associations, universities and others from around the world) launched its Sustainability Reporting Guidelines at an international conference, at Imperial College, London. As outlined above, rather than develop yet another unique guideline, or framework, the GRI seeks to foster a generally accepted framework for sustainability reporting. The GRI Guidelines were developed through consultation with a broad group of stakeholders in an effort to harmonise disparate reporting initiatives worldwide and still accommodate the requirements of other reporting programmes. (GRI 1999)

The guidelines are now entering a consultative/pilot testing period which extends to December 1999, during which time the GRI wants enterprises worldwide to trial the guidelines and feedback their experiences so that the guidelines can be revised and formally launched in 2000.

Briefly the guidelines require companies to report information in nine parts:

1. **CEO Statement** (Chief Executive's statement describing key elements of the report)
2. **Key Indicators** (These are extracted from parts 3-8, below, to give an overview of the aspects and indicators)
3. **Profile of reporting entity** (an overview of the organisation and the scope of the report to provide contextual understanding)
4. **Policies, organisation and management systems** (a statement describing the commitment to sustainable developments and how the organisational structures and management processes have been implemented)
5. **Stakeholder relationships** (information on the process and methods by which stakeholders – internal and external – are engaged)
6. **Management performance** (compliance with legal requirements and other voluntary standards including awards and suppliers' performance)
7. **Operational performance** (this is the quantitative performance data on Health and Safety, energy, materials, water, land, non-product output, as well as social and economic indicators).
8. **Product Performance** (indicators of the products performance with respect to environmental social and economic aspects of sustainability).
9. **Sustainability overview** (a discussion of the organisation's efforts and progress towards integrating sustainability into its decision making and performance measurement).

Since the GRI have involved so many stakeholders, these guidelines will be a good place to start for any organisation wishing to embark on external environmental, or indeed sustainability, reporting. Those that do not want to report externally could also use the GRI as a checklist to ensure that they were addressing the issues internally.

These guidelines do state which measurement units should be used for the Operational Performance Indicators (unlike the CERES Standard report – CERES 1997b), but do not establish definitions, although it is expected that these may be included in the 2000 amendments, following input from the first participatory organisations.

Although the GRI is a good starting point, businesses will still have to address how data is collected, collated and analysed and will also have to assess whether the most significant company issues are being addressed. Reliance on the GRI guidelines alone could divert management from specific company priorities that are not included in these guidelines.

LucasVarity would currently be unable to complete all the information (such as vehicle fuel, materials, product performance and social issues) required by the GRI, but if these guidelines are seen as the new global standard that CERES hopes they will be, then any future developments in environmental performance measurement in LucasVarity should look to redress the gaps between the current system and the GRI.

However, for the majority of businesses, especially those who have not yet got to grips with environmental performance measurement, the talk of sustainability may be enough to put them off using these guidelines altogether.

If sustainability is defined as the use of renewable resources only, with no waste or pollution, then it is unlikely that true sustainability can ever be achieved by most businesses. Probably the most that can be achieved is to minimise pollution and to extend the life of the remaining resources through greater efficiency and recycling of products made from non-renewable resources.

2 Specific deliverables developed during the project.

Section 2 of this report discusses the specific deliverables of this project. For each deliverable, the corporate situation is described along with the relevant literature, the approach taken, the results and conclusions. The deliverables described are: the overall approach; environmental auditing; management standards; self-assessment; identification of significant effects; the quantitative environmental performance measurement system and internal reporting.

2.1 Overall Environmental Performance Measurement Approach

- **The LucasVarity situation**

When the Lucas Industries HS&E department was set up in 1991, there was little corporate knowledge of environmental practices or performance of the individual companies in the business. The knowledge of current and pending legislation in all the operating companies was also weak. Site clean-ups running into millions of dollars had been experienced in North America and there was no way of knowing how widespread, or how expensive, the potential land contamination problem was.

- **What the corresponding body of literature says**

Skillius and Wennberg (1998) state that "environmental performance measurement is not an objective process but a communication tool". This implies that some measures are subjectively chosen and weighted, perhaps to monitor a particular employee or management concern. In addition, the design of the system should be developed to best meet the communications needs of the business, and should present data in a format that is understandable and consistent with company culture and expectations.

James and Bennett (1993) describe six different approaches to environmental performance measurement that have evolved, which are summarised below in a table for comparison. The final "how" column has been added by the author:

Table 2.1: Approaches to environmental performance measurement (James & Bennett 1993)

Approach	Orientation	Drivers	Measurement Focus	Metrics	*HOW?*
Production	Engineering	Efficiency	Mass/Energy Balance	Efficiency	*Measure/collect data*
Auditing	Legalistic	Compliance	Management Systems Violations	Implementation Substances	*Self Assessment or third party*
Ecological	Scientific	Impacts	LCA Impact Assessment	Efficiency Impacts Substances	*Calculate*
Quality	Continuous Improvement	Pollution Prevention Customers (Internal /External)	Waste Generation / emissions Compliance Normalisation	Customer efficiency Implementation Normalisation Substances	*Measures and analysis*

Accounting	Financial	Costs Accountability	Liabilities Overhead Allocation	Monetary	*Measure*
Economic	Welfare	Externalities	Shadow Pricing	Monetary	*Estimate & allocate*

Wehrmeyer and Tyteca 1998 also describe a similar list of environmental performance approaches:

Table 2.2: Approaches to environmental performance measurement (Wehrmeyer & Tyteca 1998)

APPROACH	DESCRIPTION	*LucasVarity*
The Production Approach	Using efficiency and financial measures primarily concerned with environmental performance of industrial processes and manufacturing systems.	*This has been the purpose of LucasVarity's quantitative measures of performance.*
Environmental Auditing	Focussing mainly on the management system, either in assessment of environmental effects or the validation of processes and procedures	*LucasVarity's audit system focuses on the management system and whether it is effective in its control of environmental effects and their contributory activities.*
The Ecological Approach	Using lifecycle assessment	*This is under development by another Research Engineer.*
The Accounting Approach	Using financial measures for external reporting	*Financial information about resources, emissions and waste are collected for internal reporting, but not for external reporting.*
The Economic Approach	Using financial and economic measures, mainly in the form of cost-benefit analysis.	*This approach is used for justification of projects requiring capital expenditure, but case-study material has been notoriously difficult to collect. Once implemented, the next project is being worked on and the success of the previous projects is not effectively reviewed.*
The Quality Approach	Relies on the interface between Total Quality Management and Environmental Management.	*Used as a communication angle and justification for improvement, especially for projects that have no short-term, obvious financial payback. Also used to explain why systems and procedures are necessary.*
Indicators of Sustainable Development	Including development of biodiversity indicators.	*Not addressed so far. Relevant expertise and knowledge not in the Company.*
A Systems Approach (or Industrial Ecology)	Using concepts from ecology, tries to identify patterns of resource use within and between industries with the aim of minimising resource use.	*This would involve symbiotic partnerships between businesses to achieve mutual and environmental benefits. This would work best with companies in a supply chain, and those located close to each other. To date this approach has not been explored by LucasVarity.*

KPMG (1997) stress that it is the process of collecting data that provides the real benefits not the actual publication of an external environmental report:

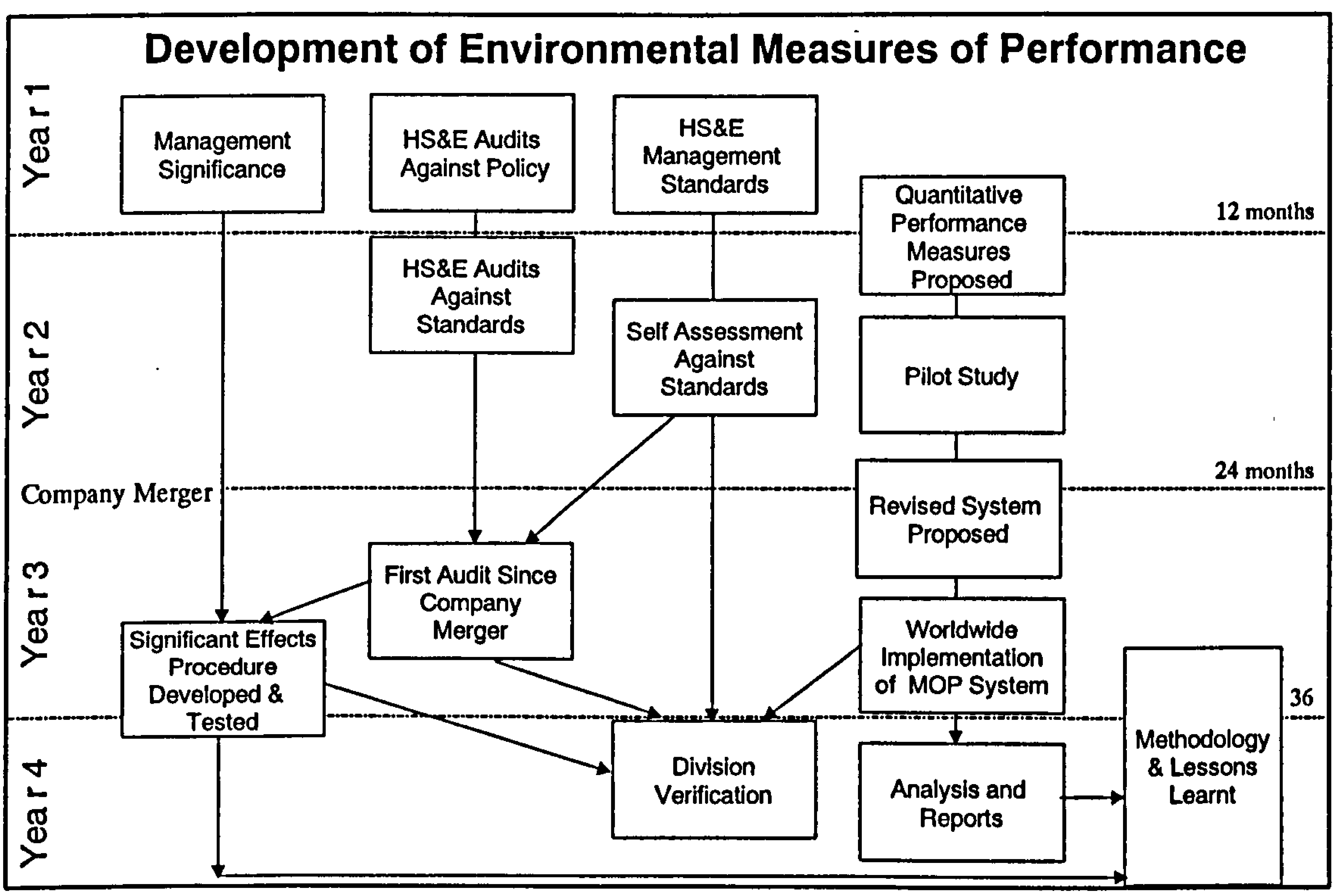
"The benefits of environmental reporting are largely intangible. A separate environmental report is seen as evidence of good company management if it demonstrates that environmental risks are being addressed. The act of collecting and presenting data for inclusion in the report exposes the need for changes in existing systems to ensure the collection of environmental performance data. These changes are the beginnings of the development of an environmental management system for the company. It is this management system that provides the company with tangible benefits, such as identifying opportunities for efficiency improvements or resource reductions."

The Lucas/LucasVarity approach has combined Production, Auditing and Quality and is moving towards Ecological with the Impact/Burden reports (as explained in the following sections 2.2 to 2.7) and additional work on LCA and DfE. But just as KPMG explain, it is the act of collecting and presenting data that has been of benefit, stimulating questions and raising awareness at all levels.

- **The approach taken in LucasVarity**

The approach taken was developed gradually over the years as the true needs of the company were better understood. Health, Safety and Environmental auditing was the first tool used, followed by standard setting, self-assessment and latterly a quantitative measures of performance system was implemented. The development of these systems over the four years of the project is shown in the following diagram. The individual components are described in more detail in the following sections.

Figure 2.1 Development of Environmental Measures of Performance System Elements.



The components of the LucasVarity performance measurement system are presented below (sections 2.2 to 2.7) in chronological order of development, starting with Environmental Auditing, then Management Standards, the Self-Assessment System, Identifying Significant Effects, the Quantitative Environmental Performance Measurement System and Internal Reporting.

- **Summary of Methodological approaches used**
- The business's needs were identified and the business constraints analysed.
- Benchmarking was carried out to evaluate other companies' approaches and any theories proposed in literature.
- The audit process and measurement systems were designed and developed then presented to key personnel (users and managers) in the business. The design was amended in the light of comments. Then a trial implementation (pilot study) was carried out, followed by an analysis of the results and evaluation of the process. This necessitated a largely retroactive (trial and error) and interactive approach.
- Proposals were amended in the light of the pilot exercise review and implementation was carried out company-wide. A proactive approach was then required to raise awareness of the process and to monitor, support and provide feedback to the users of the system.
- Improvements to the systems have then been made on an iterative basis.

2.2 Environmental Auditing

- **The LucasVarity situation**

As previously mentioned, in 1991, very little was known about the environmental performance of the Lucas businesses. Management wanted to know what the real situation was – was the company a mass of disasters waiting to happen, or had local management got everything under control? It was decided to audit the businesses, using a dedicated team of people from the HS&E department. In this way the audits would have some objective consistency and the newly created department would get first hand knowledge of the businesses, their performance and what areas needed development.

- **What the corresponding body of literature says**

Environmental Auditing is an essential part of any Environmental Management System and the only way of verifying its implementation, documentation, procedures and appropriateness (BSi 1989, BSi 1996, NSCA 1997, EA 1996).

According to ISO14011 (BSi 1996) "an EMS audit should have defined objectives; examples of typical objectives are as follows:

a) to determine conformance of an auditee's EMS with the EMS audit criteria;

b) to determine whether the auditee's EMS has been properly implemented and maintained;

c) to identify areas of potential improvement in the auditee's EMS;

d) to assess the ability of the internal management review process to ensure the continuing suitability and effectiveness of the EMS;

e) to evaluate the EMS of an organization where there is a desire to establish a contractual relationship, such as with a potential supplier or a joint-venture partner."

Following up on the conclusions of the BiE/Extel survey (1994), BiE (1996b) and its members started exploring a correlation between the quality of management and current company practice in relation to the environment. Hence the audit concentrates on management systems, based on the assumption that if management is good, good performance will follow.

Since the audit focuses on management systems it is sensible to have an integrated approach to assess the management of Health, Safety and the Environment. Arthur D Little (1995) explains that not having a co-ordinated approach can cause:

- Audit fatigue (too many audits each covering a different discipline)
- High auditing costs (since separate audits will undoubtedly have overlaps)
- Poor follow-up (a site overburdened by audits will have too many findings and recommendations, which will be hard to prioritise and follow-up effectively)
- Devaluation of the audit process (a frequent disruptive process, a poor use of resources and with many findings being left unresolved).

In the early 1990's however, in 1991/92 when the LucasVarity audit system was being developed, there was very little guidance on environmental auditing and how it should be conducted. Research was carried out through attendance at conferences and from communications with consultants practised in environmental auditing (Arthur D. Little, ERM, AIG).

- **The approach taken in LucasVarity**

Lucas Directors wanted the businesses to be audited in order to understand the level of HS&E management within the group, but they also wanted some way of ranking the businesses to effectively produce a "league table". In answer to this, a numerical scoring system was developed.

Many proprietary, self-assessment type audit packages were evaluated (such as ISRS and CHASE). Evaluation was carried out by answering the questions for a typical Lucas site and assessing the relevancy to the Company. These packages tended to be very general, designed as they were for any type of business and therefore included many non-applicable parts. They were also very long and repetitive, making them tedious to complete. It was concluded that the businesses would not have the time, or the inclination to wade through such hefty (and often irrelevant) tomes.

To use a proprietary system would have entailed significant tailoring of any system to meet the company's needs and having written a policy for the company, it was decided that this should be the benchmark against which the businesses should be audited. Therefore, rather than modify an existing audit package, it was decided to develop an in-house questionnaire, which would require the same effort as modifying a proprietary one and give the company more ownership of the system. A spreadsheet-based questionnaire was written, of over 650 questions (each with a Yes=1 / No=0 answer) which would enable an auditor to quantify a business's performance against full implementation of the policy (a copy of the questionnaire can be found in Appendix C, although this is work that the author carried out prior to commencement of the doctoral programme). The questionnaire would not be given to the businesses as this would lead to problems with misinterpretation and subjectivity, but was for the sole use of the audit team[9] leader. The questionnaire gave a percentage score for the 5-steps, identified as necessary for the implementation of HS&E management (Health and Safety Executive 1993): Policy, Organisation and Arrangements, Planning and Implementation, Measuring Performance, Reviewing. The same questions, analysed in a different way, were also used to provide a score for the four areas of Management Systems, Health & Safety, Environment and People (training, awareness, competence, communications etc.). Results were displayed on a Max-Min graph, which showed the range of scores from worst to best (Figure 2.2). The position of the current site being audited could also be plotted for comparison.

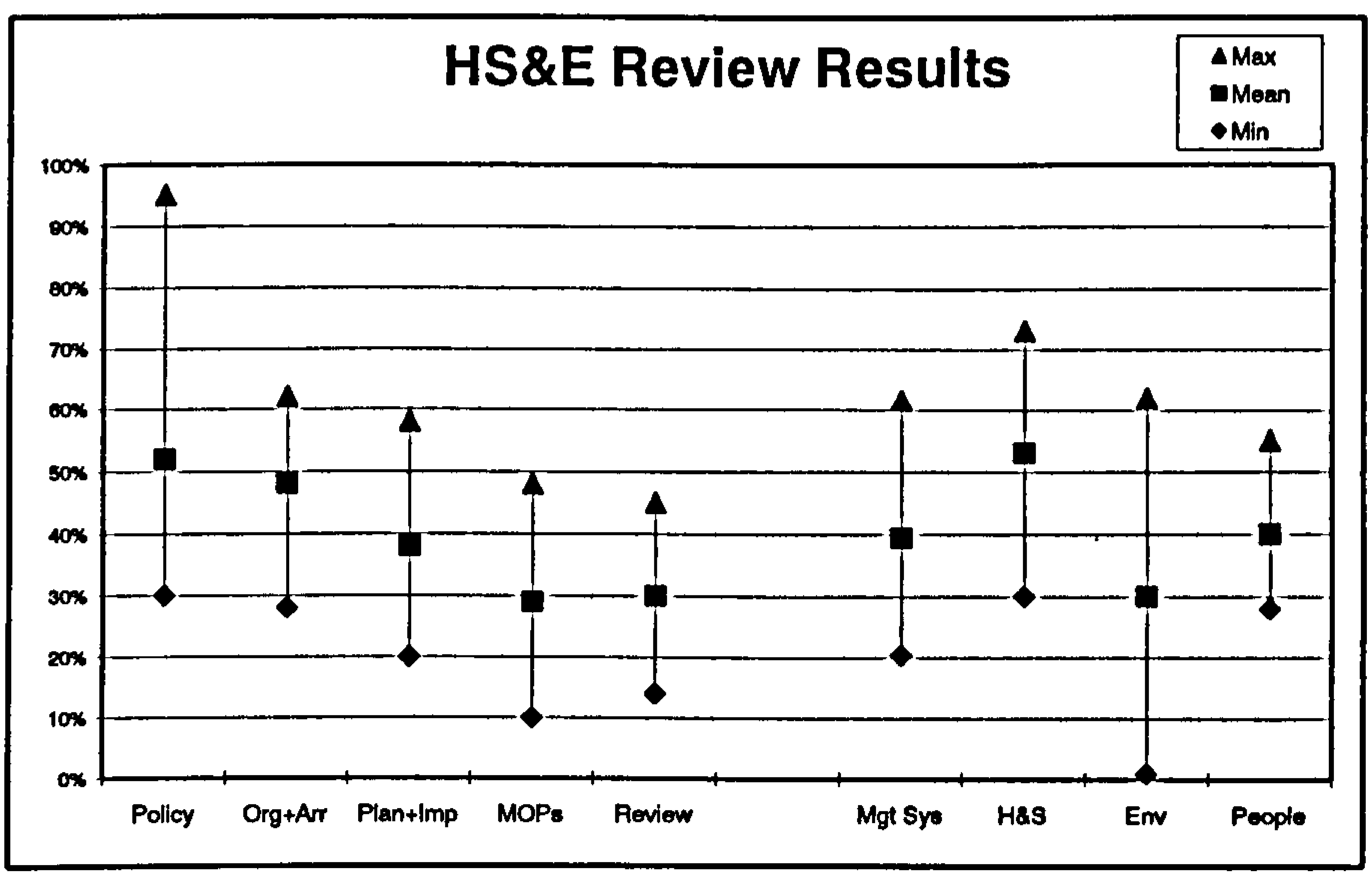


Figure 2.2 Example of Phase 1 audit result.

Interestingly, the early results tended to follow a typical profile, with Measures of Performance and Review consistently the weakest elements. Hence the need to improve this area was identified early in the process.

Following the implementation of the company HS&E management standards (see 2.3) the audit process was revised in order to use the standards as the benchmark, and a new method for scoring the businesses was devised (see 2.4).

- **The results**

Lucas audit experience produced a set of characteristics of the best performing businesses in terms of environmental management. The best performers were also generally the most profitable businesses and these characteristics are recognised as synonymous with those required of good business practice generally:

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[9] An HS&E audit team in LucasVarity consists of four members. Three specialists to address health, safety and environmental issues respectively and a team leader to assess management systems.

- Awareness and understanding of issues
- Commitment and Involvement of Senior Management
- Clear Targets and Objectives
- Effective Two-way Communications
- Employee Awareness and Participation
- Team Approach to Problem Solving
- Pragmatic
- Continuous Improvement Approach

The audit process also identified common weaknesses, which included:

- Measuring Performance
- Internal auditing and management review
- Documentation and record keeping
- Training and awareness

- **Conclusions**

Auditing is a very valuable tool, for the following reasons:

- For the businesses, it raised awareness of the issues (both good and bad practice) and helped to prioritise the necessary actions.
- For corporate management, the scoring system enabled comparison of the businesses (and generally confirmed their own analysis of general company performance)
- For the HS&E department it identified the weak areas where further work was required and also identified the practical problems and constraints under which the businesses were operating.
- For the Group it facilitated networking and cross-divisional transfer of solutions, as well as a common understanding and approach towards best practice.
- The LucasVarity audit programme has been verified by a third party and found to be "consistent, objective and systematic, and meets the criteria within ISO 14010 and ISO 14012" (ERM 1999).

2.3 Management Standards

- **The LucasVarity situation**

Half way through the first phase of audits it became clear that a set of corporate standards was required. Businesses wanted to improve their management of HS&E but had no means of knowing what they should do and what the auditors considered to be best practice. Legislation varied greatly across the continents, with environmental regulations more stringent and prescriptive in North America, although this was not necessarily considered best practice. Therefore a corporate set of standards was required that could be applied across all the companies and which would be considered best practice in any of its operating countries (this was first explained in the 6-month report – Lawson 1995a).

- **What the corresponding body of literature says**

At the time that the Lucas standards were being developed (1994-95), there was relatively little literature in this area, although EMAS had been published in June 1993 and BS7750 was formally published in January 1994 (having been piloted since 1992) but ISO14001 was not to be published until 1996 (when it replaced BS7750). It was not clear which environmental management standard would be most favoured by industry, so each of these three standards (EMAS, BS7750 and ISO14001) was evaluated.

A number of companies were contacted[10] and copies of documents borrowed from various contacts in those companies. Kodak (Bober et al 1993) had a set of one-page standards describing HS&E requirements that appealed to Lucas, and became the basis of the standards format. In later years, (after the publishing of the Lucas Standards) Azzone et al (1996) proposed a set of qualitative and quantitative indicators that can be used to characterise a corporate Environmental Management System. These include indicators for commitment, compliance, stakeholders, input, stock and output. They do not describe the more operational requirements of managing environmental issues.

BiE's (1996b) Parameters for Corporate Environmental Engagement cover ten points:

1. Corporate environmental policy
2. Main board member with environmental responsibility
3. Formal environmental management system
4. Environmental objectives
5. Measurable targets
6. Internal audit process
7. Employee environmental programme
8. Environmental stewardship of products, processes and services

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[10] Companies contacted included BA, BAe, BT, GKN, Kodak, Rolls Royce, and Rover.

9. Supply chain programme
10. Environmental communication with stakeholders

These points do highlight some areas of weakness in the company's standards, notably supply chain management and communication with stakeholders (other that internal ones).

- **The approach taken in LucasVarity**

Lucas Standards, based on a format from Kodak, cover Management, Health, Safety and Environment (a copy of the management and environment standards are included in Appendix A). Each standard is one page, it has a management aim and a set of performance expectations, against which implementation of the standard can be judged.

The Management standards cover the common elements found in the drafts (at that time) of BS7750, EMAS and ISO14001, such as policy, identifying significant effects, organisation and arrangements, programmes, measuring performance, environmental auditing and management review.

The environmental set of standards starts with an umbrella standard on environmental protection which requires that businesses identify and manage all their potential sources of pollution, provide awareness, training and instruction to employees, document all training and procedures and carry out continuous improvement. The subsidiary environmental standards cover the more specific requirements, or "performance expectations" (LucasVarity 1997) to protect, and or manage, ground and groundwater, effluent and surface water, air and waste and conserve resources and energy.

The standards, compiled in the HS&E Handbook (Lucas Industries 1995), were given to every Lucas business worldwide in 1995/96.

- **The results**

The Standards were welcomed by the businesses for being comprehensive yet concise, descriptive but not too prescriptive. Very soon afterwards however, more detailed guidelines were being prepared for businesses that were still unsure as to how to implement the standards (these are described in the 6-month report - Lawson 1995a and example copies contained in Appendix B).

- **Conclusions**

Written standards, clearly expressed, are essential, particularly in a complex company such as LucasVarity where sites are very widespread, in order to raise performance of all businesses up to a recognised level. The standards also provide a benchmark against which to audit and measure progress, in terms of implementation of the standards. Businesses in remote areas, in particular, are rarely in contact with the corporate centre and often have limited resources. Therefore the standards provide a basis for all businesses to work to. From the businesses point of view corporate consensus and guidance on such issues was welcomed.

2.4 Self Assessment System

- **The LucasVarity situation**

Having developed the HS&E Standards (which also provided a new benchmark against which to audit), a method of measuring their implementation was needed, both for the auditors and the businesses.

- **What the corresponding body of literature says**

In order to assess the businesses against the standards, a new method of evaluation was required, which if simple enough would be suitable for both auditors and site self-assessment purposes.

Many proprietary systems were assessed, such as ISRS (used by British Rail) and various American systems, which all tended to be long-winded and too compliance biased. One system assessed was the GEMI (Global Environmental Management Initiative), *Environmental Self-Assessment Program*, (GEMI 1992), based on the ICC's Business Charter for Sustainable Development. It was felt that the programme was not suitable for Lucas since it covered a different set of criteria (the ICC Charter) to the Lucas Standards, however, the GEMI format was appealing, in that it translated the performance of each element into four different levels to give a numerical score.

In 1996 (after the Lucas Self-Assessment system had been launched) Business in the Environment (BiE 1996b), launched *The Index of Corporate Environmental Engagement – A Survey of the FTSE 100 Companies.* This survey, based on self-assessment of 10 factors (see 2.3) was sent to the top 100 companies listed on the London Stock Exchange (the FTSE 100). It was intended to help businesses identify their own strengths and weaknesses in their management approach to the environment. BiE believes that self-assessment is the starting point for action and improvement. The BiE Index does not rate environmental performance or impact, it is developed on the premise that good management is a precursor for good performance and such is designed to be applicable to any corporate structure.

This system is useful for benchmarking the corporate programmes against other businesses, but is not a suitable self-assessment for businesses at an operational level.

- **The approach taken in LucasVarity**

The Lucas Management Standards are "measurable" in that performance expectations are listed for each standard and there will be some physical evidence (documentation, testimony) that the standard has been implemented. The standards could therefore be used to audit against. The average audit performance had already improved from 40% to 60% over the first three years (1992 to 1995, using the policy based system explained in 2.2) and based on this progress the Chief Executive agreed that the businesses should aim to achieve 80% compliance with the Standards by July 1998. In order to measure the progress towards 80% compliance it was decided to develop an Assessment system for the seven key Standards only:

M1 – Policy, Objectives and Targets
M2 – Organisational Arrangements
M3 – Operational Management Systems
M4 – Self-Assessment and Audit Systems
E1 – Environmental Protection Programme
S1 – Risk Elimination and Control Programmes
H1 – Occupational Health Programmes

The first four management standards representing the elements contained in external standards such as BS7750 and ISO14001, and the other three standards E1, S1, H1, each being the umbrella standard for the environment, safety and health sections respectively. It was believed that assessment of these seven Standards would be sufficient to judge the level of implementation of the Standards as a whole. Assessments for the other Standards could always be developed at a later date if deemed necessary.

It was decided to adapt the GEMI format, increasing the number of performance levels to 5, each representing 20% steps up to 100% implementation. However, since this was considered to be too coarse a scoring system, 5% increments were accepted (i.e. each level could be spilt into four quarters), to allow for partial implementation of some elements. (This is also explained in the 18-month progress report #1 – Lawson 1996, and Appendices C & K).

In 1998/99 the LucasVarity auditing system, including the standards, self-assessment system and audit team, was independently assessed and verified by the environmental consultants ERM. The verification process comprised a number of measures designed to reflect the existing LucasVarity health, safety and environment management handbook and the requirements of ISO14001. Particular attention was given to assessing the audit team (competence, qualifications and experience) and suitability of the audit process whilst on site (during three shadow audits), in order to establish whether the audit programme was consistent, objective and systematic (ERM 1999). Following the process ERM (1999) confirm that "the LucasVarity health, safety and environmental audit programme is consistent, objective and systematic , and meets the criteria within ISO 14010 and ISO 14012".

- **The results**

The simplicity and visual nature of this scoring system, which was originally intended for use by the audit team only, caught the eye of many site managers who also requested copies for their own use. This assessment system was therefore distributed for all Lucas businesses to use as a Self-Assessment system (SAS) in the intervening period between audits. However, it was made clear that, the Group audit assessment results would take precedent over any self-assessed results.

The average audit score in 1992 was 40%, by 1995 the average was 60%, 80% was therefore set as the target for 1998. Business disruptions, organisational changes and the extra Varity businesses have meant that LucasVarity has not reached its target of 80% by July 1998 (although Lucas Aerospace did reach this average by December 1998 – see 42-month report: Lawson 1999).

- **Conclusions**

Businesses relish tools that are simple, visual and preferably short, but accurate. The process is known to be reasonably accurate, as evidenced by the majority of site self-assessment results that are within a few percentage points of the auditors' scores. This is why the Self-Assessment System has stood the test of time and has been used successfully by every Lucas business worldwide for three years.

Self-Assessments are however open to interpretation. Many different meanings can be applied to a simple set of words. In 1998, a corporate audit at Lucas Aerospace (the first since the HS&E Department was disbanded) revealed a large discrepancy between the auditors' score and the site's Self-Assessment Score. This led to the identification of some common weaknesses in the businesses and procedures were developed to redress these discrepancies (one of which was the identification of significant effects – see 2.5). An internal verification process was also needed to check the Self-Assessment Scores of the other Lucas Aerospace sites. Businesses were requested to explain key processes and supply particular documentation to verify their performance. Then a tabletop audit was carried out to check the self-assessment scores of all 21 businesses in the division (discussed in the 42-month report: Lawson 1999).

Whilst Self-Assessment is a valuable tool for sites to monitor their own progress, third party audits or verification are also needed to maintain the standard of assessment across businesses.

2.5 Identifying Significant Effects

- **The LucasVarity situation**

The first Management Standard (M1) in the LucasVarity HS&E Handbook (LucasVarity 1997) states that:

"Each business will:

1. establish and implement procedures to identify all those activities which have or can have significant effects.
2. define priority issues, based on legal requirements, level of risk, levels of performance and financial implications."

These first two requirements then lead into the specifying of objectives and establishing of targets and programmes (Standard M3).

In the first Lucas HS&E Handbook (Lucas Industries 1995), the M1 standard required businesses to "create a register of all those activities which either have or potentially have a significant effect." The register of significant effects had been a requirement of BS7750, but with the advent of ISO14001, the requirement for a register was deleted and the term "effects" was replaced with "aspects and impacts". An environmental aspect is defined as an "element of an organisation's activities, products or services that can interact with the environment" and a significant environmental aspect is one "that has or can have a significant environmental impact", whilst an environmental impact is "any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services" (LRQA 1997). The term "significant environmental effects" is still used in EMAS to cover the same basic concept.

Auditing in 1998 revealed that businesses still had not developed robust, repeatable and objective procedures to identify activities having, or potentially having, an HS&E effect as required by the LucasVarity Standard M1. It was clear that some guidance was needed. A suitable "off-the-shelf" method could not be found for identifying and assessing significant effects, so a simple procedure was developed (building on previous work –see 12 month report: Lawson 1995a, as well as ideas developed by Annelli Gilbert and Linda Warrick – Teaching Company Associates working with the Lucas HS&E department from 1994 to 1997[11]) to help

[11] The Teaching Company project was set up following an MSc project by Linda Warrick to develop a site "vulnerability" risk assessment process to enable businesses to understand the potential risks of land contamination at the Lucas sites. The subsequent Teaching Company project was originally meant to carry out Waste Minimisation in the businesses. However, in the process of identifying waste minimisation opportunities, it was felt necessary to take a step back and prioritise the business issues by developing a method for identifying significant effects. Annelli Gilbert developed a workable system, which was trialled at one site. Others however did not generally adopt the process because it was too detailed, and in trying to accommodate all the criteria suggested in the literature, became too

businesses to identify and prioritise their significant effects and the activities responsible for them. The procedure is described fully in the 36-month report (Lawson 1998b, pp 9-14 and the full procedure can be found in Appendix AE).

- **What the corresponding body of literature says**

In 1994 the IEM (Institute of Environmental Managers – now "Management") published a journal entitled: "Developing Registers of Significant Environmental Effects". This was in response to BS7750 and EMAS which both required that organisations develop registers of the environmental effects for their organisations. Up to that date, however, no guidance on how to realistically approach the task existed.

"BS7750 requires that implementing organisations develop registers of significant environmental effects where an environmental effect is defined as "any direct or indirect impingement of the activities, products or services of the organization upon the environment, whether adverse or beneficial." (IEM 1994)

The British Standard specified that typically, significant environmental effects would include:

- controlled and uncontrolled emissions to atmosphere
- controlled and uncontrolled discharges to water
- solid and other wastes
- contamination of land
- use of land, water, fuels and energy, and other natural resources
- noise, odour, dust, vibration and visual impact
- effects on specific parts of the environment, including ecosystems

Furthermore the Standard stated that effects would need to be considered in the context of:

- normal operating conditions
- abnormal operating conditions, including shutdown and start up conditions
- incidents, accidents and potential emergency situations
- past activities, current activities and planned activities

Since the effects register was expected to play a central role in the formulation of a company's environmental objectives and targets and environmental programme, the IEM (1994) stated that "A systematic evaluation of significant environmental effects is therefore necessary to underpin the effectiveness of any environmental management system whether it has been designed with BS 7750 in mind or not." And "it is likely that the ability to demonstrate that a systematic and logical methodology has been used in evaluating such effects will play an important part in the certification process."

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complicated and time-consuming. The author has used sections (notably the decision matrices), developed by Linda and Annelli and simplified the process, also incorporating the original management significance exercise developed in 1995 (see 12-month report – Lawson 1995a).

The IEM (1994) identify three key stages in the development of registers of significant environmental effects:

- identification of environmental effects
- evaluation of significance
- compilation of the registers

The IEM Journal (IEM 1994) was based on work and discussions that came out of workshops with its members. It was at these workshops that it was agreed that it was generally not feasible to undertake the type of evaluation that would determine significance directly with respect to environmental impact. Rather, it was often far more appropriate to define significance with respect to the priorities of the organisation itself. In other words, significance is generally significance in the eye of the company. (IEM 1994)

The IEM (1994) suggested that typically an effect would be significant if it:

- is controlled by legislation
- has a financial implication
- has (or has potential to cause) a demonstrable environmental effect
- is of concern to customers
- is of concern to financiers or insurers
- is of concern to the local community

The IEM (1994) say the next step is to develop a set of questions — a filter — which can be applied to each of the effects that have been identified to determine whether or not it might be considered "significant".

The following table shows a list of "filter" questions proposed by the IEM document in the left-hand column. In the right–hand column is how the question has been addressed by the Significant Effects procedure developed for Lucas.

Table 2.3: Addressing significance "filters"

IEM Question	**Where this is addressed in "Significant Effects Procedure"**
• is the issue subject to legislative control?	Step 4: Assessment of Controls & Step 5: Significance Assessment – Legislation
• is the effect covered by any codes of practice or guidelines?	Step 4: Assessment of Controls
• would the emergency services be involved if there were an incident?	Step 4: Assessment of Controls
• does the effect have a demonstrable effect on the environment?	Steps 1, 2, and 3
• is the effect likely be a cause of complaints?	Step 5: Significance Assessment – Stakeholders
• does the effect have financial implications?	Step 5: Significance Assessment – Business Costs
• could the effect result in financial/legal liabilities?	Step 5: Significance Assessment – Business Costs
• is the effect likely to be of concern to customers?	Step 5: Significance Assessment – Stakeholders

In conclusion the IEM (1994) say:

"To a great extent identifying significant environmental effects is a case of horses for courses. The scope of the initial review will depend on the company aspirations and culture, and the filter for significance will focus on key stakeholder priorities. Taken together these will generate a register of environmental effects that will suit the organisation's priorities and serve the purpose for which it is designed. The process of developing the registers will involve:

- deciding what role you want the registers to play
- scoping the information gathering exercise
- gathering together a list of effects within this scope
- deciding what issues make an effect significant to your organisation
- developing a set of questions which reflect these issues
- applying these questions to the effects you have identified to ascertain whether they are significant
- drawing together a register

Whatever the approach adopted in the compilation of the registers it is important that the task is tackled in a systematic way, one which the responsible manager is able to explain and justify."

In July/August 1995, Brady, writing for The Environment Council, stated that "the key to doing something about the environment lies in a company assessing the significant environmental effects of its activities." However, he admits that the ideas for putting this into practice are difficult because:

- the appropriate methodologies are still underdeveloped
- there is a lack of quantitative data about many environmental effects; and
- there are many fundamental difficulties in comparing and interpreting data"

Brady describes a three-step methodology that was being piloted by Northumbrian Water Group. The three steps are:

1. A list of "Events" with potential environmental consequences is drawn up. Brady states that consultants will compile this list because it needs careful research. [*The author believes businesses would learn more by compiling the list themselves, possibly with guidance from a specialist*].
2. The organisation then identifies the potential release associated with each "Event" (e.g. size of spill). They then weight the effect (e.g. fish kill) and the frequency. The significance is then the effect multiplied by the frequency. [*This is an FMEA*[12] *approach*]

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[12] FMEA or Failure Modes and Effects Analysis is a Quality technique, generally used by design and process engineers to identify and then assess all the possible modes of failure concerning a product or process. For each potential failure the probability of occurrence and detection are assessed (rating from 1: low/never to 10: high/often) and the severity of the situation in the event of the failure occurring (again on a 1-10 scale). These three numbers are the multiplied together to give an overall risk score, which is used to prioritise the potential failure modes, so that safeguards can be taken against them. (Quest 1998).

3. A number of categories of significant effect are identified, based on step 2, and objectives are set in relation to these.

In September 1995, McMullan stated "in order to assess what approach is most appropriate to address environmental concerns, a company must be aware of both:

a) the effects that its activities may have on the environment

b) the commercial significance of those effects on its own operations.

McMullan (1995) proposes 5 steps to assessing the commercial significance of environmental effects [*authors comments in italics*].

"Step 1) Characterise all activities, inputs, outputs and environmental effects". It is suggested that this be done by considering each process and business activity as a set of linked "mini-processes", each with inputs and outputs. [*This approach was tried in Lucas but it was very time-consuming and a great deal of time was wasted assessing activities, which did not have a high significance. This was considered an unfocused approach and an inefficient use of time*].

"Step 2: Assess the environmental effects". McMullan admits that this is difficult [*but offers no suggestions*].

"Step 3: Identify existing and likely future performance requirement." This is where knowledge of stakeholder requirements, now and in the future, is required.

"Step 4: Analyse inherent risks and opportunities". By this McMullan means business risks, and whether or not the company can afford to address them.

"Step 5: Determine current performance". Assessing whether the company is already managing the environmental effects in an appropriate way.

In 1997, Sunderland & Thomas confirmed that "Identification and evaluation of aspects and impacts is the most important step in designing an effective environmental management system".

They suggest a four-step approach:

"Step 1 – Select an activity, a product or service. The selected activity, product or service should be large enough for meaningful examination and small enough to be sufficiently understood.

Step 2 – Identify environmental aspects of the activity, product or service. Identify as many environmental aspects as possible associated with the selected activity, product or service.

Step 3 – Identify environmental impacts. Identify as many actual and potential, positive and negative, environmental impacts as possible associated with each identified aspect. Characterise and quantify them as far as possible – e.g. hazardous chemicals purchased.

> Step 4 – Evaluate significance of impacts. The significance of each of the identified environmental impacts can be different for each organisation. Quantification can aid judgement."

Sunderland & Thomas (1997) (from Arthur D Little) state that "categorising your activities, products and services and identifying the associated aspects and impacts can be a daunting task." They describe so many factors, considerations and what-ifs that it does indeed sound like a daunting task. So daunting in fact, one might be tempted to hire a consultant.

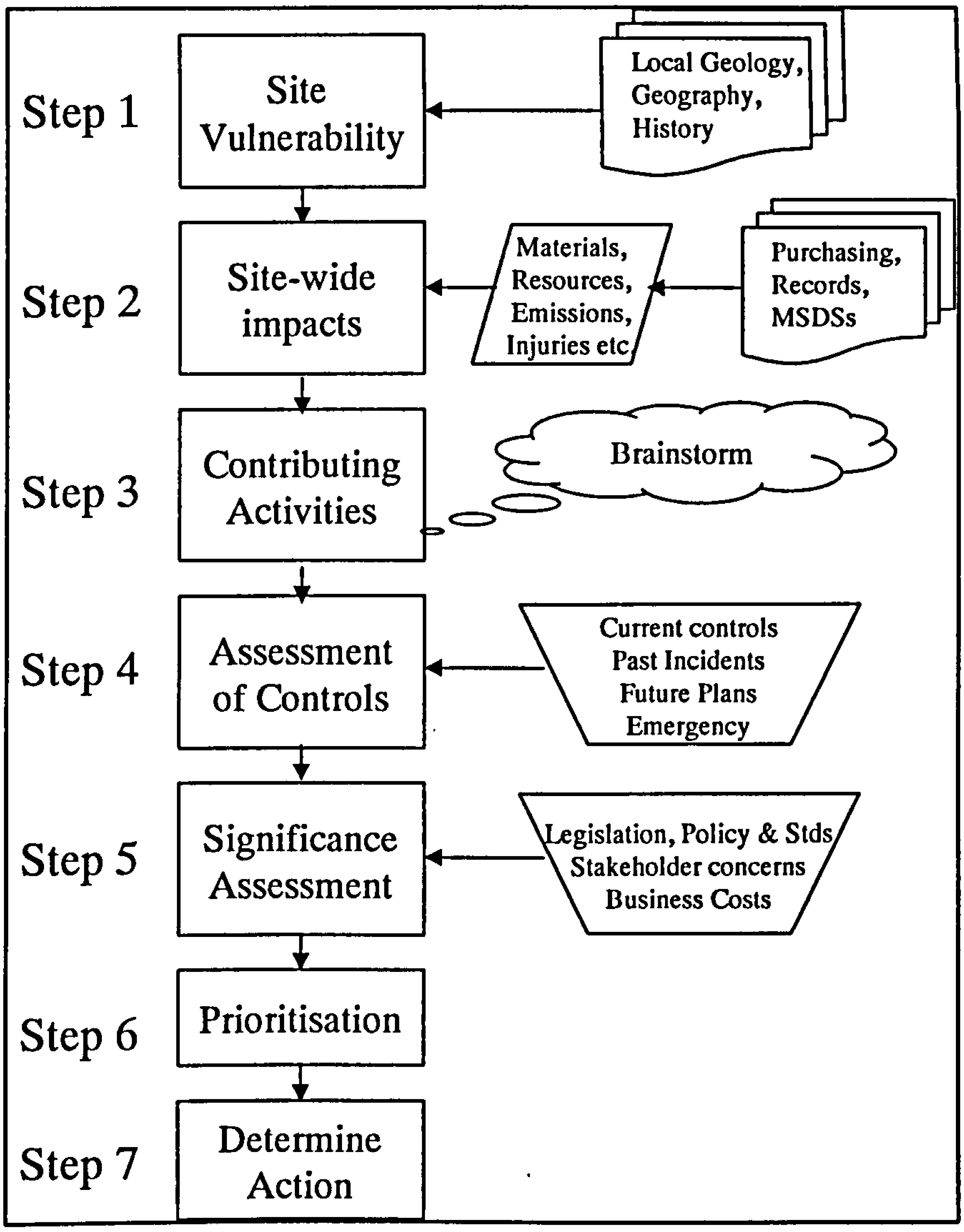
None of the methodologies proposed in the available literature was suitable for LucasVarity. Most did not provide enough information, some were just complicated and time consuming, some not objective or repeatable enough. And many authors admit that it is better to develop something to fit the organisation anyway. Sunderland & Thomas (1997) stated:

> "think about the methodology you need to determine your significant environmental aspects and impacts. It is important that you develop your own methodology to decide what works for you. There are no right or wrong ways, just better or worse, simple or complicated...The approach you adopt needs to be standardised and as objective as possible, but keep your approach sensible and simple and apply reality checks on the results of the analysis."

- **The approach taken in LucasVarity**

So that is what was done. A methodology was developed, that was standardised and as repeatable as possible, practical, simple (without being simplistic), and suitable for the LucasVarity organisation. A methodology for identifying significant environmental effects and the activities that contribute to them was first developed as a management tool and tested with groups of managers at several Lucas businesses (see 12 month report: Lawson 1995b). This methodology was structured but still subjective since it relied on the managers to weight the factors influencing an activity's "significance". Since that time, the methodology has been augmented into a step by step procedure that provides a wider range of criteria against which to judge "significance". In this way it is a more robust and repeatable procedure which requires less subjective judgement on the part of the user. The criteria also includes an assessment of risk since it not only assesses the hazards (such as toxicity) but also the likelihood of failure due to management and control (or lack of it). This ensures that a proactive and predictory element is built in to the assessment of significance. The full procedure is explained in detail in the 36-month report (Lawson 1998b, pp 9-14 and Appendix AE). The step-by step approach is represented in the following diagram (figure 2.3).

Briefly, the process assesses the local receiving environment (Step 1: Site Vulnerability), then an assessment of the total site-wide impacts (Step 2), including quantities and toxicity. In Step 3, all the activities that contribute to these impacts are identified and then rationalised (reduced to one entry each, but weighted by the impacts they contribute to). If an activity contributes to more than one impact it starts to rise up the "Significance" list. Then for each of the activities

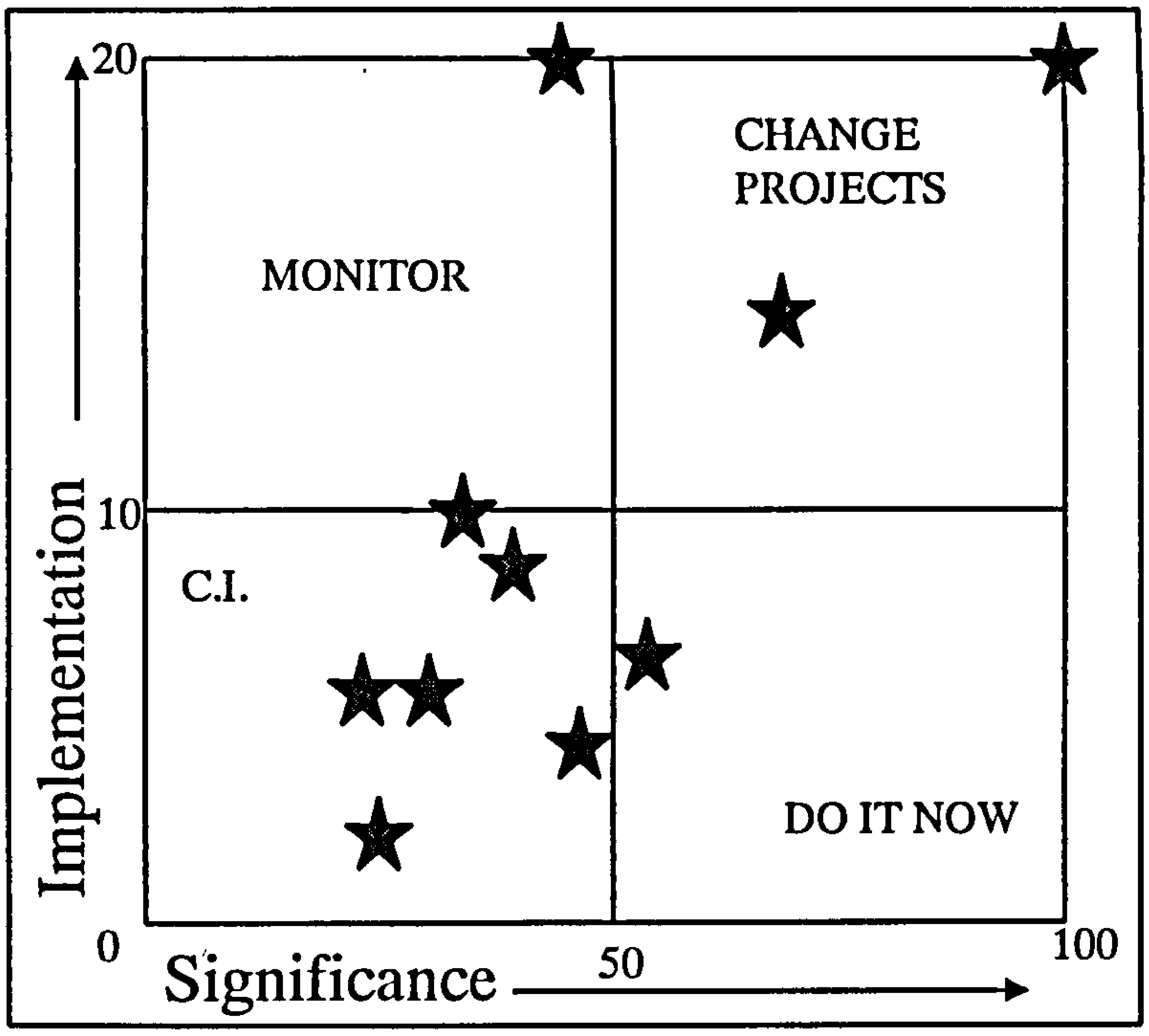


identified as associated with the impacts, the controls are assessed (Step 4) past, current and future. In Step 5 even more variables are factored into the process: legislation and policy, stakeholder concerns and business costs. All these factors are quantified and totalled for the final prioritisation process in Step 6.

Figure 2.3: Procedure for Identifying Activities that have Significant HS&E effects

A further step (7) assesses the ease and cost of taking action (implementation) to improve these activities and plots them on a Boston-matrix type chart (figure 2.4), which helps management to determine the type of action needed. As figure 2.4 shows: Change Projects are needed to improve those activities (shown by the stars on the grid) that are very significant and very difficult or expensive to implement. Anything that is difficult and not significant just needs to be monitored. Highly significant activities, which are easy to address, should be tackled straight away, and continuous improvement teams could tackle lower significance activities that are easy to address.

Figure 2.4 Prioritised Action Matrix



- **The results**

The procedure has been used by the seven UK Lucas Aerospace businesses, who have expressed enthusiasm for the process. One general manager, who had been involved in using the procedure to identify their most significant activities, stated "I am happy with the process, it has been useful", another manager was particularly pleased with the resultant Significance v. Implementation Matrix which visually positions the company's priority projects.

The top ten significant activities from the seven sites have been compiled and compared in the following table. A total of 33 activities were listed ranging from heat treatment and plating or surface treatment to administration.

Table 2.4 Most significant activities, as identified by 7 sites testing "Significant Impact" process

Significant Activity Scores									
Site:	**B**	**M**	**Y**	**H**	**W**	**C**	**S**	**TOTAL**	**SITE COUNT**
Top 10 Activities									
Degreasing (Solvents)	62		80	72	65	59	34	**372**	6
Surface Treatment	69			69	95		57	**290**	4
Machining	56			58	58	38	44	**254**	5
Assy & Test (with oils)		102			58		60	**220**	3
Heat Treatment	64			72	30			**166**	3
Waste disposal	61		49			48		**158**	3
Boiler/Heating		58		42	18		28	**146**	4
Admin		42		45	10		30	**127**	4
Painting (Spraying)				60	65			**125**	2
Solders			60			56		**116**	2

The activity with the highest total significance score, which affects six of the seven sites, is degreasing (or cleaning) using solvents. This is a significant activity, since it has a potential for air emissions, land and water contamination, produces special waste, affects health and is, or will be (depending on the quantity[13]) controlled by legislation. There is also potential for great savings if it can be eliminated, but being an aerospace company, any changes to processes have to be re-validated, which can be a lengthy and expensive process.

The second most significant activity, across the sites, is surface treatment. This generally involves chemicals, has the potential to emit air emissions, effluent, special waste, affects health and controls are costly.

Most of the top ten activities are to be expected (this gave the users satisfaction that the process results were believable), although it is surprising, yet refreshing, that Administration has also made it into the top ten. Those sites identifying Administration as a significant activity recognise its impacts to be: use of paper, electricity, creation of waste and contributing to illnesses and injuries (some of the biggest claims are due to musculo-skeletal disorders incurred by office workers).

The effects of both direct and indirect activities were considered by the businesses, but no indirect activities made it into the "top tens". As direct activities are addressed and their environmental effects reduced, then more indirect activities will become priorities.

- **Conclusions**

A simple, repeatable, step-by-step, objective procedure was developed, which was successfully used by practitioners and managers of varying specialist knowledge. Following training in its use, the process was completed quickly by each management team, with no external (or internal) consultants, and produced good information, which management had confidence in, for the businesses to base their objective and target-setting on.

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[13] In the UK, solvent cleaning processes prior to surface coating, which emit 5 tonnes or more are subject to Part B authorisation under the Environmental Protection (Prescribed Processes and Substances) Regulations 1991. Under IPPC it is likely that any process using solvents and emitting more than 1 tonne per year will require authorisation and control (Croner's).

2.6 Quantitative Environmental Performance Measurement System

- **The LucasVarity situation**

A need for **quantitative environmental performance measures** to complement the Management Systems based audit measures, was recognised in 1994, and proposals for such a system were put to the Group HS&E Committee in 1995 (see 12-month progress report – Lawson 1995b). A pilot exercise was carried out with 6 sites in 1995/96 to see if the proposed quantitative performance measurement system was workable (see 18-month progress report #2 – Lawson 1997a). The results of the pilot study (see 24-month progress report– Lawson 1997b and Appendix T) were presented back to the Group HS&E committee, and the study participants, who unanimously agreed that it was a useful exercise and should be implemented across all the businesses. A change in business management (merger with Varity) delayed the process slightly and some further modifications were requested, but eventually a worldwide environmental performance measurement and reporting system was introduced in January 1998. Data has been collected and analysed each quarter since then and there is now one year's worth of data (a sample of the data is included in Appendix AI). This will be the baseline for future improvement and target setting.

- **What the corresponding body of literature says**

> "Almost every company will need to pay greater attention to environment-related performance measurement, both to have better data for internal decision making and to meet the demands of ever more sophisticated stakeholders. They will also have less flexibility as initiatives such as ISO14031 (guidelines on environmental performance measurement) and government regulations build a consensus about what should be measured and how it should be communicated." (Bennett & James 1998)

As already discussed in section 1.8, engineering companies are lagging behind in the race to report on environmental performance. In companies that do not measure environmental performance, it could be that they do not understand the issues and how they apply to their company, or, they may be frightened of what might be revealed, as McGonagill & Kleiner explain:

> "If managers are trying to deny or stonewall information within the firm, it's much easier to make sure that information is never recorded. Ten years later, a team that decides to take the fundamental route will find it all the more difficult to gather the pertinent data. Records will be incomplete, measurement will never have been taken, and the habits of enquiry will never have been cultivated to make people skilled at learning from bad news. To cope with the anxiety, people will continue to cut corners on environmental

safety, which makes it even more likely that there are hidden secrets waiting to be unearthed. (McGonagill & Kleiner in Senge et al 1997, p462).

KPMG's 1997 analysis of environmental reporting concluded that there had been little real growth in the past 3 years in companies reporting on quantifiable targets against which to measure environmental performance (less than 15% of FTSE 100 reported quantifiable targets). In terms of quantitative information:

- 21% explained quantitative data using analogies to put into context.
- 16% provided previous year's environmental performance data for comparison
- 13/14 reported implementation deadlines
- 12% of FTSE100 reported on progress with previous targets
- 8% detailed reasons why targets had not been met

The PIRC 1998 survey of Environmental Reporting amongst FTSE350 companies, finds that many businesses are reporting quantified (impact) EPIs, (these are summarised in Table 2.1.11.1), but that the "General Industrial" (engineering) sector is still lagging behind in the process of measuring environmental performance (see sections 2.1.9 and 2.1.11).

Perhaps the reason for such low levels of environmental performance measurement, is that there is very little practical advice on how to go about it. Azzone et al state that:

> "In spite of the growing demand from the public, regulators and pressure groups for information on companies' environmental performance, there are few studies that have systematically defined the type of information and measures that are needed to make an objective assessment of a company's environmental policies and performance." (Azzone et al 1996, p70).

Azzone et al's paper then goes on to suggest a theoretical framework, but it is not one that has been tested in practice (see section 1.14 and figure 1.3).

Although the BiE FTSE100 "Environmental Engagement" survey concentrates on management systems issues, their last questionnaire (October 1998) started to collect information about quantitative measures because they recognise that this is where the key to real performance measurement lies.

The CERES Standard Report Form (CERES 1997b) does request quantitative information for resources used, energy, air emissions, chemical releases, hazardous and non-hazardous waste, but does not provide any definitions or standard units. The Global Reporting Initiative (GRI 1999) takes this one step further and does specify standard units of measurement, but no standardised definitions.

- **The approach taken in LucasVarity**

The choosing, acceptance, design and implementation of quantitative environmental performance measures was a long process involving many discussions with people from directors to practitioners, specialists to generalists. The pilot study (detailed below) also gave practitioners the chance to participate in the design of the system, since they were asked to provide data, to raise any problems caused by the data collection and to suggest improvements to the system. Business culture (experience of what works and what does not) and politics (the changing organisation and responsibilities) had a large influence on the design of the system, reducing it to the minimum acceptable to all parties involved. In fact, it was non-practitioners who were more cautious and concerned about the additional workload than those who were to provide the data. Whilst this approach may be criticised by academic purists, a simple, practical system that is accepted and implemented is better than a theoretically perfect system which is not accepted or ever implemented. The author views this as the "thin end of the wedge", in other words, once a system (however simple) is implemented and shown to work, it will be institutionalised into the business and then will be subject to continual review, improvement and augmentation, as more data is collected and more people become aware of the results. Trying to implement a large, complex system is like starting with the thick end of the wedge, rather painful and a shock to the system. Obviously, any system has to address the most significant issues or it risks losing its credibility. Therefore, it is essential that its effectiveness is reviewed and any gaps highlighted at least annually. Cross-comparison against the results of other surveys and assessments (such as the results of the significant effects process) will also help to identify areas where the process needs upgrading.

Initially, a long list of potential measures was drawn up based on a brainstorm of the concerns of different business functions (see table 2.5). The list was then reduced down to an agreed set of commonly accepted measures. The final chosen measures were ones where there was confidence that the data could be obtained, they were easily (usually directly) measured and readily available. There was also a sufficient range of measures to interest most of the business functions, with obvious exceptions being Product Design (being addressed by another doctorate project), Purchasing (these were more indirect concerns, which the company preferred to postpone until they had a better understanding of the in-house concerns), Quality (really integrated into the other business functions) and Sales & Marketing (difficult to measure directly).

The chosen measures were trialled at six sites (one from each division, 5 in the UK, 1 in Germany), to ensure that it was possible to collect the information study (see 24-month progress report– Lawson 1997b and Appendix T). then further refined and implemented worldwide in January 1998, for reporting each quarter (see 30-month report and Appendix Y for final measures and proforma used – Lawson 1998a).

Table 2.5 Original Ideas for Integration of Environmental Performance Indicators into Business Processes

Business Function	Concerns	Measures	Status of Input data	*Measures chosen*
Business Management	Future Strategy Cost of Operations Compliance Public Image Investors Reporting	Research, Trends Incidents, Clean-ups Prosecutions External Reputation Efficient management External benchmark	Known – not compiled Costs – not compiled Known – not compiled Survey ? Survey ? Reports collected	*Clean-up costs* *No. of prosecutions*
Facilities Engineering	Energy Efficiency Water Efficiency Ground protection Extraction Drains and pipes	Some reporting Some reporting Pollution incidents Emission lists Types & condition	Examples collected Examples collected Costs – not compiled Compiled by sites Variable	*Energy use & cost* *Water use & cost* *Clean-up costs*
Finance	Cost of waste disposal Cost of materials Cost of abatement Cost of prosecutions Business Risk Investors	Costs by site Costs by site Costs by site Costs by site ? ?	Costs – not compiled Costs–some compiled Costs – not compiled Costs – not compiled ? ?	*Disposal costs* *Cost of VOCs lost* *Fines, etc.*
HS&E	Compliance Pollution Control Waste Minimisation Education Envir. Reporting Management systems	No. incidents Measured emissions Savings No. people trained Internal benchmark Against standards	Known – not compiled Known by site Examples collected H&S, not E Audit results Audit result/Self Ass't	*No. of incidents* *VOCs lost* *Waste recycled* *Training completed* *Self Assessment*
Human Resources	Competence of staff Training effectiveness Morale / I.R. Culture	Training/qualifications Incidents Absenteeism? Continuous Improv'mt	Records–not compiled ? Available ?	*Training complete* *No. of incidents* *Days lost due to injury/illness*
Manufacturing Engineering	Process Efficiency Waste Minimisation Alternative substances	Waste, water, energy Savings No. hazards	Some examples Examples collected Recorded @ site	*Waste produced* *water, energy used*
Manufacturing Operations	Process capacity Process capability Waste production Operator competence Packaging	Products per hour Waste/scrap produced Waste per product No. incidents Disposable :returnable	Recorded @ site Scrap recorded @ site Some calculated Not recorded Dawn's project	*Total waste*
Product Design	Number of parts Types of materials Types of processes Dismantle-ability Repair-ability Material identification Recyclability LCA	DFA Least hazardous Least hazardous Aftermarket index Aerospace index Marking ? ?	Sometimes Few products Aerospace products Few components ? EngD project	*(This will be addressed by a separate project)*
Purchasing	Interruption of supply Cost of supply Supplier performance	Supplier audit Supplier audit Supplier assessment	Being devised Being devised To be integrated	
Quality	Product Quality Scrap Procedures Systems	Scrap Scrap Audit Audit	Measured @ sites Measured @ sites Measured @ sites Measured @ sites	
Sales & Marketing	Image Competitiveness Customer needs	Reputation External Benchmark Customer delight	External Benchmark Orders won Repeat orders	

- **The results**

The first quarter's results were collected in April 1998, the second in July. Data was collected, compiled and analysed in detail for one of the six divisions, Lucas Aerospace, the fourth largest in terms of people. Lucas Aerospace consists of 21 sites, covering the UK, France, North America, Australia, China, Indonesia and Singapore. Each site submitted 128 items of data each quarter, so over four quarters and 21 sites this amounts to 10,752 items of raw data which were totalled, averaged, normalised and graphically charted. Questions raised during data analysis necessitated further discussions with data providers and a rewrite of the data definitions.

Aggregate results across the six divisions (five by the end of the year) were also compared. This showed some abnormally large differences in performance which, when investigated, revealed simple differences in presentation of data across the divisions (see 36-month progress report – Lawson 1998b and Appendix AD).

This hands-on approach to the collection, analysis and rectification of problems has enabled the Research Engineer to find out what difficulties the businesses were experiencing and the practicalities of collecting, compiling and analysing this type of data (see also 36-month report – Lawson 1998b, p8 and Appendix AH for samples of the data and associated documents).

A discussion of the practicalities of implementing an environmental performance measurement system are discussed in *The Practicalities Of Measuring Environmental Performance,* the 1998 EngD Conference Paper (Lawson 1998c – see Appendix AB).

The final results for Lucas Aerospace, for 1998, have been collected and compiled into a report entitled "Our Environmental Challenge". (see Appendix AH) For this report, the data has been converted into indicators of environmental impact as explained in the following section (2.7). The data for all the other divisions, is still in the process of being compiled.

In summary, the Aerospace corporate view is that:

- Reporting has raised awareness at all levels from Sites to Divisional Directors.
- Management now have a better idea of environmental performance and the divisional priority areas: Energy and Effluent
- There are some gaps in the data, notably effluent toxicity & land contamination potential.

As far as site comparison is concerned:

- Although, sites are not strictly comparable, due to different products and processes, reporting has highlighted site priority areas.
- The only "common denominators" are number of Employees or Sales.
- Data errors & questions have reduced from 55 in quarter 1 to 21 in quarter 4. But it should be better by now.

Sites should now:

- Have systems in place to collect data easily and accurately (especially if they are claiming 80% compliance with the HS&E Management Standards)
- Be using the MOPs and comparisons with other sites to drive improvements
- Be collecting additional data for their own in-house priorities
- Check that all data submitted is accurate. It will be used to gauge improvements.

- **Conclusions**

Quantitative measurement of environmental performance is an essential part of any environmental management system: it is fuel for company communications, the improvement process and decision making.

However, it can be difficult to persuade managers to measure environmental performance, particularly when they have not been asked to do so before and they do not see it as a strategic issue. Or as McGonagill & Kleiner put it:

> "There is something about environmentalism that brings out defensive routines in full force, so that corporate managers risk failing to see and capitalize upon the potential benefits that environmentalism offers" (McGonagill & Kleiner in Senge et al 1997, p458)

Nevertheless, once implemented, the data collected from an environmental performance measurement system can start to provoke questions and awaken interest that had previously lay dormant.

It is important to remember that environmental performance measurement may be just one initiative of many in the business. All initiatives are important, but each new one diverts attention and resources away from the others that are still in progress. After the initial launch and communication, implementation is expected to happen magically, resource is withdrawn and the next initiative launched. On the contrary, implementation is the most crucial stage and yet often the least supported[14]. The all-important review of achievements of targets is often overshadowed, or even forsaken, by the next new initiative. It is therefore essential that there is sufficient support and back-up during the initial implementation phase to ensure that problems are ironed out and clarifications are made, in order that the data integrity is improved and all participants are confident in their use of the process[15].

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[14] Personal experience from six years working on manufacturing systems and change projects. Reasons that implementation was seen to fail have included:

- hand-over from a design team to an implementation team that lacks ownership and involvement with the design;
- "cherry-picking" (i.e. implementing the best or easy bits of the system but not the rest)
- poor communications and training leading to confusion and resistance to change;
- lack of involvement of those that have to work with the new system.
- less emphasis on project management, meeting targets, resolving conflicts etc.

[15] Personal experience from implementation of the Measures of Performance system in LucasVarity.

2.7 Internal Reporting

- **The LucasVarity situation**

When the LucasVarity corporate HS&E department was still in existence, a newsletter was produced bimonthly, which was sent to all sites worldwide. As part of the general HS&E newsletter, there were two specialist environmental papers: "Green Page" and "Energy Page", where latest issues, good news, bad news and "seasonal" ideas were tabled. Since the divisional organisation of HS&E, there has not been a common approach to internal HS&E communications across the business. In Lucas Aerospace, a one page "Broadcaster" has been produced monthly and a more detailed newsletter –"HS&E Messenger"- with news from each of the sites has just had its first issue.

Following the collation of quantitative performance data, internal reports were produced for the Lucas Aerospace division after each quarter of data had been received (see 36-month progress report – Lawson 1998b and Lucas Aerospace Report "Our Environmental Challenge", Appendix AH).

- **What the corresponding body of literature says**

The key benefits of external reporting of environmental performance (KPMG 1997), are:

- "Reporting on environmental performance strengthens the company's commitment to gaining a higher level of environmental performance"
- reporting on environmental performance demonstrates progress made
- reporting on environmental performance allows problem areas to be identified
- reporting on environmental performance assists in improving public relations for the company" (see also sections 1.2, 1.3)

There are plenty of guides on external environmental reporting and how to improve it or standardise it (PERI 1994, WICE 1994, Owen, Gray & Adams 1996, UNEP/SustainAbility 1997, ACBE 1997, ACCA 1997a, Green College 1997, KPMG 1997, DETR 1998b, Hopkinson & Whitaker 1998, PIRC 1998) and this has culminated in the GRI (Global Reporting Initiative) "Sustainability Reporting Guidelines" released in March 1999 (see also section 1.14). None of these guides, however, looks at internal reporting.

KPMG (1997) reported that only 5% of reports surveyed, had used recognised guidelines, most companies use their own [*this begs the question, what is wrong with the guidelines? I suspect that many companies started work on this before guidelines were available, having developed the internal mechanisms for collecting the data, it is then natural to develop one's own approach to reporting*].

Recent new reporters, Vauxhall Motors (1998) (whose report was recognised by ACCA as one of the best newcomers), used the CERES principles (outlines in section 1.14) as their reporting framework. It is expected the more newcomers will use the CERES, or now the GRI, guidelines for reporting.

In the light of increased discussion on the issue of sustainability (backed up by initiatives such as GRI), Lucas Aerospace was looking for ways of relating its measures of performance with environmental impacts and issues of environmental sustainability.

PIRC covers reporting for sustainability in its assessment of the FTSE350 (PIRC 1998). It regards the following as indicators of sustainability thinking:

- Consideration of global impacts, such as
  - Energy efficiency (of products, and manufacturing) in order to minimise CO_2 and hence Global Warming, and other emissions that lead to smog, acid rain and health effects.
  - Conservation of non-renewable resources, through waste minimisation, recycling, product design
  - Social issues through sourcing, the rights of indigenous people
- The quantification of global environmental impacts, (which will become more important as governments seek to meet their obligations under the Kyoto agreement):
  - Greenhouse gases: Kyoto agreement Dec 97 includes targets for CO_2, methane, nitrous oxide, HFCs, PFCs, SF6 (only 4% of General Industrials reported this type of information – the lowest sector score).
  - Quantification of Ozone Depleting gases – most report on moves to eliminate, not quantities [*only 1% of General Industrials reported this type of information – although, if they are anything like LucasVarity, they will have already eliminated the use of CFCs and therefore have nothing to record*].
- Movement to renewable energy sources – this was mentioned by utilities and oil companies.

With respect to PIRC's second point, Azzone et al (1996) maintain that a company does not need to measure its direct effect on the environment, but by measuring their releases to the environment companies can estimate their relative contribution to environmental impact.

The UK Government's proposed measures to curb greenhouse gases (DETR 1998a, p21), include:

- Carbon Dioxide: Integrated Pollution Prevention and Control Directive (IPPC) will be brought into force between 1999 and 2007, replacing the UK's current Integrated Pollution Control (IPC) system. This will cover many small firms (since many more processes will require authorisation and there will be lower qualifying limits than the present UK IPC), and under IPPC they will have to obtain authorisation to discharge all significant pollutants. Also, for the first time they will be required to use energy efficiently.

- Methane: predominantly from landfill – and therefore landfill tax will be raised by £10 per tonne of active waste from April 1999 in order to encourage more recycling of methane generating waste.

The other greenhouse gases:

- Nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride are less important to general engineering companies such as LucasVarity, where they are neither used nor emitted.

UNEP/SustainAbility 1997 state that "Information on environmental impacts remains very rare in this latest crop of CERs" (company environmental reports).

- **The approach taken in LucasVarity**

After two factual quarterly reports about the results of the HS&E MOPs (Measures of Performance) – the first about all the measures generally and the second focusing on waste – the third and fourth were assessments of the company's global environmental impact with respect to specific environmental issues. This section concentrates on the approach taken for this latest report "Our Environmental Challenge" which can be found in Appendix AH).

It was decided that the MOPs data should be linked to global environmental issues in order to be able to communicate the relationship between the company's activities and well-known environmental problems.

ICI (1997), Sunderland & Thomas (1997) and the Open University (1998) all propose a set of global environmental Issues. These are tabled below against those chosen for the Lucas report.

Table 2.6 Categories of Environmental Issues

Issue	**ICI 1997**	**Sunderland & Thomas 1997**	**OU 1998**	***Chosen for Lucas 1998***
Air Pollution (Acid Rain)	Acidity – Atmospheric	Acid Rain	Air Pollution (Acid Rain)	*Air Pollution (Acid Rain)*
Air Pollution (Smog)	Photochemical Ozone Creation Human Health Effects	Local Air Quality	Air Pollution (Smog)	*Air Pollution (Smog)*
Global Warming	Global Warming	Greenhouse effect (Global Warming)	Global Warming	*Global Warming*
Ozone depletion	Ozone Depletion	Stratospheric ozone depletion	Atmospheric ozone chemistry	*Ozone Depletion*
Surface Water	Acids to Water Aquatic Toxicity Aquatic Oxygen Demand	Surface Water	The Marine Environment	*Aquatic Toxicity*
Waste	X	Waste Burden	X	*Land Degradation*

Use of Resources	X	Natural Resources	X	*Resource Depletion*
Soil & groundwater contamination	X	Soil & groundwater contamination	Land Degradation	*Land Degradation*
Bioaccumulation of toxins	X	Bioaccumulation of toxins	Land Degradation	*Land Degradation*
Ecological loss/species depletion	X	Ecological loss/species depletion	Forests	*Deforestation*
Socio Economic	X	Socio Economic	X	*X*
Visual intrusion	X	Visual intrusion	X	*X*

There is general agreement for Air Quality issues such as Acid Rain, Smog, Global Warming and Ozone Depletion. There is also agreement on the water environment, with ICI choosing three indicators for this media. There is less agreement on "Land" issues, which cover waste, use of resources, soil and groundwater contamination, bioaccumulation of toxins and ecological loss. Sunderland & Thomas (1997) also propose socio-economic and visual intrusion issues.

Seven Global Issues were chosen, which it was felt Lucas has a significant impact on. Then some indices were proposed which could show the Company's key contributions to these issues. This is represented in the table below:

Table 2.7 Possible Lucas Environmental Impact Indices

	Global Issues:						
Proposed Indices:	**Air Pollution**	**Ozone Chemistry**	**Global Warming**	**Deforestation**	**Land Degradation**	**Aquatic Toxicity**	**Resource Depletion**
Acid Rain Index	✓						
Smog Index		✓					
Ozone Hole Index		✓	✓				
Greenhouse Index			✓				
Paper Index				✓			✓
Land Contamination Potential					✓		
Waste Index					✓		✓
Surface Water Index						✓	
Effluent Index						✓	
Resource Index							✓

For each of the proposed indices, the following table details how quantitative information could be calculated and whether or not the calculation is possible now, given the current Measures of Performance data available. This process revealed several gaps in the current data, which will be addressed, in next year's revision of the MOPs data requirements.

Table 2.8: Analysis of feasibility of satisfying proposed indices.

Proposed Index	Calculation	Possible Now?
Acid Rain Index	calculated by the amount of SO_2 produced as a result of energy use	Yes, based on 1996/97 statistics from the UK Electricity Industry and average % content in fuels (used in report)
Smog Index	calculated by the amount of NO_x produced as a result of energy use	Yes, based on 1996/97 statistics from the UK Electricity Industry and NOx produced from fuels during combustion (used in report)
Ozone Hole Index	calculated by the amount of CFCs and Halons released	In theory, all sites should have stopped using CFC solvents. Therefore leakage from refrigeration units is the next source. We do not currently measure this as it is assumed to be negligible. Although it would be possible to record "topping-up" of systems, during maintenance/servicing. Halon, where still in place, should be in totally sealed fire-protection systems, which must only be released in the event of a fire. A Halon survey would reveal the potential harm within Lucas Aerospace.
Greenhouse Index	calculated by the amount of CO_2 produced as a result of energy use <u>Or</u>, CO_2 produced plus NOx and VOCs expressed in CO_2 equivalents	Yes, quantities of CO_2 produced during combustion of each type of fuel are known (used in report).
Paper Index	calculated by the amount of virgin paper used and cardboard packaging	Paper and packaging use is not currently measured, although we could use the paper & cardboard waste figure. However, most paper & card ends up in general (other) waste and so this is not a good indicator. Recording of purchased quantities (weight of paper and cardboard) could give this figure.
Land Contamination Potential	the total capacity of underground storage tanks plus a factor for known historical land contamination	Not currently measured. But this would be good information to collect, given that land contamination is LAe's most costly environmental issue.
Waste Index	the total weight of waste sent to landfill	This can be provided now (used in report). However, due to the mixed nature of the wastes the true environmental burden, due to toxicity of wastes could not be given.
Surface Water Index	the incidents of non-compliance against the surface water consent limits	Not specifically reported, although it could be.

Effluent Index	the amount of effluent discharged multiplied by the average annual concentrations of COD (chemical oxygen demand), toxic metals, oil, suspended solids etc.	Quantity of effluent is reported, although its nature needs to be checked (i.e. some sites report domestic wastewater as effluent) (used in report). Average annual concentrations could be obtained from sites (although not currently requested). Alternatively, their allowable concentrations of substances as defined by consents to discharge. This would give the maximum allowable pollution levels, rather than actual.
Resource Index	The amount of virgin materials used, which cannot be / are not used again.	Fuels for energy could be calculated (used in report). Waste disposed of, including VOCs lost, could be used as an indicator of depleted resources (used in report). Effluent is generally recycled, via the Water treatment companies, and therefore not lost.

Graphs, by site (in descending order of impact) were generated for the 6 indices that could be calculated:

- Acid Rain contributions (SO_2) – due to energy use only
- Smog contributions (NOx) – due to energy use only
- Carbon Dioxide contributions – due to energy use only, and Equivalent Carbon Dioxide emissions – including NOx and VOCs
- Aquatic Toxicity – quantity of effluent discharged only
- Land Degradation – quantity of waste disposed of only
- Resource Depletion – due to fuel for energy, material wasted and VOCs lost

Calculations and assumptions used are explained in the report's Appendix A. In Appendices B and C of the report, each of the above graphs is compared to data normalised by number of employees (B) and £,000 Sales (C)[16]. In both these cases an average line is also plotted, so that points above the line can be regarded as less efficient and those below the line can be regarded as more efficient than the average (the full report can be seen in Appendix AH of this portfolio).

- **The results**

The report is still in the process of being disseminated, but initial reaction has been good. It has raised the profile of environmental issues and agreement is now in place to set some stretching targets for the year ahead.

A summary of the Division's performance data is given in the report and reproduced below. It was felt to be important to relate the information to everyday items, which would enable the report reader to more easily identify with the results, hence the "Totals in Context" column:

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[16] See sections 1.6 and 2.6 for more discussion about the choice of normalisation factors.

Table 2.9 1998 Performance Measures- Summary

Measure	Includes:	units	1998 Total	Per employee	Cost	Totals In Context
Energy	Gas, electricity, oil etc.	MWh	259,839	38	£ 5,823,923	As much as 64,960 average UK homes use in a year
Water	Process & domestic use	tonnes	939,964	142	£ 563,278	Equivalent to 522 Olympic Sized swimming pools
Waste Disposal	Hazardous, oils, general, etc.	tonnes	8,543	1.6	£ 330,540	As much as 13,350 average UK homes produce in a year
VOCs Lost	Solvents, paint, adhesives etc.	tonnes	303	0.045	£ 1,527,804	Enough to fill over 6,000 balloons
Days lost	Work related injury & illness	days	718	0.1067	£ 269,250	(Assuming £375 per lost day)
					£ 8,514,795	

The related environmental impacts are summarised in the following table:

Table 2.10: Resulting Environmental Impacts (or Burden)

Input Measures	Issue	Item	1998 Total	units
Energy	**Air Pollution – Acid Rain**	SO2	815	tonnes
Energy	**Air Pollution - Smog**	NOx	164	tonnes
Energy VOCs	**Global Warming**	CO2 and equivalents	136,976	tonnes
Water	**Aquatic Toxicity**	Process Effluent	611,727	tonnes
Energy Waste VOCs	**Resource Depletion**	Waste, Fuel & lost VOCs	54,621	tonnes

Calculations of SO_2 and NOx are based on assumptions about the sulphur content and the NOx given off by fuels used to produce the energy that Lucas Aerospace uses. The actual conversion figures used are explained in Appendix A of the Lucas Aerospace "Our Environmental Challenge" report (see Appendix AH).

The Global Warming figure is based on CO_2 (the main Greenhouse gas), produced as a result of energy use, plus NOx and VOCs since they also have a "Greenhouse" effect. However each kg of NOx and VOCs released is more potent than a kg of CO_2, therefore these have been converted to CO_2 equivalents, assuming that 1 kg NOx is equivalent to 160 kg CO_2 and 1 kg VOCs is equivalent to 10 kg CO_2 (ICI 1997, NIFES Consulting Group 1985-1997).

Of the parameters measured for the HS&E Measures of Performance, fuels for energy, waste disposed of and VOCs lost were considered to be indicators of depleted resources.

Waste and VOCs are already measured in kg, but the fuel used to create energy has been calculated based on known CO_2 figures (NIFES Consulting Group 1985-1997), for example:

- For Gas, 1kg of fuel produces 2.75kg CO2 (at 68% efficiency) and 1 kWh produces 0.273kg CO2 (at 68%), therefore 0.099 kg of fuel is required to produce 1kWh.
- For Heating oil 0.116 kg of fuel produces 1kWh (at 68%)
- And Coal requires 0.404 kg of fuel per kWh (at 33%)

However, currently (1997) in the UK, coal now only represents a third of electricity generation. Allowing for the fact that gas and nuclear power now both contribute over a quarter of electricity in the UK and the use of CHP (combines heat and power) and renewables are increasing (Electricity Association 1998), 0.25kg of mixed fuel is considered a better approximation for electricity.

In all these calculations site contributions are heavily dependent on their mix of gas, electricity and fuel oil use. No account has been made for national variations (all calculations based on UK fuel mix) and no estimation has been made for the impact of company transport or employee travel. It is recognised that these calculations are based on many assumptions and variable factors that will change over time and location. For example, electricity in France is predominately generated by nuclear power stations and therefore air emissions from energy use in France will be less than that in the UK. However, it was felt necessary to apply consistent conversion factors to all sites worldwide, and accept that the results are potential impacts rather than actual.

Despite the fact that most of the major environmental impacts have been considered, the author recognises that there are still some areas that need to be addressed. For example:

- Transport (for goods and employees) has not been considered. (Employee transport to work will be addressed by separate, site-led, initiatives).
- Toxicity of effluent has not been included. (Heavy metal concentrations have been added to the 1999 data proforma).
- Toxicity of waste has not been included (but all waste is disposed of via specialist treatment and disposal contractors).
- Land contamination potential is not known (although this year's targets include a full survey of all bulk storage facilities and rectification of those that fall below acceptable standards).
- The total amount of material used is not known, although it is not considered a priority for Lucas Aerospace, because all wasted materials are recorded and any other material goes into the product. Products typically have a 30-40 year life span

(including repair and overhaul) and will usually be recycled at the end because of the value of the materials used.

- **Conclusions**

Using company environmental performance data to illustrate the business impact on certain environmental issues was a valuable exercise. As explained earlier, it is still a very rare thing for companies to do. Readily available conversion data was hard to find and much had to be assumed and extrapolated from many different sources. There are so many variables, that any calculation of this sort is likely to be far from accurate. However, it is an indicator and as long as the same process is followed each year, it will be comparable over time.

These reports have helped to change the focus and priorities of management. The site comparisons, by employee and Sales, whilst not strictly comparable, have highlighted vast differences between sites that need to be investigated. There may be a perfectly logical explanation, or it could be that a business does not know how efficient, or inefficient, it is until they have something to compare themselves with.

Many of the gaps in the present data will be filled by the next year's reporting and data quality will continue to improve until the company builds up a profile of information that it has confidence in.

3 Environmental Performance Evaluation – A Methodology

The following section describes a methodology which combines all the environmental performance evaluation elements that have been developed incrementally in Lucas / LucasVarity over the life of the project. This method is based on the lessons learnt during this project and is the approach that the author would take if starting with a company from scratch[17]. There are plans to write this up as a paper.

- **What the corresponding body of literature says**

Environmental Performance Evaluation (EPE) is defined by ISO 14031 as a

> "process to facilitate management decisions regarding an organization's environmental performance by selecting indicators, collecting and analysing data, assessing information against environmental performance criteria, reporting and communicating, and periodic review and improvement of this" (ISO 1997).

Implementation is difficult. As a practitioner in change management, the author can testify that implementation is the poor relative of design, it gets less attention and support, and yet is the most difficult stage of any change process.[18]

McGonagill & Kleiner state that:

> "Typically, the environmental initiative begins when a senior manager makes a pronouncement that they will embrace 'an environmental vision'. But translating the vision into reality proves difficult because managers are caught between conflicting incentives. On the one hand, there's the new 'green' imperative from above, and on the other hand, established values reject rapid change, reward systems remain pegged to quarterly profits, accounting systems disregard 'externalities' such as environmental impact, and there is still the ongoing reality of meeting the bottom line. Managers are told they have to change, and to diminish their pollution, but they are not told how." (McGonagill & Kleiner in Senge et al 1997, p459).

[17] Initial inquiries have been made with the Engineering Employers Federation for the possible use of this methodology to help small and medium sized companies implement environmental performance measurement systems.

[18] The author considers that the key success factors in change management include: leadership (enthusiastic, motivational management that is trusted by the workforce), communications (regular project reviews, open meetings to encourage comments and suggestions, especially from those who will be most affected), flexibility (a willingness to accept, encourage and adapt new ideas) and teamwork (a multi-skilled team representing different functions and levels within the organisation).

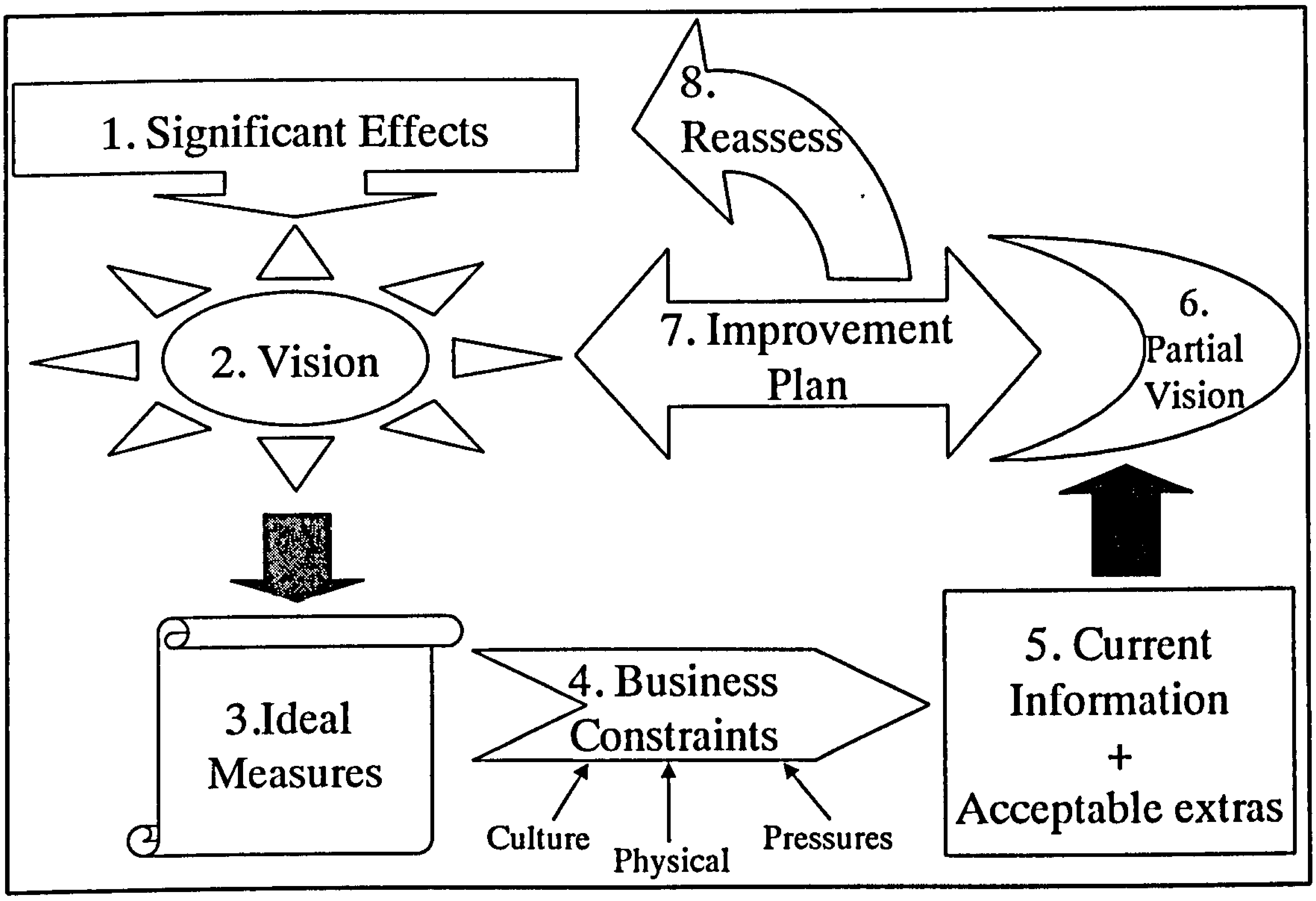
Clearly some guidance is needed. Busy managers do not have time to figure everything out for themselves, on the other hand, handing over the design of a system to a consultant often results in poor ownership on the company's part and even more painful implementation.

None of the literature mentioned in the above discussions, leads managers gently through a thought process that they can buy-in to, customise for their own purposes, and then build on allowing further iterations to give them more confidence and knowledge. The literature surveyed tends to propose only an end point, the methodology proposed by the author will take a business from where they are now to that end-point.

- **The approach taken**

Environmental performance measurement requires a multidisciplinary approach and a consensus of opinion from all the business functions. It is for this reason that the author believes this methodology, for designing an Environmental Performance Evaluation System, works best in a management workshop setting.

Figure 3.1 EPE Methodology



The process is represented diagrammatically here and the stages are explained in detail below.

1. The <u>Significant Effects</u> procedure (as described in section 2.5 of this report) is the starting point. It could be completed quite comprehensively prior to the workshop, by a small team, since a thorough approach requires site-wide data collection in some detail. However, a "quick and dirty" approach could be used within a Workshop setting, which would still give sufficient results to get the process started. This could then be refined at a later date, as part of the iterative process.

2. Defining the Vision is the second step. Having identified those activities, which have the most significant environmental effects, the management needs to imagine a future where these activities are either eliminated or substantially changed such that their environmental impact is minimised. The vision should therefore contain a set of objectives and targets (quantifiable) which specifically address the company's most significant effects.

   How far a company can see into the future will depend on its present position, prospects and the enlightenment of management. Assessment Matrix 1 (below) describes three levels of Vision, which a company may seek to achieve from Minimalist, through Efficient to Sustainable. Consideration of five factors: Company Environmental Vision; Operational Environmental Objectives; Product/Service Environmental Objectives; Environmental Measurement Objectives and Company Drivers result in an assessment positioning the company with respect to its reasons for measuring environmental performance.

Assessment Matrix 1: Step 2: VISION - What would the company like to achieve?

(partly inspired by Bennett & James 1998, p101)

VISION OF FUTURE	**Minimalist**	**Efficient**	**Sustainable**
Company General Environmental Vision	To survive and avoid prosecution.	To use resources efficiently and produce minimal pollution	To operate in a sustainable way
Operational Environmental Objectives	To be compliant with legislation	To reduce risk of pollution and waste	To eliminate all polluting activities
Product/Service Environmental Objectives	To be compliant with legislation	To produce current products in most efficient way	To provide a sustainable service/product. This may mean a change from current products.
Environmental Measurement Objectives	Risk Management	Impress stakeholders, improve communication, & drive continuous improvement	Assess business sustainability & strategic impacts, support debate & drive discontinuous improvement
Company Drivers	Cost & Legislation	Customer and other direct stakeholder pressure, TQM	Moral values / social responsibility
ASSESSMENT	**Little vision of sustainable future. Focus on measures to ensure compliance, assess risk and some efficiency measures. No intention of publishing data.**	**TQ vision of future. Focus on measures to achieve objectives and show progress in resource efficiency. Data required mainly for internal reports and decision making.**	**Sustainable vision of future. Focus on measures to assess strategic effectiveness of activities and products. Data required mainly for external reports and stakeholder dialogue.**

It is important that business managers are honest about their intentions and are not tempted to present a wish list, which the company is not in a position to achieve. Once on the ladder (such as that described by Robinson 1998, p5), the company can start to build a foundation based on environmental measurement and then move up. It is almost impossible to jump to the top rung of the ladder if you have not prepared the ground and taken the steps in sequence.

3. Having set some quantifiable targets, the question of how to measure progress against these targets must be addressed. Here the workshop should brainstorm the ideal measures, or indicators, which would accurately describe the company's position in relation to its goals. In terms of research, a database of possible measures, gathered from environmental reporting literature, is being compiled which will serve as examples of what could be accomplished and what is commonly seen as best practice and achievable (the current database – to be enhanced and enlarged – can be found in Appendix AI).

4. At this point, the business team needs to be transported back to reality and what can actually be achieved within the current business constraints. Issues such as the company culture, its physical systems and external pressures need to be assessed. Matrices 2, 3 and 4 summarise the factors which need to be considered in terms of cultural constraints, physical constraints (or its antithesis: enabling factors) and external pressures. As in matrix 1, three levels of progress are described against a list of various factors, resulting in an assessment predicting the outcome of EPE implementation currently achievable in this type of organisation. Analysis of the business constraints should be seen as a positive appraisal process and not a justification for long standing excuses. Conversely, it does not mean that they should not aspire to greater things, but that they should not try to run before they can walk. The matrices can be used to highlight weak areas and barriers, which are hindering progress in all areas, not just environmental performance. It is then in the management's interests to address the weak spots in order to move from a restrictive to an enabling business environment.

Assessment Matrix 2: Step 4a: CULTURAL CONSTRAINTS - What is the company culture and how could it restrict or aid implementation?

(partly inspired by Wheeler & Sillanpää 1997)

CULTURE	Poor (Restrictive)	Intermediate	Advanced (Enabling)
Leadership style	Autocratic, secretive	Mixed	Inspirational, open
Corporate Governance	No corporate guidance or governance	Limited corporate guidance and governance	Corporate leadership, guidance, governance and standard setting.
Commitment	No management commitment	Verbal management commitment but little action.	Management Champions actively demonstrate commitment
Environmental Profile	Minimalist approach to environmental issues	Specialist approach to environmental issues, limited integration	High profile role within business, integrated into all functions
Environmental Awareness & Training	No awareness or training	Some awareness, some training	All employees environmentally aware and trained regularly.
Enlightenment	Dormant, unaware	Enlightened or pragmatic self-interest	Social responsibility up to social mission
Group Communications	No / little communications between businesses or from Corporate functions	One-way corporate communications to businesses.	Two-way corporate communications to businesses and between businesses.
Implementation of Initiatives	Few initiatives and few successfully implemented	Many initiatives but not many successfully implemented	Many initiatives successfully implemented
Management of Change	Resistant to change	Step changes made when necessary	Embedded continuous improvement / kaizen culture
Participation	Little/no employee participation	"Allocated" employee participation	Voluntary employee participation
Strategies / Planning Horizon	Short Term	Medium Term	Long Term
Drivers	Financial / Compliance	Customers / Competitors	Stakeholders / Best Practice
ASSESSMENT	**Difficult to implement Group-wide EPE system. Focus on drivers and financial benefits. Start small and simple.**	**Success possible, build on past successes, highlight benefits to current projects and plans. Focus on efficiency.**	**High success rate possible, include long term strategic and sustainability measures**

Assessment Matrix 3: Step 4b: PHYSICAL CONSTRAINTS / ENABLING FACTORS - What does the company have in place now?

PHYSICAL FACTORS	Poor (Restrictive)	Intermediate	Advanced (Enabling)
Organisation	Fragmented group of businesses with no common goals and objectives.	Group of businesses with some corporate governance and policies.	Single business or integrated group with strong corporate identity, governance and policies
Systems - EMS	No systems	Informal Systems	ISO14001 or equivalent
Systems – Financial	No analysis or allocation of overhead costs.	Some analysis and allocation of overhead costs	Activity Based Costing used and/or Environmental Accounting
Systems - Quality	No systems	Informal Systems	ISO9000 or equivalent
Technology	Little or outdated I.T. equipment and software. No/little commonality.	Variable levels of I.T. and software across business(es)	Latest IT hardware and software, common to all businesses.
Technology - Infrastructure	No/little electronic communications.	Some electronic communication links (e.g. within divisions)	All businesses linked to and making full use of intranet (or equivalent).
Information	No common information available. Few records retained.	Some common information recorded by businesses. Some records retained.	Comprehensive, common information recorded by all businesses and readily available.
ASSESSMENT	**Difficult to implement Group-wide EPE system. Start with very simple measures or third party audit.**	**Implement semi-manual Group-wide EPE system. Identifying common information to start.**	**Fully automated EPE system should be easy to implement**

Assessment Matrix 4: Step 4c: EXTERNAL PRESSURES - Stakeholder Analysis

(partly inspired by Wheeler & Sillanpää 1997)

EXTERNAL PRESSURES	Low	Moderate	High (Compelling)
Investors and Shareholders	No requests for environmental performance data from investors	Occasional requests for environmental performance data from investors	Regular requests for environmental performance data from investors
Employees and managers	No employees or managers have raised environmental concerns	Some employees and managers have raised environmental concerns	Many employees and managers have raised environmental concerns
Customers	No mention of environmental issues	Some environmental conditions applied (e.g. material restrictions)	Good environmental management is a condition of contract
Suppliers and partners	Suppliers are not addressing environmental issues. OR suppliers present no environmental risk.	Some suppliers are addressing environmental issues.	Suppliers are proactive in addressing environmental issues. OR suppliers present high environmental risk.
Local Community	No complaints about business activities.	Occasional complaints about business activities.	Active community concern. Frequent complaints about business activities.
Competitors	No competitors are addressing environmental issues	Some competitors are addressing environmental issues	Key competitors are in strong environmental position
Government and legislation	No government restrictions & legislation anticipated	Current government restrictions & legislation not anticipated to change in near future	Increasing government restrictions & legislation aimed at products and/or key activities.
Media	Media have taken no interest	Associated effects of products and activities have drawn some media attention	Products and activities are drawing direct media attention
Social Trends	Products and activities perceived as environmentally benign	Associated effects of products and activities increasingly seen as unacceptable	Products and activities directly identified as increasingly unacceptable
NGOs and Pressure Groups	No attention from pressure groups	Products and activities indirectly targeted by pressure groups	Products and activities directly targeted by pressure groups
ASSESSMENT	**Little or no external pressure to address environmental issues. Focus on internal drivers.**	**Worth starting to measure environmental performance. Chance to be proactive before pressure increases.**	**Definite need to address environmental issues and measure environmental performance. Identify strongest influences.**

5. Many of the ideal measures will not be currently available within the business, and data collection systems may need to be set up. However, there is often a lot of current information that can be used directly or adapted to provide adequate performance indicators. Some other information can be collected quite easily at little extra cost and existing systems (e.g. central MRP[19] systems) can be altered to record and report the extra information. Existing data that can be used includes:

- Purchasing records – this should indicate all materials, goods and services bought in, although some amendments are often necessary to convert materials and substances to common units.
- Utility Bills – electricity, gas and water are usually supplied by metered pipe line and paid for based on quantity used. Utility bills should provide both financial and consumption data. If meters are accessible, the site could also read the meters on a more regular basis than the bill frequency, in order to track improvements more closely. On a large site, sub-metering can help to identify and monitor large consumers and then improvement projects can be targeted at particular departments. On one Lucas site, 30 extra water meters were installed and the water consumed by each department was reported back to the responsible manager each week. Just by increasing awareness of consumption, water use dropped by 50% within 6-months (Pope & Lawson 1994).
- Waste records – although sometimes the data recorded is not too helpful, as it may combine wastes together, or record the number of skips removed, rather than the weight of waste.
- Production records – number of hours worked or products made can be used to normalise data to give "per unit" efficiency figures.

6. The current information and some "acceptable extras" (i.e. extra information that will not be too difficult or costly to collect) will go part of the way towards the vision (i.e. a Partial Vision). At this stage a business may want to collect data for a specified period (say one year) in order to give itself a baseline against which to set new targets (this has been the case at LucasVarity).

7. An Improvement Plan would then need to be developed with the management team in order to make changes to working practices and processes, which would take them nearer to their vision. Current business constraints (time, money, and human resources) will need to be incorporated in order to develop an implementable and realistic Plan.

[19] Material (or manufacturing) Resource Planning

8. Following implementation of significant actions in the improvement plan, the business will need to reassess its position, in terms of its significant effects (incorporating the latest business changes and external pressures) and hence its Vision. It may be that parts of the vision have already been realised, or events have overtaken the business, necessitating reassessment of the whole performance evaluation system.

- **The results**

As previously mentioned, the Significant Effects part of this methodology has been used, with success, by seven (to date) of the UK Aerospace businesses. These businesses range in size from 99 to 1030 people and the technology ranges from electronics to "metal-cutting" type manufacturing and some Repair and Overhaul.

Unfortunately there has not been sufficient time or opportunity to test the rest of methodology. However, it does employ methods which have been used with success in other instances, namely assessment matrices (a commonly used approach for risk assessment in LucasVarity), brainstorming and gap analysis.

- **Conclusions**

The intention was to devise a methodology which uses tried and tested techniques, but that is simple and flexible, facilitating the necessary thought processes and decision making. It is believed that this EPE Methodology, with supporting documentation (such as the Environmental Performance Indicator database, Appendix AI), will satisfy these criteria.

4 Implications for Industry in General

4.1 What are the specific conclusions, applicable to LucasVarity and similar organisations?

The companies that have made the most progress with environmental issues are, not surprisingly, those for which environmental issues have taken on a strategic importance (e.g. chemical manufacturers, process industry, consumer goods) (Wilson & McLean 1993, Skillius and Wennberg 1998).

Engineering companies, however, do not feature prominently in the list of companies renowned for their environmental efforts (KPMG 1993, PIRC 1998, see also 1.8). The overall response rate to the Business in the Environment FTSE100 Environmental Engagement survey was 73%. Of the different sectors "engineering" had the lowest response rate of 57% (BiE 96b). This low response rate could be due to the fact that engineering companies are not taking any environmental action, or alternatively they are addressing environmental issues, but do not wish to participate in such a survey (as was the case with GKN). The Engineering Sector is the field that LucasVarity falls in to.

Engineering companies, are typically in the middle of the supply chain (i.e. they neither mine raw materials, nor sell directly to consumers) and therefore are not associated with the "plundering" of the environment that is associated with mining and oil companies or the outright consumerism associated with retailers and brand-name product manufacturers. They tend to believe that they have low environmental impacts because they do not use vast amounts of chemicals and also tend not to have direct consumer pressure since they are generally suppliers to other companies and their company names are not in the consumer spotlight.

The work at LucasVarity, however, clearly indicates that engineering businesses do have important environmental impacts which need to be acknowledged and addressed (as demonstrated in section 2.7). A further finding is that it is possible to implement a useful environmental performance measurement system, even across diverse businesses in many countries.

4.2 What are the broader conclusions, applicable to any company?

The internal and external environmental pressures on a business need to be understood when designing and implementing environmental performance measurement systems. However company culture, management politics and business conflicts also need to be appreciated and accommodated. Although it is starting to change, many managers are still defensive, and ignorant, about environmentalism:

> "Managers' defensiveness also reflects tensions left over from thirty years of warfare between environmentalists and corporations. Technologically trained managers, in particular, tend to see environmentalists as uninformed, presumptuous dilettantes, intruding judgementally into areas where corporations once had a free hand. Corporate managers also make a point with which many environmentalists agree: environmental regulation and legislation tend to be crude tools, all too frequently enforced with more emphasis on the letter, rather than the spirit, of the law."
>
> "At the root of corporate defensiveness is a mental model that environmentalism, by its nature, entails significant risk. In some companies, the mental model contains truth: there is indeed the risk of litigation, extra expenses, and personal liability. But the *perceived* risk often feels much higher that it otherwise would, precisely because the company's environmental history is unknown." (McGonagill & Kleiner in Senge et al 1997, p459)

As well as improving their environmental performance, businesses are also trying to improve their company's competitiveness, productivity, cost base etc. Many of these business issues may conflict with the approach environmentalist are trying to take. For example:

> "Just-In-time Manufacturing was developed in Japan, and later copied everywhere. The idea of a constant stream of deliveries to your factory door, as and when you needed them, was blindingly obvious when you thought about it. Cut out the warehouse and all those storage costs. Let the suppliers carry the inventory costs instead, or rather, eliminate them completely, provided always that you can guarantee that the lorries with the bits will arrive 'just-in-time'. Unfortunately, the idea became too popular. They tell me that the delivery vehicles now jam all the freeways around Tokyo, meaning that just-in-time often gives way to just-too late. The costs of the traffic jams are beginning to outweigh the costs of the original warehouses, to say nothing of all the environmental damage caused by those idling exhausts." (Handy 1995a p58)

According to Zairi (1996), critical elements for successful [general] performance measurement systems include [*authors comments in italics*]:

- "Leadership and commitment to measurement and continuous improvement [*the ideal starting place, but lack of clear management commitment should not put off the dedicated individual.*]
- Full employee involvement and participation in the design, implementation, review and audit of aspects of measurement linked to their processes [*again, an ideal, but in a very large and diverse company it would be almost impossible to involve every employee in every part of the process. However, it is essential to communicate widely and provide opportunities for participation by those who want to participate*

and encouragement for those who need to. A sad fact of life is that most people are apathetic and are happy to leave the work to someone else – they will moan if it goes wrong however.].

- Good planning, monitoring and review mechanisms [*help to keep a project on track and resolve any problems before they become serious*].
- Good measurement reflects good progress – the two are inseparable [*make sure measures are accurate and as complete as possible, if not state limitations and assumptions*].
- Measurement is relative and has to lead to stretch objectives as a result of benchmarking activity [*beware setting the same targets for poor performers as good performers.*].
- Good measurement is only concerned with value adding activity – focussing on the customer [*data must be used for communication, improvement purposes and decision making, otherwise data providers will see no point to the exercise*].
- Measurement has to focus on 'negative quality' aspects but also has to be used proactively for developing a competitive advantage in the market place [*i.e. it is necessary to measure non-compliance issues and accidents, but these are usually after the event and do nothing to prevent further incidents. Proactive measures such as risk assessments, audits of management systems and regular consumption figures can check that systems and facilities are managed and maintained to avoid 'negative quality' incidents*].
- Measurement in a TQ context is geared for continuous improvement, the control of process and activities and not the people [*as it should be for the environment – however, people's attitudes and behaviour also need improving.*].
- Effectiveness of measurement systems can be greatly enhanced by reward and recognition systems* [*measurement systems enable the recognition and reward of good practice. Some of the North American Lucas Aerospace businesses measure time since the last lost-time accident, and senior managers present certificates when 500,000 and million hour targets are reached. It is hoped that more widespread recognition and reward of good environmental performance will be possible once more performance data has been collected. Based on Lucas experience[20] of company suggestion schemes with financial rewards, it is known that financial rewards should be avoided as they can stimulate the wrong type of motivation, i.e. people will avoid making suggestions for improvement unless they know they will get "paid" for it*].

[20] Anecdotal evidence of suggestion schemes working against continuous improvement ideologies. Some sites experienced a reluctance for employees to put forward improvement suggestions, whilst the suggestion scheme was still in place, since the employees felt that they may lose out on potential financial reward if their improvement suggestions were not put through the scheme.

So, what are the lessons for industry in general?

The steps described below are the basis of the EPE methodology in section 3, which the author believes could be implemented by any business or organisation.

- Understand the company's significant activities in terms of environmental effects
- Visualise a new future (preferably a sustainable one)
- Decide what steps would need to be taken to get to the vision and what the ideal measures of performance would be.
- Understand the current business constraints, including culture, physical factors and pressures (internal and external)
- Assess what current information is available that can be used to monitor performance, drive improvement and move the company towards its vision.
- Implement the improvements
- Reassess the company's significant activities and go round the loop again, and again, and again.
- Realise the vision.

4.3 Summary of findings - General

Management commitment

Most people can achieve their goals if they have the right attitude, and they believe in themselves. The same is true of organisations. But the attitude starts with top management, so the most important ingredient in successful environmental management (or anything for that matter) is demonstrable management commitment.

> "Until one is committed there is the chance to draw back; always ineffectiveness. Concerning all acts of initiative (and creation) there is one elementary truth, the ignorance of which kills countless ideas and splendid plans; - that the moment one definitely commits oneself, the providence moves too." *Goethe, quoted in Jack Black's "Mindstore", 1994*

If management commitment is evident, most other problems can be overcome. The second most important ingredient then is communications, in order to spread that attitude to the whole workforce. In the absence of true commitment and leadership, progress can still be made, but the drivers of the change will have to be committed themselves and will have to work a lot harder. Also, the process has to be made as easy as possible for reluctant managers to implement – hence the need for guidelines and methodologies.

> "Never doubt the power of a small group of committed people to change the world. That's the only way it has ever happened in the past."
> *Margaret Mead, quoted in Robbins & Finley 1997.*

Vision

Walley & Whitehead (1994) criticise the likes of Schmidheiny (Swiss businessman) for offering a vision but no clear guidance – but as mentioned above, if a vision communicates true commitment, then perhaps the guidance is less necessary.

Guidance

True commitment is, however, a very rare commodity, and therefore guidance, in the forms of methodologies, frameworks and case studies are still needed by the majority. Guidance is helpful, but if it is too general, or puts too much emphasis on issues that are not relevant for a business it can devalue the good parts of the guidance. The balance must be right, because there are still things that people have to work out for themselves, in order to get buy-in to the process, and with luck – that all important change in attitude and behaviour.

Implementation

The process of implementing Environmental Management Systems and MOPs is how people learn about their own businesses and it gives them the information to make the right decisions and to see their activities in a new light.

Just do it

Whilst demonstrable senior management commitment is desirable, there is no need to wait for the internal climate to be right before starting to measure environmental performance. The progress may be slower, but the process itself and the results can be used to build-up awareness until management become committed to the cause.

The right message

However, during this phase the balance of communications have to be right – the emphasis has to be on those things that management do believe are important and therefore being able to link environmental performance with other business issues such as cost saving, productivity, quality and reputation is important. By the same token, putting too much emphasis on less obvious or direct issues such as biodiversity or sustainability could undermine the credibility of the process within the company.

4.4 Summary of findings - Specific

This list is repeated in the Executive Summary, section 1.4.

Self-Assessment systems

Whilst Self-Assessment is a valuable tool for sites to monitor their own progress, third party audits or other verification are also needed to maintain the standard of assessment across businesses. Calibration is achieved by cross-referencing and triangulation with audit results and other measures (such as quantitative results, compliance records etc.) to ensure that self-assessed results are moderated. It has been demonstrated that, in this way, results remain within an acceptable tolerance, enabling business decisions that take account of both financial and environmental considerations to be made.

Identifying and prioritising significant effects

The "significant effects" methodology is a step by step procedure that provides a wide range of criteria against which to judge "significance". Significance is assessed using a set of criteria which combine the significance of 1) the impact on the environment and 2) the impact on the business. It is a robust procedure which brings more objectivity to the decision-process than was previously the case in LucasVarity. The whole process, plus the use of the matrix as a visual output is considered to be a contribution to knowledge.

Linking environmental performance data with global environmental impacts

Using company environmental performance data to illustrate the business impact on certain environmental issues is a valuable exercise because it has enabled the company to understand its impact on global environmental issues, it has highlighted areas where the performance measurement systems needs refinement and it is known to be a forward thinking approach within engineering companies. The impact indicators used will allow for comparisons to be made across time and businesses.

Industry information requirements

Industry requires practical systems to reflect businesses' need to measure environmental performance. None of the literature researched, leads managers through a thought process that they can buy-in to, customise for their own purposes, and build on. The literature surveyed tends to propose only an end point, the EPE methodology developed by the author is designed to take a business from where they are now to that end-point.

Engineering companies do have an important environmental impact

The work at LucasVarity, clearly indicates that engineering businesses do have important environmental impacts which need to be acknowledged and addressed, and it is possible to implement a useful environmental performance measurement system, even across diverse businesses in many countries.

4.5 Criticism of the methods – A summary

Problems such as **organisational changes** (mergers, redundancies, and take-overs) and weak management commitment have led to slow development and implementation of ideas at LucasVarity. Organisational changes in particular have been de-motivational since they introduce uncertainties into the system, which interrupts progress as people worry about their very survival, wonder what will happen next and whether their current course of action is still worth pursuing.

Comparability and **standardisation** are the two things external stakeholders crave (WRI 1997, Skillius & Wennberg 1998, PIRC 1998, The Aspen Institute 1998, FEE 1999). Particularly financial institutions and rating agencies (such as EIRIS; the Safety and Environment risk Management Rating [SERM]; The Natural Step and many others – well detailed in Skillius and Wennberg 1998). However, comparability is fraught with danger, even if two companies make the same product. Consider the case of vertical integration, i.e. one company may assemble only and buy in all components completed, whilst another may manufacture all components from raw materials and assemble them into a finished product. The processes, substances, emissions, energy use and risks will then be very different for two companies essentially turning out the same product. Even seemingly identical measures may not necessarily be comparable with other companies since each may have drawn their system boundaries in different places – and this is not always defined in reports. Comparability therefore should not be taken at face value. As a first line filter it is useful, but conclusions should not be drawn until further information has been gathered.

Standardisation of, for example, definitions, calculations, report formats, etc. can be useful. A core of common measurements is also beneficial, but it is still important for each business to identify its own specific issues, which could be influenced by the processes and materials they use, the products they make or the location in which they operate, or a combination of factors.

The environmental performance measurement systems have not yet been fully **integrated** into other business processes at LucasVarity, and until this happens the true benefits of such information will not be realised. Wilson & McLean (1993) explain:

> "Well-developed, formal systems exist to store, retrieve, and analyze environmental information, but these systems are self-contained and separate from corporate and divisional operating databases. As a result only limited capability exists for relating data across functional and business lines to highlight possible opportunities for business process improvement (e.g. relating emissions levels or waste-generation rates to manufacturing process operating parameters in the search for cost-saving pollution prevention initiatives)."

More work is needed to institutionalise the data collection and analysis process, so that it is a constantly updated "live" system accessible to all, rather than a set of regular, one-off exercises.

Many **assumptions** have had to be made, in the absence of more authoritative information. Assumptions are included in the definitions of measures and in the calculations of impacts (i.e. those used in the internal report – see Appendix AH). However, as long as they are expressed and are transparent they should not present a problem, and they should not be used as an excuse to hinder progress.

The data gathered contains many **gaps** (explained in 2.6 and 2.7). The most noticeable gaps are:

- Transport
- Toxicity of emissions
- Land contamination (actual and potential)
- Materials used
- Indirect effects from the product, the suppliers and at end-of-life

Therefore it must always be remembered that we are not looking at the full picture, although more pieces of the picture will be discovered the longer the process continues. But then how complete is financial data, and those measurement systems have been around for fifty years or more? Perhaps the Macnamara fallacy, quoted below, [*with additional comments by the author*] actually refers to financial and economic systems?

> Macnamara fallacy: "The first step is to measure whatever can be easily measured [*things we pay or charge for*]. This is OK as far as it goes. The second step is to disregard that which can't be easily measured [*reputation, pollution, environmental impact, loss of biodiversity, etc.*] or give it an arbitrary quantitative value [*like 'goodwill' or 'share prices'.*]. This is artificial and misleading. The third step is to presume that what can't be measured easily really isn't important [*sustainability?*]. This is blindness. The fourth step is to say that what can't be easily measured really doesn't exist [*what environmental issues?*]. This is suicide." [21]

So whilst financial measurement systems have gained a respectability due to their formal accounting rules and rigid guidelines, they still fail to measure many of the issues that are important to business, such as reputation, environmental risk, efficiency etc. Why then is there so much concern over the gaps in environmental data, after all most decisions in life are based on assumptions and incomplete information?

The most comprehensive assessment of the state of the environment in Europe, called "Europe's Environment – The Dobriš Assessment", was published in 1995 by the European Environmental Agency (EEA). This 676 page report was already out of date when it was published. Whilst aiming to collect the best and latest data available, in reality this ranged from the late 1980s to 1993. In the foreword, by Ritt Bjerregaard (then, member of the European commission responsible for Environment, Nuclear Safety and Civil Protection) and Domingo Jiménex-Beltrán (Executive Director, EEA), it is acknowledged that the report "certainly has its limitations" and it "has not been possible in all cases to obtain appropriate data or data of sufficient quality." Having said that "it has provided not only for the compilation of what is considered to be the best available data, and therefore for the best possible base to support the

[21] Source: D Yankelovich 1072 Corporate priorities: A continuing study of the new demands on business, Daniel Yankelovich Inc, Stamford, Conn (Gray 1993}

mentioned goals, but also for the building up during the exercise of a network of institutions, official as well as non-governmental bodies, working together."

In summary, it is not possible to collect perfect data – especially if it is the first time. But the best available data is better than no data at all and the process of collecting and compiling it brings people together and gets them talking about the issues. And once started, things can only improve.

4.6 Future Trends in General

When corporations became aware of environmental issues in the late 80's/early 90's many still thought it was a fad which would die out, but as the decade draws towards a close the green brigade (of environmental managers) are stronger than ever and their numbers have swollen[22]. Many did not even notice themselves turning green, so subtle and all pervading was the change. However, many, particularly small and medium enterprises, have not taken action to address environmental issues and it is likely that mandatory instruments will be needed to get everybody on board.

Few people would still argue that man has not had a significant adverse effect on the world and sustainability should still be the goal, but it cannot be achieved by individual businesses in isolation. At this stage it is important to get the non-starters at least on to the first rung of the ladder and addressing eco-efficiency[23], rather than scaring them with the concept of sustainability[24]. Once they are out of their current comfort zones and starting to address eco-efficiency, the concept of sustainability will start to seem a little closer and more possible.

The UK Government believes that business should report publicly on environmental performance and set their own improvement targets (DETR 1998a, p23). Other governments, such as the Netherlands and Sweden, Denmark and Norway (Skillius and Wennberg 1998) are already making performance reporting mandatory. All these proposals will require businesses to measure their environmental performance, in order to prove their achievements.

In the field of environmental reporting ACCA (1997b) reports that environmental reporting is now mainstream, but not widespread. "Only about 70% of the UK FTSE 100 mention the

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[22] The UK Institute of Environmental Management, which was established in 1992, reports its membership in 1999 to be around 2,400. Of these around 40% are accredited to Associate Membership and 5% are Full Members (IEM 1999b).

[23] Eco-efficiency is defined as "producing more with less resources and less pollution". It is a term that has been developed by the business led World Business Council for Sustainable Development and taken up by UNEP and OECD (DETR 1998c).

[24] Sustainability at the enterprise level means addressing three areas: environmental aspects (including pollution and use of resources), social aspects (including treatment of minorities, child labour, union issues etc.) and the economic aspect (including shaping demand for products and services, employee compensation, community contributions and local procurement policies) (GRI 1999)

environment in their annual report and accounts. About 40% have issued separate environmental reports. And there are real questions to be asked about the quality and relevance of some of these disclosures. Below the FT 100 these percentages dip alarmingly."

The ACCA (1997b) environmental report judges propose their "shopping list" for the future as:

- "A continuing focus on improving the quality of reporting – particularly in terms of transparency, consistency and comparability.
- Better accounting for and reporting of resource use (including a stronger focus on environmental reports on eco-efficiency related discussions and environmental performance indicator measurement and disclosure)
- An increased level of experimentation with "ecological footprinting" and impact on the environment disclosures
- The development and reporting of performance indicators on a sectoral basis so as to enable inter-company comparability
- Improved financial disclosures – these remain at relatively low level especially the quantification of benefits flowing from environment-related activities
- Improved integration of financial, environmental and social issues – in particular to integrate environmental and financial risk issues
- Improved levels of reporting outside the FTSE100 (submissions for SMEs were only notable by their absence – and the public sector is not much better represented)
- More substantial discussions of sustainability issues: though their frequency has improved, such discussions are largely at an elementary stage
- Institutional initiatives to reduce the continuing confusion over the appropriate format and content of environmental reports."

So environmental reporting will continue to get better and more widespread and people will start to discuss the real implications of sustainability. Will this have an effect on the way we live?

The recent slump in consumer spending is worrying for retailers, but could it be the start of a backlash against consumerism? Are people getting tired of the endless stream of new products designed to make out lives easier, faster and more global. Do we need another 50 TV channels? Do we need CDs, DVDs, hard disks, floppy disks, mini disks, zip disks and so on?

> "We act as though comfort and luxury were the chief requirements of life, when all that we need to make us really happy is something to be enthusiastic about" (Kingsley 1982)

Why is there a growing interest in Feng Shui, reflexology, hypnotherapy, aromatherapy and other less scientific, "alternative" subjects? Have people realised that science and technology, despite its wonderful advances, does not have all the answers?

So businesses will need to question their raison d'être and their long-term philosophies. Are they going to continue to make ever more products, which use even more resources, and produce continually more waste? Or will they start to see their role as a different one, being responsible for both ends of the supply chain and providing their customers with a service rather than a product, as the likes of Xerox (McIntyre 1996) are trying to do?[25] As Taichi Kiuchi (MD at Mitsubishi) stated at the GRI conference (1999) "Business purpose is not to earn profit, but to earn profit in order to run business".

The pressure is on to do more of the same, but better, more often, involving more people and with more long term thought. But are our efforts still inadequate – "as effective as bailing out the Titanic with teaspoons" (Hawken 1994 p7), or has the Supertanker really started to turn?

The results of our efforts will not be seen for years to come, so any business that has not yet learnt to swim had better start now.

5 Epilogue: The Future of Environmental Performance Measurement in LucasVarity?

As LucasVarity enters 1999 it is about to become part of another company, the American conglomerate TRW. The future is once again uncertain – what will the new owners expect or dictate? Hopefully the benefits of the HS&E programme will live on and permeate parts of the new organisation as it did previously in the merger with Varity in 1996. If the corporate philosophy changes (for the worse), the individual businesses should continue with the programmes and objectives that they have set themselves.

Ideally, the environmental performance measurement system would continue to develop, providing fuel for communications and continuous improvement initiatives. More business functions would get involved and would integrate environmental thinking into their processes (as is happening with new product design – thanks to another Engineering Doctorate project).

A company the size of TRW (125,000 employees, including LucasVarity) will not escape the environmental spotlight, but will its approach be minimalist or proactive? It is known that TRW has corporate HS&E staff, although health and safety is separated from environment (unlike LucasVarity). Their literature and approach is very much U.S. compliance driven (they employ 4 corporate lawyers to deal with environmental issues), unlike LucasVarity whose focus is on best practice and looking "beyond compliance".

It remains to be seen whether the LucasVarity approach to HS&E will survive the take-over, but it is hoped that, whatever the corporate requirements, the principles which the individual LucasVarity businesses have learnt and implemented will live on and continue to improve.

[25] Xerox now sells a "document service" rather than a photocopier. They provide a customer with a photocopier and all the servicing requirements and then take the copier back (when the customer has finished with it or requires and upgrade) to be "remanufactured" (stripped down and rebuilt as new).

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6-Month Report

Nicolette Lawson
Eng. D Year 1

3rd April 1995

Nicolette Lawson, Eng. D Yr.1
6 monthly report
3rd April 1995

6-Monthly Report : Year 1

"Environmental Performance Indicators in Management Systems"

Contents

Background to Eng. D project

Since 1990, industry world-wide, with the support of governments, has shifted the emphasis on environmental management from a regulation driven mode to the implementation of environmental management systems, similar to changes affecting the management of quality in the 1980's.

In November 1991, Lucas Industries set up a corporate Health, Safety and Environment (HS&E) Department. The department built on an existing Health and Safety structure, adding expertise in Total Quality, Manufacturing and Management Systems to bring a new approach and to incorporate Environmental issues.

The application of quality management principles to environmental management meant that companies had to redefine their corporate strategies. At Lucas, a new Policy and Audit system was developed and launched in July 1992 to a meeting of 130 European Managers. By March 1995, 52 audits have been completed by the team, covering all the major UK and European sites and some of the North American sites.

By mid 1993 the audit results indicated that consistent targets ("Commitments to Progress") were needed across all the businesses in order to raise the minimum level of performance. Environment targets for each site included elimination of Ozone Depleting Substances, compiling an inventory of environmental impacts, preparation of a waste map and reduction of energy and water consumption by 10%.

Performance indicators to date have been

- the audit results which benchmark the businesses against the policy,
- feedback from the Commitments to Progress,
- "directly measurable" such as energy and water consumption
- ad hoc response from sites,

However, data received from sites is inconsistent and effective systems are not in place to collect and collate data. The problem is what to measure and how to put systems in place to indicate environmental performance in the manufacturing businesses. Targets and performance indicators need to be realistic, functional, motivational and useful, allowing for meaningful reporting in the future.

The HS&E Department strategy to improve the HS&E performance of Lucas businesses involves

A) implementing Management Systems (including performance measurement),

B) communicating and co-ordinating with, and between, the businesses

C) raising the competence of Lucas personnel through training and education.

Completed Workpackages:

A) Implementing Management Systems (including performance measurement)

A1) HS&E Auditing

HS&E Auditing has been carried out since 1992. In the last six months audits have been carried out at two North American sites.

Personal contribution: As Team leader for both American sites, I was responsible for interviewing site management and co-ordinating the specialist members of the audit team, compiling the report, drawing up overall recommendations and feeding back to the sites

Reference: Environmental Audit reports

Future Work: Completion of first phase in USA and rest of the world. Second phase audits in Europe. A shorter, more streamlined audit will be developed for second phase audits.

A2) Handbook of Management Standards

Lucas HS&E Department has recently developed a Handbook containing Management Standards. The standards are:

⇒ Based on best practice and the lessons learnt during the Review Programme.

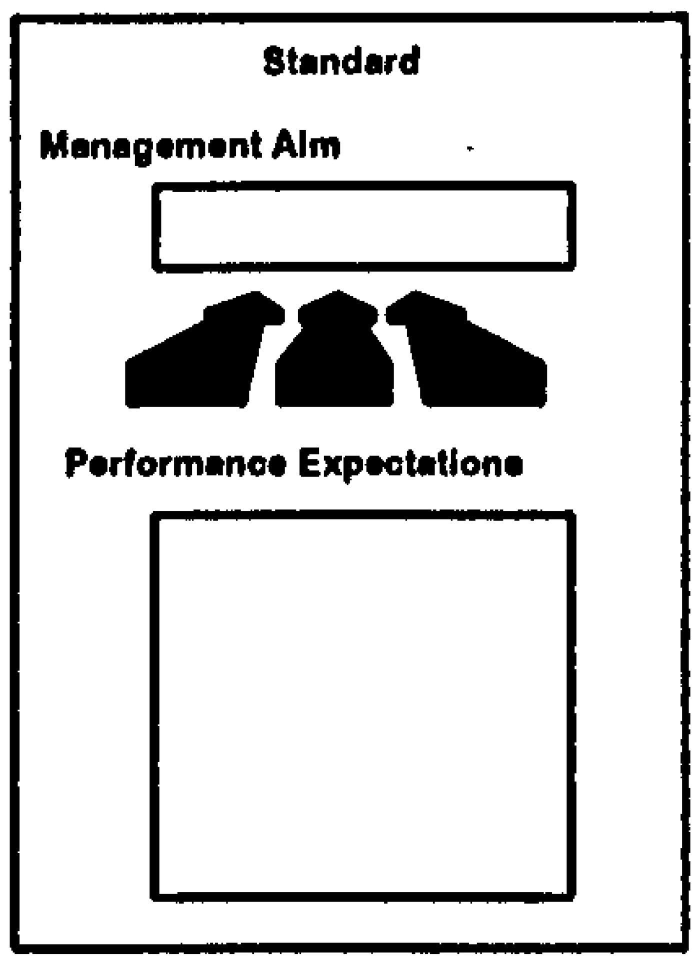
⇒ A set of simple statements of HS&E management principles.

⇒ They translate the Lucas Policy into basic aims for management to achieve best practice management of HS&E.

⇒ They establish the minimum requirements (arrangement and systems) to be met to achieve the aims.

⇒ They are divided into four sections: management systems, health, safety and environment.

⇒ They will be regularly reviewed and updated as and when required.



These are then "measurable" - i.e. there will be some physical evidence that they exist. The standards can therefore be used to audit against.

The Lucas Management Standards define business requirements for successful management of HS&E. These requirements have been compared to the requirements of the following International Environmental Management Systems:

- The European union's Eco-Management and Auditing Scheme Regulations (EMAS)
- The International Standard Organisation's standard for Environmental Management Systems **(ISO 14001)**
- The British Standards Institute standard for Environmental Management **(BS7750)**
- Principles of the International Chamber of Commerce Charter for Sustainable Development.

These requirements are tabulated in Figure 1 on the next page and show that Lucas Standards will meet (and exceed) the requirements of IS014001 and BS7750. The Lucas Standards meet all of the EMAS requirements except the public reporting and verification. This may be added at a later date, for those businesses that implement the standards most effectively.

Personal contribution: I wrote 100% of the Environmental standards plus I contributed to the Management Standards and overall handbook concept.

Reference: Management and Environmental Standards in Appendix A.

Future Work: Self Assessment will be devised, so that businesses can audit themselves against the Standards.

A3) Management Guidelines

To help businesses to implement the standards, management guidelines have been written. Management Guidelines fall into two categories:-

1. *Programme guidelines* aim to help people develop something new, that they probably haven't attempted before, these would need to be project managed.
2. *Operational Guidelines* include more specific data about the management or control of a particular issue and can be used as a checklist for current procedures and systems.

Personal contribution: I wrote 100% of the Environmental guidelines plus contributed to the overall guideline concept and format.

Reference: Environmental Guidelines in Appendix B

Future Work: More guidelines will be written if the need arises, but it is expected that training and management consultancy will be needed to help businesses to implement the management standards.

Comparison of Requirements — FIGURE 1

System Component	EMAS	ISO 14001	BS 7750	ICC Charter	Lucas
Policy	■	■	■	✣	■
Senior Management Commitment	■	■	■	✣	■
Review of Impacts	■	■	○		■
Register of Significant Impacts	■	1	■		■
Register of Regulations	■	1	■	2	■
Allocated Responsibilities	■	■	■	✣	■
Objectives & Targets	■	■	■	✣	■
Employee Participation				✣	■
Management Programme	■	■	■	✣	■
Manual	■	■	■		■
Records	■	■	■		■
Training	■	■	■	✣	■
Internal Audits	■	■	■	✣	■
Self Assessment	○	○	○	○	■
Public Reporting	■	○		✣	
Internal Reporting		○	○		■
System Verification	■	■	■		■
Report Verification	■				
Continuous Improvement	■	■	■	✣	■

KEY

■ A requirement of the standard
○ Guideline/ good practice
✣ Principle
1 Requires a review of impacts and regulations
2 Requires a compliance assessment

B/C) Environmental Awareness and Communications

B1) Environmental Seminar

An Environmental Seminar to raise awareness of Lucas managers, entitled "Integration of Environmental Issues into Business Management" was held in the Autumn of 1994.

Subjects covered:

- Launch of Global Action Plan
- Rover Environmental Strategy
- Coca-Cola experience of Waste Minimisation project (Aire & Calder)
- Lucas examples of waste & energy minimisation
- Ground water pollution policy by the National Rivers Authority
- Waste minimisation in Germany (Koblenz)
- Lucas position on Environmental Management Systems.

Personal contribution: I organised and project managed this first Environmental seminar for 100 Lucas managers.

Future Work: At least one Environmental seminar will be held each year.

B2) Environmental Training

A training and strategy planning workshop was held in January for Engineers at Lucas Diesel systems in Blois, France.

Personal contribution: I prepared part of the material and presentation.

Future Work: Environmental training will be developed further. An environmental seminar for women in Lucas will be held in May.

B3) USA Workshop

A three day seminar was held in March for 50 managers from USA businesses. External and Internal speakers were invited to speak on various HS&E subjects.

Personal contribution: I gave a talk on Environmental Protection and Pollution Prevention Pays. I also acted as a group facilitator during syndicate sessions.

B4) Newsletters

A bi-monthly HS&E Newsletter is prepared by the HS&E department and sent to over 300 managers and HS&E specialists throughout the businesses.

Personal contribution: I write the "Green Page" and Energy Page".

- **Future Work**

The following Table shows what has been achieved, what is planned and what my involvement will be(◆ total, ◈ part of team, ◇ involved).

Requirement		Achieved	Planned	My involvement
Policy	■	Adopted in 1992. Currently under review.	To be reviewed every three years.	◈
Senior Management Commitment	■	HS&E Committee Each business has appointed a Senior Manager responsible. Several businesses have included HS&E into their CAPs	Endorsement of policy and standards by CEO. Incorporation into CAPs by 1996.	
Review of Impacts	■	Part of the HS&E Review Programme. Guidelines for implementation available to the businesses.	Formalise the process as part of the implementation of standards.	◈
Register of Significant Impacts	■	Set as a target for European businesses in 1994. Guidelines and report documentation being prepared.	Business will be requested to provide information to Corporate, using a common format. Target date summer 1996.	◆ Develop "significance" tool
Register of Regulations	■	Only at corporate level. Already implemented in most USA facilities, as a legal requirement.	Business will be requested to provide information to Corporate, using a common format. Target date summer 1996.	◇
Allocated Responsibilities	■	Corporate responsibilities well defined. Including Due Diligence process. Every Lucas site has appointed a Senior Manager Responsible. Roles and responsibilities included in the Handbook, containing the standards.	To continue the assessment of site arrangements as part of the Review programme. Define role and responsibilities for all employees, to be included in their job definitions. Group arrangements review by the HS&E Committee.	◇
Employee Participation	■	Several sites have incorporated HS&E into their continuous improvement programmes. Global Action Plan launched in the UK. Suggestion scheme in the UK.	Disseminate best practice, through cases studies highlighting the cost benefits.	◈
Objectives & Targets	■	Global aims included in the policy. Targets first introduced as "Commitment to Progress" in 1994.	Formulation of corporate objectives and targets. To incorporate HS&E into the appraisal process of managers. The review Programme will incorporate the setting of priorities and an action plan.	◆

Management Programme	■	As the result of the Reviews, most business have established risk reduction and conservation programmes.	Disseminate results of pilot projects in Waste Minimisation and design for the Environment. Encourage cross-fertilisation through the use of Seminars and the Network newsletter.	◈
Manual	■	Partial implementation in few sites.	Integral part of the Standards implementation plan. Target date for completion Europe & USA: July 1996 Rest of the World: July 1997	◈
Records	■	Effectiveness varies across the group. USA, French & Germans are the most advanced.	Define Minimum data set for best practice.	◈
Training	■	Senior Managers (over 500) awareness training as part of the Review Programme Management Workshop available	Inclusion in Management Development programme Arrange Management Workshops.	◆
Internal Audits	■	A three year cycle Review programme covering more than 50 businesses (Europe & USA)	Complete 50% of USA July 95 Complete North America July 96 Start European second phase August 95 Rest of the World to start in 1996	◈
Self Assessment	■	Review of best practice. Development of systems, forms and reporting mechanism.	To be introduced as part of the second phase Review. All sites (Management Systems) by July 1996. Specific Programme evaluation	◆ Development of Self Assessment for Environmental Standards
Public Reporting		Discussed in the HS&E Committee	Prepare proposal by July 1996.	◈
Internal Reportin	■	Effective in UK and Europe.	Formalise periodicity and scope. Specification of performance indicators.	◆ Become Principal environmental Auditor.
System Verification	■	Review Programme.	Use of ISO 14001 certification process.	
Report Verification			Required in order to apply for EMAS Registration.	
Continuous Improvement	■	Applied by those businesses already implementing improvement programmes.	Disseminate best practice, through cases studies, with cost benefits.	

12 Month Report

Nicolette Lawson
Eng. D Year 1

2nd October 1995

Nicolette Lawson, Eng. D Yr.1
12 monthly report
2nd October 1995

12-Month Report : Year 1

"Environmental Performance Indicators in Management Systems"

Contents

Background to Eng. D project

The HS&E Department strategy to improve the HS&E performance of Lucas businesses involves

A) implementing Management Systems (including performance measurement),

B) communicating and co-ordinating with, and between, the businesses

C) raising the competence of Lucas personnel through training and education.

Completed Workpackages:

A) Implementing Management Systems (including performance measurement)

A1) HS&E Auditing

Starting in October 1995, Lucas sites in the UK will be audited for the 2nd time. The second phase audit process will change slightly from a first-time review:

- The business will have to present, to the audit team, the progress that they have made since the first audit,
- The business will be benchmarked against the Lucas HS&E Standards - this will change the way that performance is measured,
- Reports will be shorter,
- There will be more follow-up to ensure that the business prepares a realistic action plan and meets it's own objectives.

Personal contribution: It has been my job to devise a different performance measuring system. To this end I have been preparing "GEMI" type assessment sheets for each of the first four management standards and the first Environmental, Safety and Health standards.

Reference: Audit assessment sheets (see Appendix C)

Future Work: I will be working with another Technical Manager on the first second-phase audit to trial and refine this system. I will be team leader on an audit planned for early November, and others in the new year. I will be compiling audit results to show % improvement since the first phase audits. These performance measures will be used for internal reporting to senior management and will be the basis for an ongoing reporting system.

A2) Implementation of Handbook of Management Standards

Lucas HS&E Department developed a Handbook containing Management Standards early in 1995 and we have been presenting it to business management teams since April.

Personal contribution I have made presentations to business management teams in the UK, France, Germany and Spain and I have helped in the project management and review of progress for businesses implementing the standards (and hence the Environmental Management Standards).

A3) Site HS&E Manual

The implementation of an Environmental Management System requires businesses to implement a Site HS&E Manual which will contain all the live documentation which describes how the business manages HS&E. A workshop was held to collect ideas and views on the content and purpose of the Manual.

Personal contribution: I have written the minutes for this meeting and drawn diagrams showing the relation ship between the Management of HS&E, the Manual and the Site's Quality System. I will be writing guidelines for the businesses on how to compile a site manual

Reference: Minutes from Manual Workshop (see Appendix D)

Future Work: I will be writing guidelines for the businesses on how to compile a site manual (although the completion date has already slipped). The manual will be an important starting point for future auditing of businesses and its completeness will be a measure of the effective implementation of the EMS.

A4) Environmental Measures Of Performance.

Following the "Commitments to Progress", which were Group targets set in 1994, a proposed set of HS&E measures were tabled at the Group HS&E Committee in August.

Personal contribution: I have proposed the initial Business Environmental Measures and have helped to develop the Management Systems, Review Programme and Competence Measures.

Reference: Summary of HS&E Performance Measurement (see Appendix E)

Future Work: Following discussion at the Group HS&E Committee I will be preparing an explanatory document on the proposed Environmental Measures of Performance. This explanation will be circulated to selected businesses (8 in the UK, 3 in Europe, and 4 in North America) for comment. Following the feedback and any alterations, these measures will be implemented at volunteer businesses from 1 January 1996 for reporting at the end of July 1996. If this exercise is successful, the measures will be implemented at all Lucas businesses, along with a system for collecting and analysing the data on a regular basis.

A5) EMS Implementation Projects

To aid implementation of EMS at selected Lucas businesses, 8 MSc students were taken on over the summer period to work on site projects.

Personal contribution: I have developed objectives for the projects, liaised with site management and kept a watching brief over project progress.

Future Work: I intend to use information and methodologies gathered from these projects to develop further guidelines on the implementation of EMS and to understand the practicalities of implementing environmental measures of performance.

B/C) Environmental Awareness and Communications

B1) Literature Search

Personal contribution: I have started a literature search to raise my own awareness of current thinking on Environmental Performance Indicators. Much of my material is based on books, publications and company material that I receive through contacts that I have made in other companies and organisations.

Future Work: A bibliography is being collated. I also intend to look at financial and other business indicators as well as environmental performance indicators because these systems are already established.

B2) Environmental Tool for Purchasing / Supplier Quality Auditors

Following a successful awareness presentation to Senior Purchasing Managers in 1994, and two trial supplier audits, I was asked to develop a simple environmental auditing tool for Supplier Quality Auditors to use. The intention being that they would be able to assess the first tell-tale signs of poor environmental performance at suppliers and hence take action to reduce the associated risks.

Personal contribution: I have prepared a simple protocol for use by Supplier Quality Auditors, along with training material. This will allow Quality Auditors to assess the environmental performance of Suppliers based on a visual inspection assessment. Any supplier identified as "High Risk" would then be subjected to a full Environmental Audit.

Reference: Supplier Audit Protocol and training material (see Appendix F)

Future Work: Environmental training for Quality Auditors to be carried out. However, the timing of this implementation is dependent on senior purchasing managers who commissioned the work.

B3) Management Significance Exercise.

Following presentation of the Lucas HS&E Management Standards, several business teams have asked for guidance on how to start the implementation.

Personal contribution: I have developed a simple exercise to carry out with business management teams, to help them focus on the HS&E issues and assess their significance to the business and how they should be managed. This has been tried out with several groups and has been a helpful exercise both in raising awareness and helping teams to quickly focus and plan their activities.

Reference: Notes on how to conduct the Significance Exercise (see Appendix G)

Future Work: I intend to try it on further groups then refine the process and write up the methodology.

B4) Associate Membership of Institute of Environmental Management.

Because I have no formal environmental qualifications, I opted to take an exam, set by the Institute of Environmental Management, in order to gain Associate Membership of the Institute. This will be submitted to my portfolio as a first year elective.

Personal contribution: I answered the assessment paper in June 1995 and as a result became an Associate Member in September 1995. I am now entitled to use the letters AMIEMgt after my name.

Reference: Copy of certificate (see Appendix H)

Future Work: I intend to gain full membership over time.

C1) Newsletters

A bi-monthly HS&E Newsletter is prepared by the HS&E department and sent to over 300 managers and HS&E specialists throughout the businesses.

Personal contribution: I write the "Green Page" and Energy Page".

Future Work: These will be compiled over the four years and submitted to my portfolio together.

Future Work

The following summarises the work planned for the coming year on Environmental Measures of Performance (also referred to as Environmental Performance Indicators):

- Further develop the audit rating and results system and related internal reporting system.
- Prepare an explanatory document on the proposed Environmental Measures of Performance, circulate this to selected businesses, assess feedback, implement at volunteer businesses and assess results at the end of July 1996. Then develop a system for collecting and analysing the data on a regular basis, across the Group.
- Use information and methodologies gathered from MSc projects to develop further guidelines on the implementation of EMS and to understand the practicalities of implementing environmental measures of performance.
- Continue with literature search and compile a bibliography.
- Carry out training for Quality Auditors.
- Refine management significance process and write up methodology.

18 Month Report #1

Nicolette Lawson
Eng. D Year 2

April 1996

Nicolette Lawson, Eng. D Yr.2
18 month report #1
April 1996

18-Month Report : Year 2

"Environmental Performance Indicators in Management Systems"

Contents

Discussion

Thesis

The following quote is from: ESRC Global Environment Change Programme & New Economics Foundation, Briefings #4, Feb. 1995.

> *"Indicators are a key mechanism for encouraging progress towards sustainable development. To be effective they must communicate useful information - enabling situations to be understood and decisions made.*
>
> *Indicators must be both meaningful - accurately portraying what is happening - and resonant - allowing people to grasp the relevance to their own lives".*

After consideration of this statement, I am proposing the following thesis for my Doctorate:

> **"A robust set of Environmental Performance Indicators can be developed and implemented in a manufacturing industry which will enable:**
>
> - **situations to be understood**
> - **informed decisions to be made**
> - **progress to be described"**

Questions to be explored

The following questions will be explored and discussed for the second year dissertation:

Why are Lucas doing this ? (what are the business reasons/drivers).

How do Measures of Performance link with other Environmental Management issues (see Mind Map in Appendix I) ?

Who are we communicating to ? (internally and externally)

What is needed in addition to the Measures of Performance ?

How are customers measuring our performance ?

What are the reasons for choosing metrics ?

Do differing physical measures imply other factors or influences on business ?

Why have we chosen to measure management systems and not environmental performance in our audit ? How does this system ensure best performance ? (cause v. symptoms - reflects management performance of business)

How will addressing environmental performance increase business performance? (similar to quality).

How do Self Assessment Results compare with Group Audit Results ? How do people perceive their own performance ?

How do idealised Performance Indicators compare to practical considerations ?

Completed Workpackages:

A) Implementing Management Systems (including performance measurement)

A1) HS&E Auditing

In the last six months, a shorter, more streamlined audit has been developed for second phase audits. Six second-phase audits have been carried out at UK sites to date. The HS&E audit measures each business' progress towards implementation of the HS&E standards. Although the audit will highlight risks and areas of poor environmental performance, the measure of performance is the level of implementation of the Management Systems. This is the only measure that can be consistently applied across such a diverse range of businesses. The belief is that a well managed business that has good management systems will naturally improve environmental performance. To compare absolute environmental performance between businesses would be almost impossible, although it is recognised that each business should be measuring its own environmental performance against time and other variables such as level of production and number of employees.

Personal contribution: I have developed the assessment tools and report format and been Team leader for two of the second-phase audits. We also set our own Measure of performance for the department - a turn-around time of four weeks for the audit report.

Reference: New Audit report format and rationale behind it (see Appendix J for report format and example Executive Summary).

Future Work: Compilation of results from second-phase audits.

A2) Handbook of Management Standards - Self Assessment system

The Management Standards are "measurable" in that performance expectations are listed for each standard and there will be some physical evidence (documentation, testimony) that the standard has been implemented. The standards can therefore be used to audit against.

The Chief Executive agreed that the businesses should aim to achieve 80% compliance with the Standards by July 1998. In order to measure the progress towards 80% compliance an Assessment system was developed for the seven key Standards:

M1 - Policy, Objectives and Targets

M2 - Organisational Arrangements

M3 - Operational Management Systems

M4 - Self-Assessment and Audit Systems

E1 - Environmental Protection Programme

S1 - Risk Elimination and Control Programmes

H1 - Occupational Health Programmes

This assessment system was originally intended for use by the audit team only but has now been distributed for all Lucas businesses to use as a Self-Assessment system (SAS) in the intervening period between audits. The Group audit assessment results will however take precedent over any self-assessed results.

Personal contribution: I developed the SAS and trialed it at the first second-phase audits.

Reference: HS&E Self Assessment System presentation in Appendix K.

Future Work: Self-Assessment sheets for other standards. Comparison of business Self-Assessment perceptions compared to Group HS&E Audit Assessments.

A3) Measures of Performance

Following discussion at the Group HS&E Committee I prepared an explanatory document on the proposed Environmental Measures of Performance. This explanation was circulated to selected businesses for comment. Presentations were then made to business management teams at 6 pilot sites (5 in the UK, 1 in Europe). These measures will be implemented at the volunteer businesses for reporting at the end of July 1996.

If this exercise is successful, the measures will be implemented at all Lucas businesses, along with a system for collecting and analysing the data on a regular basis.

Personal contribution: I developed the MOPs and wrote the paper.

Reference: Group HS&E Measures of Performance paper in Appendix L.

Future Work: Preparation of a pro-forma for businesses to supply the requested data in a consistent manner. Collection of data and experiences. Development of system for implementation Lucas-wide in 1997.

A4) External Benchmarking

I have participated in a Benchmarking exercise with Martin Bennett of Wolverhampton University.

Future Work: Comparison of results from Martin Bennett's survey.

A5) Environmental Management Systems

Through a Teaching Company Scheme, I manage three Teaching Company Associates who are working on the development of Environmental Registers and Significant Effects at various Lucas businesses. This work will culminate in guidelines, training material and case study material.

Future Work: To work with those businesses implementing environmental Management systems to develop site-specific measures of performance to support Objectives and Targets set to address Environmental Issues.

B) Literature:

Summary of Books and articles read:

- Alternative Economic Indicators: V Anderson. (see book review in Appendix M)
- Many other articles and books have been gathered for review during the coming summer.

C) Seminars and Courses Attended:

- 1 day seminar on Environmental Reporting, at Dragon Consultants, London (26 September 1995).
- 2-day course on Environmental Auditing, hosted by Arthur D Little, Brussels. (25-26 October 1995)
- 2-day course (of 1 week MSc Environmental Management Module), on Environmental Accounting, Performance Measurement and Reporting at Brunel Management Centre (16-17 November 1995). This course was taken as an Elective Module and culminated in an assignment and exam in January 1996 (results not yet received).
- On 13 December 1995 I presented the "Practicalities of Auditing - the Do's and Don'ts" at the Midlands Group Meeting of the Institute of Environmental Management. (see Appendix N for presentation handout).

D) Personal Factors:

- My Industrial Supervisor, Dr. José Guzman left the department in the autumn of 1995. My new Industrial Supervisor, is the Director of HS&E, Dr. Mike McKiernan, who is also my direct reporting manager.
- I will be taking Maternity Leave from June to December 1996. This will introduce certain delays in the system. For instance I will carry over one Module (Sociology 2) into the next year, and I will not be attending the Annual Conference in September 1996. My Academic Supervisor, Dr. Chris France, has advised me that I can submit my Dissertation (due September 1996) in January 1997.

Summary of Future Work

A) Implementing Management Systems

HS&E Auditing	Compilation of results from second-phase standard-based audits.
Assessment Tool for Standards	Self-Assessment sheets for other standards. Comparison of business Self-Assessment perceptions compared to Group HS&E Audit Assessments.
Measures of Performance	Preparation of a pro-forma for businesses to supply the requested data in a consistent manner. Collection of data and experiences. Development of system for implementation Lucas-wide in 1997.
External Benchmarking	Comparison of results from Martin Bennett's survey.
Environmental Management Systems	To work with those businesses implementing environmental Management systems to develop site-specific measures of performance to support Objectives and Targets set to address Environmental Issues.

B) Literature	Articles and books to be reviewed during the coming summer.

18 Month Report #2

Nicolette Lawson
Eng. D Year 3

April 1997

Nicolette Lawson, Eng. D Yr.3

6-Monthly Report : Year 3

"Environmental Performance Indicators in Management Systems"

Contents

Discussion

Thesis

My April 1996 progress report proposed the following thesis:

> **"A robust set of Environmental Performance Indicators can be developed and implemented in a manufacturing industry which will enable:**
>
> - **situations to be understood**
> - **informed decisions to be made**
> - **progress to be described"**

A pilot study into the implementation of environmental performance indicators was carried out in 1996 and the results have been reported in my dissertation (delayed until April/May 1997 due to maternity leave in 1996).

Questions to be explored

The following questions were also proposed. Brief answers are given here, but some of them are discussed in more depth in the dissertation and others will be explored in future papers:

- **Why is Lucas doing this ? (What are the business reasons/drivers)?**

  Lucas (now LucasVarity) are proposing to implement environmental measures of performance to:

  - demonstrate that HS&E achievements have been made,
  - highlight areas of potential improvement,
  - enable performance comparisons to be made between its businesses,
  - provide information for Group-wide reporting.

- **Who are we communicating to? (internally and externally)**

  Initially, performance data will be used for internal reporting in order to facilitate improvement and prioritise areas for resource allocation. When data collection systems become sufficiently robust, and several years' information has been collected, the Company will be in a position to publish an external report if it so wishes.

- **What is needed in addition to the Measures of Performance?**

  In addition to Measures of Performance, Management Systems need to be in place. Performance measurement is just one element of a management system. However,

- **How are customers measuring our performance?**

  Over the last 12 months it has become common practice for automotive customers to send environmental questionnaires to their suppliers. Questionnaires have varied in length and complexity and some customers have admitted that they were not sure what they were going to do with the data. Those companies taking the lead on environmental issues (particularly the European car manufacturers VW, BMW, Volvo etc.) are starting to measure their suppliers' performance seriously and have stated that they will be using environmental performance as part of their supplier selection criteria.

- **What are the reasons for choosing metrics?**

  In assessing the level of performance in implementing HS&E management systems, we developed a numerical system for representing performance, i.e. a percentage score, with 100% representing a perfectly integrated "Total Quality" approach. Metrics were chosen because they made comparison between businesses easier and performance over time clearer. Being an engineering company, metrics were readily accepted as a suitable method of describing performance and also enabled results to be represented graphically.

- **Do differing physical measures imply other factors or influences on business?**

  There are many factors and influences that can affect measures of performance. These variables need to be recognised when interpreting data and it is important not to jump to conclusions about business performance based on a set of figures in isolation. The influence of outside factors will be discussed in greater detail when future data is analysed.

- **Why have we chosen to measure management systems and not environmental performance in our audit? How does this system ensure best performance?**

  The HS&E department has taken the view that management systems need to be in place in order to achieve good HS&E performance. To this end, the Group audit system has concentrated on measuring management systems, as defined by the Group HS&E Standards. As mentioned in the answer to the question above, there are many variables and outside influences that can affect actual environmental performance. However, the presence of management systems can be detected in any business irrespective of size or complexity, and hence is the only area of common ground that can be compared across such a diverse group of businesses.

  Our assumptions have been borne out by the results of the audits to date, in that the businesses with the best management systems scores were also those that achieved best performance in other areas (not only environmental performance).

  The focus on management systems also seeks to identify the underlying causes to problems rather than just the symptoms. Symptoms can be rectified, but with no management systems in place they are likely to occur again.

- **How will addressing environmental performance increase business performance?**

  Environmental issues are usually tied in with other business issues such as efficiency, quality, training, legislative compliance and company image. Therefore improving environmental performance will have a direct impact on these other issues. Some examples are shown in the following table:

Improvement in Environmental Performance	Leads to	Improvement in Business Performance
Minimisation of waste	→	Increased profit due to: • reduced material costs, • reduced disposal costs, • less waste handling
	→	Increased production due to : • more efficient use of material & plant • less waste handling
Energy Efficiency	→	Increased profit due to: • reduced fuel costs,
	→	Increased production due to : • more efficient equipment
Pollution prevention measures & elimination of hazardous processes	→	Improved Company image due to : • positive media reports
	→	Reduced level of risk due to: • better facilities • better training • elimination of hazardous processes
	→	Increased employee morale due to: • safer processes, • better training
	→	Financial savings (real & potential) due to • minimal risk of fines • no need for authorisation or abatement
General Environmental Improvement	→	Improved Company image due to : • positive media reports
	→	Increased employee morale due to: • improved business image, • responsible action taken by business
		Increased business due to: • confidence of customers

- **How do Self-Assessment Results compare with Group Audit Results? How do people perceive their own performance?**

Self-Assessment results tend to vary from Group Audit Results due to over confidence, lack of understanding or over-cautiousness of the assessor. The differences can be minimised by the Group Audit team working with the site to explain how results have been attained and maintaining sufficient contact with the business to understand whether the self-assessment results are a realistic indicator of performance. So far, the system has not been in operation long enough to have gathered any trends.

- **How do idealised Performance Indicators compare to practical considerations?**

  When implementing a set of Performance Indicators, practical considerations are paramount. Measures that are too costly, time-consuming or are perceived to have no real function will not be implemented by the business.

  The criteria for targets and performance indicators in LucasVarity are that they must be realistic, functional, motivational and useful. Measurement systems must be compatible with business objectives and existing management systems. They should ensure that consistent and accurate data is collected from all businesses in the Group allowing for meaningful reporting on HS&E performance in the future.

  This topic will be explored in greater depth in future papers.

A) Completed Workpackages:

Measures of Performance

Six pilot sites were chosen (5 in UK, 1 in Germany) to trial the MOPs. These sites were known to be well managed and would therefore stand a good chance of being able to supply the data. The sites were provided with a Pro-forma for the results and supplied their 1995/96 data in August 1996. Results were analysed, and discrepancies followed up. In March 97 (delayed due to business re-organisation), a workshop was held to present the findings back to the businesses involved. All the businesses agreed that it had been a useful exercise and volunteered to carry on with the measures, whatever the decision made at the Group Committee. The results were then communicated to the newly formed Group HS&E Committee who agreed that the measures should be formulated into a list of 10 and prepared for Group-wide implementation.

Personal contribution: I developed the MOPs, prepared the pro-forma (see Appendix O), collected and analysed the results. I then presented the results (see Appendix P) back to the sites involved and to the new Group HS&E Committee (March 1997).

Reference: Dissertation / 24 month report.

Future Work: development of 10 HS&E MOPs for implementation across LucasVarity.

B) Literature:

Summary of Books and articles read:

- "A Measure of Commitment - guidelines for measuring environmental performance", September 1992 – Business in the Environment (BiE)
- "Corporate Environmental Strategy", Bruce W. Piasecki, John Wiley & Sons *(see review/extracts in Appendix Q)*

- "Environment - Requirements for suppliers - A holistic approach", Issue 1, June 1996, Volvo Car Corporation, Strategic Sourcing and Purchasing
- "Environmental Reporting and the Financial Sector, An approach to good practice", February 1997 - Advisory Committee on Business and the Environment
- "Europe's Environment - The Dobris Assessment", 1995 - Edited by David Stanners and Philippe Bourdeau, European Environment Agency.
- "HS&E Management System Model", December 1996 – George Allcock
- "HS&E Measures of Performance, Initial thoughts and proposals for development", November 1994 – George Allcock
- "Successful Health & Safety Management, Health & Safety series booklet HS(G)65", 1991 (revised 1993) - Health and Safety Executive
- "The Costs of Accidents at Work, Health & Safety series booklet HS(G)96", 1993 - The Health and Safety Executive

C) Summary of Future Work

1. Develop 10 HS&E MOPs for implementation across LucasVarity.
2. Summarise and extract information from literature read.
3. Develop answers to questions posed (see Discussion section).
4. Explore integration of Packaging Regulation Data with general Environmental Performance Indicators.
5. Investigate Customer mechanisms for measuring Supplier's Environmental Performance.
6. Set-up database system for on-going collection of data, analysis and reporting.

D) Personal Situation

1. I took maternity leave from work (May to Dec. 1996) and my Eng. D. was held in abeyance from Jan – July 1996.
2. Lucas entered into a merger with Varity in August 1996 to become LucasVarity. In November 1996 our department was told that it would be closed and, where possible, jobs would be found for people in other parts of the business. No suitable positions were identified for me, resulting in redundancy from April 1997.
3. I intend to continue with my Eng. D. whilst working on a freelance basis.

24 Month Report

Nicolette Lawson
Eng. D Year 2/3

October 1997

Nicolette Lawson
LucasVarity plc & Brunel University

24 Month Report (Dissertation)

"The Development and Implementation of Environmental Performance Indicators into Industrial Management Systems"

Contents

1 Dissertation Summary

1.1 Overall Goals and Objectives of the 4 year research programme

- To design, develop and implement a workable system for measuring Corporate Environmental Performance in a large diverse business, using LucasVarity plc as an example. To evaluate the effectiveness of the system and the impact of company culture and constraints on the design of the system, and recommend future improvements. To assess whether LucasVarity has the right set of measures to satisfy all its stakeholders and sufficient information to deliver an external environmental report.
- To review how Environmental Performance is measured generally in industry, but specifically in large, diverse corporations. To analyse a selection of the latest Environmental Reports (1996/1997) and surveys, evaluate the types of measures now being used and review the latest developments. Also to evaluate the robustness of the systems adopted, i.e. are the metrics interpreted similarly by the users, are they comparable across time, location and organisations, and are they repeatable.
- To develop a decision-making methodology for Environmental Performance Evaluation in LucasVarity. This may also be tested at other companies (if time and opportunities allow).
- To assess the extent to which the EPIs contribute to measures of Sustainability.

1.2 Contributions to knowledge

- A critical evaluation of the current methods of measuring performance in large diverse businesses.
- An understanding of the effect of cultural barriers and business constraints on the implementation of Environmental Performance Measurement in large businesses.
- Contemplation on the relationship between Sustainable Development and current corporate objectives.

1.3 Methodological approaches used/to be used

- Benchmarking to evaluate other companies' approaches and theories proposed through literature.
- Design, review and development of measurement system, trial implementation (pilot study), analysis of results and evaluation of process. This will necessitate a largely retroactive (trial and error) and interactive approach.
- Amendment of proposal and implementation company-wide. A proactive approach will be required to raise awareness and monitor implementation of the system.

1.4 Titles and target refereed journals for two papers to be submitted by the end of the project

Title	Actual /Provisional	Journal
"Environmental Performance Indicators in management systems"	Actual (in July 97 EMA conference proceedings – not yet submitted to the journal)	Eco-Management and Auditing (EMA) (ERP Environment & Wiley)
"Measuring Environmental Performance is Business Strategy"	Provisional	Business Strategy and the Environment (ERP Environment & Wiley)

"Is it all too little, too late?"	Provisional	Sustainable Development (ERP Environment & Wiley)

2 Overview of Project and RE

The project, to develop and implement an environmental performance measurement system across the Lucas/LucasVarity Group was born out of the Company's HS&E programmes which commenced in 1991 with the setting up of the HS&E department and the first HS&E policy in 1992. The project has evolved alongside the development and implementation of the HS&E programmes. Environmental Performance Measurement started as the outcome of the HS&E auditing programme and developed when "Commitments to Progress" were reported in 1994. The maturing of the audit programme led to the derivation of HS&E management standards in 1995, which were to become the auditing and management performance yardstick, and also the basis for self-assessment.

In 1995 it was decided that quantitative, objective, "impact" measures were also needed to complement and confirm the semi-quantitative and relatively subjective management systems measures obtained by the audit programme. A set of measures was developed and a pilot study carried out in 1995/96 to investigate whether the required information could be easily gathered and to assess the size of the Company's environmental "impact". The remainder of the project will follow the development of the company-wide system, looking particularly at the factors influencing the implementation of the system. The longer-term issue of sustainability will also be considered and whether businesses are likely to achieve sustainability via environmental performance improvement.

The Research Engineer (RE) commenced the Eng.D. project, in conjunction with Brunel University and Lucas Industries plc in October 1994. In July 1996, the RE took maternity leave and the Eng.D. project was held in temporary abeyance until September 1997.

Lucas Industries merged with Varity in 1996 to form LucasVarity plc. LucasVarity is an international engineering company with approximately 50,000 employees, manufacturing a range of automotive, aerospace and industrial components.

At the start of the project the RE was already employed as Technical Manager, with responsibility for environmental projects in the corporate Health, Safety & Environment (HS&E) department. In January 1996, she was promoted to Programme Manager for Environmental and Management Systems programmes. In April 1997, following the merger with Varity, the corporate HS&E department was dissolved and the RE made redundant. She now continues the Eng.D. project as a freelance consultant working in close association with LucasVarity.

3 Discussion

3.1 Why do we need to measure environmental performance?

Scientists are measuring the effects of man's activities on the environment in order to prove, or disprove, the tales that environmentalists have been telling us for years. Now the proof is here, in chart form, as graphic displays and as harrowing news items broadcast across the world in glorious techni-colour. Few can still deny that man has had, and is still having, a deleterious effect on the earth that supports us. People from all walks of life want to stop the rot, but many do not know what to do or whether they can make a difference. Whilst each individual can only make a small contribution, businesses, as major users of energy and materials, as manufacturers of consumer products, as gigantic, powerful multinationals are being looked upon to take the lead and reduce their environmental impact. But how will they know what to do and whether it is having the desired effect?

Business has always placed great store by quantified information. Situations are analysed, decisions are made and performance predicted based on quantified information. Measuring business performance enables companies to manage their businesses, so measuring environmental performance is seen to be a logical step towards managing industry's environmental impacts. In a growing technological world, where more people have access to more information, faster than ever before, stakeholders, from financial shareholders to employees and the local community are demanding information from businesses. Increasingly, stakeholders are looking for information that demonstrates that businesses are improving their environmental performance.

Brown & Laverick (1994) describe the appraisal of business performance as "a means for corporate organisations to assess the effectiveness of their decision making" which in turn enables them to appraise the success or failure of their strategic planning.

BiE and KPMG (1992) describe my own view precisely: "Environmental management is one of the main challenges to management in the 1990's and performance measurement the most demanding individual component. Companies which successfully integrate these will improve their competitive position not only through meeting market and regulatory demands for improved performance, but because the process will reinforce good management and performance in other areas of their business".

Mudie (1995) also expounds the business case for improved environmental performance and how a balanced range of measures is needed to demonstrate that achievements have been made. He agrees with BiE and KPMG (1992) when he states that "environmental performance measurement is a relatively young subject and there is scope for originality and for companies to tailor measures to their own needs". Houldin (1994) recognises that one of these needs is to develop mechanisms to make environmental management more tangible to all personnel. "In general there is an underlying willingness by individuals to take environmental management seriously - what is needed is a framework within which they can effectively do so." Environmental performance measurement could form such a framework.

Klassen and McLaughlin (1996) back-up the idea that environmental performance improvement can benefit business in other ways. Their study shows how improving environmental management (specifically by winning an award) can have a positive effect on financial performance (share price), since it is seen by the stock market as an indicator of good management

Porter and van der Linde (1995) also demonstrate that measuring direct and indirect environmental impacts is the first step towards a more competitive approach. Their research indicates that the act of measurement alone can lead to enormous opportunities to improve productivity, as one Lucas business discovered when it fitted 33 extra water meters to monitor departmental consumption. By simply taking daily meter readings and reporting results back to the responsible department managers, water usage dropped by 50% in just a few months (Pope & Lawson 1994). Measurement gives a company a better understanding of the interaction between their activities and the environment. Porter and van der Linde (1995) conclude that "One of the major reasons that companies are not very innovative about environmental problems is ignorance". I believe this ignorance is multi-faceted: not only are many businesses ignorant of the problems and the extent of the issues but also how their business impacts on it and what the potential solutions are. Environmental performance measurement can provide information that will allow informed decisions to be made and innovative solutions to be assessed in a new light. Unfortunately many business managers prefer to operate in "ignorance-is-bliss" mode, worrying that if unpleasant facts are revealed they will be forced to make difficult and, possibly, unpopular decisions. However, environmental law does not assume that you are innocent until proven guilty, it is in fact the opposite. The onus is on businesses to prove their innocence, so ignoring their environmental impacts is an irresponsible approach to take. If the old maxim "Information is Power" is true then clearly lack of information about one's own business is a serious weakness.

Macgillivray and Zadek (1995) take the longer-term view that "Indicators are a key mechanism for encouraging progress towards sustainable development. To be effective they must communicate useful information – enabling situations to be understood and decisions made. Indicators must be both meaningful – accurately portraying what is happening – and resonant – allowing people to grasp the relevance to their own lives."

Understanding what is sustainable development and how to recognise whether we are getting there is a much broader subject which will be considered and discussed before the end of this Eng.D. project.

3.2 What are the drivers behind environmental performance measurement?

The external drivers are now well known by businesses undertaking environmental action, they include legislation, international standards, customer requirements and shareholder concerns.

Internal drivers for implementing Environmental Performance Indicators in large businesses, such as Lucas, are very similar to those defined by Bennett and James (1994):

- <u>to monitor improvement</u> of business environmental performance over time and to compare business units with each other. This will demonstrate whether environmental programmes are having the desired effect, and stimulate peer pressure across the group.

- expectations from Managers - if targets are set, performance will be measured. Business Unit managers expect to be given Corporate targets for those issues that are seen to be of strategic importance.
- to make the business case for environmental policies and action. Without environment-related information, the business cannot make long-term decisions about investments and future business direction.
- to demonstrate that resources are being applied to the best possible effect and show the advantages of managing Environmental Issues. Measures of environmental performance can identify where effort is needed most.
- to help set priorities for action. Reviewing environmental performance should be part of strategic planning and integrated into business objectives and targets.

3.3 What's wrong with the current ways of measuring business performance?

One problem with current business performance measurement is that it is dominated by financial measures which only address short-term performance and do not show progress in achieving long-term objectives.

Brown & Laverick (1994), in their comprehensive paper on measuring corporate performance, criticise conventional measures, which are predominantly financial, because they only satisfy one stakeholder – the shareholder. As BiE and KPMG (1992) put it: "In business, performance measurement has traditionally emphasised quantitative financial measures reported to management alone. Such measures are often unintelligible and treated as irrelevant by most other staff and are unlikely to provide feedback to staff on how they can individually contribute to improving the company's performance."

Gray's (1993) opinion is that pictures painted by accountancy must be incomplete. This incompleteness may be dangerous as it forms part of the basis for important decisions and helps to measure the success of actions.

Gray also cites the Macnamara fallacy:

> "The first step is to measure whatever can be easily measured. This is OK as far as it goes. The second step is to disregard that which can't be easily measured or give it an arbitrary quantitative value. This is artificial and misleading. The third step is to presume that what can't be measured easily really isn't important. This is blindness. The forth step is to say that what can't be easily measured really doesn't exist. This is suicide." (Source: D Yankelovich "1072 Corporate priorities: A continuing study of the new demands on business", Daniel Yankelovich Inc, Stamford, Conn).

The conclusion, then is that current ways of measuring business performance are myopic and inadequate and the Macnamara fallacy is a method which many companies may follow without realising it. The Environment was never considered to be a business issue in the past and the development of business processes has ignored it. Now that the link between industrial activity and environmental degradation has been firmly established, business performance measurement systems must reflect the non-financial aspects of operating a business.

3.4 Are there any alternative ways of measuring business performance, which would include the environment?

The balanced scorecard developed by Kaplan & Norton is one alternative methods of measuring business performance. It supplements financial measures with performance measured from three additional perspectives: those of Customers, Internal Business Processes and Learning and Growth, to give a more balanced view of corporate performance (but this is still based on an internal management view). Kaplan & Norton (1996) explain that companies have been using the scorecard as a strategic management tool which "addresses a serious deficiency in traditional management systems: their inability to link a company's long-term strategy with its short-term actions." Varity has been using the "Balanced Scorecard" system and it is now (1997-1998) being introduced to the Lucas businesses. Clearly it would be advantageous for the company if any further developments in environmental performance measurement were integrated into the Balanced Scorecard system.

Brown & Laverick (1994) also outline how an external view of businesses is reported in the "UK Most Admired Companies" (Economist, 1992) – which asks questions about the companies, which would appeal to all stakeholders.

Eccles (1991) suggests that "revolutions begin long before they are officially started. For several years senior executives have been rethinking how to measure the performance of their businesses. They have recognised that new strategies and important realities demand new measurement systems". Eccles identifies and details five areas of activity that should be addressed when considering new corporate performance measures. These are: 1) Develop an information architecture, 2) Provide technological support, 3) Align incentives to new system, 4) Draw on outside resources, and 5) Design a process to ensure success. This approach would demand serious commitment and a complete overhaul of systems in a company like LucasVarity. It remains to be seen whether the new regime of Balanced Scorecard and Best Practice will identify this as an area for renewal.

Brown & Laverick (1994) conclude that "Instead of yesterday's performance measuring yesterday's decisions, what are needed are measures that provide today's decisions which will benefit tomorrow's performance. Quality measures are increasingly being applied to goods and services, quality requirements from suppliers, employee and customer satisfaction, competitive benchmarking plus appreciation of environmental issues."

3.5 What guidance is there on EPIs?

Since the first industrial environmental reports were published in the early 1990's, the spotlight on environmental performance has grown brighter and larger. Norsk Hydro was the first to "go public" about its environmental performance, and slowly but surely more and more companies have felt the need to tell all about their polluting activities and their efforts to mitigate the consequences.

Some environmental reports were full of good intentions and no hard data. KPMG (1993) reported "There are numerous reports with extensive narrative and detailed plans and targets but overall there is a lack of statistical data", and as Azzone and Manzini (1993) point out "public opinion will not trust reports based on information that cannot be measured". So the search began for an answer to the question "If we need to show that our environmental performance is improving, how are we going to measure it?"

One of the earliest guides to environmental measurement was "A Measure of Commitment" in 1992 by Business in the Environment (BiE) and KPMG, with Foreword from Charles somebody at Kensington Palace! This was a useful document providing an outline methodology, lots of encouragement and more than a dozen case studies on how other companies had "done it". Coming as it did in 1992, the subject area was too early in its development and most of the case studies were only focussing on single-issue performance measures.

Martin Bennett, of Wolverhampton Business School, and Peter James, of Ashridge Management Research Group, have been two of the most prolific writers in this area. Usually writing together, they produced various useful papers and courses from 1993 onwards (see titles under References).

With the introduction of certified Environmental Management Systems (BS7750, ISO14001, EMAS) the need for consistent ways to measure environmental performance has taken on more legitimacy. This year (1997) the British Standards institute has released a draft for public comment: "BS ISO 14031: Environmental Management – Environmental Performance Evaluation - Guidelines" which provides a complete, if somewhat repetitive, guide to "Environmental Performance Evaluation" and the selection of Environmental Performance Indicators (EPIs).

3.6 What are environmental performance indicators?

The literature describes numerous types and classes of environmental performance indicators or measures.

Bennett & James (1994) identify ten types of environmental performance measures:

1. **Impact Measures**: these directly measure the effects of the organisations activities on the environment e.g. BOD
2. **Risk Measures**: these measure the likelihood that future adverse impacts may result from present activities.
3. **Emissions & Waste**: these are the most commonly found measures, since regulators already require the data and they also have financial implications (e.g. cost of waste disposal).
4. **Input measures**: these do not reflect performance itself, but actions being taken to improve future performance (e.g. training given, management actions implemented).
5. **Resource Measures**: these track physical inputs, particularly energy, water and materials.
6. **Efficiency Measures**: these are commonly used in manufacturing businesses to assess how much of the input is being turned into useful output (product) as opposed to waste.
7. **Customer Measures**: ("customers" here refers to stakeholders in general) they are usually obtained directly or from surveys (e.g. complaints, attitude surveys)
8. **Financial Measures**: these relate to the costs, or costs and benefits, of environment-related actions. This is a notoriously difficult area, because it is difficult to define which costs are specifically related to the environment, when so many "environmental" improvements also turn out to improve productivity, quality, efficiency, image and so on.

9. **Normalised Measures**: these are obtained by dividing one of the above measures by an appropriate base to obtain a ratio. The base is usually some measure of activity or throughput, such as tonnes of production, or turnover.
10. **Aggregate Measures**: these combine several individual measures into a single composite measure, to represent the environmental performance of the organisation as a whole. This can cause confusion when "apples and pears" are added together and subjectively assessed weightings are assigned to different measures, but can be useful if the transparency of the process is maintained.

I think there are too many types described here, for instance I would categorise emissions and waste as an impact measure. Others are two sides of the same coin: such as Resource measures and Efficiency measures. Another potential for confusion here is to call these all measures. Measure has several meanings: an action or procedure; a quantity; a standard or an actual device for measuring. I would only describe 3 of these, "impact", "emissions and waste" and "resource", as measures since they are direct, quantitative measurements. Others, such as "risk" and "customer", are assessments since they are based on subjective data such as probability and opinions. "Input" measures here are actions or what is also described as contributor measures. Whilst those measures derived from other information (mainly direct impact measures) I would term indicators, i.e. "financial", "normalised" and "aggregated". Obviously, in order to talk about these things in general terms, the word "measure" or "indicator" tends to be used to describe all the different types.

Piasecki, B, W (1996) describes 16 Measures of Environmental Excellence from 5 different perspectives:

Environmental Stewardship	Common Effort				
Stakeholder orientation	Transfer of technology		Advice to Customers		
Human Resource excellence	Employee education	Prior education		Emergency Preparedness	
Product / process leadership	Products & Services	Facilities & Operations	Research	Precautionary Approach	Suppliers
Management Leadership	Corporate priority	Integrated Management	Process of Improvement	Compliance & Reporting	Openness to concerns

Source: LAW Companies Environmental Policy Center, Westinghouse Productivity and Quality Center.

Whilst providing an interesting checklist, Piasecki does not offer to explain how these measures might be implemented, or what indicators should be selected.

The EPIs described by BS ISO 14031 come in three flavours OPIs, MPIs and ECIs. Unwittingly, LucasVarity has used all three.

- OPIs are Operational Performance Indicators. These provide information about the environmental performance of an organisation's operations. In LucasVarity the Environmental Measures of Performance that are being developed (and were tested in a pilot study in 1996) are the OPIs.

- MPIs are Management Performance Indicators. These provide information about the management efforts to influence an organisation's environmental performance. In LucasVarity the audit and self-assessment score which assesses the extent to which a business has implemented the company HS&E Standards (or EMS) is an MPI.
- ECIs are Environmental Condition Indicators. These are specific expressions that provide information about the local, regional, national environment or global condition of the environment. In LucasVarity, this is known as "site vulnerability". Due to the geographical locations of the businesses this will be different for each site.

BSi (1997) also describes the following characteristics of data for environmental indicators:

1. **Direct measures or calculations**: basic data or information, such as total tonnes of contaminant emitted in a given year. These are often termed "impact measures" since we cannot measure actual impact but we can measure the "loads" that lead to impact, such as quantities of waste going to landfill, or air emission levels. They are especially necessary at company/corporate level and are considered to be the starting point of any measuring process. BiE and KPMG (1992) explain that "Impact measures are directly related to policy and effectively reflect the company's environmental "bottom line". They are the measures most likely to be reported externally."
2. **Relative measures or calculations**: data or information compared to or in relation to another parameter (e.g., production level, time, location or background condition), such as tonnes of contaminant emitted per ton of product manufactured,
3. **Normalised / Indexed**: data or information converted to units or to a form which relates the information to a chosen standard or baseline, such as contaminant emissions in the current year expressed as a percentage of those emissions in a baseline year.
4. **Aggregated**: data or information of the same type, but from different sources, collected and expressed as a combined value, such as total tonnes of a given contaminant emitted from production of a product in a given year, determined by summing emissions from multiple facilities producing that product. This is a different definition to that used by Bennett and James above, and one that I am happier with.
5. **Weighted**: data or information modified by applying a factor related to its significance.

The guidance describes the different types of indicator that are available, but there is no particular combination that is recommended as a recipe for success. Indicators should be selected by organisations as a means of presenting quantitative or qualitative raw data or information in a more understandable and useful form. The information can be expressed as direct measures, or as relative, normalised or indexed, aggregated or weighted as appropriate to the nature of the information and its intended use. Where aggregation and weighting is carried out a certain amount of subjectivity is introduced and therefore should be done with care to ensure verifiability, consistency, comparability, and understandability. BSi (1997) states "There should be a clear understanding of assumptions made in the handling of data and the transformation of it into information and indicators for EPE."

What is clear is that most authors recommend a balanced range of measures and are opposed to the single environmental indicator. As BiE and KPMG (1992) explain "It is important to note that environmental performance cannot be indicated by a single measure. We have learnt the hard way from other areas of performance measurement that single measures very often give exactly those results which we were not seeking. Those companies which have sought to measure their managers by sales or turnover alone, rather than profitability, have had to alter measurement and appraisal systems. What we must seek therefore is a balanced range of measures".

3.7 Quantitative "Impact" Measures

Quantitative measures are the most objective and comparable performance indicators, and most favoured for external reporting. However, despite their seemingly straightforward nature, quantitative measures are often the most elusive. In Lucas, we developed a semi-quantitative system to measure implementation of the environmental management system in 1992, yet company-wide quantitative systems are still to be implemented. The semi-quantitative system developed translated the auditor's subjective view of management systems implementation into a completion percentage (see 4.2.1. HS&E Auditing). This satisfied senior executives request for a "league table", showing the business units' HS&E performance.

KPMG's 1993 International Survey of Environmental Reporting covered 690 companies. Of these, no engineering companies had provided quantitative data. This could indicate that most Engineering Companies have yet to establish the necessary systems to collect the required information, or that they have yet to recognise the need to publish performance data. If LucasVarity can be considered representative of Engineering companies, then it may be that they do not yet consider that their environmental impacts are sufficiently significant to warrant too much effort in this area (as opposed to say the major Chemical companies, who clearly have a significant environmental impact). A cynical view might suggest that it could be that reporting of quantitative indicators would expose just how poorly environmental issues are being managed!

3.8 Qualitative "Contributor" Measures

BiE and KPMG (1992) explain that "While measures of environmental impact performance constitute the 'bottom line', information on where or how to improve performance is often more likely to be gained by identifying and measuring performance in contributor areas or activities." Contributor measures are especially important in implementing environmental management systems and are of particular importance in identifying sources of poor performance and managing strategies for change. BiE and KPMG (1992) illustrate that contributor measures shift the emphasis from impact measures alone and help in addressing the underlying drivers of performance. To use an analogy from pollution control, it shifts the emphasis from 'end of pipe' considerations towards 'cleaner technology'. The Lucas HS&E department's first foray into the field of environmental performance measurement was by auditing management systems and expressing the performance as a percentage of full implementation. The Department was convinced that good management practice would produce good environmental performance, although they had no way of proving it at the time. The lessons of total quality, such as the systems approach (every action taken in the light of the whole), teamwork, training, communication, participation and never-ending improvement (Wille, 1992) were considered to be essential elements for total quality environmental management and used as a yardstick of good management practice.

Thor (1993) encourages us by saying "Just because you can't measure something exactly, doesn't mean it should not be measured. Many measures will be opinion and subjective views." He goes on to cite two ancient laws:

- It is better to be approximately right than precisely wrong
- In determining progress, consistency is more important than accuracy."

So, qualitative measures are an important part of measuring environmental performance and as the Macnamara fallacy (section 3.3.) highlights it would be foolish to ignore things just because they cannot be measured easily. However, to ensure a complete picture of environmental performance, qualitative and quantitative measures must be used in tandem to reinforce and support each other.

3.9 What makes a good EPI?

Although Anderson (1991) is discussing economic indicators, the characteristics of a good indicator, which he describes, are also applicable within industry:

- An indicator does <u>not</u> have to have automatic evaluation e.g. increase is good
- An indicator should <u>not</u> correspond to a political instrument i.e. requires easy action
- An indicator does <u>not</u> have to be new
- An indicator should <u>not</u> be based on assumptions that something is true or false.

He then goes on to describe seven criteria for good indicators:

1. They should be readily available - easily and cheaply
2. They should be relatively easy to understand (seem real and significant, i.e. represent a "fact")
3. They should be about something measurable
4. They should measure something believed to be important in its own right
5. There should be a short time lag between the state of affairs and the availability of the indicator (to give early warning)
6. They should be based on information which can be used to compare different groups, so that distribution can be shown.
7. They should be comparable (e.g. in different countries)

In addition, indicators should focus on priorities (not everything can, or should, be measured).

Caplice and Sheffi (1994) define the following eight criteria for evaluation of metrics:

Criterion	Description
Validity	The metric accurately captures the events and activities being measured and controls for any exogenous factors.
Robustness	The metric is interpreted similarly by the users, is comparable across time, location and organisations, and is repeatable.
Usefulness	The metric is readily understandable by the decision maker and provides a guide for action to be taken.
Integration	The metric includes all relevant aspects of the process and promotes co-ordination across functions and divisions
Economy	The benefits of using the metric outweigh the costs of data collection, analysis and reporting.
Compatibility	The metric is compatible with the existing information, material and cash flows and systems in the organisation
Level of Detail	The metric provides a sufficient degree of granularity or aggregation for the user
Behavioural Soundness	The metric minimises incentives for counter-productive acts or game-playing and is presented in a useful form.

Although these criteria are all laudable, there will be many trade-offs resulting in the fact that a single metric cannot achieve all of the desired characteristics. In practice, a company like LucasVarity would be more comfortable with a much shorter list of recommendations, such as that provided by BiE and KPMG (1992:

- Consistent with policy and corporate objectives
- Not too many
- Simple and understandable
- Appropriate for users.

A simple and straightforward approach is more likely to gain acceptance across a large diverse business, and is more able to be interpreted in such a way as to accommodate the variability present in such an organisation.

3.10 The Process

The relevant literature about Environmental performance Indicators (EPIs), Environmental Performance Evaluation (EPE) and Environmental Performance Measurement, all describe relatively simple processes, some of which are outlined below.

BSi (1997) describes its environmental performance evaluation (EPE) as "an ongoing internal management process and tool that uses indicators to convey information comparing an organisation's past and present environmental performance with its environmental performance criteria." The process of EPE includes:

- selecting (e.g., developing or choosing) indicators for EPE;
- measuring (e.g., collecting data);

- analysing and converting data into information describing the organisation's environmental performance;
- assessing information describing the organisation's environmental performance in comparison with the organisation's environmental performance criteria (objectives and targets);
- reporting and communicating information describing the organisation's environmental performance; and reviewing and improving the EPE process.

BSi (1997) provide some "Practical help boxes". I have compared this one to the process that was carried out at Lucas/LucasVarity:

BSI steps	**LucasVarity**
a) Identify activities, products & services of the organisations operations, the specific environmental aspects associated with those activities, products & services, and the type of impact related to each environmental impact.	Through auditing the company's operating facilities, the HS&E department was able to broadly identify the activities which were felt to have a significant impact on the environment. No quantitative data was collected at this stage.
b) use information about the condition of the environment to identify activities, products & services or the organisation that may have an impact on specific conditions,	Ground contamination was known to be a problem particularly in the USA, where expensive clean-ups had been carried out. There had also been a couple of incidents in the UK, identified by neighbours' complaints. A graduate geologist carried out an UK-wide site vulnerability study and a Risk Assessment technique was developed for assessing the risk of land contamination and the potential for harm due to local environmental conditions.
c) Analyse the organisations existing data on material and energy inputs, discharges wastes and emissions and assess these data in terms of risk.	This process started in 1994 with the "Commitments to Progress". Businesses were asked, among other things, to measure and reduce energy and water by 10% and to understand their environmental impacts. At corporate level a clear picture was not available and the need for a coherent cross-company system for collecting and assessing data was recognised (hence the Eng.D. project). This system has yet to be implemented company-wide.
d) Identify the views of interested parties and use this information to help establish the organisations significant environmental aspects.	No stakeholder analysis was carried out, except a compilation of customers' environmental requirements, taken from product specifications and questionnaires.

e) Identify environmental activities of the organisation that are regulated, for which data have likely been collected by the organisation.	Compliance was checked through the audit process. A register of all EPA authorised processes was compiled. In addition all new legislation was disseminated, with guidelines, through the HS&E department.
f) Consider the design, development, manufacturing, distribution, servicing, use, re-use, recycling and disposal of the organisations products.	A separate "Design for the Environment" Eng.D. project was set up to address this issue.
g) Identify those activities of the organisation with the most significant environmental costs, benefits or other financial effects.	Anecdotal evidence was collected through the audit process and from personal contact with businesses. However, hard evidence was never compiled. The size of environment-related costs was estimated following the Measures of Performance Pilot Study.

Bennett and James (1994a) state that "the scale of the challenge is such that even the simplest measures are better than nothing at all. Immediate action of almost any kind can signal a serious intention to the world, make some reduction of environmental impacts, reduce risks of negative reactions by regulators, customers and stakeholders and provide a platform for further action. The overriding necessity is to begin the process of continuous improvement of environmental performance".

Although LucasVarity's approach has been evolutionary rather than planned, in retrospect it has followed a somewhat similar approach to that defined by Bennett and James (1994a). The following table, compares the steps that Lucas initially took towards environmental performance measurement, with the eight key stages defined by Bennett and James (1994a)

Eight key stages:	**Lucas steps taken:**
Define environmental context & objectives	HS&E Department set up (1991) and Policy written (1992). Review programme devised to compare businesses to policy.
Identify potential measures	Policy requirements, results of HS&E Reviews (1992-1993) and review of claims and compliance issues.
Select measures	Environmental areas highlighted for measurement were: elimination of Ozone Depleting Substances (ODS), compilation of an inventory of environmental impacts, preparation of a waste map and reduction of energy and water consumption, for each business.
Set targets	By the end of 1994: eliminate ODS, compile an inventory of environmental impacts, prepare a waste map and reduce energy and water consumption by 10% (compared to 1993).
Implement Measures	Above "Commitments to Progress" were communicated to all businesses early in 1994.
Monitor and communicate results	Progress monitored quarterly by return of progress chart to Group HS&E. Results reviewed at Group HS&E Committee

Act on results	Guidelines written to help businesses having difficulty in meeting targets and practical help provided where needed.
Review	STRENGTHS: Targets had the desired effect of causing businesses to focus on HS&E issues. WEAKNESSES: Timescales were not realistic for all businesses. Targets were not separated into "must do" and "should do". % Progress towards target reported rather than actual figures. OPPORTUNITIES: Good response to target concept therefore foundation for future measurement. Set objectives at group level and allow businesses to set timescale targets. THREATS: Lack of follow-up could de-motivate and lose credibility. Measures must be simple, relevant and useful.

Whilst all the methodologies outline what steps to take, what appears to be missing from these methodologies is any advice on how to go about. About as useful as a recipe that gives you the ingredients but no further instructions. Probably the instructions are just too difficult to write for such a potentially large and diverse audience, but some practical advice and examples could be given, which users could then adapt for their own purposes. Over the next two years I intend to write some guidelines which would lead an engineering business through the process of developing and implementing environmental measures of performance.

3.11 Future Trends

Birchard (1996) identifies the following trends in "Green Measures":

- Normalising – Assuring year-to-year comparability of figures by adjusting them for changes in revenue or production.
- Standardising – furthering cross-industry comparability by adopting standard measures.
- Materials Accounting – reporting inputs as well as outputs of raw materials, energy, water.
- Monetising – translating quantitative measures into financial ones
- Auditing – retaining outside auditors to certify the integrity of measures.

IBM, in its "Consulting the Stakeholders" report (1995), has adopted a forward looking and much braver approach by asking Stakeholders their opinions on what the company's environmental priorities should be. I am sure that other companies will soon start to follow this approach too. Commitment in LucasVarity has not been at a sufficiently high level to dream of taking such a brave step. The Group HS&E Department has largely driven the environmental agenda and the development of Environmental Measures of Performance (EMOPs). Whilst Environmental issues are reported to senior directors via the HS&E Committee, Senior Management have not truly embraced the environment as part of business strategy.

I can see all of the above happening, plus stakeholders will demand better quality and more diverse information from businesses. Companies will continue to be judged publicly through cross-company comparisons such as the FTSE100 Environmental Performance Index and KPMG's International Survey of Environmental Reporting and investors will start to take notice of those who continually come top, or bottom!

3.12 Towards Sustainable Development?

Authors such as Welford have written at length about Sustainable Development and what it would mean to businesses. In his paper "Measuring Sustainability in Business" (1996) he lists several pages of measures that he believes a business should put in place in order to achieve sustainable development. This type of thinking is still too radical for a traditional company like LucasVarity. The real crux may be that it would shake the whole foundation of the business – that of supplying components for motor vehicles – if they were to consider true sustainable development. It would mean evaluating the role of the car and the whole personal transport question. I believe the company should start to consider its long-term future seriously, but it has an unwritten policy of not sticking its neck out too far. In the past Lucas has been burnt by projects that were ahead of their time, such as development of the electric vehicle, which begun in the 1960's. The market was not ready and the project was a commercial failure, so Lucas gave up its share of the project to concentrate on more commercial technology.

The company's approach so far has been to comply with environmental legislation and move towards improving efficiency and implementing best practice management systems, at a speed that does not interrupt the other business activities. With the HS&E Department now disbanded, following the company merger, it remains to be seen whether the businesses will grasp the environmental nettle, if there is no corporate pathfinder to lead the way. Unless a senior environmental champion stands up to take the lead, I believe the company will continue to drag its feet. That aside, a few of the individual businesses are well motivated and have senior management who have been transformed by their own paradigm shift to lead the way in environmental management. Perhaps divesting the responsibility to the businesses is the right approach – the only way to find out is to measure their environmental performance!

If management were brave enough to take the Environmental Bull by the horns and address the real strategic issues, it would demand a radical rethink but it could result in innovative changes (Porter 1985, 1995). A real example at one of the Lucas Braking businesses occurred when the site realised it had to register its solvent paint plant as a prescribed process under the Environmental Protection Act. To meet the emission requirements demanded by the authorisation would have necessitated expensive, end-of-pipe modifications to the existing plant. The process engineers decided to look at other options including the possibility of installing a brand new plant for water-based paint. This option turned out to be cheaper that retrofitting the existing process. In addition it eliminated the solvent emissions, making the authorisation unnecessary. Added benefits were that it was much cheaper to run in terms of energy, less paint was used on the product and less was wasted in the process and operators did not have to be protected from solvent fumes. Typically, though the evidence is all anecdotal, since no systems existed to record the environmental or financial benefits for posterity.

4 Work carried out to date: Year 1 & 2

(Oct 94 to Sept 97 – including 12 months maternity leave)

4.1 Thesis

"A robust set of Environmental Performance Indicators can be developed and implemented in a large diverse industry which will enable:

- situations to be understood
- informed decisions to be made
- progress to be described"

4.2 Work carried out:

4.2.1 Implementing Management Systems (including performance measurement)

HS&E Auditing

HS&E Auditing has been carried out since 1992. As a Team Leader for European and North American audits, I was responsible for interviewing site management and co-ordinating the specialist members of the audit team, compiling the report, drawing up overall recommendations and feeding back to the sites.

In October 1995, Lucas sites in the UK were due to be audited for the 2nd time. The second phase audit process gave us an opportunity to review and update the process. The following changes were incorporated:

- The business was asked to present, to the audit team, the progress that they had made since the first audit,
- The business would be benchmarked against the Lucas HS&E Standards (see below) - this necessitated a change in the way that performance was measured,
- Reports would be shorter,
- There would be more follow-up to ensure that the business prepared a realistic action plan to meet it's own objectives.

It was my job to devise a different performance measuring system. To this end I prepared a "GEMI" type assessment sheet for each of the first four management standards and the first Environmental, Safety and Health standards. These result in a percentage measure showing a business' progress towards implementation of the HS&E standards (Management Systems). I also developed the new audit report format (see 18-month progress report) and carried out a number of second-phase audits.

In 1995 the Chief Executive agreed that the businesses should aim to achieve 80% compliance with the Standards by July 1998. In order to measure the progress towards 80% compliance an Assessment system was developed for the seven key Standards:

M1 - Policy, Objectives and Targets
M2 - Organisational Arrangements
M3 - Operational Management Systems
M4 - Self-Assessment and Audit Systems

E1 - Environmental Protection Programme

S1 - Risk Elimination and Control Programmes

H1 - Occupational Health Programmes

The assessment system I developed was originally intended for use by the audit team only but has now been distributed for all Lucas businesses to use as a Self-Assessment System (SAS) in the intervening period between audits (see 18-month progress report). The Group audit assessment results will however take precedent over any self-assessed results.

Handbook of Management Standards

In 1994/95, the Lucas HS&E Department developed a Handbook containing Management Standards. I wrote the Environmental Standards plus I contributed to the Management Standards and overall handbook concept (see 6- month progress report).

The standards:

⇒ Were based on best practice and the lessons learnt during the review Programme.

⇒ Are a set of simple statements of HS&E management principles.

⇒ Translate the Lucas Policy into basic aims for management to achieve best practice management of HS&E.

⇒ Establish the minimum requirements (arrangement and systems) to be met to achieve the aims.

⇒ Are divided into four sections: management systems, environment, safety and health.

⇒ Will be regularly reviewed and updated as and when required.

The Lucas Management Standards define business requirements for successful management of HS&E. These requirements were compared to the requirements of the following International Environmental Management Systems:

- The European union's Eco-Management and Auditing Scheme Regulations (EMAS)
- The International Standard Organisation's standard for Environmental Management Systems (ISO 14001)
- The British Standards Institute standard for Environmental Management (BS7750)
- Principles of the International Chamber of Commerce Charter for Sustainable Development.

In order to implement the Handbook and Standards I made presentations to business management teams in the UK, France, Germany and Spain and I helped in the project management and review of progress for businesses implementing the standards.

The Management Standards are "measurable" in that performance expectations are listed for each standard and there will be some physical evidence (documentation, testimony) that the standard has been implemented. The standards can therefore be used to audit against (see HS&E auditing, above).

Management Guidelines

To help businesses to implement the standards, management guidelines were written. I wrote the environmental guidelines plus contributed to the overall guideline concept and format (see 6-month progress report).

Environmental Measures Of Performance.

Following the "Commitments to Progress", which were Group targets set in 1994, a proposed set of HS&E measures were tabled at the Group HS&E Committee.

I proposed the initial Business Environmental Measures and have helped to develop the Management Systems, Review Programme and Competence Measures.

Following discussion at the Group HS&E Committee I prepared an explanatory document on the proposed HS&E Measures of Performance (See 12 month progress report). This explanation was circulated to selected businesses for comment.

It was decided to trial the system before implementation company-wide. Six pilot sites were chosen (5 in UK, 1 in Germany) to trial the MOPs. These sites were known to be well managed and would therefore stand a good chance of being able to supply the data. The sites were provided with a Pro-forma for the results (see 18-month progress report) and supplied their 1995/96 data in August 1996. Results were analysed, and discrepancies followed up. Financial information obtained, showed that environment-related costs were not insignificant and should be considered as a more serious business issue. In March 97 (delayed due to business re-organisation), a workshop was held to present the findings back to the businesses involved. (See company report: "Group HS&E Measures of Performance: Results of Pilot Study", 11th March 1997, and 1997 Eng.D. conference paper "A Measure of Success?" in Appendices T and U). All the businesses agreed that it had been a useful exercise and volunteered to carry on with the measures, whatever the decision made at the Group Committee. The results were then communicated to the newly formed Group HS&E Committee who agreed that the measures should be simplified into a list of 10 and prepared for Group-wide implementation.

EMS Implementation - Project Management

To aid implementation of EMS at selected Lucas businesses, 8 MSc students were taken on over the summer period to work on site projects. I developed objectives for the projects, liaised with site management and kept a watching brief over project progress.

Through a Teaching Company Scheme, I managed three Teaching Company Associates who worked on the development of Environmental Registers and Significant Effects at various Lucas businesses. This work has culminated in guidelines, training material and case study material.

4.2.2 Environmental Awareness and Communications

Environmental Training

I organised and project managed an Environmental Seminar to raise awareness of Lucas managers, entitled "Integration of Environmental Issues into Business Management". Approximately 100 people attended it.

I prepared material, gave presentations and acted as a group facilitator during syndicate sessions, at

- a training and strategy-planning workshop, held in Blois, France for Engineers at Lucas Diesel systems.
- a three-day seminar held in Williamsburg, Virginia, for 50 managers from USA businesses.

Newsletters

I wrote the "Green Page" and Energy Page" for the bi-monthly HS&E Newsletter which was prepared by the HS&E department and sent to over 300 managers and HS&E specialists throughout the businesses.

Literature Search

I carried out literature search to raise my own awareness of current thinking on Environmental Performance Indicators. Much of my material is based on books, publications and company material that I receive through contacts that I have made in other companies and organisations.

Environmental Tool for Purchasing / Supplier Quality Auditors

Following a successful awareness presentation to Senior Purchasing Managers in 1994, and two trial supplier audits, I was asked to develop a simple environmental auditing tool for Supplier Quality Auditors to use. The intention being that they would be able to assess the first tell-tale signs of poor environmental performance at suppliers and hence take action to reduce the associated risks.

I prepared a simple protocol for use by Supplier Quality Auditors, along with training material. (see 12-month progress report). This will allow Quality Auditors to assess the environmental performance of Suppliers based on a visual inspection assessment. Any supplier identified as "High Risk" would then be subjected to a full Environmental Audit.

Management Significance Exercise.

Following presentation of the Lucas HS&E Management Standards, several business teams have asked for guidance on how to start the implementation.

I developed a simple exercise to carry out with business management teams, to help them focus on the HS&E issues and assess their significance to the business and how they should be managed. This has been tried out with several groups and has been a helpful exercise both in raising awareness and helping teams to quickly focus and plan their activities (see 12-month progress report).

Summary of Research Work to date (what I have achieved)

I have helped to develop and refine the HS&E audit system, which has been used extensively, worldwide. I was instrumental in the development and implementation of the HS&E Standards, which define the requirements of the LucasVarity HS&E management system. They have been delivered to all businesses in the Group and are used as a basis for environmental auditing and self-assessment. Guidelines and training were also developed to help businesses to implement the standards, as well as an easy-to-use self-assessment and auditing tool. I developed the Environmental Measures of Performance, which were piloted in six Lucas businesses, and recommended changes for the future. I designed a simple audit tool for supplier quality auditors and a management significance methodology, which can be used by management teams for team building and focusing on HS&E issues.

On a personal level, I have developed as an environmental auditor (registered with EARA) and team leader. As a programme manager, I have managed and co-ordinated company-wide programmes and site-based projects. I have developed and tested workable methodologies and I have improved my presentation and communication skills. My knowledge of environmental performance management has increased greatly through the literature that I have read, although I recognise that this is far from complete and will in fact be an ongoing task.

4.2.3 Personal Development

Associate Membership of Institute of Environmental Management.

Because I have no formal environmental qualifications, I opted to take an exam, set by the Institute of Environmental Management, in order to gain Associate Membership of the Institute. This was submitted to my portfolio as a first year elective (see 12-month progress report).

I answered the assessment paper in June 1995 and as a result became an Associate Member in September 1995. I am now entitled to use the letters AMIEMgt after my name.

Seminars and Courses Attended (in addition to Eng.D. courses):

- 1 day seminar on Environmental Reporting, at Dragon Consultants, London (26 Sept. 1995).
- 2-day course on Environmental Auditing, hosted by Arthur D Little, Brussels. (25-26 Oct. 1995)
- 2-day course (of 1 week MSc Environmental Management Module), on Environmental Accounting, Performance Measurement and Reporting at Brunel Management Centre (16-17 Nov. 1995). This course was taken as an Elective Module and culminated in an assignment and exam in January 1996.

- On 13 December 1995 I presented the "Practicalities of Auditing - the Do's and Don'ts" at the Midlands Group Meeting of the Institute of Environmental Management. (see 18-month progress report).

5 Further Work:

- Benchmarking work to date has focussed on assessing other companies' attributes (e.g. policy, audit programme). This information was non-quantitative, in the public domain, easily accessible and not commercially sensitive, therefore companies were willing to share it. However, it doesn't indicate quality or effectiveness of environmental programmes. In the immediate future, my research will focus on examining the role of quantitative performance measurement in achieving actual environmental improvements. I intend to analyse a selection of the latest Environmental Reports and surveys (1996/1997), using a methodology similar to that employed by Azzone and Manzini (1993), to see what types of measures are being used now and what the latest developments have been. I also intend to evaluate the robustness of the systems adopted, i.e. are the metrics interpreted similarly by the users, are they comparable across time, location and organisations, and are they repeatable? This will be a useful guide to anyone wanting to put together an environmental report or designing an environmental performance system. This work will be constrained by using environmental reports, which are in the public domain and may not present a true and objective picture of each company's actual performance.
- Using the above as a benchmark, I will assess whether LucasVarity has the right set of measures to satisfy all its stakeholders (as outlined by James and Bennett 1993 and compared to the IBM approach). This will help the company to decide if it wishes to present an external environmental report and if so, which of its stakeholders it is likely to please.
- Sustainability Measures have been put forward by the likes of Welford and Jones (1994). I want to contemplate whether current actions (as described in environmental reports) are likely to satisfy the ultimate long-term goal of sustainable development. If not, what else is needed, and is sustainability a realistic aim?
- I will interview key personnel in order to understand how the Balanced Scorecard system works at LucasVarity and assess whether Environmental Performance Indicators can be integrated into the system.
- In order to help businesses considering environmental performance measurement for the first time, or wishing to review their current system, I aim to develop a methodology, consisting of a flowchart, which will guide people through the EPI decision process, taking into account their own business constraints. If time and opportunities allow I will try out the methodology at other companies, in order to ascertain whether an adaptable, generic process can achieve the required results in companies with different cultures and modes of operation.
- I will consider the environmental indicators required at different levels within the company, i.e. for each business process, at business unit and at group level and show how they link with each other and map onto the overall business objectives. This will help business units to translate corporate objectives into local action.

- I intend to analyse the results returned from the Company-wide Measures of Performance (due at the end of 1998) and draw conclusions based on the data and the process so that improvements can be made.

Whilst the first two years of my research has been largely dominated by my industrial work, I intend to expand the academic side in the next two years, widening the scope and putting my research into a more general industrial context. Further literature will be sought to aid in the accomplishment of the above and at least two papers will be submitted to journals. Refer to Appendix S for timing plan for years 3 and 4.

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30 Month Report

Nicolette Lawson
Eng. D Year 3

April 1998

30-Month Report
Year 3

"The Development and Implementation of Environmental Performance Indicators into Industrial Management Systems"

Contents

Discussion

Feedback from the 24-month Dissertation and Viva presented in October 1997 has refocused the remainder of this Eng.D. project.

The Examiners recommendations were as follows:

- Extend reading to cover Management Science Literature in order to find out where my work fits in and what style I should write in.
- Focus the remainder of the work on that required to complete the Thesis, obtain further empirical evidence and ensure that the methodology is nomothetic (not restricted to LucasVarity).

The following section therefore reassesses the goals and objectives outlined in the 24-month report and redefines the extent of the future work.

Overall Goals and Objectives of the 4 year research programme

24-month Dissertation	Current status and future work
• To design, develop and implement a workable system for measuring Corporate Environmental Performance in a large diverse business, using LucasVarity plc as an example. To evaluate the effectiveness of the system and the impact of company culture and constraints on the design of the system, and recommend future improvements. To assess whether LucasVarity has the right set of measures to satisfy all its stakeholders and sufficient information to deliver an external environmental report.	⇒ The implementation of this work is in progress. ⇒ Evaluation of the effectiveness of the system will be completed during 1998 and into 1999, as more data is received from the LucasVarity businesses. ⇒ Assessment of the LucasVarity set of measures will be completed following assessment of Corporate Environmental Reports (see below).
• To review how Environmental Performance is measured generally in industry, but specifically in large, diverse corporations. To analyse a selection of the latest Environmental Reports (1996/1997) and surveys, evaluate the types of measures now being used and review the latest developments. Also to evaluate the robustness of the systems adopted, i.e. are the metrics interpreted similarly by the users, are they comparable across time, location and organisations, and are they repeatable.	⇒ This work will still be carried out and is essential for the EPE Methodology (see below). ⇒ An analysis of the FTSE100 Survey "Environmental Engagement" can be found in the "**Literature**" Section.
• To develop a decision-making methodology for Environmental Performance Evaluation in LucasVarity. This may also be tested at other companies (if time and opportunities allow).	⇒ This will be the main focus of the remaining work and will be tested in at least one other organisation. Ideas for this methodology are explained later in the section headed "**EPE Methodology**".

• To assess the extent to which the EPIs contribute to measures of Sustainability.	⇒ Examiners recommended <u>no further work</u> in this area, since it was considered to be a distraction from the main thrust of the thesis.

Contributions to knowledge

24-month Dissertation	Current status and future work
• A critical evaluation of the current methods of measuring performance in large diverse businesses.	⇒ This will be achieved through analysis of the relevant literature. Scope to be extended to cover Management Science.
• An understanding of the effect of cultural barriers and business constraints on the implementation of Environmental Performance Measurement in large businesses.	⇒ This will be based on the experience gained from working within a large corporation and an analysis of Management literature (particularly concerning Change Management, corporate culture, motivation and other related areas).
• Contemplation on the relationship between Sustainable Development and current corporate objectives.	⇒ Examiners recommended <u>no further work</u> in this area, since it was considered to be a distraction from the main thrust of the thesis.

Methodological approaches used/to be used

24-month Dissertation	Current status and future work
• Benchmarking to evaluate other companies' approaches and theories proposed through literature.	⇒ This will be achieved through analysis of the relevant literature.
• Design, review and development of measurement system, trial implementation (pilot study), analysis of results and evaluation of process. This will necessitate a largely retroactive (trial and error) and interactive approach.	⇒ A retroactive approach has been used to date to develop the LucasVarity systems. ⇒ A systematic methodology will be devised, based on past experience and best practice obtained from the relevant literature. ⇒ This will be tested with at least one other organisation. ⇒ See section headed "**EPE Methodology**".

• Amendment of proposal and implementation company-wide. A proactive approach will be required to raise awareness and monitor implementation of the system.	⇒ Company-wide implementation has commenced. ⇒ Analysis of the data and a critique of the system will be carried out over 1998 and 1999 as quarterly data is received from the LucasVarity businesses.

Revised titles, and target journals, for papers to be submitted by the end of the project

Title	Actual /Provisional	Journal
"Environmental Performance Indicators in management systems"	Actual (in July 97 EMA conference proceedings – not yet submitted to the journal)	Eco-Management and Auditing (EMA) (ERP Environment & Wiley)
"Measuring Environmental Performance is Business Strategy"	Provisional	Business Strategy and the Environment (ERP Environment & Wiley)
"Measuring Environmental Performance – A Methodology"	Provisional	Business Strategy and the Environment (ERP Environment & Wiley)
"Have Engineering Companies missed the Environmental Boat?"	Provisional	Professional Engineering (Mechanical Engineering Publications)

Further Work:

24-month Dissertation	Current status & future work
• In the immediate future, my research will focus on examining the role of quantitative performance measurement in achieving actual environmental improvements. I intend to analyse a selection of the latest Environmental Reports and surveys (1996/1997), using a methodology similar to that employed by Azzone and Manzini (1993), to see what types of measures are being used now and what the latest developments have been. I also intend to evaluate the robustness of the systems adopted, i.e. are the metrics interpreted similarly by the users, are they comparable across time, location and organisations, and are they repeatable? This will be a useful guide to anyone wanting to put together an environmental report or designing an environmental performance system. This work will be constrained by using environmental reports, which are in the public domain and may not present a true	⇒ There is limited progress to report in this area. See the **"Literature"** section. ⇒ This work will be completed during the next six months.

and objective picture of each company's actual performance.	
• Using the above as a benchmark, I will assess whether LucasVarity has the right set of measures to satisfy all its stakeholders (as outlined by James and Bennett 1993 and compared to the IBM approach). This will help the company to decide if it wishes to present an external environmental report and if so, which of its stakeholders it is likely to please.	⇒ This work will follow the analysis of Environmental Reports and surveys (above).
• Sustainability Measures have been put forward by the likes of Welford and Jones (1994). I want to contemplate whether current actions (as described in environmental reports) are likely to satisfy the ultimate long-term goal of sustainable development. If not, what else is needed, and is sustainability a realistic aim?	⇒ This work was considered too ambitious to complete in the doctoral timescale and will therefore be omitted.
• I will interview key personnel in order to understand how the Balanced Scorecard system works at LucasVarity and assess whether Environmental Performance Indicators can be integrated into the system.	⇒ An attempt has been made to incorporate Environmental Performance indicators into the Balanced Scorecard system at Lucas Aerospace. This is explained in the **"Work Completed"** section.
• In order to help businesses considering environmental performance measurement for the first time, or wishing to review their current system, I aim to develop a methodology, consisting of a flowchart, which will guide people through the EPI decision process, taking into account their own business constraints. If time and opportunities allow I will try out the methodology at other companies, in order to ascertain whether an adaptable, generic process can achieve the required results in companies with different cultures and modes of operation.	⇒ This will be the <u>main focus</u> of the remaining work and will be tested in at least one other organisation. ⇒ Ideas for this methodology are explained later in the section headed **"EPE Methodology"**.
• I will consider the environmental indicators required at different levels within the company, i.e. for each business process, at business unit and at group level and show how they link with each other and map onto the overall business objectives. This will help business units to translate corporate objectives into local action.	⇒ This work will be completed if time allows.
• I intend to analyse the results returned from the Company-wide Measures of Performance (due at the end of 1998) and draw conclusions based on the data and the process so that improvements can be made.	⇒ The Performance Measurement system was introduced in January 1998 and data will be submitted quarterly, starting April 1998. I will be compiling and analysing the data for

	one division (Lucas Aerospace) and commenting on the data aggregation at LucasVarity Corporate Level.

A revised timing plan for years 3 and 4 is included in Appendix W.

Work Completed since October 1997:

A) Management Systems – Lucas Aerospace

Work for the Lucas Aerospace HS&E Manager to introduce Health, Safety and Environmental management systems has included implementation of the following Performance Measurement systems.

- Self-Assessment System

  The Self-Assessment System, originally developed in 1995 (see 18-month report) to measure the progress towards implementation of the company HS&E standards, was re-introduced to the Lucas Aerospace companies in 1997 and self-assessments were completed by all 21 companies world-wide during November and December 1997. The Self-Assessment was conducted in accordance with the LucasVarity HS&E Handbook (August 1997 version) and covered the seven key Standards:

  M1 - Policy, Objectives and Targets
  M2 - Organisational Arrangements
  M3 - Operational Management Systems
  M4 - Self-Assessment and Audit Systems
  E1 - Environmental Protection Programme
  S1 - Risk Elimination and Control Programmes
  H1 - Occupational Health Programmes

  Each of the standards has up to nine measurements. No external verification of the scores took place other than ensuring that all scores of 95% or greater were supportable.

  Results fall into 5 categories:

Poor:	0-20%
Minimalist:	21-40%
Starter:	41-60%
Good:	61-80%
Best Practice:	81-100%

  Appendix X contains graphs of the results.

  Summary of Results:

  - Four sites assessed themselves to be in the Best Practice (80-100%) score range. Although this was an average score, with some Standards scoring below 80%.
  - The overall average score for all Aerospace businesses was 59% (at the upper end of the "Starter" category). This is a fair overall view as my own perception is that, on average, businesses are beginning to implement management systems, albeit rather inconsistently.
  - Regional averages were: Far East 44%, Europe 59%, and North America 69%. It is not certain whether the score differentials are due to actual performance or a different self-perception of performance which is linked to

national characteristics and cultural differences. Further investigation will clarify this result.

- Of the three disciplines, (Health, Safety and Environment) Environment scored the lowest and Safety the highest, although the actual differential was small. This is probably due to the fact that environmental management is still relatively new compared to safety.
- The worst average scores were shared by the requirements for "Project Plans" (standard M3, requirement 3), where it is apparent that HS&E changes are not managed in the same way as other improvement initiatives and "Environmental Protection Programmes" (standard E1, requirement 1). This was a suspected area of weakness, implying that a systematic approach to environmental protection is still not being applied.
- All sites have now submitted improvement plans to get their average scores to at least 80% by the end of 1998.

Conclusions

- There are pockets of best practice in the Division which can be used to help improvement of the under performers.
- The wide variance in scores demonstrates a lack of communication, co-ordination and sharing of problems and solutions across the businesses.
- Generally, the sites operate at a sufficient level to ensure compliance, but do not seek to be much better.
- The self-assessment scores illustrate where certain resources and expertise are needed and which sites are capable of providing it.

Self-Assessment Scores will be reassessed on a six-monthly basis to ensure that there is a general improvement in performance.

The pro's and con's of self-assessment are well understood. Although the scores are subject to local variances due to misinterpretation, over-optimism or pessimism, at least it is a quick and cost-effective way to obtain some level of assessment, and after all "It is better to be approximately right than precisely wrong" (Thor 1993).

(See also "The Index of Corporate Environmental Engagement - A Survey of the FTSE 100 Companies" in the **Literature** section.)

- <u>Measures of Performance</u>

  The HS&E Measures of Performance System, piloted in 1996 (see 24 month Dissertation for report) was revised and introduced to the Lucas Aerospace companies in Autumn 1997. A copy of the revised proforma and explanatory notes is included in Appendix Y. The businesses will be reporting back on a quarterly basis starting in April 1998 (results for January, February and March 1998). The results will be analysed and compiled for each division and then aggregated to give LucasVarity corporate results, which will be presented to the Group HS&E Committee in early May 1998.

In order to tie in with the Business' "Balanced Scorecard" (Kaplan & Norton 1995), of goals and measures, the chosen HS&E measures were grouped into the four Balanced Scorecard categories: Financial, Customer, Internal Business and Innovation and Learning.

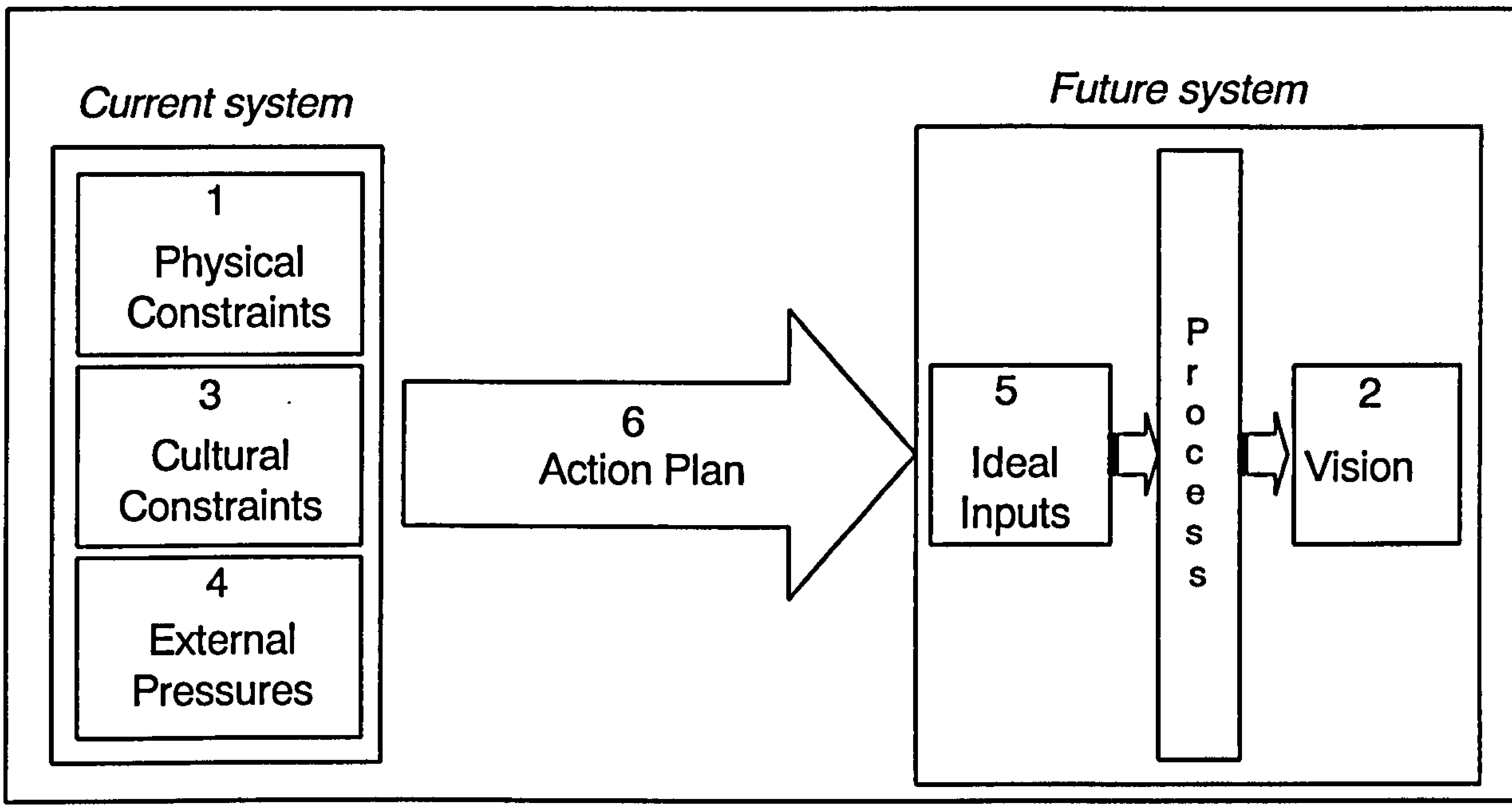
HS&E & the Balanced Scorecard

Category	Business Goals	HS&E Measures	Notes
Financial	Produce Superior and sustainable returns for our stakeholders	• Cost of resources & waste • Fines • Clean-up costs	Environmental improvements can result in direct financial savings or avoidance of unintentional costs (fines, clean-up, legal fees) that are incurred due to an environmental incident.
Customer	Delight our customers	• Hazardous Substances • Incidents (non-compliance)	Customers are increasingly concerned by the risks that may be encountered due to their suppliers' mismanagement. The amount of hazardous substances used and the number of incidents of non-compliance are an indicator of the potential size of that risk.
Internal business	Operational Excellence	• Self-Assessment Scores • Emissions • Waste • Resources	Good management and efficiency demonstrate operational excellence. Environmental efficiency in this case is measured by material losses such as emissions, waste and consumption of resources. Good management is indicated by the improvement in the implementation of the company's HS&E Standards (measured by self-assessment)
Innovation & Learning	Industry Leadership Develop & reward our people	• H&S Performance • HS&E Training	Enlightened companies realise that they must invest in and look after their most critical resource - their people. The co-operation and involvement of all employees is also an essential ingredient in successful environmental management. To this end, the health and welfare of employees is monitored and the amount of HS&E training that is given.

These measures are represented diagrammatically on the front page of the HS&E Measures of Performance Proforma (Appendix Y).

B) EPE Methodology

The following diagram and table explains the structure of the Environmental Performance Evaluation (EPE) Methodology that I will be developing. I see this being implemented through a series of workshops with business management and key personnel, to obtain the relevant business-specific information needed to feed into the models. The models themselves must contain generic information about current best practice (this is where my literature survey and analysis of company reports comes in). Each stage of the methodology will be based on models that have been tried and tested at LucasVarity.



Stage	Model/Method	Generic Input to develop model	Specific Input needed
1. PHYSICAL CONSTRAINTS What does the company have in place now? • Systems • Infrastructure • Technology • Organisation • Information • etc	Audit via protocol type form	What is seen as best practice (used to measure against) – analysis of best practice environmental reports etc.	Management knowledge of organisation
2. VISION What would they like to achieve?	Describe a vision of the future.	Use SAS[1] format to suggest various levels of commitment.	Company goals and objectives, drivers

[1] Self-Assessment System (as explained in previous section)

Stage	Model/Method	Generic input to develop model	Specific input needed
3. CULTURAL CONSTRAINTS What is the company culture?	Protocol to suggest high, medium or low risk strategy	Use SAS format to suggest various types of culture.	Review of projects, achievements, what has worked or not
4. EXTERNAL PRESSURES Stakeholder Analysis	Adaptation of "Management Significance" tool	Blank tables and "Boston" Matrix	What are the business' environmental issues? What pressures are there on the business to address them?
5. IDEAL SYSTEM Identification of measurement system requirements	Input/Output analysis - to identify ideal inputs & process required to achieve desired outputs	What is seen as best practice – analysis of best practice environmental reports and surveys.	
6. ACTION PLAN	Gap Analysis – how to get from current systems to ideal		Business constraints (time, money, human resources)

In order to progress with the methodology, the main task will be an analysis of corporate environmental reports and surveys. This will be carried out over the next six months.

The following section comments on an important annual environmental survey of FTSE 100 companies.

C) Literature:

Business in the Environment (BiE) 1996 and1997:

<u>"The Index of Corporate Environmental Engagement - A Survey of the FTSE 100 Companies"</u>

> "Since its creation in 1989, BiE's experience of working with companies on environmental issues suggests that managers continuously ask the same question: how do we compare with other companies? As an awareness raising exercise, the index is intended to encourage environmental comparison between companies, and so encourage companies to collectively improve standards of environmental management." (BiE 1996a)

In 1996 BiE launched an Environmental Survey of the FTSE 100 Companies, entitled "The Index of Corporate Environmental Engagement". The survey was "designed to gauge the extent to which large UK companies are gearing themselves up to manage environmental issues." (BiE 1996b)

"The overall objective of the Index is to raise awareness of environmental best practice by gauging the level of environmental activity and commitment in the corporate community. The survey will present a clearer understanding of what companies are doing and encourage comparison. BiE hopes that it will also motivate companies to further improve their performance." (BiE 1996b)

Background

A research project commissioned by BiE, entitled "City Analysts and the Environment – A survey of Environmental Attitudes in the City of London", found that 87% of analysts voted "Quality of Management" most important, compared with 76% for "the bottom line".

The survey has therefore been developed on the premise that good management is a precursor for good performance. This was also an assumption made by the Lucas HS&E department in 1995 when the Self-Assessment System (SAS) was designed to measure the businesses' implementation of the Corporate HS&E Management Standards. The BiE survey (like the Lucas SAS) does not rate environmental performance or impact.

Following up on the conclusions of the "City Analysts" survey, BiE and its members started exploring the correlation between quality of management and current company practice in relation to the environment. At Lucas, our own HS&E audit experience gave us a set of characteristics of the best performers, which were all to do with the quality of management. The characteristics identified by Lucas were:

- Awareness and understanding of issues
- Commitment and Involvement of Senior Management
- Clear Targets and Objectives
- Effective Two-way Communications
- Employee Awareness and Participation
- Team Approach to Problem Solving
- Pragmatic
- Continuous Improvement Approach *(Lucas HS&E presentation 1995)*

Designed to be applicable to any corporate structure, the BiE Index itself is based on ten parameters which represent good environmental practice and asks company leaders whether for example, they have an environmental management system, a main board member with specific responsibility for the environment and a written policy.

The Ten Parameters, representing good environmental practice are:

1. Corporate environmental policy
2. Main board member with environmental responsibility
3. Formal environmental management system
4. Environmental objectives

5. Measurable targets
6. Internal audit process
7. Employee environmental programme
8. Environmental stewardship of products, processes and services
9. Supply chain programme
10. Environmental communication with stakeholders (BiE 1996a)

There are no weightings to the parameters since pilot surveys confirmed that these did not have a significant effect on the rankings (BiE 1996a).

The BiE survey is based on self-assessment and is intended to help businesses identify their own strengths and weaknesses in their management approach to the environment. Although the subjective nature of self-assessment is understood, BiE believes that self-assessment is the starting point for action and improvement.

In the 1997 survey, the method was still based on self-assessment, but four extra measures were put in place to validate the company responses and add further credibility and confidence in the results. They were:

i. A set of qualifying statements and/or sub-questions that must be answered as a pre-requisite to the appropriate answer for each of the ten parameters.
ii. Documentation was required to support two answers (3&4)
iii. The completed questionnaire was to be signed off by the chairman, Chief Executive or Board Director with environmental responsibility.
iv. A sample of participating companies would be selected for a visit and review of the questionnaire.

The 1996 Survey results show a profile of scores ranging from 90% for parameter 1 (Policy) to less than 40% for parameter 10 (Environmental communication with stakeholders). This implies that each subsequent parameter is harder and more time-consuming to implement and therefore less likely to have been achieved. Lucas HS&E first audit programme measured businesses against the 5 steps outlined in the Health and Safety Executive's 1993 "Successful Health and Safety Management". The five steps: Policy, Organising, Planning & Implementing, Measuring Performance and Reviewing Performance, also produced a typical average score profile ranging from approximately 90% for Policy down to 40% (approx.) for Measuring and Reviewing Performance. Again, this implied that the businesses were good at introducing policies and allocating responsibilities, but less good at implementing plans and following them through with performance measurement and review. Although to be fair, these elements of the management process are also more involved and take time to bear fruit.

The overall response rate to the FTSE 100 survey in 1996 was 73%. Of the different sectors "Engineering" had the lowest response rate of 57%. This is the field that Lucas falls in to. Based on my own experience, engineering companies tend to believe that they have a lower environmental impact than other companies (particularly the likes of Chemical and Oil companies), in that they do not use vast amounts of hazardous substances. However, this is a perception based only on gut feel and not measurement. They also tend not to have direct consumer pressure, as they are generally suppliers to other companies.

The low response rate from engineering companies coupled with the results of KPMG's 1993 International Survey of Environmental Reporting, which showed that of the 690 companies assessed no engineering companies had provided quantitative data, underlines the importance of producing an effective Environmental Performance Process for engineering companies.

In 1997, the average score of participants rose to 67% from 60% in 1996, although some companies, including Reuters, the business news supplier, and Legal & General, the insurer, withdrew from the 1997 survey, complaining that it was biased towards more polluting sectors. This time, companies in the engineering, property and transport sectors showed the greatest progress (Boulton 1998a). In 1997, LucasVarity entered the FTSE 100 and was invited to participate in the survey. It reached the 4th Quintile (52 to 63%). It's engineering customers British Aerospace and Rolls Royce achieved the 3rd Quintile (67 to 73%), whilst comparable companies Smiths Industries were rated in the 5th quintile (0-52%) and GKN declined to enter the survey at all.

The BiE Survey indicates the growing public awareness and interest in the environmental performance of business and the increasing trend towards being rated. As a result, the importance of disclosing accurate information will become paramount. John Elkington, sums up the current situation by saying that "whether businesses like it or not, rating is here to stay." (BiE 1996b)

Boulton (1998b) also reinforces the need for Environmental Performance Measurement:

> "Before the link between greenness and profitability can be established with any rigour, a measure of what constitutes good environmental performance first has to be made. The absence of standard measuring tools has meant that investors have been unable to compare companies' environmental performance as they can return on investment or profit margins.
>
> Investors, consumers and even companies themselves are searching for better green tools with which to measure performance and exposure to environmental risk."

And so are Doctoral Research Engineers!

Summary of Future Work

Research

- Development and Testing of EPE Methodology
- Investigation into two tools mentioned by Boulton (1998b):

  1, A Carbon Dioxide emission indicator (by Imperial college and National Provident Institution) and

  2, An Environmental Risk Rating (by Serm Rating Agency).

Personal Development

- I intend to apply for Full Membership of the Institute of Environmental Management by 30th April 1998. This will demonstrate the level of experience and competence that I have gained in the field of environmental Management and entitle me to use the initials MIEMgt after my name.

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36 Month Report

Nicolette Lawson
Eng. D Year 4

October 1998

36-Month Report
Year 4

"Environmental Performance Indicators in Industrial Management Systems"

Contents

Summary of progress against project objectives

The following section reassesses the goals and objectives outlined in the 24-month report and redefines the extent of the future work.

Overall Goals and Objectives of the 4 year research programme

• OBJECTIVES	Progress since 30 month report (April 1998)
• To design, develop and implement a workable system for measuring Corporate Environmental Performance in a large diverse business, using LucasVarity plc as an example.	⇒ Finally a worldwide reporting system was introduced in January 1998. The first quarter's results were submitted in April. I compiled and analysed the data for Lucas Aerospace, and produced a first internal "Did you know" report. I also compiled a list of problems arising from the submitted data (e.g. gaps, mathematical errors, wrong units etc.) In addition I analysed the Group data to compare performance across the divisions: this showed some very large differences in performance which we were able to investigate and revealed differences in presentation of data across the divisions. The second quarter's data was received and analysed in July. This raised more questions about the data for both quarters, necessitating further discussions with data providers and a rewrite of the data definitions. The practicalities of data collection and analysis were discussed in my 1998 EngD Conference paper (see Appendix AB).
• To evaluate the effectiveness of the system, the impact of company culture, and constraints on the design of the system, and recommend future improvements.	⇒ Evaluation of the effectiveness of the system will be completed during in 1999, as more data is received from the LucasVarity businesses and the measures are reviewed for next year's reporting. The impacts of company culture and constraints on the design of the system have been considered in tabular form later in this report (see EPE Methodology, from p.15).
• To assess whether LucasVarity has the right set of measures to satisfy all its stakeholders and sufficient information to deliver an external environmental report.	⇒ No progress has been made to date. Assessment of the LucasVarity set of measures will be completed following further literature surveys and in-house review on the effectiveness of the system. However it is unlikely that there will be sufficient time to conduct the research necessary to discuss this point in detail.
• To review how Environmental Performance is measured generally in industry, but specifically in large, diverse corporations.	⇒ I have had an interview with the environmental manager for GKN (a similar sized organisation in the same sector) but I still need to draw some comparisons and conclusions between the companies. I have access to GKN, and other companies, if I need further information. I am in the process of writing a joint paper with ICI on environmental performance indicators and the similarities and differences experienced by the two industries.

• To analyse a selection of the latest Environmental Reports (1996/1997) and surveys, evaluate the types of measures now being used and review the latest developments.	⇒ My strategy has changed here, since I have come across a raft of new survey reports in the last few months (including ACCA, PIRC, DETR) which have analysed Environmental Reports for me. I will now review these reports to see if they give me the information I am looking for. (The ACCA report by Bennett and James is reviewed in this progress report: see **Literature** section, pp 22-36)
• Also to evaluate the robustness of the systems adopted, i.e. are the metrics interpreted similarly by the users, are they comparable across time, location and organisations, and are they repeatable.	⇒ This should become clear as I review these "survey" reports.
• To develop a decision-making methodology for Environmental Performance Evaluation in LucasVarity. This may also be tested at other companies (if time and opportunities allow).	⇒ Further development in this area has resulted in a revised diagram (p15) and cultural factors being summarised into "assessment matrices" (pp 17-20). A method for identifying "significant effects" (p9) has also been developed, based on work first described in my 12 monthly report, but expanded to be more robust, objective and repeatable. This also provides a "front-end" to the EPE Methodology described in pp 15-20.

Contributions to knowledge

Objective	Current status and future work
• A critical evaluation of the current methods of measuring performance in large diverse businesses.	⇒ This has been addressed by the ACCA and PIRC reports. However, I intend to review them in order to provide additional interpretation to these reports.
• Practicalities, design and implementation of environmental performance measurement systems	⇒ I intend to focus on the practicalities of implementation (some of which were discussed in the 1998 EngD conference paper "The practicalities of measuring environmental performance"- see Appendix AB) since this appears to be an area largely ignored by authors in this field. I intend to extract key findings from the academic papers and incorporate them into a practical guide, for use in industry.

• An understanding of the effect of cultural barriers and business constraints on the implementation of Environmental Performance Measurement in large businesses.	⇒ This is based on experience gained from working within a large corporation and an analysis of Management literature (particularly concerning Change Management, corporate culture, motivation and other related areas). I also draw on my previous experience as a Manufacturing Systems Engineer designing and implementing organisational change. A summary of cultural issues are included in the "Assessment Matrices" used in the EPE Methodology (pp 15-20)

Methodological approaches used/to be used

24-month Dissertation	Current status and future work
• Benchmarking to evaluate other companies' approaches and theories proposed through literature.	⇒ This will be achieved through analysis of the relevant literature. Others (Bennett & James 98, PIRC 98, UNEP/Sustainability, etc) have recently published much of the work required for this. These documents will be used as the basis of my review.
• Design, review and development of measurement system, trial implementation (pilot study), analysis of results and evaluation of process. This will necessitate a largely retroactive (trial and error) and interactive approach.	⇒ A retroactive approach has been used to date to develop the LucasVarity systems. ⇒ A systematic methodology is being devised, based on past experience and best practice obtained from a broad range of relevant literature. ⇒ See section headed "**EPE Methodology**".
• Amendment of proposal and implementation company-wide. A proactive approach will be required to raise awareness and monitor implementation of the system.	⇒ Company-wide implementation commenced in January 1998. ⇒ Analysis of the data and a critique of the system are being carried out over 1998 and 1999 as further quarterly data is received from the LucasVarity businesses. See "MOP" reports in Appendix AA, and Divisional Analysis of data, Appendix AD.

Revised titles, and target journals, for papers to be submitted by the end of the project

Title	**Actual /Provisional**	**Journal**
"Measuring Environmental Performance: A tale of two industries"	In progress	To be decided
"Implementing Environmental Performance Measurement – The practicalities"	In progress	To be decided

Further Work:

24-month Dissertation	Current status and future work
• In the immediate future, my research will focus on examining the role of quantitative performance measurement in achieving actual environmental improvements. I intend to analyse a selection of the latest Environmental Reports and surveys (1996/1997), using a methodology similar to that employed by Azzone and Manzini (1993), to see what types of measures are being used now and what the latest developments have been. I also intend to evaluate the robustness of the systems adopted, i.e. are the metrics interpreted similarly by the users, are they comparable across time, location and organisations, and are they repeatable? This will be a useful guide to anyone wanting to put together an environmental report or designing an environmental performance system. This work will be constrained by using environmental reports, which are in the public domain and may not present a true and objective picture of each company's actual performance.	⇒ There is limited progress to report in this area. See the "**Literature**" section. ⇒ The need for this work has been re-assessed in the light of new literature available this year - much of it assessing the adequacy of environmental reports and their data. ⇒ I will give an overview of the types of measures being used by companies and compile a database of measures and their variations, by the next six-month report.
• Using the above as a benchmark, I will assess whether LucasVarity has the right set of measures to satisfy all its stakeholders (as outlined by James and Bennett 1993 and compared to the IBM approach). This will help the company to decide if it wishes to present an external environmental report and if so, which of its stakeholders it is likely to please.	⇒ This work will follow the analysis of Environmental Reports and surveys (above).
• In order to help businesses considering environmental performance measurement for the first time, or wishing to review their current system, I aim to develop a methodology, consisting of a flowchart, which will guide people through the EPI decision process, taking into account their own business constraints. If time and opportunities allow I will try out the methodology at other companies, in order to ascertain whether an adaptable, generic process can achieve the required results in companies with different cultures and modes of operation.	⇒ This may not be as detailed as first anticipated, due to difficulties in obtaining data. However, work developed so far has been pulled into the model to make it as complete as possible in the time remaining. It is unlikely that there will be time to test the methodology in other organisations. ⇒ See sections headed "**EPE Methodology**" (p15) and "**Significant Effects**" (p9).

Further Work continued:

24-month Dissertation	Current status and future work
• I intend to analyse the results returned from the Company-wide Measures of Performance (due at the end of 1998) and draw conclusions based on the data and the process so that improvements can be made.	⇒ **The main thrust of my work in the last six months has been in this area.** The Performance Measurement system was introduced in January 1998 with data submitted quarterly, since April 1998. I have been compiling and analysing the data for one division (Lucas Aerospace) and commenting on the data aggregation at LucasVarity Corporate Level. I have also prepared two "Did you know?" reports for Lucas Aerospace (see Appendix AA) and rewritten the data definitions (see Appendix AC) to try and address continuing interpretation problems. My 1998 EngD conference paper "The practicalities of measuring environmental performance" (Appendix AB) concentrated on the practical problems encountered with the data collection and analysis process.

A revised timing plan for year 4 is included in Appendix Z.

Work Completed since April 1998:

Management Systems – Lucas Aerospace

Work for the Lucas Aerospace HS&E Manager to introduce Health, Safety and Environmental management systems has included implementation of the following Performance Measurement systems.

- **Self-Assessment versus independent audit**

  The Self-Assessment System as discussed in the 30-month report has been used by the Lucas Aerospace businesses to assess themselves against the LucasVarity HS&E Standards. Most sites have reassessed themselves in the last six months and all sites have now passed the July 98 target of 50% compliance with the standards. 10 sites have reported reaching the December 98 target of 80% compliance.

  In August 1998, one of the Aerospace sites, which had assessed itself at an average of 83%, was audited under the LucasVarity HS&E audit programme (the research engineer acted as independent team leader for this audit).

  Following reassessment by the audit team the average score was adjusted to 63%. The reason for the discrepancy in the scores was a general misunderstanding of the requirements of the standards and an over optimistic view of the site's own procedures and documentation.

  This has highlighted what further work needs to be done to raise business awareness. One of the main areas of weakness is in the identification and prioritisation of activities that have a significant effect on the environment. A procedure has been developed to help businesses address this in a more systematic manner (see "Significant Effects" below). This activity is key to environmental management, since it forms a basis for all further decision making and setting of objectives and targets.

- **Measures of Performance**

  The LucasVarity HS&E Measures of Performance System was implemented worldwide in January 1998. In April and July the first and second quarter's data was received from the businesses. The data was compiled and analysed and two reports were written for Lucas Aerospace to feedback to the businesses, in order that they understand the aggregate figures and business comparisons (reports can be found in Appendix AA).

  The process of data collection and analysis raised a lot of issues about the data, much of which was discussed in the 1998 EngD Conference Paper "The Practicalities of Measuring Environmental Performance" (see Appendix AB). It also resulted in a revised set of definitions to explain the requirements of the system to data providers (see Appendix AC).

  Following the collection of data for the first quarter it was possible to analyse the data across the divisions, this raised further questions about the consistency of approach. The graphs and commentary can be found in Appendix AD.

- **Significant Effects**

The first management standard (M1) in the LucasVarity HS&E Handbook[1] states that "businesses will:

1. establish and implement procedures to identify all those activities which have or can have significant effects.
2. define priority issues, based on legal requirements, level of risk, levels of performance and financial implications.
3. specify objectives, with demonstrable links to priority issues.
4. establish targets with specific results and allocation of resources, timescales and measurements for each objective."

These first four requirements are all sequentially dependent on each other. Therefore if the first requirement is not fully satisfied, the others will be incomplete. The fourth requirement involves establishing measurements to gauge progress towards objectives, therefore the identification of significant effects is the first step in the process of deciding what indicators of environmental performance are required by a business.

The main failing by businesses is that they do not have a systematic and repeatable way of identifying significant effects and their contributing activities*.

A suitable "off-the-shelf" method could not be found for identifying and assessing significant effects, so a simple procedure has been developed (building on my previous work -see 12 month report- as well as work carried out by Annelli Gilbert[2] and Linda Warrick[3] – Teaching Company Associates working with the Lucas HS&E department from 1994 to 1997) to help businesses to identify and prioritise their significant effects and the activities responsible for them. The full procedure can be found in Appendix AE. The basic steps are described here:

Step 1: Site Vulnerability.

This involves understanding the local site environment and the vulnerability of the receiving media (air, land, and water). A simple protocol is used to rate the local environmental conditions (see tables on following page). For instance, an assessment of vulnerability of air is based on the proximity of nature reserves, the surrounding land use (e.g. residential is more vulnerable than industrial), and whether air emissions meet local air quality standards. For vulnerability of local waters the proximity of nature reserves, the distance from and quality of surface waters, and the amount of bulk storage on site is considered. For land (including ground water) the distance from nature reserves, the type of aquifer, the nearest abstraction wells and their use, the geological construction, soil type and likelihood of previous ground contamination are all assessed.

The assessment results in a vulnerability score (2 to 10) for each of the three receiving media. For instance a site on a major aquifer, used for drinking water and having large capacity bulk storage tanks should be concerned about the risk of polluting the ground and ground-water. A site on a non-aquifer, but surrounded by residential housing may be more concerned about their contribution to air pollution.

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* *Based on personal experience as lead auditor in this industry.*

Vulnerability of Air

Vulnerability Criteria	Classification Scores	Score
How close are the nearest **nature reserves**, sites of special scientific interest, areas of outstanding natural beauty or agricultural land?	<200m = 10 200m - 500m = 8 500m - 1km = 6 1km - 5km = 4 > 5km = 2	*Example* *6*
What is the main **surrounding land use**?	Residential = 10 Agricultural / Forestry = 8 Greenfield = 6 Commercial = 4 Industrial = 2	*Example* *2*
Should your Air Emissions meet with Local Air Quality Standards	Yes but not met = 10 Yes and met = 5 No = 2	*Example* *10*
	Average Air Score	*6*

Vulnerability of Water

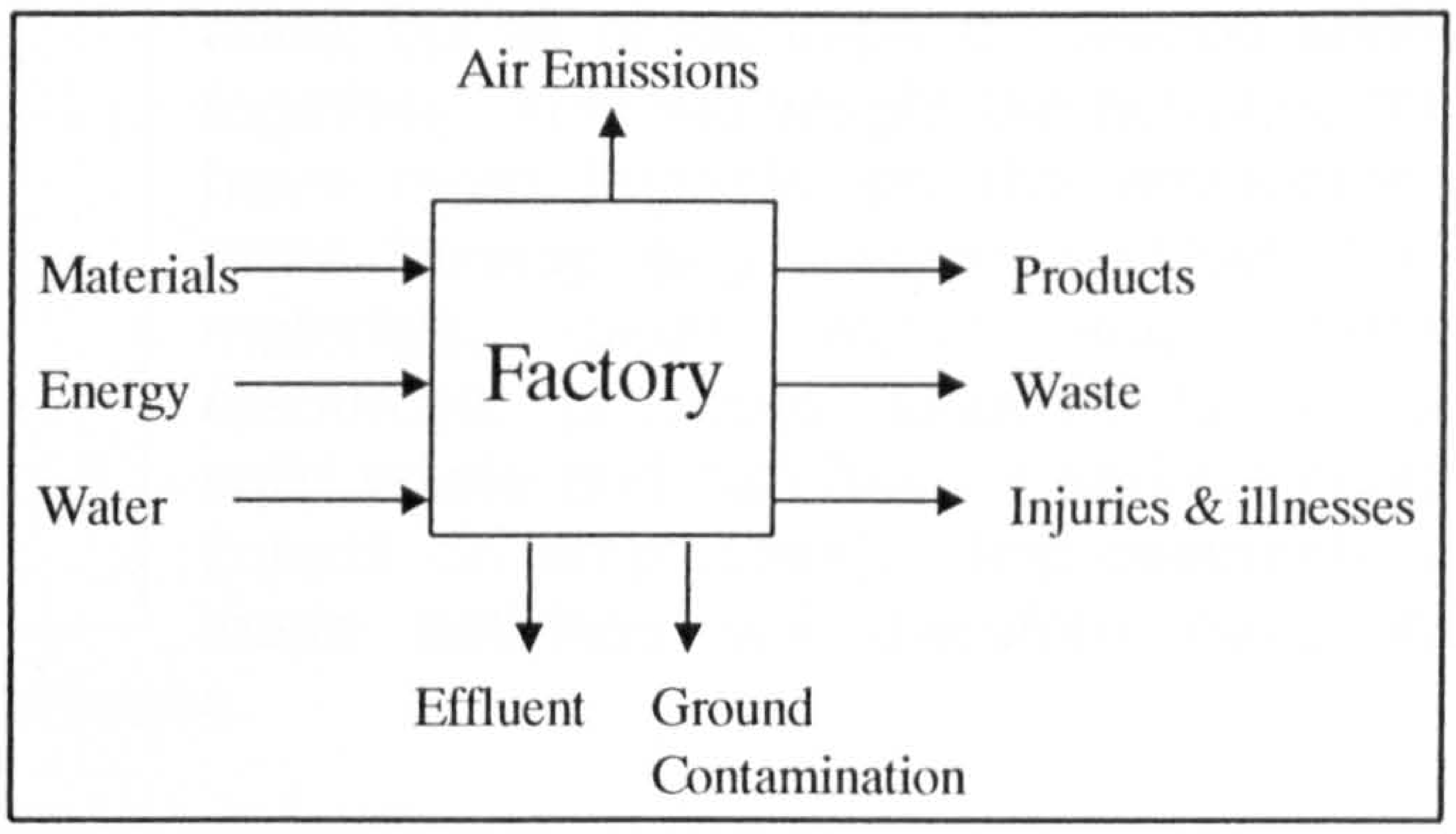
Vulnerability Criteria	Classification Scores	Score
How close are the nearest **nature reserves**, sites of special scientific interest, areas of outstanding natural beauty or agricultural land?	<200m = 10 200m - 500m = 8 500m - 1km = 6 1km - 5km = 4 > 5km = 2	*Example* *6*
How close are the nearest **surface waters** (river, stream, lake)?	<200m = 10 200m - 500m = 8 500m - 1km = 6 1km - 5km = 4 > 5km = 2	*Example* *6*
What is the **classification** of the nearest surface waters? *(based on UK Surface Water classifications)*	RE1:V.good quality suitable for all fish=10 RE2:Good quality suitable for all fish=8 RE3:Fair, OK for high class coarse fish=6 RE4:Fair, OK for coarse fish=4 RE5: Poor, likely to limit coarse fish=2	*Example* *10*
What bulk storage do you have for substances with environmental impact? (UGST=Under Ground Storage Tank, AGST=Above Ground Storage Tank)	UGST >200 gallons = 10 UGST < 200 gallons = 8 AGST >200 gallons = 6 AGST <200 gallons = 4 < 201 l in any area = 2	*Example* *10*
	Average Water Score	*8*

Vulnerability of Land

Vulnerability Criteria	Classification Scores	Score
How close are the nearest **nature reserves**, sites of special scientific interest, areas of outstanding natural beauty or agricultural land?	<200m = 10 200m - 500m = 8 500m - 1km = 6 1km - 5km = 4 > 5km = 2	*Example* *6*
What type of **aquifer** exists in this area?	Major-no capping geology = 10 Major-with capping geology = 8 Minor- no capping geology = 6 Minor-with capping geology = 4 None = 2	*Example* *4*
How close is the nearest **abstraction well**?	<200m = 10 200m - 500m = 8 500m - 1km = 6 1km - 5km = 4 > 5km = 2	*Example* *10*
What is the local **groundwater used for**?	Drinking water = 10 Process water = 5 None = 2	*Example* *5*
What is the predominant **geological construction** of the local area?	Permeable e.g.Chalk/Limestone=10 6 Impermeable e.g.Granite = 2	*Example* *6*
What is the predominant **soil type** in the local area?	Permeable e.g. Gravel = 10 6 Impermeable e.g.Clay = 2	*Example* *2*
Are previous Site uses likely to have caused ground contamination?	Previous use with potential to pollute = 10 Previous use unlikely to cause pollution = 5 Greenfield = 2	*Example* *10*
	Average Land Score	*6*

Step 2: Site Wide Impacts.

The second step is to identify all the HS&E impacts arising from the site and its operations. It is suggested that a top-level site "input-output" diagram is drawn and that all the inputs (material types, energy & water consumption) and outputs (products, waste types, air emissions, effluent, ground contamination, work-related injuries and illnesses) are identified with quantities (actual or estimated) and hazard information.



Example:

	VUL.	QTY.	HAZ.	IMPACT TOTAL
INPUTS:				
MATERIALS				
metals		3	1	**4**
oils		3	2	**5**
chemicals		2	3	**5**
solvents		2	3	**5**
paper		3	1	**4**
RESOURCES				
electricity		3	1	**4**
gas		3	2	**5**
water		2	1	**3**
OUTPUTS:				
AIR EMISSIONS	**10**	1	2	**13**
EFFLUENT	**10**	3	3	**16**
WASTES	**3**	2	3	**8**
ILLNESSES & INJURIES		3	20	**23**

List different types and quantify each if data available

Site Vulnerability scores by media

The materials and wastes should then be transferred to a table (example shown). The materials and wastes can be grouped into generic types, to reduce the list and simplify the assessment process. Then a 1, 2, 3 ranking is allocated for both quantity and hazard (guidance is given in the procedure's appendix 2).

The site vulnerability scores from step 1 are then added to the "Emissions Impacts" for air, land (waste) and water emissions (effluent).

Step 3: Identify Contributing Activities.

The third step is to identify the main activities causing the site HS&E impacts. It is suggested that a multi-disciplinary team be used to brainstorm the activities which contribute to each of the HS&E impacts identified in step 2. "Activities" need only be described in a generic sense, such as "use of lighting", "machining" etc since too much detail at this stage would make the process very complicated.

Example:

	IMPACT TOTAL	ACTIVITIES
INPUTS:		
MATERIALS		
metals	4	Machining
oils	5	Machining, Test
chemicals	5	Plating
solvents	5	Cleaning
paper	4	Admin/Design
RESOURCES		
electricity	4	Lights, machines
gas	5	Heating
water	3	Plating, domestic water
OUTPUTS:		
AIR EMISSIONS	13	Plating, boilers
EFFLUENT	16	Plating, domestic water
WASTES	8	Machining, packaging
ILLNESSES & INJURIES	23	Plating, machining, test

Example:

KEY ACTIVITIES	TOTAL IMPACT
Plating (5+3+13+16+23)	60
Machining (4+5+4+8+23)	44
Test (5+23)	28
Domestic water (3+16)	19
Boilers/heating (5+13)	18
Packaging	8
Admin	6
Cleaning	5
Design	4
Lights	4

The list of activities can then be rationalised, so that each is only mentioned once, but all of the impacts must be added together. This will weight the activities that have more impacts on the environment more heavily (e.g. plating employs toxic materials, uses water and energy resources, produces effluent, hazardous solid waste and can have a serious health impact on employees). Improvements to these activities will therefore have the greatest impact on HS&E performance.

Step 4: Assessment of Controls.

The "impact assessment" in step 3 only indicates what impact the activities could have on the environment. If all the necessary hardware and software controls were in place and operating correctly the actual likelihood of an environmental release or safety problem would be small. However, if controls and management are inadequate then the likelihood of an incident is greatly increased. Step 4, "assessment of controls", is therefore a proxy for "likelihood".

The assessment is carried out on a worst case example, or as an overall assessment, for each activity. A simple protocol (shown below) is used to allocate a score to the following questions:

	High Risk 3	Medium 2	Low Risk 1	Score
Are controls required by law or as a result of risk assessment?	Yes - legislation	Yes – Best Practice	No	
Are the controls adequate?	No	OK	Yes – Best Practice Or Not Required	
Is there any evidence of inadequate control (past)?	Frequent past occurrences	Rare past occurrences	None	
Will controls be adequate for the future?	No - Legislation tightening Or Volume increasing	Volume and/or legislation to stay the same	Volume will decrease or Equipment will be replaced.	
Would controls be adequate in an emergency?	Not adequate	Patchy	Good equipment, plans & procedures	
TOTAL SCORE (Max 15 – Min 5)				

Step 5: Significance Assessment

Having obtained an "impact" score (step 3) and a "likelihood" score (step 4) from the assessment of controls, it is then necessary to assess the significance based on drivers for action such as legislation, stakeholder concern and business costs. Again a simple matrix-type protocol (below) guides the user in the allocation of scores for these variables.

LEGISLATION	High 15	Medium 10	Low 5	None 0	Score
Legislation – current and future	Non compliant	Applies – some measures in place	Applies – measures in place	None applies	

STAKEHOLDER CONCERN	High 9	Medium 6	Low 3	None 0	Score
Questions, concerns, requirements, audits	Customers Investors	Neighbours	Employees	None	

BUSINESS COSTS	High 3	Medium 2	Low 1	None 0	Score
Can savings be made?	High	Medium	Low	None	
Is compliance maintenance expensive?	High	Medium	Low	None	
Is clean-up / remediation expensive?	High	Medium	Low	None	
Is there potential for business disruption?	High	Medium	Low	None	
TOTAL (max 12 – min 0)					

Step 6: Prioritisation

Example:

Steps 1,2,3 — Step 4 — Step 5 — Step 6

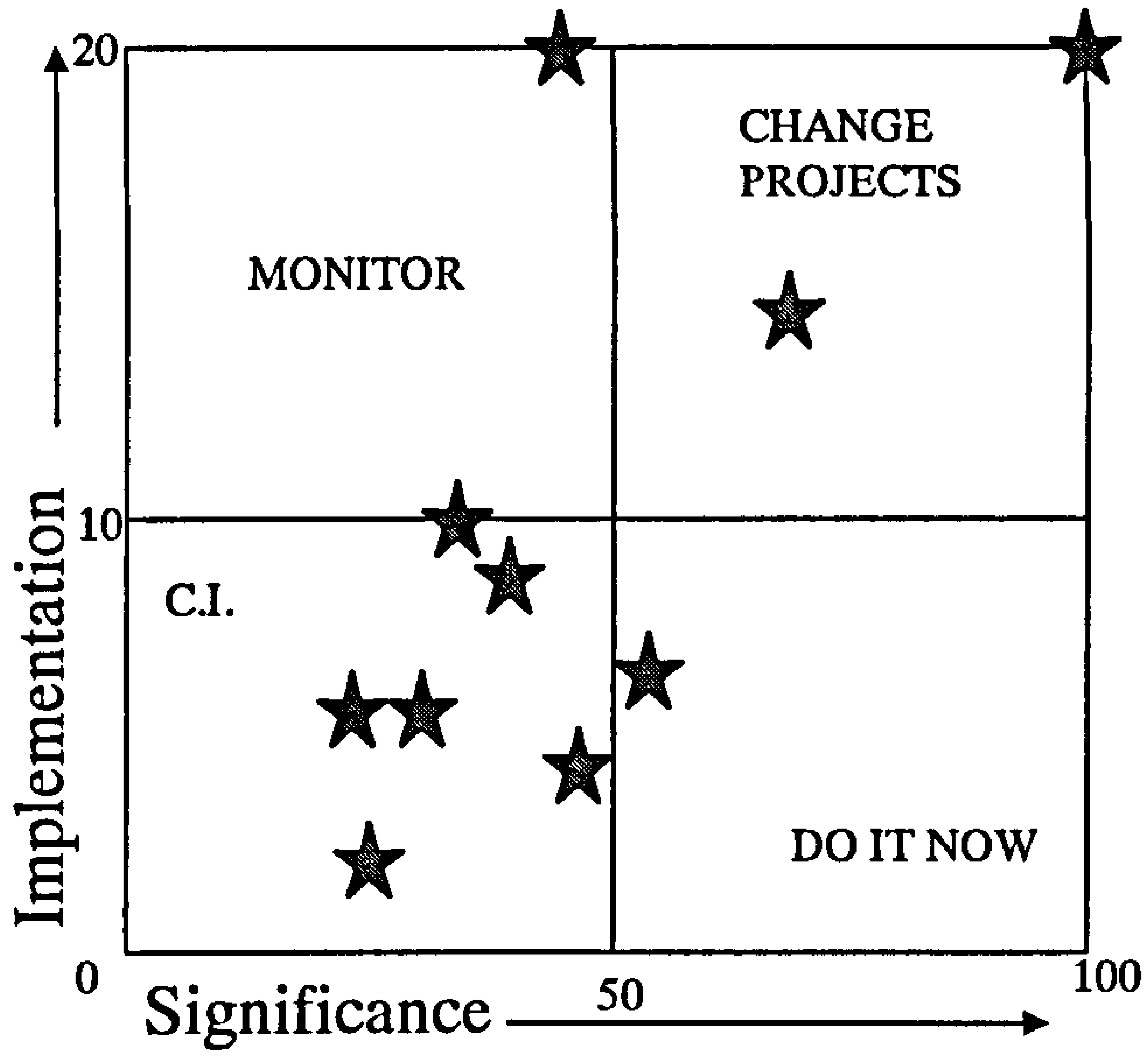
ACTIVITIES	Impact	Control	Leg.	S'holder	Cost	TOT	Priority
Plating	60	15	15	6	12	108	1
Machining	44	5	5	6	9	69	3
Test	28	13	10	9	10	70	2
Domestic water	19	9	5	0	6	39	6
Boilers/heating	18	5	5	3	12	43	5
Packaging	8	8	10	9	9	44	4
Admin	6	5	0	3	4	17	10
Cleaning	5	5	0	3	4	18	9
Design	4	5	0	9	2	20	8
Lights	4	5	0	3	10	22	7

This step combines all the scores from the previous steps in order to prioritise the activities that have a significant HS&E effect. Objectives and targets for improvement can then be set.

Step 7: Determine Action

The last step can help management to decide how each issue should be handled. An assessment of the ease/difficulties and cost of implementation should be carried out (scoring 1-10 for each criteria) and the results plotted on a Boston Matrix (see below) against the total significance scores.

KEY ACTIVITIES	IMPLEMENTATION Ease	Cost	TOTAL	SIG
Plating	10	10	20	108
Test	10	10	20	70
Machining	8	8	16	69
Packaging	2	2	4	44
Boilers/heating	5	5	10	43
Domestic water	5	3	8	39
Lights	3	3	6	22
Design	4	2	6	20
Cleaning	3	4	7	18
Admin	1	1	2	17



Projects will then fall in to 4 main categories:

1. High significance and difficult to implement = change projects
2. High significance and easy to implement = do it now.
3. Low significance and easy to implement = continuous improvement
4. Low significance and difficult to implement = monitor to see if influencing factors change.

The four requirements of the first LucasVarity management standard (M1), mentioned at the beginning of this section, can be described in the following flow chart which leads directly into the Environmental Performance Evaluation (EPE) Methodology described in the next section of this report.

Tools available	**Activity**	***Purpose***
"Significant Effects" procedure (above and Appendix AE)	**Identify significant effects and define priority issues/activities**	*Identifies and prioritises which issues management should focus on.*
Local management team decision	**Specify objectives and establish targets**	*Provides direction and milestones to aim for.*
"EPE Methodology" below	**Identify measurements to evaluate environmental performance against each objective**	*Identifies what measures can be and should be implemented to monitor on-going achievement of environmental improvement.*

EPE Methodology

The following diagram (Figure 1) was included in the last progress report (30 month) to explain the structure of the Environmental Performance Evaluation (EPE) Methodology that was being developing as a result of this research.

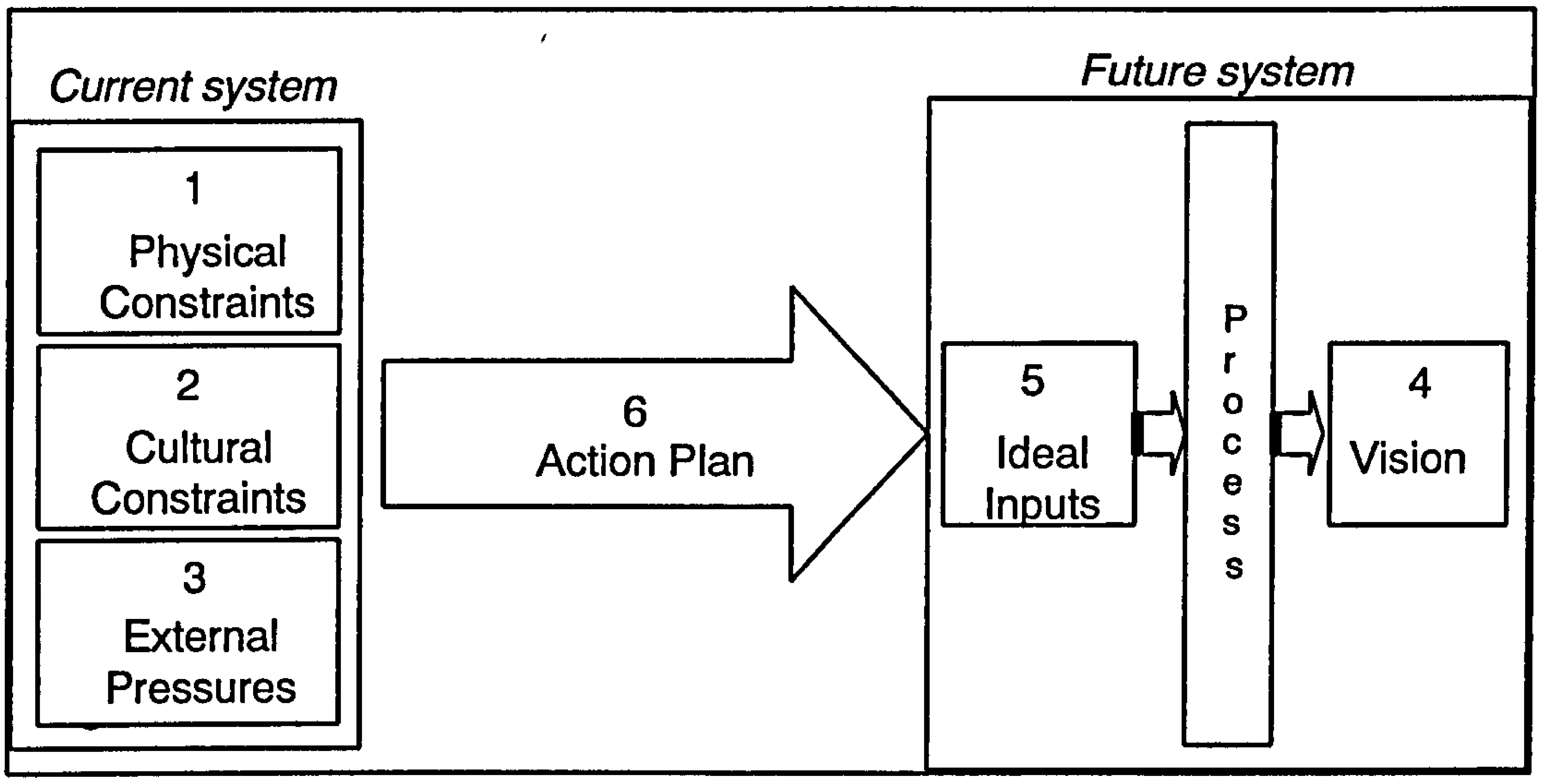


Figure 1: EPE Methodology (version 1)

Since then, a practical procedure for determining the Significant Effects of a business has been developed (see previous section). I now consider this to be the most effective starting point for determining Environmental Performance Evaluation (EPE) or Measurement.

A second version of the diagram (below) has subsequently been developed which includes the Significant Effects activity and also shows the overall process as an iterative one, which it is.

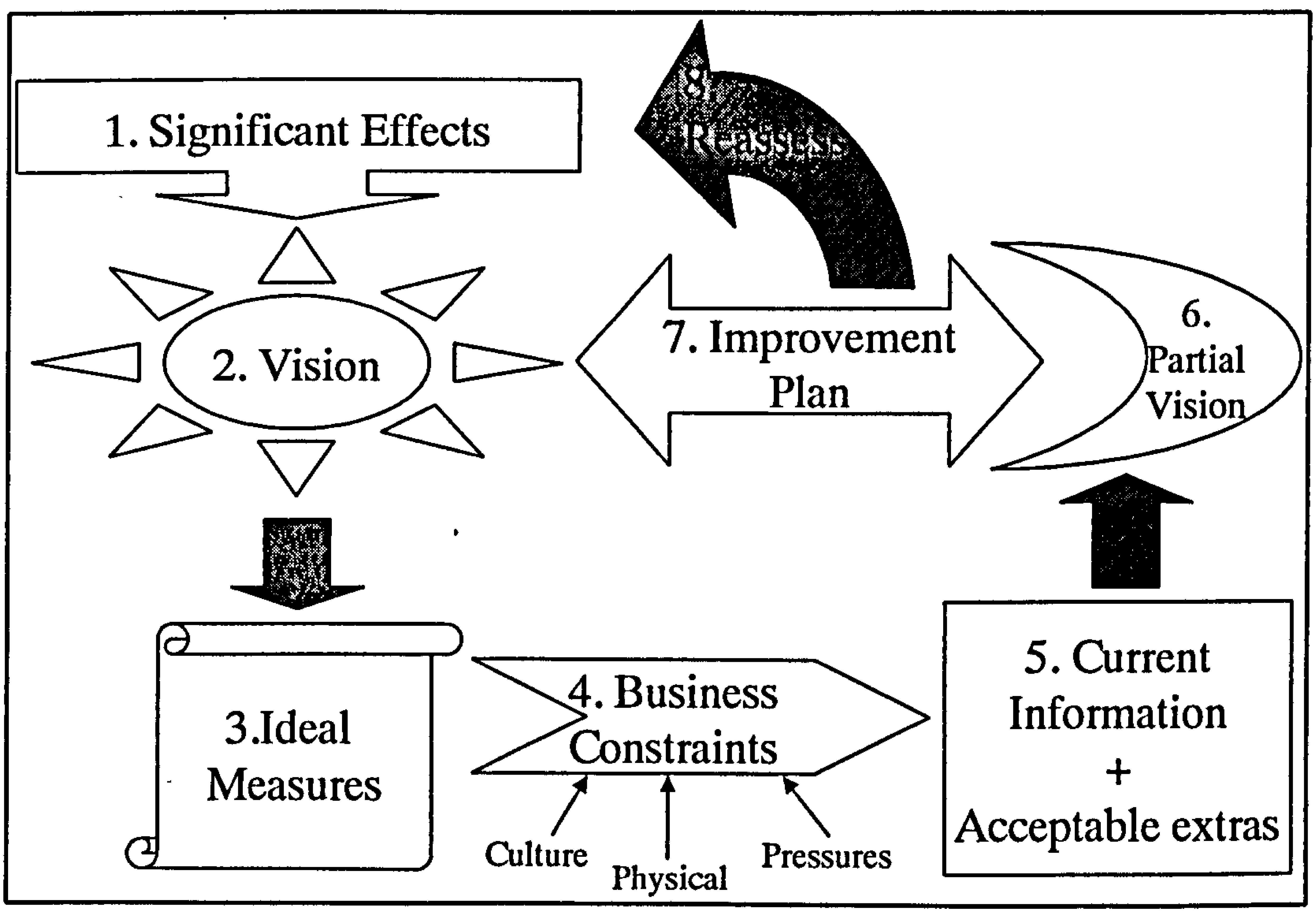


Figure 2: EPE Methodology (version 2)

This sort of process requires inputs from all the business functions and a consensus needs to be reached as to the direction, constraints and capability of the organisation. For this reason I believe the quickest and most effective way of implementing this process would be through a series of workshops with business management and other key personnel.

1. The Significant Effects procedure (as described in the previous section of this report) could be completed quite comprehensively prior to the workshop, by a small team, since a thorough approach requires site-wide data collection in some detail. However, a "quick and dirty" approach could be used within a Workshop setting, which would still give sufficient results to get the process started. This could then be refined at a later date, as part of the iterative process.

2. Defining the Vision is the second step. Having identified those activities, which have the most significant environmental effects, the management needs to imagine a future where these activities are either eliminated or substantially changed such that their environmental impact is minimised. The vision should therefore contain a set of objectives and targets (quantifiable) which specifically address the Company's most significant effects.

   How far a company can see into the future will depend on its present position, prospects and the enlightenment of management. Assessment Matrix 1 (below) describes three levels of Vision, which a company may seek to achieve from Minimalist, through Efficient to Sustainable. Consideration of five factors: Company Environmental Vision; Operational Environmental Objectives; Product/Service Environmental Objectives; Environmental Measurement Objectives and Company Drivers result in an assessment positioning the Company with respect to its reasons for measuring environmental performance.

   It is important that business managers are honest about their intentions and are not tempted to present a wish list, which the company is not in a position to achieve. Once on the ladder[4] (such as that described by Robinson 1998, p5), the company can start to build a foundation based on environmental measurement and then move up. It is almost impossible to jump to the top rung of the ladder if you have not prepared the ground and taken the steps in sequence.

3. Having set some quantifiable targets, the question of how to measure progress against these targets must be addressed. Here the workshop should brainstorm the ideal measures, or indicators, which would accurately describe the company's position in relation to its goals. In terms of research, a database of possible measures, gathered from environmental reporting literature, is being compiled which will serve as examples of what could be accomplished and what is commonly seen as best practice and achievable.

4. At this point, the business team needs to be transported back to reality and what can actually be achieved within the current business constraints. Issues such as the company culture, its physical systems and external pressures need to be assessed. Matrices 2, 3 and 4 summarise the factors which need to be considered in terms of cultural constraints, physical constraints (or its antithesis: enabling factors) and external pressures. As in

matrix 1, three levels of progress are described against a list of various factors, resulting in an assessment predicting the outcome of EPE implementation currently achievable in this type of organisation. Analysis of the business constraints should be seen as a positive appraisal process and not a justification for long standing excuses. Conversely, it does not mean that they should not aspire to greater things, but that they should not try to run before they can walk. The matrices can be used to highlight weak areas and barriers, which are hindering progress in all areas, not just environmental performance. It is then in the management's interests to address the weak spots in order to move from a restrictive to an enabling business environment.

Assessment matrix 1:

Step 2: VISION - What would the company like to achieve? (partly inspired by Bennett & James 1998[5] p101)

VISION OF FUTURE	**Minimalist**	**Efficient**	**Sustainable**
Company General Environmental Vision	To survive and avoid prosecution.	To use resources efficiently and produce minimal pollution	To operate in a sustainable way
Operational Environmental Objectives	To be compliant with legislation	To reduce risk of pollution and waste	To eliminate all polluting activities
Product/Service Environmental Objectives	To be compliant with legislation	To produce current products in most efficient way	To provide a sustainable service/product. This may mean a change from current products.
Environmental Measurement Objectives	Risk Management	Impress stakeholders, improve communication, & drive continuous improvement	Assess business sustainability & strategic impacts, support debate & drive discontinuous improvement
Company Drivers	Cost & Legislation	Customer and other direct stakeholder pressure, TQM	Moral values / social responsibility
ASSESSMENT	**Little vision of sustainable future. Focus on measures to ensure compliance, assess risk and some efficiency measures. No intention of publishing data.**	**TQ vision of future. Focus on measures to achieve objectives and show progress in resource efficiency. Data required mainly for internal reports and decision making.**	**Sustainable vision of future. Focus on measures to assess strategic effectiveness of activities and products. Data required mainly for external reports and stakeholder dialogue.**

Assessment matrix 2:

Step 4a: CULTURAL CONSTRAINTS - What is the company culture and how could it restrict or aid implementation? (partly inspired by Wheeler & Sillanpää 1997[6])

CULTURE	Poor (Restrictive)	Intermediate	Advanced (Enabling)
Leadership style	Autocratic, secretive	Mixed	Inspirational, open
Corporate Governance	No corporate guidance or governance	Limited corporate guidance and governance	Corporate leadership, guidance, governance and standard setting.
Commitment	No management commitment	Verbal management commitment but little action.	Management Champions actively demonstrate commitment
Environmental Profile	Minimalist approach to Environmental issues	Specialist approach to Environmental issues, limited integration	High profile role within business, integrated into all functions
Environmental Awareness & Training	No awareness or training	Some awareness, some training	All employees environmentally aware and trained regularly.
Enlightenment	Dormant, unaware	Enlightened or pragmatic self-interest	Social responsibility up to social mission
Group Communications	No / little communications between businesses or from Corporate functions	One-way corporate communications to businesses.	Two-way corporate communications to businesses and between businesses.
Implementation of Initiatives	Few initiatives and few successfully implemented	Many initiatives but not many successfully implemented	Many initiatives successfully implemented
Management of Change	Resistant to change	Step changes made when necessary	Embedded continuous improvement / kaizen culture
Participation	Little/no employee participation	"Allocated" employee participation	Voluntary employee participation
Strategies / Planning Horizon	Short Term	Medium Term	Long Term
Drivers	Financial / Compliance	Customers / Competitors	Stakeholders / Best Practice
ASSESSMENT	**Difficult to implement Group-wide EPE system. Focus on drivers and financial benefits. Start small and simple.**	**Success possible, build on past successes, highlight benefits to current projects and plans. Focus on efficiency.**	**High success rate possible, include long term strategic and sustainability measures**

Assessment matrix 3:

Step 4b: PHYSICAL CONSTRAINTS / ENABLING FACTORS - What does the company have in place now?

PHYSICAL FACTORS	Poor (Restrictive)	Intermediate	Advanced (Enabling)
Organisation	Fragmented group of businesses with no common goals and objectives.	Group of businesses with some corporate governance and policies.	Single business or integrated group with strong corporate identity, governance and policies
Systems - EMS	No systems	Informal Systems	ISO14000 or equivalent
Systems – Financial	No analysis or allocation of overhead costs.	Some analysis and allocation of overhead costs	Activity Based Costing used and/or Environmental Accounting
Systems - Quality	No systems	Informal Systems	ISO9000 or equivalent
Technology	Little or outdated I.T. equipment and software. No/little commonality.	Variable levels of I.T. and software across business(es)	Latest IT hardware and software, common to all businesses.
Technology - Infrastructure	No/little electronic communications.	Some electronic communication links (e.g. within divisions)	All businesses linked to and making full use of intranet (or equivalent).
Information	No common information available. Few records retained.	Some common information recorded by businesses. Some records retained.	Comprehensive, common information recorded by all businesses and readily available.
ASSESSMENT	**Difficult to implement Group-wide EPE system. Start with very simple measures or third party audit.**	**Implement semi-manual Group-wide EPE system. Identifying common information to start.**	**Fully automated EPE system should be easy to implement**

Assessment matrix 4:

Step 4c: EXTERNAL PRESSURES - Stakeholder Analysis (partly inspired by Wheeler & Sillanpää 1997[6])

EXTERNAL PRESSURES	**Low**	**Moderate**	**High (Compelling)**
Investors and Shareholders	No requests for environmental performance data from investors	Occasional requests for environmental performance data from investors	Regular requests for environmental performance data from investors
Employees and managers	No employees or managers have raised environmental concerns	Some employees and managers have raised environmental concerns	Many employees and managers have raised environmental concerns
Customers	No mention of environmental issues	Some environmental conditions applied (e.g. material restrictions)	Good environmental management is a condition of contract
Suppliers and partners	Suppliers are not addressing environmental issues. OR suppliers present no environmental risk.	Some suppliers are addressing environmental issues.	Suppliers are proactive in addressing environmental issues. OR suppliers present high environmental risk.
Local Community	No complaints about business activities.	Occasional complaints about business activities.	Active community concern. Frequent complaints about business activities.
Competitors	No competitors are addressing environmental issues	Some competitors are addressing environmental issues	Key competitors are in strong environmental position
Government and legislation	No government restrictions & legislation anticipated	Current government restrictions & legislation not anticipated to change in near future	Increasing government restrictions & legislation aimed at products and/or key activities.
Media	Media have taken no interest	Associated effects of products and activities have drawn some media attention	Products and activities are drawing direct media attention
Social Trends	Products and activities perceived as environmentally benign	Associated effects of products and activities increasingly seen as unacceptable	Products and activities directly identified as increasingly unacceptable
NGOs and Pressure Groups	No attention from pressure groups	Products and activities indirectly targeted by pressure groups	Products and activities directly targeted by pressure groups
ASSESSMENT	**Little or no external pressure to address environmental issues. Focus on internal drivers.**	**Worth starting to measure environmental performance. Chance to be proactive before pressure increases.**	**Definite need to address environmental issues and measure environmental performance. Identify strongest influences.**

5. Many of the ideal measures will not be currently available within the business, and data collection systems may need to be set up. However, there is often a lot of current information that can be used directly or adapted to provide adequate performance indicators. Some other information can be collected quite easily at little extra cost and existing systems (e.g. central MRP systems) can be altered to record and report the extra information. Existing data that can be used includes:

   - Purchasing records – this should indicate all materials, goods and services bought in, although some amendments are often necessary to convert materials and substances to common units.
   - Utility Bills – electricity, gas and water are usually supplied by metered pipe line and paid for based on quantity used. Utility bills should provide both financial and consumption data. If meters are accessible, the site could also read the meters on a more regular basis than the bill frequency, in order to track improvements more closely. On a large site, sub-metering can help to identify and monitor large consumers and then improvement projects can be targeted at particular departments. On one Lucas site, 30 extra water meters were installed and the water consumed by each department was reported back to the responsible manager each week. Just by increasing awareness of consumption, water use dropped by 50% within 6-months[7].
   - Waste records – although sometimes the data recorded is not too helpful, as it may combine wastes together, or record the number of skips removed, rather than the weight of waste.
   - Production records – number of hours worked or products made can be used to normalise data to give "per unit" efficiency figures.

6. The current information and some "acceptable extras" (i.e. extra information that will not be too difficult or costly to collect) will go part of the way towards the vision (i.e. a Partial Vision). At this stage a business may want to collect data for a specified period (say one year) in order to give itself a baseline against which to set new targets (this has been the case at LucasVarity).

7. An Improvement Plan would then need to be developed with the management team in order to make changes to working practices and processes, which would take them nearer to their vision. Current business constraints (time, money, and human resources) will need to be incorporated in order to develop an implementable and realistic Plan.

8. Following implementation of significant actions in the improvement plan, the business will need to reassess its position, in terms of its significant effects (incorporating the latest business changes and external pressures) and hence its Vision. It may be that parts of the vision have already been realised, or events have overtaken the business, necessitating reassessment of the whole performance evaluation system.

Literature:

Environmental Performance Measurement is still an important yet difficult to define subject. The Institute of Environmental Management (IEM) has identified "measuring and reporting business performance" as one of its four areas key to the development of environmental management and successful business[8].

IEM focus on three areas: Benchmarking, Reporting and Measurement.

- Benchmarking compares businesses with their competitors and contemporaries
- Reporting informs stakeholders of environmental progress and
- Measurement is the internal mechanism of collecting the relevant information in order to aid management decision making.

It is this third area, of measurement for internal awareness, management and improvement of environmental performance, which this thesis focuses on. One could argue that this is also essential before Benchmarking and Reporting can be effectively carried out.

One of the most significant and comprehensive reports published this year was ACCA's "Environment under the Spotlight" by Martin Bennett and Peter James[5] (I participated in the research for this report in 1996, as an interviewee in the guise of Environmental Manager at Lucas Industries). This section summarises the contents of the report and in some cases compares LucasVarity actions with those described in the book.

Bennett and James' Executive Summary (p i) opens with the prediction:

> "Almost every company will need to pay greater attention to environment-related performance measurement, both to have better data for internal decision making and to meet the demands of ever more sophisticated stakeholders. They will also have less flexibility as initiatives such as ISO14031 (guidelines on environmental performance measurement) and government regulations build a consensus about what should be measured and how it should be communicated."

Their research, based on a survey of the Times 100 companies and interviews with environmental managers and stakeholders – including the then Environment Manager at Lucas Industries (the author of this progress report!), produced these main findings (p i-ii):

1. There is wide variation in practice from first to third generation* approaches.
2. More reliable and focussed communication is needed
3. Barriers must be overcome
4. Lack of comparability creates serious problems

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* See page 35 for a table describing First, Second and Third Generation approaches. In brief, First Generation is a reactive, compliance driven approach, Second Generation is more an efficiency and quality approach, whereas those with a Third Generation approach are striving towards Sustainability. I have tried to reflect these 3 generations (or levels) in the assessment matrices shown in the EPE Methodology section.

5. Important areas are being neglected
6. Institutional infrastructure is underdeveloped.
7. Governments should illuminate with lasers, not light bulbs (i.e. focus on a small area intensively (mandatory disclosure) rather than a wide area to varying degrees of intensity).

They cite External pressures for better environment-related performance measurement (p iv) as:

- "Demands for information by regulators and other government agencies" {packaging regulations, authorised processes etc.}.
- "Public concern about risks to health and ecology".
- "The desire of investors and lenders for reassurance that their financial interests are not jeopardised by environmental problems" {clean-up costs, closure, bad publicity – Lloyds crash was mainly due to environmental liabilities}.
- "Pressures from industry associations and other business sources to improve performance" {ISO14001, Chamber of Commerce Charter for Sustainable Development}.

Internal business and environmental benefits (p.v) (from European Green Table report) are given as:

- "Provides the management with concise and quantifiable environmental information"
- "Improves the basis for companies' environmental policy objective and targets."
- "Improves the basis for companies' internal and external environmental reporting as well as communication regarding environmental issues"
- "Enables companies to define their significant environmental aspects and describe and measure their environmental performance"
- "Enables companies to focus on and demonstrate continual improvement of environmental performance"
- "Serves as a useful tool for those aiming at certification to ISO14001 and EMAS"
- "Enables companies to complement existing environmental performance scopes by including developments of indicators for Health and Safety"
- "Improves the basis for internal and external benchmarking"

Disparaging remarks about internal efforts to improve environmental performance (p vi), which Bennett and James collected during their interviews, include the following [*my own comments are added after each point*]:

- "Much common environmental action (including environment-related performance measurement and reports) is for public relations reasons rather than motivated by a desire for real environmental improvement." [*This was certainly true in the past – the interviews were conducted over the last 2-3 years – but over that time increasing awareness of the public, and scrutiny by* *pressure groups, has dissuaded businesses from making claims that cannot be backed-up.*]

- "Internal desires for environmental improvement are often diluted by budgetary and other business constraints – hence external compulsion, such as mandatory environmental reporting, is necessary to achieve effective action and to provide necessary information to external stakeholders. [*It is certainly true that business constraints can dilute efforts, particularly in businesses where management is not truly committed to environmental improvement. Mandatory environmental reporting would not make a difference to the most advanced companies, who have probably already surpassed any mandatory level of reporting, but it would help to raise the less committed participants to a minimum level of achievement.*]
- "In practice, companies pay much more attention to measurement of environmental parameters than to other aspects of the sustainable development agenda such as eco-justice, so that the latter is effectively marginalised." [*This is true because this is the starting point for environmental measurement and the majority of companies are still only just starting or yet to start environment-related performance measurement. Also, legal and societal constraints concentrate on such measures to the exclusion of the sustainability criteria.*]
- "A focus on measurement and quantification can itself be a symptom of a rationalistic "managerialist" discourse which attempts to impose its own limits on environmental debate by marginalising alternative points of view, such as those which are based on more spiritual approaches, or which challenge the basic legitimacy of multinational companies." [*This is a valid point, but realistically, this is where business managers currently need to focus because measurement is a language they understand and can deal with. More "spiritualistic" approaches are a whole paradigm shift away from present practice and are unlikely to be accepted as valid or necessary to the business manager who is struggling to achieve production output and survive against competitors.*]

Bennett & James' response (p vii) is to be sympathetic to some of these points. They explain that most companies are still responding to compliance and are far from sustainable [*as I have intimated in my responses above*]. They state that in their practical experience measurement does not have to be in place to achieve environmental performance, if belief and commitment are strong [*I know this is true – but you can only go so far, especially if management are not fully convinced, which is usually the case*]. Bennett and James state that they do believe that business level measurement can be useful but that the reality of the activity is much messier than outsiders think [*I agree – the messy bits are to do with the culture, infrastructure, personalities and other factors (see assessment matrices 2,3, & 4, pp 18-20)*].

Bennett & James' approach is one of management accounting (p viii) (i.e. using data for internal decision making) rather than financial accounting (data for the external world).

I agree with this approach for the following reasons:

1) when we clearly have so little understanding of our own business impacts, data collection and analysis must be focussed on internal audiences and

providing tools for prioritisation, objective and target setting, decision making, motivation and progress monitoring.

2) data is often incomplete or semi-qualitative, this would not be suitable for external scrutiny, but is sufficiently useful for internal purposes,

3) external reporting may open the company up to more questions than they feel capable of answering. It is better to build self-confidence internally first, being sure of the issues, the impacts and having some tangible solutions ready.

Chapter 1 covers 3 levels of <u>performance measurement activities</u>.

a) Individual performance indicators

b) The performance system as an entity

c) The relationship between the performance measurement system and its external context

a) Individual Performance Indicators (p5):

People have attempted to develop broad categories of indicator (e.g. ISO14031's EC, OP & MP[9]), but however they are categorised, the detailed data is still required. "Whatever the area of measurement, good indicators have the purpose of turning basic data into useful information which can alter perceptions and change behaviour."

Relative measures are particularly useful – though not always easy to find the right business indicator to relate to the environmental data.

b) Performance measurement system (p6)

There is always a risk of focussing on a few measures at the expense of others [*that's life!*]. A balanced scorecard is one way of ensuring that financial factors do not dominate and helps to link environmental measures to business-focused measures. [*see 30-month report for Lucas Aerospace application of environmental measures to their balanced scorecard*]. Effective information is also dependent on systems for collecting, collating, analysing and using the relevant data [*see comments in 1998 EngD Conference Paper, in Appendix AB*]

c) Relationship with the External Environment (p8-10)

There have been many surveys analysing the subject of corporate environmental reports and a few surveys on the first EMAS reports. [*No surveys have been carried out on internal reports, mainly because this information is not in the public domain – this could be an interesting area of research, but beyond the timescale of this project.*]

The problem of comparability is that organisations and their divisions are measuring different things, in different ways, for different purposes. Comparisons therefore have to be against historical performance or with present targets / benchmarks. Commonality is not a problem if the business is not interested in external comparisons, although there is more and more call for standardised reporting formats.

Bennett and James discuss the major differences between the UK & USA. The major difference is the legislation that requires disclosure of certain information in the USA (e.g. Toxic Release Inventory [TRI]). The by-product of this however, is that the US companies are very reticent to publish any other information, which could possibly be used as evidence in litigation. As a result the American corporate report tends to be less factual, quantitative or informative than European reports.

Chapter 2 looks at examples of Environment-related performance indicators. Each of these examples is compared to LucasVarity's approach to environmental performance measurement.

ISO14031 Environmental Condition (EC) Indicator types (p18/19):

BSI ISO14031	LucasVarity
a) receptor indicators – air, water, soil (e.g. BOD)	Not collected at Group level. Receptor (i.e. air, land, and water) vulnerability assessed at site level.
b) sustainability indicators (e.g. level of emission per unit of production)	Accurate emission data not available. Mixed production makes per unit indicators difficult.
c) proxy/risk environmental condition indicators (e.g. ICI's Environmental Burden)	Risk assessments, calculation of significance. Site vulnerability assessment. – at site level.

ISO14031 Operational Environmental Performance (OP) Indicators (p20–24):

BSI ISO14031	LucasVarity
a) Materials – e.g. how much x how toxic, or utilisation of recycled materials	Risk assessments, calculation of significance
b) Energy – one of the most important, plenty of information, government initiatives etc	Yes
c) Input Service – e.g. transport	No (company does not operate own delivery transport service, therefore data is difficult to obtain. This would need collaboration with our transport supplier. Company car mileage is not currently collected, although this would be possible via expense claims).
d) Facilities and Equipment - indicators of efficiency (e.g. no. leaks, downtime)	Not currently.
e) Logistics – e.g. vehicle fuel efficiencies	No (see c.)
f) Product – measures of what make the product "greener" e.g. fuel efficiency or drinking water quality	PIM (Product Introduction Management) Gateway reviews (how many questions answered positively)
g) Output service – e.g. provision of water meters to help stop wastage	Not generally, but implemented at some sites.
h) Emissions & waste – often required by regulators & usually highly visible – very common. ICI prioritise their waste based on Environmental Burden	Yes, VOCs (air), Waste (broad categories), Effluent (Quantities) No attempt at Environmental Burden approach yet.

ISO14031 Management Environmental Performance (MP) Indicators (p26-31):

BSI ISO14031	LucasVarity
a) Implementation & conformity – implementation of policies and programmes, customer satisfaction, training	Management systems self-assessment Customer Satisfaction not measured. Training (though problems agreeing on common approach)
b) Stakeholder Indicators – e.g. customer satisfaction, Ecotec survey for IBM	None
c) Financial – any indicator expressed in monetary terms & any environmental cost (see table 2.2 p30)	Divisional – Energy, water, waste, VOCs, clean-up costs

Relative, Normalised, Aggregated and Weighted Indicators (p31-40)

Bennett & James	LucasVarity
Relative Indicators – relate data to different units e.g. emissions/production (complementary to absolute figures not replacement, because total can still rise even if relative goes down!)	Use Sales and FTE to normalise. Not many other comparable numbers (but could use "standard hours" (a measure of labour – so proportional to production)
Normalised – relate and absolute or relative measure to a defined baseline (e.g. a year)	Not yet, a complete set of annual data has yet to be collected.
Aggregate – overall figures – crude indicators	Energy Waste & effluent VOCs
Weighted – often used internally, to help prioritisation (contentious outside)	Included in Significant Effects calculations Take part in BiE's Index (10 questions of equal weighting)
Eco-points – weighted product indicators	Not used so far

Environmental Risk Ranking (p41)

Bennett & James	LucasVarity
Often used by investment companies, score based on a set of criteria – often a small number can be used as a proxy, due to difficulty of obtaining information	Included in Significant Effects calculations

Supplier Assessment (p43)

Bennett & James	LucasVarity
Many companies using questionnaires and conformance with independent standards, e.g. ISO14001	Simple Audit protocol developed to be used by supplier quality auditors.

All the above are different types of performance indicators. There are relatively few examples in each category [*because it is too complicated!*]

Chapter 3 covers current thinking amongst environmental management practitioners (p47-50)

Thirteen hypotheses were presented to environmental management practitioners who rated on a scale of 1-5 whether they were in Total Agreement (1) or Total Disagreement (5). The Hypotheses were ranked based on the which most respondents were in total agreement with (as follows).

A. Simple, easily communicated, environmental performance data is better than sophisticated data which is difficult to understand. [*I totally agree with this – from practical experience performance measurement data is not completely reliable and therefore there is no point trying to be too clever, because too much analysis may magnify errors.*]

B. Environmental performance data is not yet as reliable as financial performance data. [*This is undoubtedly true because the environmental data collection systems are not as mature as financial ones and the requirements are not clearly defined – if at all!*]

C. The best way to improve environmental performance is to use measures which have business as well as environmental significance. [*this is clearly an advantage when trying to persuade environment-sceptics to invest time and effort into measuring environmental performance.*]

Five other hypotheses commanded less total agreement (between 31%-52%] but still enjoyed total or partial agreement from a majority of respondents. The highest ranked of these five - and the fourth highest ranked overall - is :

D. Environmental performance measurement is context-specific and will continue to vary between companies, industries and countries. [*There is a paradox here which can be accommodated. Greater comparability and standardisation can be achieved, but each business will still want to retain some specific performance measures for its own purposes of addressing its own environmental impacts and related objectives.]*

E. It is essential to identify the ultimate users of environmental data and involve them in developing measures. [*This is an iterative process, since my experience has shown that many users will not know what they want until presented with some data. Environmental measures can be designed initially without the users full involvement (although their requirements must obviously be addressed) – however, development of the process and review of the effectiveness of the measures must involve those who collect the data and use the results.*]

F. In future, organisations will have to pay much more attention to measuring the compatibility of their activities with sustainable development [*this is true, but is still an alien concept to many.*]

H In future, organisations will have to pay much more attention to measuring their ultimate impact on ecosystems [*as above*].

G. Internal audiences for environmental performance measures will become more important over the next decade. [*From my own point of view, the internal audience is the most important already*].

The rating of other statements concluded that :

It is easier to justify the resources involved in the preparation of site reports rather than external reports, since the benefits created are far greater [*Definitely a view I* *share*].

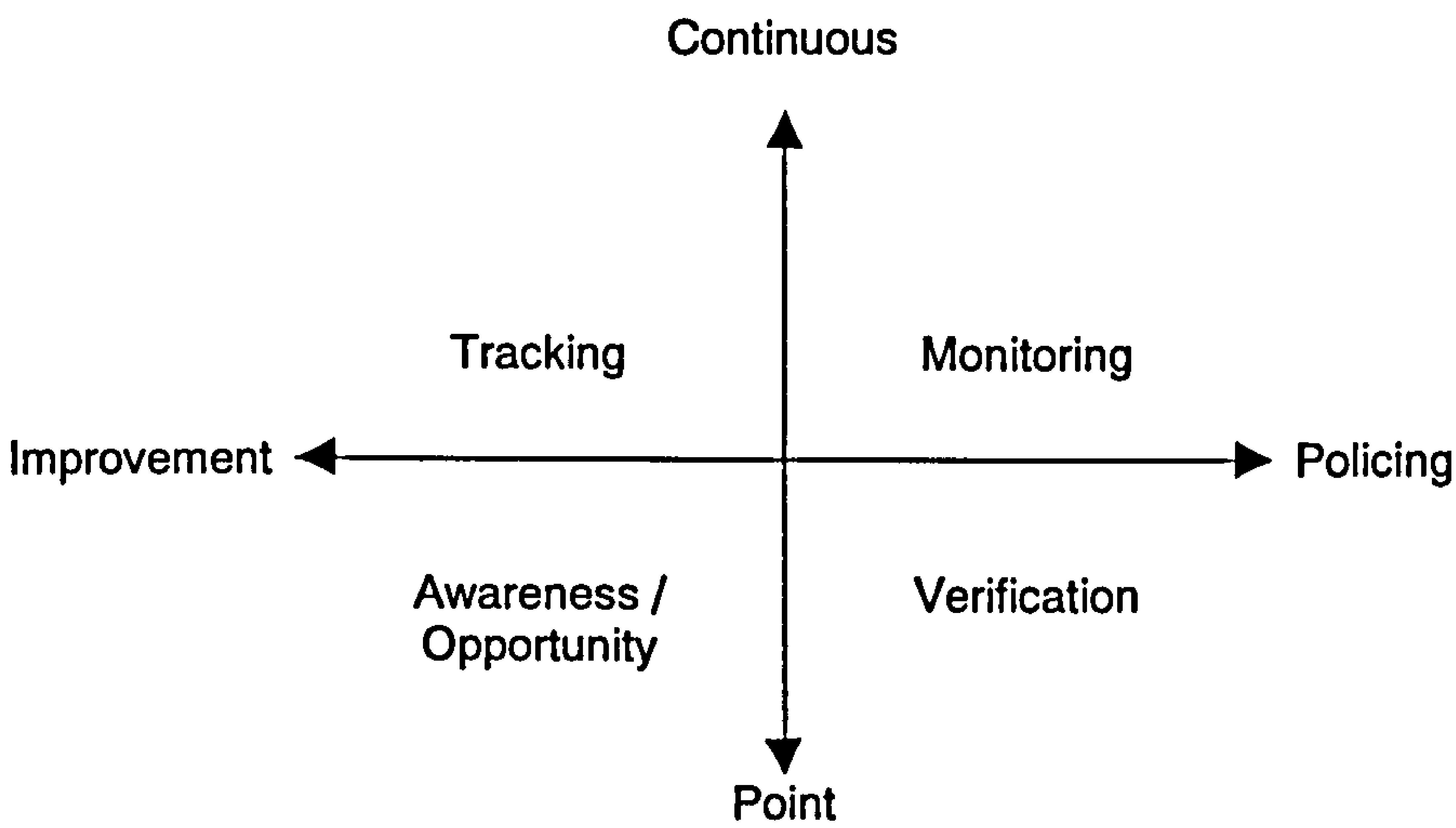
The conclusions of this survey (p50) suggest that, "at least amongst our respondents, environment-related performance measurement is in a transitional stage in its development. Most acknowledge that more needs to be done, in particular to pay greater attention to impacts rather than emissions and to a broad sustainability agenda rather than a narrow environmental one. But for the present their focus is on more immediate concerns, such as developing simple, readily understood measures which speak to non-environmental staff in the company by addressing mainstream business concerns. This reflects the generic position of environmental managers as agents who must generally rely on influence rather than direct authority and must often translate environmental concerns into business language (James and Stewart, 1995). Even so, there are some grounds for concern in the mismatch between practitioner responses and some key themes in the general literature, particularly with regard to the importance of sustainable development, comparability and reporting."

Chapter 4 (p 51) covers the <u>Audiences for Measurement</u>.

Another survey identifies internal audiences (managers, environmental staff, and employees) as most important, this compares with the previous views favouring internal reporting over external reporting.

The most important external audience was regulators.

A categorisation of environment-related performance indicators by purpose, is represented (p55) by the following diagram:



For LucasVarity, the quantitative data is mainly for improvement, although there is a policing element in the self-assessment process. Monitoring for compliance purposes is usually carried out by/for external agencies and sites are trusted to do that on an on-going basis. Verification happens when corporate audits assess compliance with legislation and company standards.

Another survey (p57) looks at which forms of comparison are considered important. Bennett and James' respondents rank these in order of importance.

1. Comparison with past performance [*considered most important (most specifically comparable)*]

2. Comparison with improvement targets [*linked to 1*]
3. Comparison between divisions/sites [*important for competition purposes/peer pressure*]
4. Comparison with external "best practice" organisation [*less important but helps to gauge that we're going in the right direction*]
5. Comparison with other external organisations in general [*less important but helps to feel good, and promotes camaraderie and support amongst companies of similar size, organisation and sector*]
6. Comparison with ideal type of environmental management [*LucasVarity Standards aim to do this*]

In summary, most Environmental Performance Measurement is focussed on resource consumption, emissions, and waste. These are straightforward, visible and the data is generally available for compliance or efficiency purposes. Underdeveloped areas include impacts, stakeholder satisfaction and financial indicators. This is in part due to the conservatism and lack of ambition of UK companies, but also due to difficulties in measuring and obtaining external reference data. There is no environmental equivalent to standard financial and operational performance data.

Chapter 6 covers the Implementation of Environment-related performance measurement (ERPM)

The challenges and themes are listed below:

- The process of ERPM can be as, or more, important than the data. It raises awareness, starts people thinking, and builds support for more proactive environmental initiatives. It is also an ongoing, iterative process, because much data is incomplete to begin with, and will be improved over time. [*this concurs with LucasVarity's experience*]
- Balancing simplicity and complexity – the general lesson is to start in simple ways and then build on this over time. But beware that you don't miss the real impacts, just because the data is hard to get to [*there is no room for complacency!*].
- Life cycle Assessment – used by a few. Involves Inventory (inputs and outputs at each stage of life cycle); impact assessment (what is the impact of each area documented in the inventory); improvement analysis (what are technical and economically feasible ways to improve environmental impacts of product). Main problems are in defining boundaries and collecting information outside your area of control; also difficult to communicate outcomes in a simple manner [*this takes considerable resources, but is being developed by another Research Engineer working with LucasVarity*].
- Ensuring reliability of data – directly measured data is the most reliable, but can be expensive or very difficult to obtain. Therefore data is often derived e.g. input - output = losses, this introduces margins of error. Data reported from sites may be estimated, actual, calculated, converted from different units, described differently, etc. [*This is discussed in more detail in the 1998 EngD Conference Paper, see Appendix AB*].

- Achieving Cost-Effective Data Collection – balance between what is economically feasible to measure. Often there is more data around than is commonly realised [*this was the case in LucasVarity*]. Bennett and James advice is to gather all existing data and see what can be gleaned from that, before setting up new systems.

  Stages:

  - Development of a standardised form [*yes – we took this approach, otherwise information is returned in a multitude of formats, which makes it impossible to analyse.*]
  - Development of standardised definitions and data collection protocols [*yes, definitely needed to ensure that all data suppliers return compatible data.*]
  - Maximisation of direct measurement in order to reduce errors associated with estimation or conversion [*yes where possible, although collection of data from other countries invariably results in some conversion and estimation of data.*]
  - Continuous monitoring wherever this is feasible [*required at some sites with compliance issues, e.g. air emission or effluent discharge monitoring.*]

An overview of data gathering methods is shown on p72

Source: Wehrmeyer, W, Measuring Business Environmental Performance, Cheltenham: Stanley Thomas, 1995, p220. [*adapted by N.Lawson*]

Method of Data Gathering	**Examples**	**Advantages**	**Problems**	**Likely cost of Data**	**Relevance of Data**	***N.Lawson comments***
Existing Records	• Energy bills • Car mileage records • Materials use	• Often accurate • Available • Historic analysis possible	• Different use of data • Often only secondary or combined data • At times too aggregate (annual data)	Often low (cost of data retrieval)	Varies, often very high (esp. for resources such as energy, materials, water)	*Good place to start.* *May have to hunt around different departments for it (e.g. Finance, HS&E, WED, personnel)*
Automated	• Steam pressure/ temperature • Production figures	• Easily available • High data reliability • Chronology possible • Use of IT	• No data in case of equipment breakdown • Technology available? • Learning curve	High start-up costs, very low running costs	High but very specialised	*Company unlikely to invest unless clear benefits can be seen, or it is required by legislation.*
Special collection – regularly	• Waste arising • CO_2 emissions • Failure records • Health & Safety	• Primary data (1 dimension) • Allows bench-marking • Time series possible	• Rise in fixed costs • May generate relevant data	Difficult to identify, depends on how well collection can be integrated	Depends, but potentially high since data gathering is tailored to specific purpose	*Manual records often available* *Some can be calculated (e.g. CO_2)*
Special collection – one-off	• Supplier survey • Boiler house testing • Emissions testing	• Allows high specification • Usually primary data • Good for initial survey • One-off costs	• Cost • No chronology possible • Difficult to compare	Can be very high	High since tailored to a specific purpose	*May be necessary for compliance, or could be justified by other measures*
Interviews (formal or informal)	• Supplier feedback • Supervisor report	• Detailed data gathering • High specific	• Limited applications • Confidentiality • Time-consuming • Difficult to standardise	High opportunity costs (management time)	Depends on the quality of responses and the perceived freedom of respondents to be honest	*Can be obtained during audits or using feedback forms.*
Questionnaire	• Supplier audit • Employee attitude survey	• Good for complex issues • Chronology possible • Statistical analysis	• Difficult to compare • No easy bench-marking	Rises with method, survey size and number of questions	Depends on the questions and sample size, but potentially high	*Needs to be targeted at the right people*

Target setting is described on p81:

If targets are too easy (as they inevitably are) they will not drive improvement. "Stretch" targets, if ambitious, can achieve radical improvements, once mental barriers have been removed. However if they are not achieved, they can demoralise or be criticised. The best targets are unambiguous and specific.

Key success factors in implementation of indicators and targets are listed on p82 against experience gained from LucasVarity:

Success Factors	Notes	*LucasVarity*
Gaining senior management support	Senior management must back the initiative, review the data and be seen to act on it.	*Difficult to get senior management commitment at first. Divisional executives, represented on the Group HS&E committee were more conservative about what the sites were capable of than the sites.*
Distinguishing between strategic and operational indicators	Not just operational indicators – there is a need to link it to strategic issues	*Linked through EMS and need to identify significant effects and hence targets and objectives.*
Making progress through incremental steps	Start small and simple, then build on it. Particularly important if support is poor.	*Tried to be too ambitious to begin with. Management nervous. Simpler approach accepted. Now we expect they will demand more information.*
Ensuring that indicators and activities are compatible with corporate culture	Don't try things that are too radical for the organisation. Balance between top-down and bottom-up approaches.	*This is why we have concentrated on a small number of measures, based generally on available data.*
Providing incentives	e.g. building it into personal objectives of managers. In some cases environmental performance is related to bonuses.	*Some divisions have included environmental performance in managers objectives. It has focussed minds!*
Making indicators clear and controllable	Allocating costs to individual budgets, if the managers are in a position to do something about it (e.g. can they switch off the lights if they want to or are they controlled centrally?	*Needs to be broken down into more detail at site level*
Providing maximum flexibility	Provide targets but allow sites flexibility in how they do it.	*Lesson learnt in 1994 when targets were set, which could not be achieved by all sites (in some cases, nothing to reduce!). In future we would prefer to set general corporate objectives and let sites set own targets & achievement dates, based on local priorities.*
Maintaining momentum	How to stop people getting blasé? Re-launches, changing focus, targeting specific issues at different times.	*Will review process annually.* *Lucas Aerospace MOP reports to focus on different area each time, identical format each time thought to bore the reader.*

The development of Financial Indicators is discussed on p85:

It is felt that financial indicators could help to build commitment, by showing contributing of environmental actions to business success [*this is important to LucasVarity since they utilise the Economic-Value-Added (EVA) approach – see EVA diagram in Appendix AF*].

The Baxter Healthcare example (p86) lists 3 types of Expenses:

1. Definite – already occurred as a result of basic contractual commitments or operational needs. Avoidance of these costs = savings.
2. Probable – highly likely to occur e.g. unavoidable regulatory requirements and other projected variables. Avoidance of these = "avoided expenses"
3. Possible – could occur given certain developments, such as new regulations.

Variations in Corporate Approach are discussed on p87:

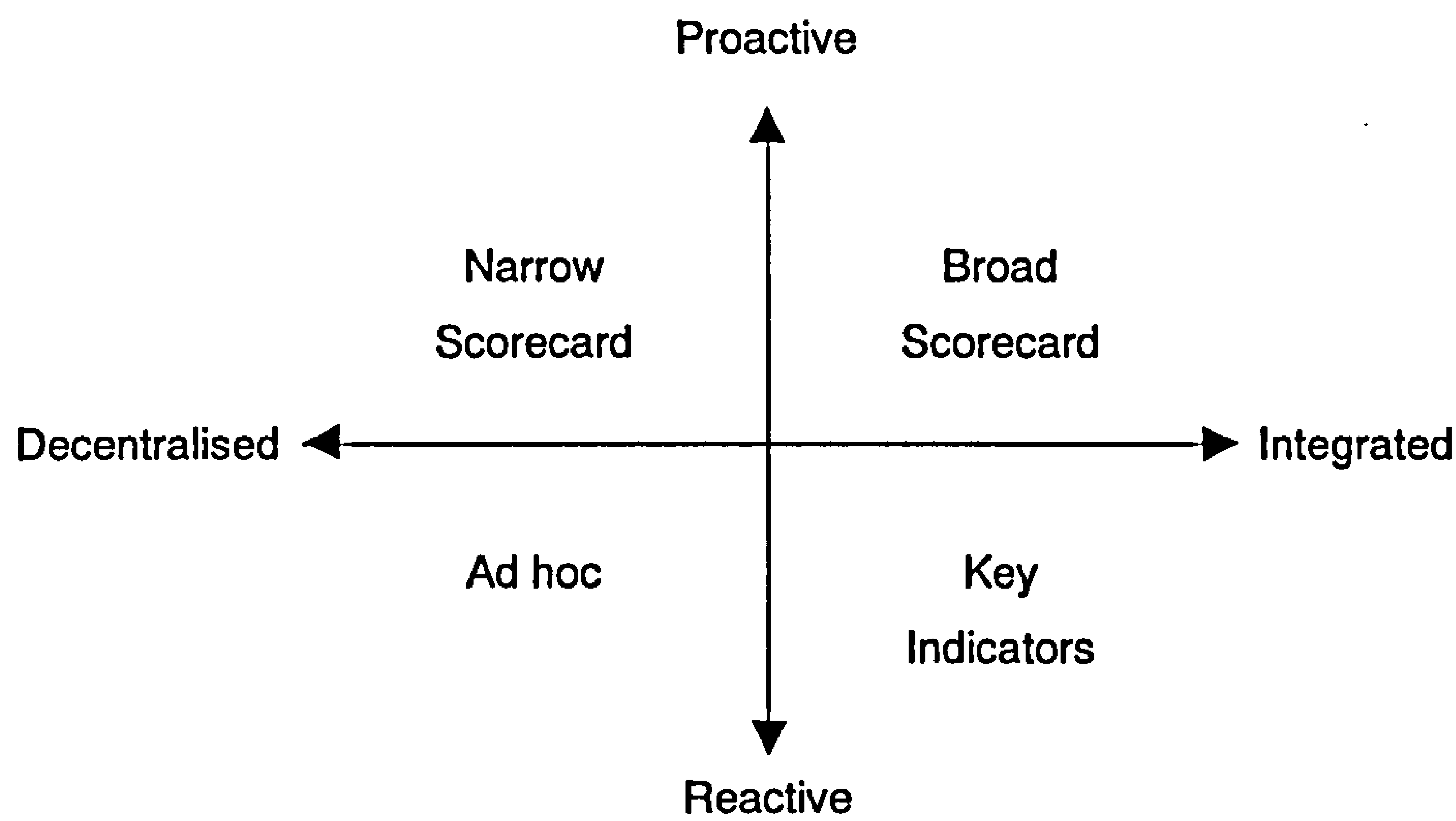
The approach depends on the structure of the organisation, i.e. decentralised vs. centralised. In more decentralised companies there is a bias against transmitting data to headquarters and vice versa, unless absolutely necessary. (This is seen as bureaucratic, time-wasting, even "big-brother", therefore there is a need to give something useful back in return for the raw data – i.e. an overall assessment, analysis of the data, graphs, league tables, comparisons to more "domestic" type information). [*This is the attitude taken by LucasVarity*].

"Many stakeholders also interact with the company at a corporate level, and are seldom impressed when the centre appears not to know what is happening at the periphery."

Why is data needed centrally at LucasVarity?

- *Originally the HS&E department wanted to use the data as a measure of*
    - *a) the effectiveness of its work (policy, standards, audits, guidelines, technical advice) and*
    - *b) to target areas that needed more development and central input.*
- *Now the data is needed to*
    - *a) give the "big" picture,*
    - *b) understand the global impact of company,*
    - *c) focus on companies with poor environmental management or having difficulties,*
    - *d) have a corporate response to stakeholder inquiries, and*
    - *e) raise the profile of environmental issues.*

<u>Corporate Approaches to environment-related performance measurement</u> are represented on p88:



These 4 approaches can be summarised by:

Approach	**Organisation**	**Activity level**	**Reason for E-MOPs***	**Type of E-MOPs employed**
Ad-hoc	Decentralised	Reactive	Compliance	Incidents Simple costs Energy use
Key Indicator	Integrated	Reactive	Focus on main significant effects, using existing data	Risk & Resource utilisation Implementation (from auditing)
Narrow Scorecard	Decentralised	Proactive	To measure all significant effects	Develop a few representative indicators
Narrow Scorecard	Integrated	Proactive	To measure all areas of impact	

****E-MOPs = Environmental Measures of Performance***

Conclusions on p89 confirm that it is an on-going process, which is never likely to be completed since constant development and change will occur. This is seen as positive, since it helps to provide dialogue, builds awareness [*and could maintain momentum*].

There are two spectra to environmental performance measurement: The detailed academic standpoint (LCA, eco-balance) versus the simple industrial practitioner. A common ground will eventually be found in the middle as industry becomes more sophisticated and academics more pragmatic.

There is also general agreement on the unreliability of environmental management data (but this is not a reason not to do it).

Chapter 7 Summarises the conclusions of the whole report:

1. Most companies need to pay more attention to it for internal decision making and to meet demands of increasingly sophisticated stakeholders. Less flexibility in future when ISO14031 and government regulations define areas to be measured.
2. Wide variety of practice, at three levels: first, second third generation (see next table). The more progress made by a few, the more it will be demanded of others.
3. Scepticism about corporate environmental reports (concerns are accuracy, focus and audience)
4. Internal audiences seen as more important than external
5. Implementation: The best approach is to start simple with maximum use of available data, addressing mainstream business issues.
6. Process can be as important as the measures – it raises awareness, creates new links between functions and encourages more environmentally focused thinking.
7. Development currently impeded by difficulties such as standardisation of data, communicating to diverse audiences, limited measurement on key strategic areas, little focus on sustainability or social issues, main focus on direct rather than indirect effects, underdevelopment of institutional infrastructure.

Three generations of Environment-Related Performance Measurement (ERPM) (p101) is shown in the table overleaf.

Three generations of ERPM (p101) [*LucasVarity is moving from first to second*]

	First Generation	**Second Generation**	**Third Generation**
Drivers	• External Pressure for compliance • Costs	• Stakeholder management • TQM • Pollution prevention	• Stakeholder dialogue /partnership • Sustainable development • Life cycle Management
Measurement objectives	• Risk Management	• Impress environmental stakeholders • Communicate targets and progress internally / externally • Drive continuous improvement • Resource productivity	• Strategic effectiveness through a balanced scorecard and data repurposing • Data credibility • Support debate • Assess business sustainability • Drive discontinuous improvement • Assess strategic business impacts
Primary audiences	• Senior management • Environmental Staff	• Mass media • Environmental stakeholders • Line management • Sites/communities	• Employees • Product Chain members • Financial stakeholders • Functional management
Key indicators	• Business process • Regulated emissions and wastes • Costly resources • Compliance	• Energy & materials usage/efficiency • Significant emissions and wastes • Financial • Implementation	• Balanced scorecard • Relative (comparative) • Eco-efficiency • Stakeholders • Environmental condition • Products
Data collection	• Ad-hoc	• Required monitoring • Questionnaire • Simple mass balance	• Integrated environmental information system • Eco-balancing

<u>Current Challenges</u> are discussed on p104.

Don't run before you can walk. i.e. you can't jump into level 3 (sustainability) before level 1 is sorted. So there is no sense in developing complex approaches before the fundamental problems are ironed out.

Other difficulties:

- "Limited standardisation of data and a consequent lack of comparability" (if the user considers that comparability matters – although comparison can be "an important stimulus of performance improvement"). [*My work does not propose a standard set of measures – I am more interested in getting businesses* *started on the process. Then, once the wheels are turning they can drive to the finishing point (when someone has decided where that is – it's currently a treasure hunt, with no map, with everyone picking up as many clues as they can, hoping that when the final destination is eventually decided, the pieces they have collected will form a good enough map to get them there). The current route may be tortuous, and they may go round in circles for a while, but at least they will learn a lot about their surroundings at the same time, having explored all the dead ends, put up their own sign posts and generated ownership of the solution*].

- "Problems of communicating with a growing diversity of audiences and stakeholders" (as you go up to 3rd generation) & need to adapt data to be presented in different levels of detail and in different format for different people.
- Limited measurement of the key strategic areas of business impacts and sustainability. [*The dilemma is that people are still trying to understand what their impacts are and they may not know they are strategic until they start to measure them, or they may not measure them if they are not thought strategic! The question of what is sustainability is a whole paradigm shift away from most managers minds. The significant effects procedure will help to identify key impacts.*]
- An excessive focus on firms and sites as appropriate boundaries for measurement. [*This is reasonable – it's what you can see and control – once that's sorted you move beyond it. If everyone just got their own house in order it would be a great move forward – external bodies often try to get firms to run before they can walk – and then they get criticised for overstepping the mark if their own practices leave something to be desired*].
- An underdeveloped institutional infrastructure. [*Is it any wonder that everyone's doing their own thing?*]

On p109 Bennett & James talk about the light bulb versus the laser and they suggest that given a choice one should go for the laser. I would argue that you have to put the light bulb on first before you can to see where to aim the laser!

Summary of Future Work

Research

- Further development and testing/assessment of EPE Methodology
- Completion of literature survey
- Submission of 1-2 papers for journals

Personal Development

- I applied for Full Membership of the Institute of Environmental Management in April 1998. Following submission of my application and short paper, and a telephone interview I have now been awarded the title of "Member" of the Institute of Environmental Management (MIEMgt). (See Appendix AG). This demonstrates the level of experience and competence that I have gained in the field of environmental Management. There are only 100 Full Members of the Institution, which has a total membership of around 2000.

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42 Month Report

Nicolette Lawson
Eng. D Year 4

April 1999

Contents

Boxes and Tables

1 Completed Workpackages:

1.1 Self-Assessment verification

In August 1998, a corporate audit at Lucas Aerospace (the first since the HS&E Department was disbanded) revealed a large discrepancy between the auditors' score and the site's Self-Assessment Score. A verification process was therefore needed to check the Self-Assessment Scores of the other Lucas Aerospace sites. Businesses were requested to explain key processes and supply particular documentation to verify their performance.

The questions used to gather evidence to verify the self-assessment scores are listed in the box below:

Box 1: Verification Questions:

Lucas Aerospace target to reach 80% compliance with the LucasVarity HS&E Standards by December 1998.

Most sites are now reporting Self-Assessment scores of 80%. It will not be possible to conduct full audits of each site before the end of the year but I wish to carry out a verification programme. Wherever possible, I will visit the site and view appropriate documentation. I will be seeking answers or supporting evidence for the following:

<u>Standard MI: Policy, Objectives and Targets</u>

- Please explain your procedure for identifying all those activities which have or can have significant HS&E effects.
- How do you prioritise these issues and what objectives and targets have been set?

<u>Standard M2: Organisational Arrangements</u>

- Please provide the name of the senior manager responsible for HS&E
- Provide a list of the managers and functions represented on the Steering Group, a copy of the terms of reference and minutes for the last three meetings.
- Provide a copy of your HS&E training plan with targets and achievements so far

<u>Standard M3 : Operational Management Systems</u>

- Provide a list of your HS&E programmes, showing the named managers responsible for each programme, an outline project plan and achievements so far.

<u>Standard M4: Self-Assessment and Audit System</u>

- Explain how you review your compliance with the LV Standards and legal requirements.
- How do you assess the effectiveness of arrangements and procedures?
- Are HS&E performance indicators or objectives incorporated into management appraisals?

<u>Standard H 1 : Occupational Health Programmes</u>

- Explain how health risks due to substances, activities and workplace design are evaluated?

- How are Occupational Health considerations incorporated into the management of the business?

Standard SI : Risk Elimination and Control Programmes

- Provide a copy of your top level Risk Elimination and Control Programme, detailing management responsibilities.
- What progress had been made i.e. how many assessments have been completed, how many are still required, how many actions have been implemented and how many re-assessments have been carried out?

Standard EI : Environmental Protection Programme

- Explain what controls are in place to manage potential sources of contamination to ground and groundwater, effluent and surface waters, air emissions and waste

A tabletop audit was carried out in December 1998 to check the self-assessment scores of all 21 businesses in the division, prior to accepting their claim of 80% before the end of 1998.

Only one site was verified as having achieved the objective (80%) in the first verification round. Most others were within 10% and after requests for further data and clarification, sites were re-verified and eventually all achieved 80% by the December 31st deadline.

In summary, whilst Self-Assessment is a valuable tool for sites to monitor their own progress, third party audits or verification are also needed to maintain the standard of assessment across businesses.

1.2 Internal Reporting

After two factual quarterly reports about the results of the HS&E MOPs (Measures of Performance) – the first about all the measures generally and the second focusing on waste – the third and fourth were assessments of the company's global environmental impact with respect to specific environmental issues. Following the collation of the final data sets for 1998, the latest report "Our Environmental Challenge" was produced (Appendix AH).

This section describes the process:

It was decided that the MOPs data should be linked to Global Environmental Issues in order to be able to communicate the relationship between the company's activities and well-known Environmental problems.

ICI (1997), Sunderland & Thomas (1997) and the Open University (1998) all propose a set of Environmental Issues. These are tabled below against those chosen for the Lucas report.

Table 1.1 Categories of Environmental Issues

Issue	**ICI 1997**	**Sunderland & Thomas 1997**	**OU 1998**	***Chosen for Lucas 1998***
Air Pollution (Acid Rain)	Acidity – Atmospheric	Acid Rain	Air Pollution (Acid Rain)	*Air Pollution (Acid Rain)*
Air Pollution (Smog)	Photochemical Ozone Creation Human Health Effects	Local Air Quality	Air Pollution (Smog)	*Air Pollution (Smog)*
Global Warming	Global Warming	Greenhouse effect (Global Warming)	Global Warming	*Global Warming*
Ozone depletion	Ozone Depletion	Stratospheric ozone depletion	Atmospheric ozone chemistry	*Ozone Depletion*
Surface Water	Acids to Water Aquatic Toxicity Aquatic Oxygen Demand	Surface Water	The Marine Environment	*Aquatic Toxicity*
Waste	X	Waste Burden	X	*Land Degradation*
Use of Resources	X	Natural Resources	X	*Resource Depletion*
Soil & groundwater contamination	X	Soil & groundwater contamination	Land Degradation	*Land Degradation*
Bioaccumul-ation of toxins	X	Bioaccumulation of toxins	Land Degradation	*Land Degradation*
Ecological loss/species depletion	X	Ecological loss/species depletion	Forests	*Deforestation*
Socio Economic	X	Socio Economic	X	*X*
Visual Intrusion	X	Visual intrusion	X	*X*

There is general agreement for Air Quality issues such as Acid Rain, Smog, Global Warming and Ozone Depletion. There is also agreement on the water environment, with ICI choosing three indicators for this media. There is less agreement on "Land" issues, which cover waste, use of resources, soil and groundwater contamination, bioaccumulation of toxins and ecological loss. Sunderland & Thomas also propose socio-economic and visual intrusion issues.

Seven Global Issues were chosen, which it was felt Lucas has a significant impact on. Then some indices were proposed which could show our key contributions to these issues. This is represented in the matrix below:

Table 1.2 Possible Lucas Environmental Impact Indices

	Global Issues:						
Proposed Indices:	**Air Pollution**	**Ozone Chemistry**	**Global Warming**	**Deforest-ation**	**Land Degrad-ation**	**Aquatic Toxicity**	**Resource Depletion**
Acid Rain Index	✓						
Smog Index		✓					
Ozone Hole Index		✓	✓				
Greenhouse Index			✓				
Paper Index				✓			✓
Land Contamination Potential					✓		
Waste Index					✓		✓
Surface Water Index						✓	
Effluent Index						✓	
Resource Index							✓

For each of the proposed indices, the following table details how quantitative information could be calculated and whether or not the calculation is possible now, given the current Measures of Performance data available. This process revealed several gaps in the current data, which will be addressed, in next year's revision of the MOPs data requirements.

Table 1.3: Analysis of feasibility of satisfying proposed indices.

Proposed Index	Calculation	Possible Now?
Acid Rain Index	calculated by the amount of SO_2 produced as a result of energy use	Yes, based on 1996/97 statistics from the UK Electricity Industry and average % content in fuels (used in report)
Smog Index	calculated by the amount of NO_x produced as a result of energy use	Yes, based on 1996/97 statistics from the UK Electricity Industry and NOx produced from fuels during combustion (used in report)
Ozone Hole Index	calculated by the amount of CFCs and Halons released	In theory, all sites should have stopped using CFC solvents. Therefore leakage from refrigeration units is the next source. We do not currently measure this as it is assumed to be negligible. Although it would be possible to record "topping-up" of systems, during maintenance/servicing. Halon, where still in place, should be in totally sealed fire-protection systems, which must only be released in the event of a fire. A Halon survey would reveal the potential harm within Lucas Aerospace.

Greenhouse Index	calculated by the amount of CO_2 produced as a result of energy use Or, CO_2 produced plus NOx and VOCs expressed in CO_2 equivalents	Yes, quantities of CO_2 produced during combustion of each type of fuel are known (used in report).
Paper Index	calculated by the amount of virgin paper used and cardboard packaging	Paper and packaging use is not currently measured, although we could use the paper & cardboard waste figure. However, most paper & card ends up in general (other) waste and so this is not a good indicator. Recording of purchased quantities (weight of paper and cardboard) could give this figure.
Land Contamination Potential	the total capacity of underground storage tanks plus a factor for known historical land contamination	Not currently measured. But this would be good information to collect, given that land contamination is LAe's most costly environmental issue.
Waste Index	the total weight of waste sent to landfill	This can be provided now (used in report). However, due to the mixed nature of the wastes the true environmental burden, due to toxicity of wastes could not be given.
Surface Water Index	the incidents of non-compliance against the surface water consent limits	Not specifically reported, although it could be.
Effluent Index	the amount of effluent discharged multiplied by the average annual concentrations of COD (chemical oxygen demand), toxic metals, oil, suspended solids etc.	Quantity of effluent is reported, although its nature needs to be checked (i.e. some sites report domestic wastewater as effluent) (used in report). Average annual concentrations could be obtained from sites (although not currently requested). Alternatively, their allowable concentrations of substances as defined by consents to discharge. This would give the maximum allowable pollution levels, rather than actual.
Resource Index	The amount of virgin materials used, which cannot be / are not used again.	Fuels for energy could be calculated (used in report). Waste disposed of, including VOCs lost, could be used as an indicator of depleted resources (used in report). Effluent is generally recycled, via the Water treatment companies, and therefore not lost.

Graphs, by site (in descending order of impact) were generated for the 6 indices that could be calculated:

- Acid Rain contributions (SO_2) – due to energy use only
- Smog contributions (NOx) – due to energy use only
- Carbon Dioxide contributions – due to energy use only, and Equivalent Carbon Dioxide emissions – including NOx and VOCs
- Aquatic Toxicity – quantity of effluent discharged only
- Land Degradation – quantity of waste disposed of only

- Resource Depletion – due to fuel for energy, material wasted and VOCs lost

Calculations and assumptions used are explained in the report's appendix A. In Appendices B and C of the report, each of the above graphs is compared to data normalised by number of employees (B) and £,000 Sales (C). In both these cases an average line is also plotted, so that points above the line can be regarded as less efficient and those below the line can be regarded as more efficient than the average.

- **The results**

The report is still in the process of being disseminated, but initial reaction has been good. It has raised the profile of environmental issues and agreement is now in place to set some stretching targets for the year ahead.

The full report can be found in Appendix AH.

It is recognised that there are vast gaps in the data, for example:

- Transport (for goods and employees) has not been considered. (Employee transport to work will be addressed by separate, site-led, initiatives).
- Toxicity of effluent has not been included. (Heavy metal concentrations have been added to the 1999 data proforma).
- Toxicity of waste has not been included (but all waste is disposed of via specialist treatment and disposal contractors).
- Land contamination potential is not known (although this year's targets include a full survey of all bulk storage facilities and rectification of those that fall below acceptable standards).
- The total amount of material used is not known, although it is not considered a priority for Lucas Aerospace, because all wasted materials are recorded and any other material goes into the product. Products typically have a 30-40 year life span (including repair and overhaul) and will usually be recycled at the end because of the value of the materials used.

- **Conclusions**

Using company environmental performance data to illustrate the business impact on certain environmental issues was a useful exercise, if still a very rare thing for companies to do. There was no readily available conversion data and much had to be assumed and extrapolated from many different sources. There are so many variables, that any calculation of this sort is likely to be far from accurate. However, it is an indicator and as long as the same process is followed each year, it will be comparable over time.

These reports have helped to change the focus and priorities of management. The site comparisons, by employee and Sales, whilst not strictly comparable, have highlighted vast differences between sites that need to be investigated. There may be a perfectly logical explanation, or it could be that a business does not know how efficient, or inefficient, it is until they have something to compare themselves with.

Many of the gaps in the present data will be filled by the next year's reporting and data quality will continue to improve until the company builds up a profile of information that it has confidence in.

1.3 Database of Environmental Performance Indicators

In order to assist businesses using the EPE Methodology (detailed in the 36 month report), it was decided to collect together examples of all the quantitative measures currently being used by companies producing environmental reports. The database is far from complete but it currently lists 350 EPIs from over 55 companies. These are spilt into two lists: absolute and relative. This data has been collected from Company environmental reports and surveys collected during this project can be found in Appendix AI. This database will continue to be expanded and used as reference data for businesses wishing to explore the art of the possible, in terms of environmental measures of performance.

1.4 Sustainablity Reporting

On March 4th and 5th 1999, the Research engineer attended at an international conference, at Imperial College, London to launch the "Global Reporting Initiative" (GRI). These Sustainability Reporting Guidelines were convened by CERES with the participation of corporations, non-governmental organisations, consultants, accountancy organisations, business associations, universities and others from around the world. Rather than develop yet another unique guideline, or framework, the GRI seeks to foster a generally accepted framework for sustainability reporting. The GRI Guidelines were developed through consultation with a broad group of stakeholders in an effort to harmonise disparate reporting initiatives worldwide and still accommodate the requirements of other reporting programmes.

The guidelines are now entering a consultative/pilot testing period which extends to December 1999, during which time the GRI wants enterprises worldwide to trial the guidelines and feedback their experiences so that the guidelines can be revised and formally launched in 2000.

Briefly the guidelines require companies to report information in nine parts:

1. **CEO Statement** (Chief Executive's statement describing key elements of the report)
2. **Key Indicators** (These are extracted from parts 3-8 to give an overview of the aspects and indicators)
3. **Profile of reporting entity** (an overview of the organisation and the scope of the report to provide contextual understanding)
4. **Policies, organisation and management systems** (a statement describing the commitment to sustainable developments and how the organisational structures and management processes have been implemented)
5. **Stakeholder relationships** (information on the process and methods by which stakeholders – internal and external – are engaged)

6. **Management performance** (compliance with legal requirements and other voluntary standards including awards and suppliers' performance)
7. **Operational performance** (this is the quantitative performance data on Health and Safety, energy, materials, water, land, non-product output, as well as social and economic indicators).
8. **Product Performance** (indicators of the products performance with respect to environmental social and economic aspects of sustainability).
9. **Sustainability overview** (a discussion of the organisation's efforts and progress towards integrating sustainability into its decision making and performance measurement).

Since the GRI have involved so many stakeholders, the guidelines will be a good place to start for any organisation wishing to start external environmental, or indeed sustainability, reporting.

Appendices

compiled from all Progress Reports

Appendices: Contents

X: Lucas Aerospace Self-Assessment graphs	30-month
Y: Measures of Performance Proforma	30-month
Z: Revised timing plan for year 4 (months 36-50).	36-month
AA: Lucas Aerospace HS&E Measures of Performance Report 1 & 2	36-month
AB: 1998 EngD Conference Paper "The Practicalities of Measuring Environmental Performance"	36-month
AC: Measures of Performance Definitions	36-month
AD: LucasVarity Divisional Analysis of Measures of Performance data for Quarter One 1998.	36-month
AE: "Identifying Activities that have Significant HS&E effects" - A Methodology.	36-month
AF: Diagram showing how management of HS&E improves EVA (Economic Value Added)	36-month
AG: Membership of the Institute of Environmental Management: Application and Certificate of Membership	36-month
AH: "Our Environmental Challenge" Lucas Aerospace Environmental Measures of Performance Impact report	42-month
AI: Database of Environmental Measures	42-month
AJ: Summary of EngD Assignments and Marks	

Appendix A

Management and Environmental Standards

Policy, Objectives and Targets

Management Aim

To set health, safety and environmental objectives and targets in order to comply with Lucas policies and relevant legislation.

Performance Expectations

1. Each business must create a **register** of all those **activities** which either have or potentially have a **significant effect** on the health and safety of employees and/or the environment.
2. Each business must define its **priority issues**, based on the level of risk, legal requirements, levels of performance and financial implications.
3. Each business must specify **objectives**, with demonstrable links to priority issues, **to manage, improve and monitor** the requirements of the Lucas HS&E policies and standards.
4. **Targets** will be established, for the achievement of the set objectives, with specific results, resources allocated and timescales.
5. Health, safety and environmental objectives and targets must be **integrated** into the overall business plan.
6. Senior management must make a public statement of their **commitment** to the implementation of the Lucas policy and achievement of objectives and targets.
7. Policies, objectives and performance will be **communicated** openly to employees, customers, suppliers and other stakeholders.
8. Employees must be made **aware** of their role, rights and responsibilities.

9 March, 1995

Organisational Arrangements

Management Aim

To establish and maintain the organisational structure, responsibilities and systems required to achieve health, safety and environmental objectives and compliance with legal requirements.

Performance Expectations

1. Each business will make the necessary arrangements to meet its HS&E objectives and targets. These should include:

   a) The appointment of a **senior manager**, who irrespective of other responsibilities, shall have defined authority and responsibility for ensuring that the requirements of these standards are implemented and maintained.

   b) The establishment of a **steering group** to develop and implement strategies for the achievement of objectives and targets. The steering group will be chaired by a Senior Manager and all relevant business functions will participate.

   c) The allocation of sufficient and appropriate **resources** for the day-to-day co-ordination of programmes and activities. This includes identification of corrective action and provision of adequate advice on technical and legal matters.

   d) The establishment and maintenance of a site HS&E **Manual**, documenting policies, objectives, targets, arrangements, systems and programmes.

2. Competent individuals will be appointed for specific activities, as required by local laws and regulations.

3. Competence and participation of all employees will be ensured through appropriate training and awareness programmes.

4. Health, safety and environmental issues must be integrated into continuous improvement activities.

Operational Management Systems

Management Aim

To establish and maintain management systems for planning, implementing, measuring and controlling programmes and activities required to achieve agreed targets and objectives.

Performance Expectations

1. Health, safety and environmental **programmes** will be set up to meet objectives and targets. Projects and actions should be prioritised according to risks, costs and benefits.
2. **Responsibility** for the management of each programme must be allocated to a senior manager. Each programme will have clear objectives and specific milestones.
3. Clearly defined and well documented **project plans** will be produced, identifying responsibilities, implementation timescales, resources, costs and expected results.
4. Adequate **training, information and technical support** must be provided to those responsible for undertaking the required actions.
5. The following hierarchy will be applied when selecting **control measures:**
   - i. Eliminate the hazard or hazardous activity.
   - ii. Substitute by a lesser hazard.
   - iii. Introduction of engineering controls.
   - iv. Use of systems of work, such as work permits.
   - v. Use of personal protective equipment.
6. Adequate **documentation** of projects, assessments, training, resulting actions and procedures will be established and maintained.
7. Mechanisms will be installed to **identify, investigate and record** system failures and hazards.
8. Systems for monitoring and recording **compliance** with specific requirements must be established and maintained.
9. **Progress** and achievement against objectives and targets will be reported as and when required by Lucas Industries or regulatory agencies.

Lucas

9 March, 1995

Self-assessment and Audit Systems

Management Aim

To identify opportunities for improvement to the management of health, safety and environmental matters.

Performance Expectations

1. Senior Management will undertake **periodic reviews** to identify and rectify any lack of compliance with Lucas standards and policies or legal requirements .
2. Senior Management will assess, at least annually, the adequacy and scope of the **register of issues, objectives and targets.**
3. Senior Management will assess, at least annually, the **effectiveness of arrangements, procedures and supporting systems** in achieving policy requirements and objectives.
4. Senior Management must periodically evaluate their **achievements** against objectives and targets.
5. Systems and procedures will be operated to identify and incorporate **changes in legal requirements and business priorities.**
6. **Investigations** of incidents resulting in losses, "near misses", accidents or ill health will be undertaken. Underlying causes must be identified and corrective action taken to prevent re-occurrence. Causes will include failures of management systems to either predict and/or prevent hardware or human failures.
7. Health, safety and environmental performance indicators will be incorporated into the **management appraisal** system.

Emergency Procedures and Contingency Plans.

Management Aim

To control all potential emergency situations in order to minimise risks and losses to employees, the environment and the Company.

Performance Expectations

1. An **inventory** must be established and maintained of all those activities and circumstances which could give rise to an emergency situation.
2. **Contingency plans** will be prepared and documented, based on the application of risk assessment techniques and legal requirements.
3. Arrangements will be made with local **emergency services** to ensure an adequate and prompt reaction to emergency situations.
4. **All employees** likely to be involved in an emergency situation must be informed of Emergency Procedures and the action they should take.
5. **Emergency procedures will be practised**, and appropriate training carried out, on a regular basis.
6. A **procedure** must be established **for informing the relevant corporate functions** in case of an emergency situation, e.g. Communications, Legal, HS&E and Risk Management.
7. **Events**, which have led to an emergency situation, **will be investigated** and underlying causes identified.

Product Design and Development.

Management Aim

To design and develop products and services in such a way as to minimises risk to employees, customers, the business, the environment and the community at large.

Performance Expectations

1. Businesses must **review products and services** in order to **identify, evaluate and recommend specific HS&E improvements.** This will include opportunities for reducing environmental impact, conserving energy and resources, and minimising associated health and safety risks.
2. Businesses must demonstrate the integration of HS&E into the design process by:
   a) nominating a qualified member of staff to sign off designs,
   b) identifying issues, analysing trends and establishing goals,
   c) incorporating HS&E considerations into all stages of a product's life,
   d) documenting decisions and controlling changes,
   e) reviewing the effectiveness of the programme.
3. An **assessment of the environmental impact** of the product from "cradle to grave" must be carried out as part of the design process.
4. **Continual improvement** must be made in the following areas:
   a) reduction of materials and resources, at source,
   b) avoidance of components and materials that present disposal difficulties,
   c) avoidance of manufacturing processes that utilise, or produce, toxic substances,
   d) reusability and recyclability of products and packaging.
5. Appropriate **training and awareness** must be provided to employees and managers involved in the design and development of products, services and packaging.

Lucas

9 March, 1995

Changes in Equipment, Working Practices and Facilities.

Management Aim

To avoid or minimise the introduction of risks as the result in changes in work equipment, working practices and facilities.

Performance Expectations

1. Systems must be applied to **identify hazards and risks** resulting from the introduction of **significant changes** in the workplace. Significant changes may include introduction of new machinery, working practices and facilities, or substantial modification of existing ones.
2. HS&E **specifications** will be provided to suppliers of new items of plant and equipment and to building contractors.
3. A person competent to ensure compliance with HS&E specifications will inspect **new equipment** and facilities prior to commissioning.
4. Appropriate **training** must be provided to employees affected by changes.
5. Management will periodically assess the **effectiveness** of systems used for specifying and assessing new plant and working practices. This assessment must identify and rectify any lack of compliance with legal and company requirements.

Environmental Protection Programme

Management Aim

To minimise the risk environmental pollution and the costs associated with environmental damage.

Performance Expectations

1. Each business must establish an Environmental Protection **Programme** to minimise the risk of pollution damage. It must ensure compliance with regulatory requirements and standards of best practice.

2. The programme must include the **control and management of:**
   a) potential sources of contamination to ground and groundwater
   b) effluent
   c) air emissions
   d) waste

3. The programme must include **development and implementation** of:
   a) an inventory of all sources of potential pollution
   b) a system for complying with legal requirements
   c) pollution control equipment and operating procedures
   d) emergency response procedures

4. Employees who operate, maintain or manage processes that could cause pollution must be provided with **awareness, information, instruction and training.**

5. Management must ensure that **documentation** is developed, implemented and maintained. This will include all training records, emergency procedures and maintenance programmes.

6. Management must continually identify, evaluate and implement **improvement** opportunities.

Lucas

9 March, 1995

Ground and Groundwater Protection

Management Aim

To prevent ground and groundwater contamination thus minimising the risks to the environment and costs associated with contamination.

Performance Expectations

1. Each business, as part of the Environmental Protection Programme, must **develop and implement systems** to protect ground and groundwater. It must ensure compliance with regulatory requirements and standards of best practice.
2. The programme must include the **identification** of potential sources of contamination to ground and groundwater as a result of on-site and off-site operations. e.g.
   a) waste treatment or disposal
   b) waste and chemical storage
   c) underground storage tanks
   d) transportation e.g. pipes, drums
   e) leaks/spills associated with material handling or production
   f) wet process activities
   g) external sources
3. The programme must include engineering and economic **controls**, safe operational practices, spillage and emergency facilities and arrangements.
4. **Maintenance** systems must be developed and implemented for site storage facilities.
5. Management must be aware of the **hydrology** of the site, such as general water quality, flow direction and uses of groundwater, e.g. wells in the area which may be used for public or private use.
6. Procedures will be developed and implemented to monitor **groundwater quality**, if warranted.
7. Employees who operate, maintain or manage processes that could cause contamination must be provided with **awareness, information, instruction and training** on ground and ground-water protection.
8. Management must ensure that **documentation** is developed, implemented and maintained. This will include all training records, emergency procedures and maintenance programmes.
9. Management must continually identify, evaluate and implement **improvement** opportunities.

Effluent Management

Management Aim

To characterise, manage and control the discharge of effluent whilst minimising the volume, quantity and toxicity of pollutants.

Performance Expectations

1. Each business, as part of the Environmental Protection Programme, must **develop and implement systems** to manage effluent. It must ensure compliance with regulatory requirements and standards of best practice.
2. The programme must include the **identification** of discharge points and characterise foul, storm, process and non-contact cooling effluents. Documentation must include the sources, quantities, concentration and regulatory status of pollutants.
3. **Drawings** must be maintained, showing the location, size and type of sewers or other collection systems for effluent.
4. **Notices and labels** will be provided to identify and control the contents of tanks, pipes and other facilities.
5. **Maintenance** systems must be developed and implemented for effluent systems.
6. Systems must be established for **monitoring** effluents and maintaining records of measurements where required.
7. **Treatment** and pre-treatment systems will be provided, operated and maintained, where needed. Emergency arrangements will be developed and implemented.
8. Employees who operate, maintain or manage processes that discharge effluent must be provided with **awareness, information, instruction and training** on effluent management.
9. Management must ensure that **documentation** is developed, implemented and maintained. This will include all training records, emergency procedures and maintenance programmes.
10. Management must continually identify, evaluate and implement opportunities for **re-use and reduction** of waste water.

Air Emission Control

Management Aim

To characterise, manage and control air emissions whilst minimising the volume, quantity and toxicity of pollutants.

Performance Expectations

1. Each business, as part of the Environmental Protection Programme, must **develop and implement systems** to control air emissions. It must ensure compliance with regulatory requirements and standards of best practice.
2. The programme must include the **identification** of emission points and document the location, composition, quantities and regulatory status of pollutants released.
3. **Drawings and information** relevant to applicable air emission permits and authorisations must be maintained.
4. **Notices and labels** will be provided to identify relevant pipework and equipment.
5. Systems must be established for **monitoring** emissions and maintaining the records, where appropriate.
6. **Abatement systems** will be provided, operated and maintained, where needed. Emergency arrangements must be developed and implemented.
7. **Maintenance** programmes must be developed and implemented for abatement equipment to ensure its continuing effectiveness.
8. Employees who operate, maintain or manage processes that emit air pollutants must be provided with **awareness, information, instruction and training** on air emissions.
9. Management must ensure that **documentation** is developed, implemented and maintained. This will include all training records, emergency procedures and maintenance programmes.
10. Management must continually identify, evaluate and implement opportunities for the **reduction** of air emissions.

Waste Management

Management Aim

To control the storage, handling and disposal of waste, whilst minimising the risk to employees, the community and the environment, using cost effective methods and ensuring compliance with legal requirements.

Performance Expectations

1. Each business, as part of the Environmental Protection Programme, must **develop and implement systems** to manage waste. It must ensure compliance with regulatory requirements and standards of best practice.
2. The programme must **identify and monitor:**
   a) waste at source,
   b) collection controls,
   c) segregation of waste, according to physical characteristics, chemical properties and disposal methods,
   d) storage, treatment, recovery and recycling areas,
   e) disposal methods,
   f) waste contractors, ensuring that they are authorised to handle and dispose of site wastes.
3. Waste **storage facilities** must be provided, operated and maintained in a manner consistent with standards of best practice. Emergency arrangements will be developed and implemented.
4. Employees who operate, maintain or manage processes that involve waste must be provided with **awareness, information, instruction and training** on waste management.
5. Management must ensure that **documentation** is developed, implemented and maintained. This will include all training records, emergency procedures and maintenance programmes.
6. Management must continually identify, evaluate and implement opportunities for **minimisation** of waste.

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Resource Conservation

Management Aim

To optimise the use of resources thereby minimising the generation of waste and risk of pollution.

Performance Expectations

1. Each business, as part of the Resource Conservation Programme, must **develop and implement systems** to minimise waste. It must ensure compliance with regulatory requirements and standards of best practice.

2. The programme must include the **identification** of significant waste streams and document their source, composition, quantities, cost and regulatory status.

3. **Minimisation** of waste will be achieved, by applying the following criteria:

   a) elimination or reduction at source by material substitution, method and process modification and/or product re-design.

   b) re-use, recycling, recovery or reclamation

   Any waste that cannot be eliminated or re-used must be treated and carefully disposed of.

4. Resource conservation actions will be implemented against specific **targets**, and priorities will be based on environmental and economic reasoning. Meaningful **measures of performance** must be established and progress towards targets monitored.

5. Participation in resource conservation will be promoted by providing **awareness, information, instruction and training** to all employees, particularly those who operate, maintain or manage processes that produce waste.

6. Management must ensure that **documentation** is developed, implemented and maintained. This will include all training records, emergency procedures, maintenance programmes, as well as the savings and benefits achieved by implementing resource conservation measures.

7. Management must continually identify, evaluate and implement opportunities for **conservation** of resources.

Energy Management and Conservation

Management Aim

To optimise the consumption of all forms of energy by maintaining maximum efficiency from energy supply systems and energy consuming equipment, whilst implementing energy saving methods whenever possible.

Performance Expectations

1. Each business, as part of the Resource Conservation Programme, must **develop and implement systems** to manage and conserve energy. It must ensure compliance with regulatory requirements and standards of best practice.
2. The programme must include the **identification** of high use areas and monitor usage of systems and equipment.
3. Energy supply systems and energy consuming equipment must be **monitored and maintained** to ensure efficiency.
4. **Minimisation** of energy will be achieved, by applying the following criteria:
   a) elimination, or reduction of usage at source by process elimination, process or equipment substitution, method and process modification.
   b) recovery and re-use of wasted heat.
5. Energy conservation actions will be implemented against specific **targets** and priorities will be based on environmental and economic reasoning. Meaningful **measures of performance** must be established and progress towards targets monitored.
6. Participation in energy conservation will be promoted by providing **awareness, information, instruction and training** to all employees, particularly those who operate, maintain or manage processes that use energy.
7. Management must ensure that **documentation** is developed, implemented and maintained. This will include all training records, emergency procedures, maintenance programmes, as well as the savings and benefits achieved by implementing energy conservation measures.
8. Management must continually identify, evaluate and implement opportunities for **conservation** of energy.

Appendix B

Environmental Guidelines

- **PGe110: Environmental Protection - *General principles***
- **PGe110.1: Environmental Protection - *Site Inventory***
- **OGe210: Ground and Ground Water Protection**
- **OGe310: Effluent Management**
- **OGe410: Air Emission Control**
- **OGe510: Waste Management**
- **PGe610: Resource Conservation (Waste Minimisation)**

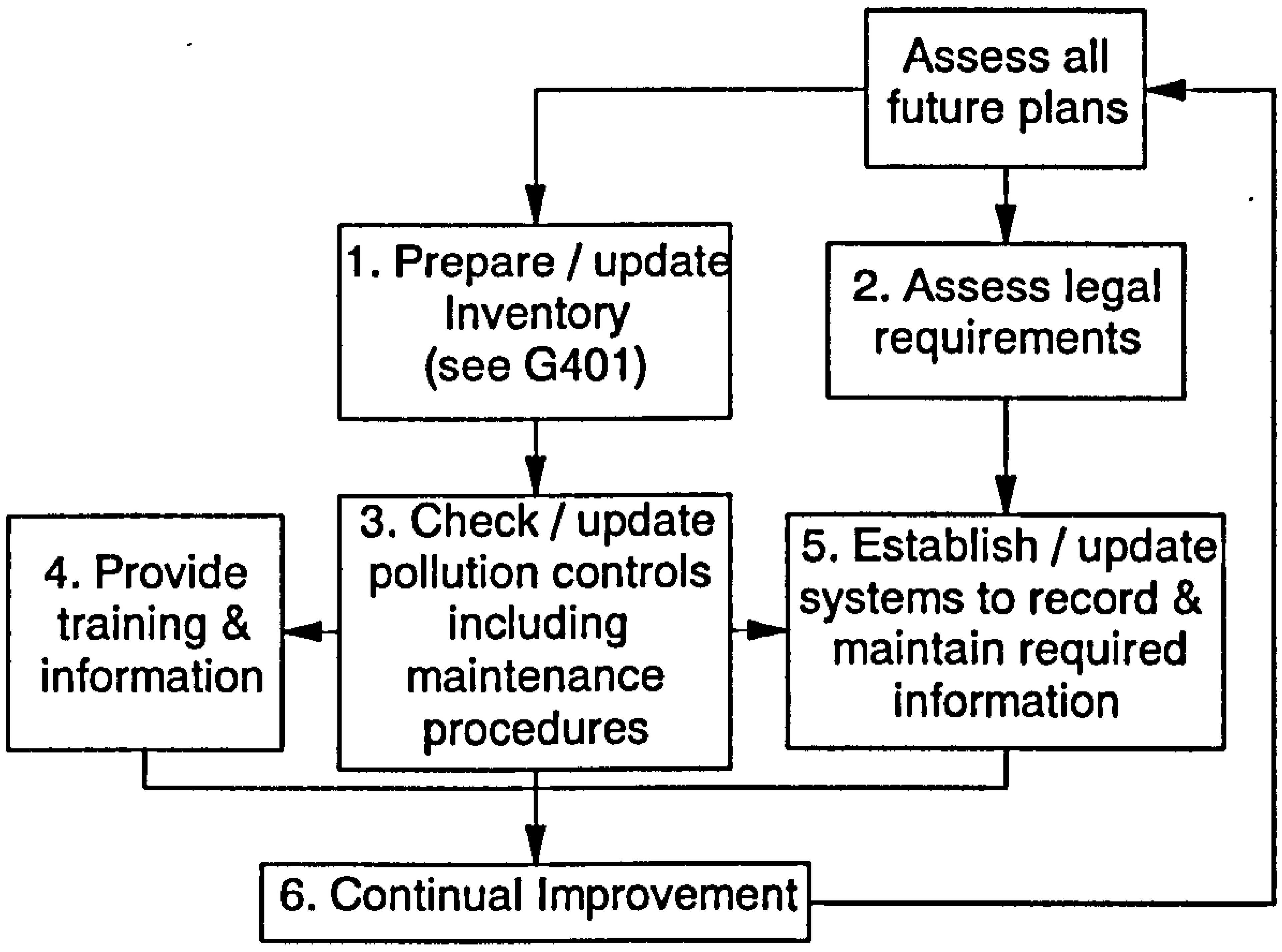
Health, Safety & the Environment PGe110
Programme Guidelines

ENVIRONMENTAL PROTECTION

General Principles

Introduction

These guidelines will assist businesses to develop an Environmental Protection Programme to minimise the risks of environmental pollution. Environmental pollution is the result of both planned, controlled releases and accidental, uncontrolled releases of substances to the environment.
By characterising, managing, controlling and minimising all sources of potential environmental contamination to the three environmental media - air, water and land, the risks and costs associated with environmental damage will be reduced.



1. Inventory

Create and inventory that Identifies sources of potential pollution. This is the first step towards understanding the environmental impact of operations and the implementation of an effective Environmental Protection Programme. It is also an essential part of any Environmental Management System and is already a legal requirement in some countries.

An inventory should include identification of all:
- air emission sources.
- waste-water sources.
- storage tanks and facilities, including tanks that are no longer used.
- other wastes.

For more detailed guidance on preparing an inventory or register of environmental impacts, see Guidance Note PGe110.1.

2. Legal Requirements

Check whether legal permits and authorisation are required for processes that have the potential to pollute the environment.

If the business is required to comply with any legal requirements, information about the process must be recorded and kept up to date. Consideration shall be given to future expansion plans, changes in regulations, and operation restrictions.

See Operational Guidelines OGe210 Ground and Ground Water Protection, OGe310 Effluent Management, OGe410 Air Emission Control and OGe510 Waste Management for further information.

3. Control - General

Developd pollution control operating and maintenance procedures for air emissions, effluents, ground and ground water protection and waste management.
These should include maintenance of facilities and pollution abatement equipment, operating procedures, reporting and record keeping, continual improvement and emergency response procedures.
See Operational Guidelines OGe210 Ground and Ground Water Protection, OGe310 Effluent Management, OGe410 Air Emission Control and OGe510 Waste Management for further information.

4. Training

Provede adequate training to employees who operate, maintain or manage process areas, control equipment, storage facilities or other sources of potential environmental pollution.
In addition management must ensure that:

Employees understand the need for pollution prevention, both for environmental and financial reasons.
Employees are trained to operate any new systems implemented to prevent pollution.
Systems exist for reporting failures in control mechanisms.
Information is displayed clearly, e.g. using notice boards and visual displays.

5. Reporting and Record keeping

Establish systems for monitoring control mechanisms and maintaining records for:

- ground and ground water protection (refer to OGe210 Ground and Ground Water Protection guidelines)
- effluents (refer to OGe310 Effluent Management guidelines)
- air emissions (refer to OGe410 Air Emission Control guidelines)
- waste management (refer to OGe510 Waste Management guidelines)

6. Continual Improvement

Continually evaluate and implemente improvement opportunities. (See also Resource Conservation guidelines PGe610). For instance:

- Use recorded data to indicate where further improvements can be made. Compare actual performance to target.
- Carry out regular reviews of implemented controls to ensure that they are maintained and do not fall into disuse. Ensure that preventative maintenance is included to maintain good performance.
- Set-up improvement groups in all relevant areas to identify and implement pollution prevention opportunities. (Include office equipment, cleaners materials etc. as well as production).

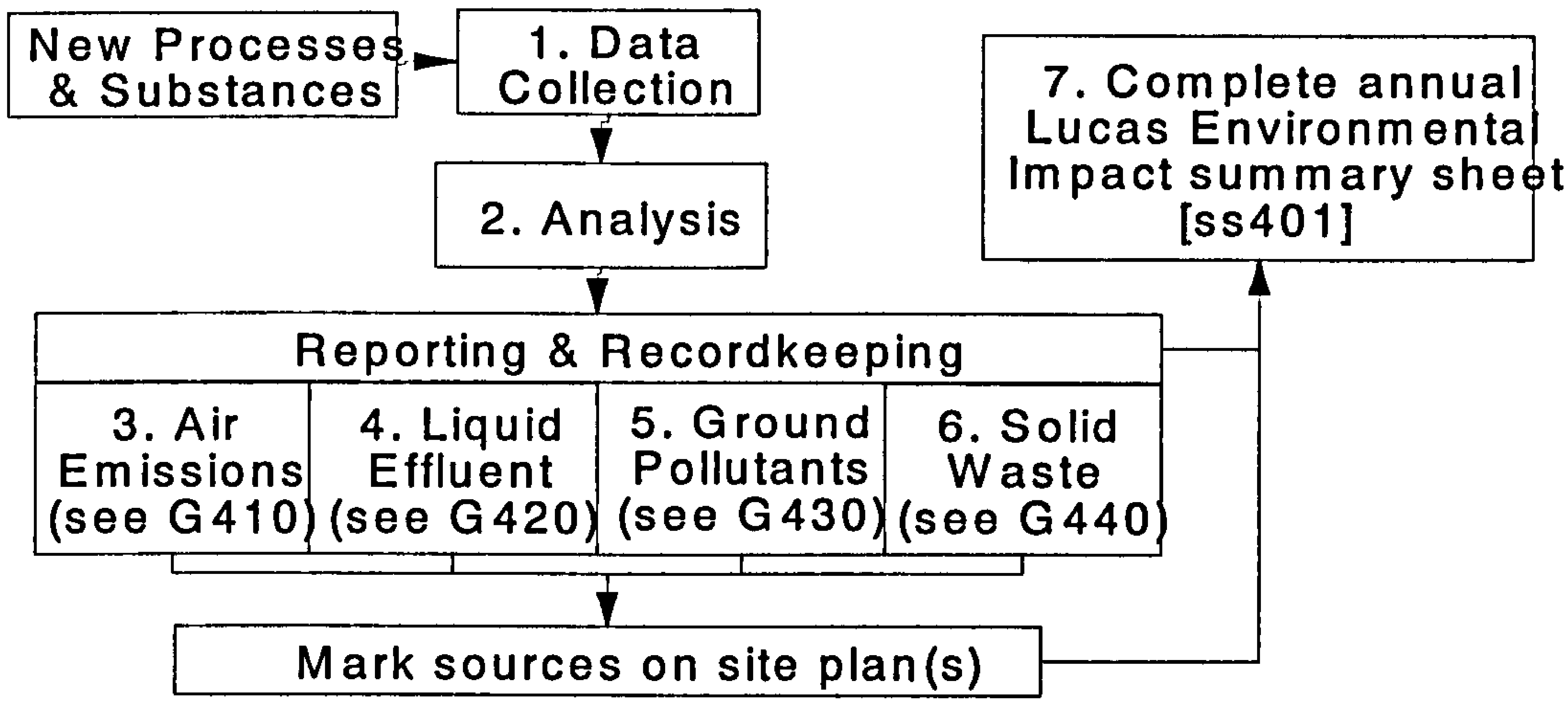
Health, Safety & the Environment PGe110.1
Programme Guidelines

ENVIRONMENTAL PROTECTION

Site Inventory

Introduction

Identifying sources of potential environmental contamination is the first step towards the implementation of an effective Environmental Protection Programme. It is also an essential part of any Environmental Management System and is already a legal requirement in some countries.



1. Data Collection

Data collection should enable the business to:

- Prepare a list of the sources and locations of all exhausted air emissions.
- Identify all the sources and locations of liquid effluent discharges.
- Estimate the volume and composition of all final emissions and liquids discharged.
- Identify the number, age, condition, contents and maintenance programmes for the following:
  - underground storage tanks
  - bulk storage tanks
  - all other chemical (including waste) storage facilities
  - any temporary storage facilities
- Identify the types and sources of all solid waste

2. Analysis - Mass Balance

Volume discharge can be measured directly or via mass balance calculations. Other losses should be identified where significant (e.g. fugitive emissions).
Mass balance calculations, which are simply the difference between the known material inputs and outputs, will determine the losses from a process. Fugitive losses can occur through evaporation, leakage or spillage and are considered as part of the environmental impact of the process. For example, evaporation losses from some solvent tanks can be 50% or more.

3. Reporting and Record keeping - Air

An inventory for air emission sources should be developed and maintained, to include the following information:

- Point and fugitive emission sources;

- Location and labelling of point emission sources;
- Types and quantities of pollutants emitted;
- Air pollution control devices and removal efficiencies;
- Permit numbers for emission sources and control devices; and
- Identification of relevant laws affecting specific air emissions

Exhausted air emissions are those extracted from the workplace via ventilation systems. The type of ventilation system and any abatement (filters, scrubbers etc.) should also be recorded.
Sources of air emissions should be defined by the process and likely composition of the emission. Both the source and emission points should be marked on a site plan.
Systems should be established to monitor air emission control mechanisms and ensure maintainance of records (refer to OGe410 Air Emission Control guidelines).

4. Reporting and Record keeping - Effluent

An inventory for liquid effluent sources (any waste-water discharged to drains, either treated or untreated) should be developed and maintained, to include the following information:

- Point of generation (e.g. plating process)
- Point of discharge, including quantity discharged and composition
- Abatement equipment and control measures
- Regulatory requirements (e.g. consents to discharge)

Sources of liquid emissions should be defined by the process and likely composition of the emission. Both the source and emission points should be marked on a site plan.
Systems should be established to monitor effluent control mechanisms and ensure maintainance of records (refer to OGe310 Effluent Management guidelines).

5. Reporting and Record keeping - Ground and Ground-Water

A ground water inventory of potentially polluting activities and sources should be developed and maintained, to include the following information:

- Activities and potential pollutants sources that can impact ground water quality e.g. external storage tanks and drum stores,
- Abatement equipment and control measures,
- Ground water monitoring records, if any,
- Geological information; and
- Identity of relevant laws and regulations regarding storage facilities.

Identification of storage tanks and facilities should be marked on a site plan, including the location of any Underground Storage Tanks (USTs) and associated piping. Also include tanks that are no longer used and describe the decommissioning procedure.
Systems should be established to monitor ground and ground water protection control mechanisms and to ensure maintainance of records (refer to OGe210 Ground and Ground Water Protection guidelines)

6. Reporting and Record keeping - Solid Waste

An inventory of all activities which create solid waste should be developed and maintained (see PGe610 Resource Conservation guidelines). Systems should be established to monitor waste control mechanisms and to ensure maintainance of records (refer to OGe510 Waste Management guidelines).

7. Reporting and Record keeping - General

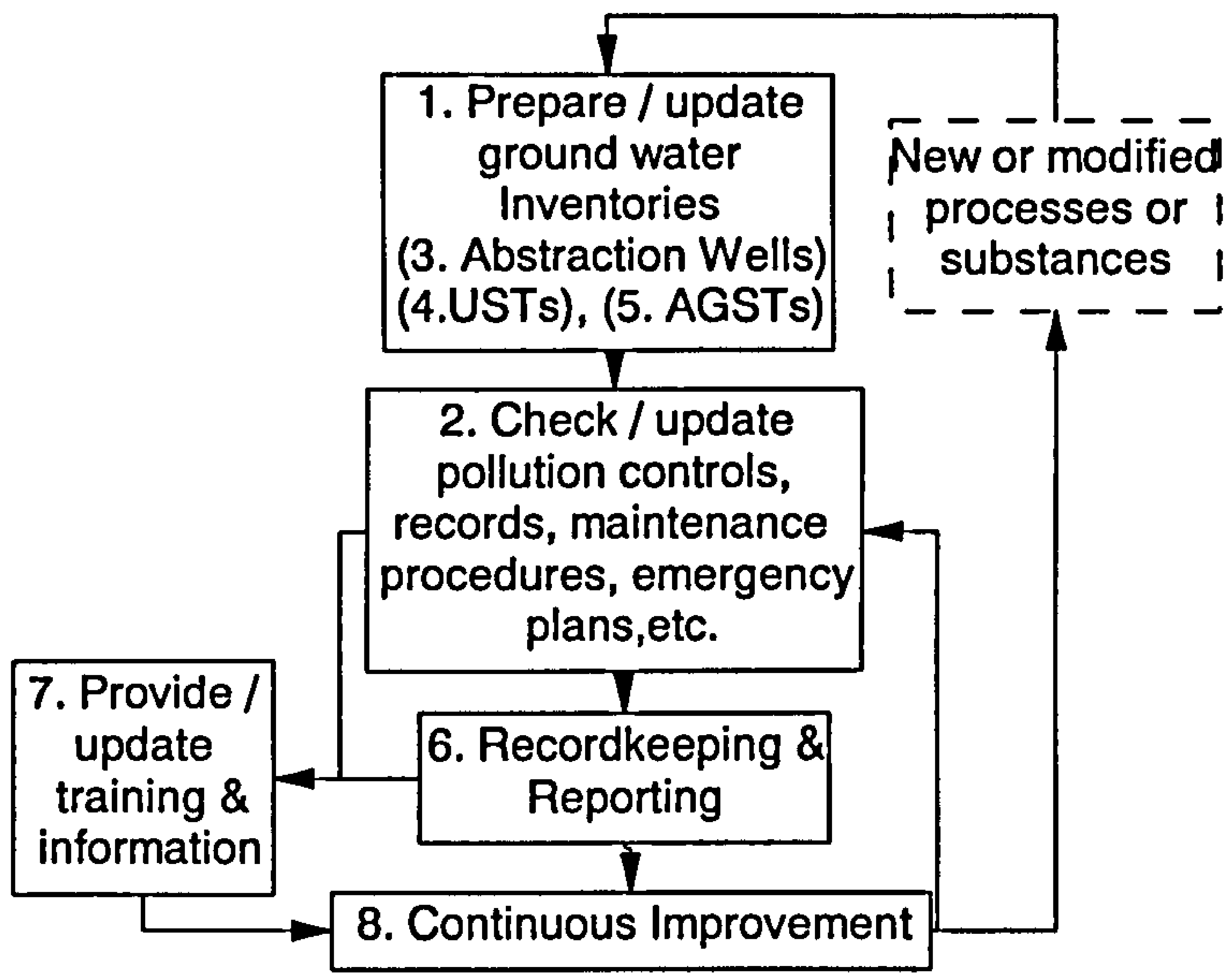
Complete an Environmental Impact summary sheet (SSe110) and return the completed form to Group HS&E Department, Shirley, annually.
N.B. Your own records will contain more detailed information, which may need to be examined by auditors.

Health, Safety & the Environment OGe210
Operational Guidelines

GROUND AND GROUND WATER PROTECTION

Introduction

As part of the integrated approach to Environmental Protection these guidelines will assist businesses to develop a programme for the protection of ground and ground-water. The management aim is to prevent ground and ground-water contamination and reduce risks and costs associated with contamination.



1. Inventory

1.1. Each site must maintain a ground water inventory of activities and potential ground water pollutant sources. The inventory should documenting the following:
- Activities and potential pollutant sources that can impact water quality.
- Ground water monitoring records, if any; and
- Identity of local laws and regulations.

Plans showing the location of any drum storage areas, above-ground storage tanks (AGST), underground storage tanks (UST) and associated piping should be maintained in the file.

1.2 Any AGSTs or USTs that are temporarily closed should be identified. Verify by looking for fill pipes, vent pipes and pumping stations.
In the event that the site has a temporarily closed tank, then;
1. The operation and maintenance of any corrosion protection systems (if empty or not) and leakage detection systems (if not empty), should be continued.
2. If the temporarily abandoned tank has been taken out of service for more than three months the following should be checked through visual inspections:
   - i) vent lines are open
   - ii) manways, lines and pumps are capped or secure
3. If the system has been temporarily closed for more than 12 months, owners should consider permanently closing the tank system.

1.3 If the site has any USTs that are permanently closed, then:
1) The site should carry out the following:
   - i) empty and clean the tank
   - ii) remove tank from the ground or fill with an inert solid

2) If tank decommissioning indicates that contamination of the soil is likely, then measurements should be carried out to determine the extent of the pollution.
3) Tank closure records should be maintained for at least three years, or longer if required by regulation.

2. Control - General

2.1 The number of tanks, skips and drums stored at a site must be kept to the minimum necessary to carry out the site operations.
2.2 All new equipment, facility designs and modifications should be evaluated. Means of preventing and/or mitigating the effects of accidental release and assuring system integrity must be identified. This may include leak testing, leakage alarms, bunding and secondary containment. National or regional authorities (such as the National Rivers Authority, in the UK) can provide advice.
2.3 Preventative maintenance plans should be established for existing equipment.
2.4 Oil and chemical stores must be located away from surface water drains.
2.5 Surface water drains, before leaving the site, should flow via an interceptor. The interceptor must be regularly cleaned and maintained.

3. Control - Abstraction Wells

3.1 The business should check if there are any public and/or private abstraction wells within 2 km's of the site. If local abstraction wells are used for drinking water, the consequences of contaminating the ground water are much greater.
3.2 If the site abstracts water from a well, ensure that the appropriate licence is maintained.

4. Control - Underground Storage Tanks (USTs)

4.1 Any USTs that are not essential should be removed. Effective measures must be taken to prevent leaking of the USTs and to confirm that the tank material and the substance being stored are compatible.
4.2 The age, construction and maintenance procedures for USTs should be identified.
4.3 The transfer of liquids must be monitored to prevent spilling and overfilling. Filling procedures should include the following:
   1. Determination of the volume available in the tank to ensure that it is greater than the volume of product to be transferred to the tank.
   2. Use of spill prevention and overfill prevention devices.
   3. Plant personnel to witness the transfer or periodically monitor the filling operations to prevent overfilling or spilling.
   4. Records of the input and output from each tank to analyse potential losses.

4.4 USTs must be repaired by authorised persons. If USTs are repaired, make sure of the following:
   1. Repairs are performed by a nationally recognised association or the manufacturer's authorised representative.
   2. All corroded pipes are replaced.
   3. The tanks are "tightness tested" within 30 days of the repair.
   4. If the protection system is repaired, the system is tested within six months of the repair.

4.5 Any UST that has been permanently closed or has had a change in service should be identified. Records should be kept to verify that it has been successfully decommissioned.
4.6 USTs should be checked to determine if and when leak detection systems were installed. If not installed, consider installation of leak detection devices. These systems must be regularly tested and maintained.
4.8 Appropriate leak detection methods should be selected for USTs. Leak detection for tanks can consist of one, or a combination, of the following methods:
   a) Tank "tightness" testing combined with inventory control (see 4.3 (4)).
   b) Automatic tank gauging systems.
   c) Monitoring for vapours in the soil
   d) Monitoring for liquids in the groundwater

Discuss the appropriate methods with the NRA in the UK, or equivalent regulatory authority.

5. Control - Above Ground Storage Tanks (AGSTs), Drums and Skips.

5.1 Tanks and drums must be contained within a sealed impervious bund. Bund capacity must be at least 110% of the capacity of the largest tank within the bund. Any filling points must also be within the bund wall.

5.2 The interior of the bunded area must not be connected to any drainage system.

5.3 Accumulated rain water within the bund should be removed by bailing or by pumping, under manual control, for off site disposal.

5.4 The age, construction and maintenance procedures for AGSTs should be recorded.

5.5 Drums and skips should be protected from sun and rain. Storage areas should be provided with ground protection which will prohibit any spillage or leakage from entering the ground or storm water drains.

6. Recordkeeping and Reporting

6.1 Operating records / reports must be maintained. These should include:

1. Corrosion expert's analysis
2. Corrosion protection equipment operation
3. UST system repairs or upgrade
4. Pollution prevention performance, i.e.:
   - The previous year's monitoring results and most recent tightness test (one year).
   - Copies of performance claims provided by leak detection manufacturers (five years).
   - Records of recent maintenance, repair and calibration of equipment installed on-site.
   - Records of release detection manufacturer schedules showing required calibrations and maintenance (keep for at least 5 years from installation).
5. If permanent closure, site investigations and closure reports.

6.3 In the case of a significant spill, or overfill, which may find it's way into waters, the appropriate authority (NRA in the UK) must be informed as soon as possible, and

1. Immediately clean up.
2. Submit a release report and a corrective action report to the appropriate authority within 24 hours.

7. Training and Awareness

Adequate training must be provided to employees who operate, maintain or manage process areas, control equipment, storage facilities or other sources of potential environmental pollution. In addition you must ensure that:

Employees understand the need for pollution prevention, both for environmental and financial reasons.

Employees are trained to operate any new systems implemented to prevent pollution.

Systems exist for reporting failures in control mechanisms.

Information is clearly displayed e.g. using notice boards and other visual displays.

8. Continuous Improvement

Storage facilities should be regularly reviewed and any measures that will minimise quantities stored, improve the standard of the facilities and/or eliminate the potential for environmental pollution should be implemented.

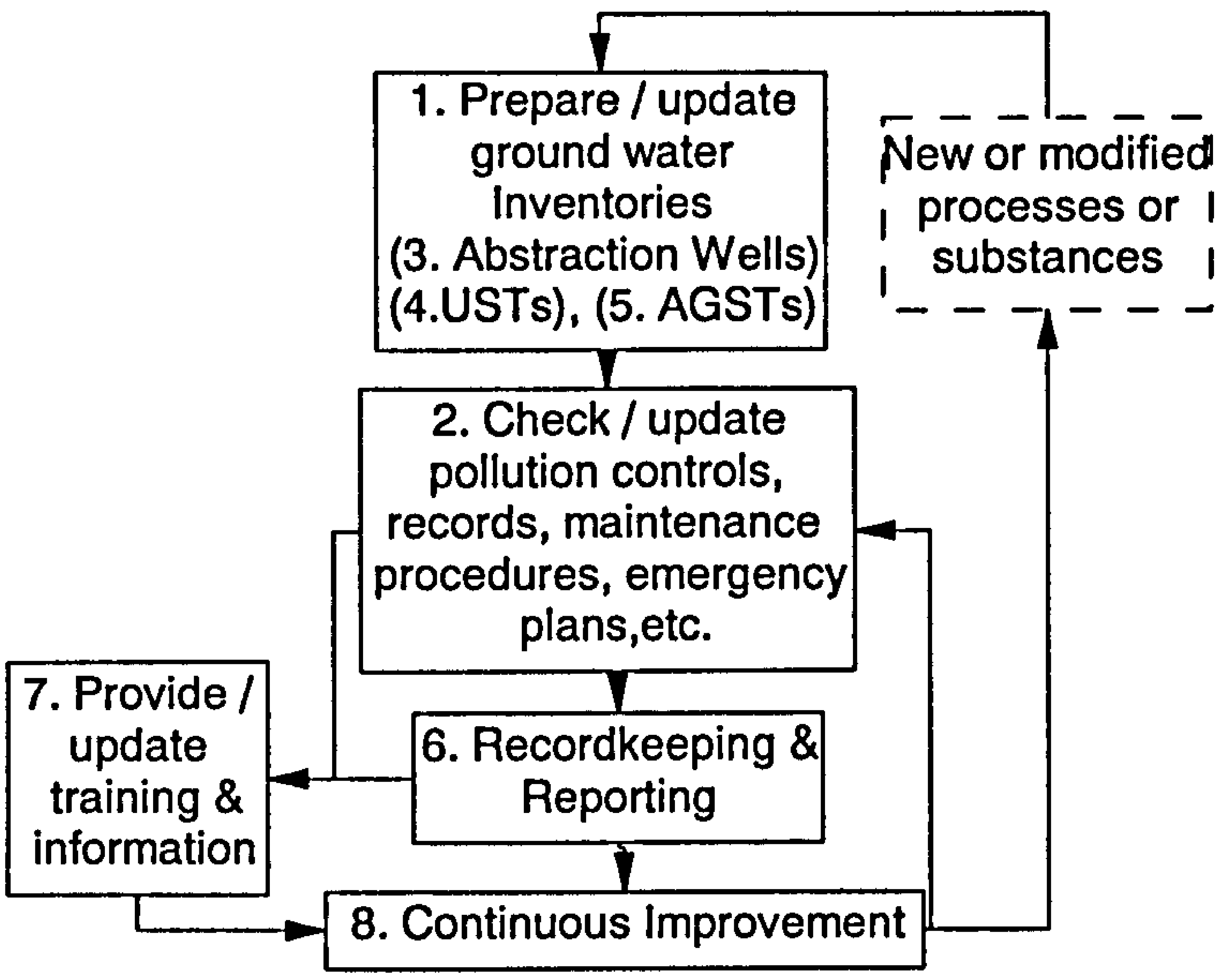
Lucas

Health, Safety & the Environment OGe210
Operational Guidelines

GROUND AND GROUND WATER PROTECTION

Introduction

As part of the integrated approach to Environmental Protection these guidelines will assist businesses to develop a programme for the protection of ground and ground-water. The management aim is to prevent ground and ground-water contamination and reduce risks and costs associated with contamination.



1. Inventory

1.1. Each site must maintain a ground water inventory of activities and potential ground water pollutant sources. The inventory should documenting the following:
- Activities and potential pollutant sources that can impact water quality.
- Ground water monitoring records, if any; and
- Identity of local laws and regulations.

Plans showing the location of any drum storage areas, above-ground storage tanks (AGST), underground storage tanks (UST) and associated piping should be maintained in the file.

1.2 Any AGSTs or USTs that are temporarily closed should be identified. Verify by looking for fill pipes, vent pipes and pumping stations.
In the event that the site has a temporarily closed tank, then;
1. The operation and maintenance of any corrosion protection systems (if empty or not) and leakage detection systems (if not empty), should be continued.
2. If the temporarily abandoned tank has been taken out of service for more than three months the following should be checked through visual inspections:
   - i) vent lines are open
   - ii) manways, lines and pumps are capped or secure
3. If the system has been temporarily closed for more than 12 months, owners should consider permanently closing the tank system.

1.3 If the site has any USTs that are permanently closed, then:
1) The site should carry out the following:
   - i) empty and clean the tank
   - ii) remove tank from the ground or fill with an inert solid

2) If tank decommissioning indicates that contamination of the soil is likely, then measurements should be carried out to determine the extent of the pollution.

3) Tank closure records should be maintained for at least three years, or longer if required by regulation.

2. Control - General

2.1 The number of tanks, skips and drums stored at a site must be kept to the minimum necessary to carry out the site operations.

2.2 All new equipment, facility designs and modifications should be evaluated. Means of preventing and/or mitigating the effects of accidental release and assuring system integrity must be identified. This may include leak testing, leakage alarms, bunding and secondary containment. National or regional authorities (such as the National Rivers Authority, in the UK) can provide advice.

2.3 Preventative maintenance plans should be established for existing equipment.

2.4 Oil and chemical stores must be located away from surface water drains.

2.5 Surface water drains, before leaving the site, should flow via an interceptor. The interceptor must be regularly cleaned and maintained.

3. Control - Abstraction Wells

3.1 The business should check if there are any public and/or private abstraction wells within 2 km's of the site. If local abstraction wells are used for drinking water, the consequences of contaminating the ground water are much greater.

3.2 If the site abstracts water from a well, ensure that the appropriate licence is maintained.

4. Control - Underground Storage Tanks (USTs)

4.1 Any USTs that are not essential should be removed. Effective measures must be taken to prevent leaking of the USTs and to confirm that the tank material and the substance being stored are compatible.

4.2 The age, construction and maintenance procedures for USTs should be identified.

4.3 The transfer of liquids must be monitored to prevent spilling and overfilling. Filling procedures should include the following:

1. Determination of the volume available in the tank to ensure that it is greater than the volume of product to be transferred to the tank.
2. Use of spill prevention and overfill prevention devices.
3. Plant personnel to witness the transfer or periodically monitor the filling operations to prevent overfilling or spilling.
4. Records of the input and output from each tank to analyse potential losses.

4.4 USTs must be repaired by authorised persons. If USTs are repaired, make sure of the following:

1. Repairs are performed by a nationally recognised association or the manufacturer's authorised representative.
2. All corroded pipes are replaced.
3. The tanks are "tightness tested" within 30 days of the repair.
4. If the protection system is repaired, the system is tested within six months of the repair.

4.5 Any UST that has been permanently closed or has had a change in service should be identified. Records should be kept to verify that it has been successfully decommissioned.

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a) Tank "tightness" testing combined with inventory control (see 4.3 (4)).
b) Automatic tank gauging systems.
c) Monitoring for vapours in the soil
d) Monitoring for liquids in the groundwater

Discuss the appropriate methods with the NRA in the UK, or equivalent regulatory authority.

5. Control - Above Ground Storage Tanks (AGSTs), Drums and Skips.

5.1 Tanks and drums must be contained within a sealed impervious bund. Bund capacity must be at least 110% of the capacity of the largest tank within the bund. Any filling points must also be within the bund wall.

5.2 The interior of the bunded area must not be connected to any drainage system.

5.3 Accumulated rain water within the bund should be removed by bailing or by pumping, under manual control, for off site disposal.

5.4 The age, construction and maintenance procedures for AGSTs should be recorded.

5.5 Drums and skips should be protected from sun and rain. Storage areas should be provided with ground protection which will prohibit any spillage or leakage from entering the ground or storm water drains.

6. Recordkeeping and Reporting

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1. Corrosion expert's analysis
2. Corrosion protection equipment operation
3. UST system repairs or upgrade
4. Pollution prevention performance, i.e.:
   - The previous year's monitoring results and most recent tightness test (one year).
   - Copies of performance claims provided by leak detection manufacturers (five years).
   - Records of recent maintenance, repair and calibration of equipment installed on-site.
   - Records of release detection manufacturer schedules showing required calibrations and maintenance (keep for at least 5 years from installation).
5. If permanent closure, site investigations and closure reports.

6.3 In the case of a significant spill, or overfill, which may find it's way into waters, the appropriate authority (NRA in the UK) must be informed as soon as possible, and

1. Immediately clean up.
2. Submit a release report and a corrective action report to the appropriate authority within 24 hours.

7. Training and Awareness

Adequate training must be provided to employees who operate, maintain or manage process areas, control equipment, storage facilities or other sources of potential environmental pollution. In addition you must ensure that:

Employees understand the need for pollution prevention, both for environmental and financial reasons.

Employees are trained to operate any new systems implemented to prevent pollution.

Systems exist for reporting failures in control mechanisms.

Information is clearly displayed e.g. using notice boards and other visual displays.

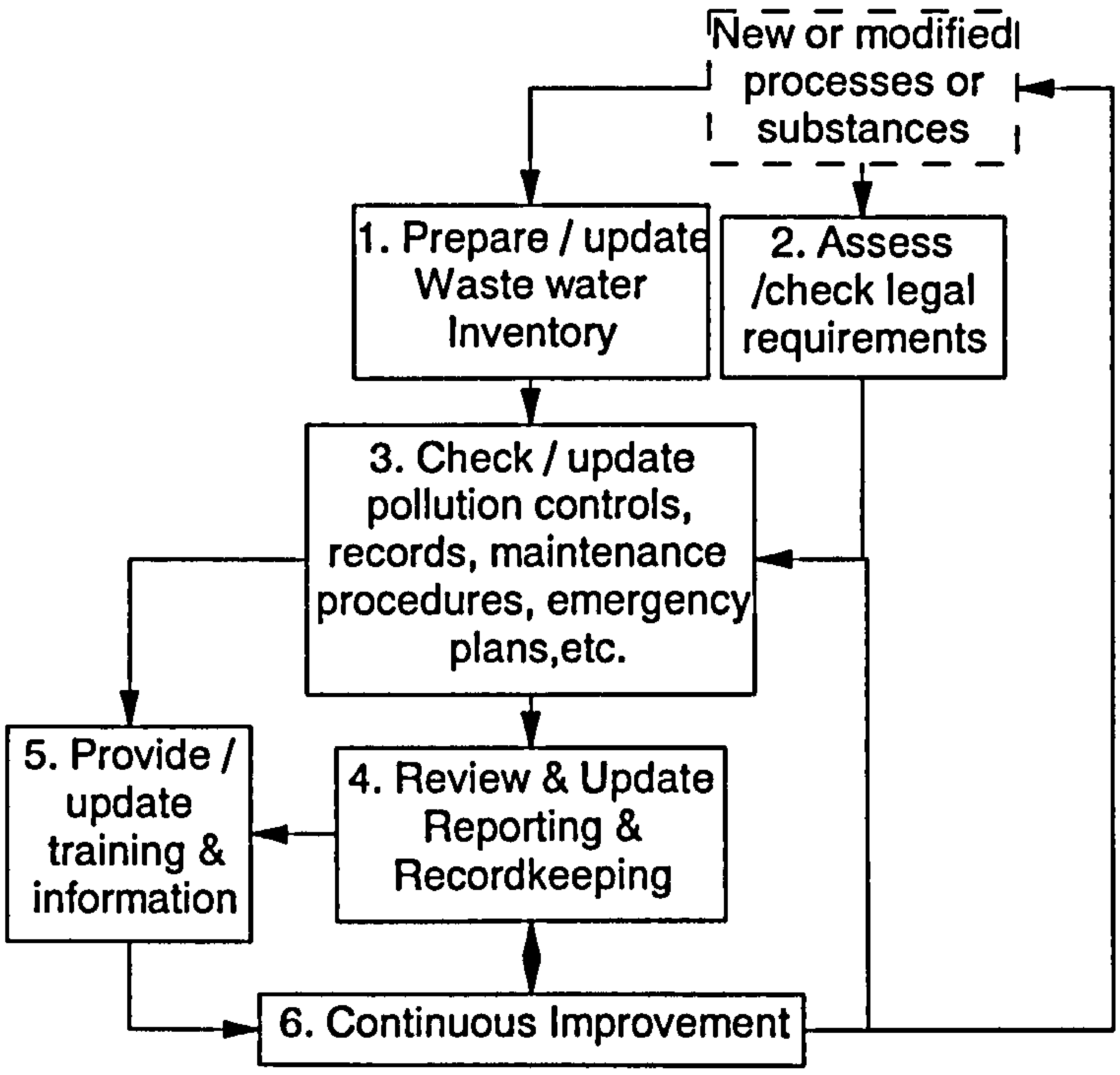
8. Continuous Improvement

Storage facilities should be regularly reviewed and any measures that will minimise quantities stored, improve the standard of the facilities and/or eliminate the potential for environmental pollution should be implemented.

EFFLUENT MANAGEMENT

Introduction

As part of the integrated approach to Environmental Protection these guidelines will assist businesses to develop a programme for the management of industrial effluent. The management aim is to characterise, manage and control the discharge of effluent in accordance with Lucas policies and standards, and applicable laws and regulations, whilst reducing the volume, quantity and/or toxicity of pollutants discharged.



1. Inventory

1.1 An inventory of waste-water sources should be developed to include the following information:
- Point of generation (e.g. plating process)
- Point of discharge, including quantity discharged and composition
- Abatement equipment and control measures

2. Legal Requirements

Legal permits and authorisation may be required or controls applied to processes that have the potential to pollute the environment. For example, in the UK, this may include:

Consents to discharge industrial effluent in agreement with the National Rivers Authority (NRA) and the Sewage undertaker.

Part A registration with the HMIP[1] under the UK Environmental Protection (Prescribed Processes and Substances) Regulations.

2.1 Industry has three options regarding the disposal of process waste-water.

[1] HMIP = Her Majesty's Inspectorate of Pollution

1. Waste water can be treated in an industrial treatment plant prior to discharge to a receiving water (e.g. river) subject to consent from the appropriate authority (e.g. in the UK the NRA or HMIP, for non-prescribed and proscribed processes respectively).
2. Untreated waste water can be discharged to the municipal sewage treatment plant subject to consent by the sewage company concerned (or the HMIP, in the UK).
3. Industrial wastes may be pre-treated at the industrial site prior to discharge to the sewerage system.

2.2 If the site is required to apply for registration (e.g. with the HMIP in the UK):
1. The application should be examined for accuracy, completeness of data and compliance with required filing dates.
2. Applications should be signed by the appropriate persons.
3. Any changes in the facility that would result in changing the terms of the authorisation should be verified. For example, if there has been:
    a) Facility expansion, modification or shut down.
    b) Production increase, modification or decrease.
    c) Process modification including changing raw materials.
    d) Quantity and type of pollutants.
    e) Revision of water quality parameters for receiving waters.
4. All waste-water discharge points or sources should have appropriate permits.

2.3 Any applicable waste-water permit modifications or revisions should be reviewed.

2.4 Effluent discharges should be checked to ensure that they do not exceed agreement limitations.

3. Control

3.1 The site's internal procedures should be verified to ensure that unauthorised materials are not put down the sewers. Laboratory waste, in particular, should not put down the sewer if it is known to contain certain materials that may be prohibited.

3.2 Any laboratory analytical procedures used to analyse waste-water should be reviewed to verify compliance with test procedures determined in the regulations. Items to check include:
1. Whether proper sample containers, holding times and quality control procedures are used.
2. Procedures used comply with those approved by permit or by regulation.
3. When compliance samples are taken and analysed by the agency, split samples should be taken and tested to provide a check and balance to the agency's sample.

3.3 If the business does any additional monitoring, it should be verified that all the necessary information is reported. Legally required analytical results should be cross-checked with internal process monitoring results for discrepancies.

3.4 Corrective actions should be carried out promptly. Corrective actions include revision of operating procedures, repair of equipment, installation of new equipment, etc.
Failure events that occur (on an on-going basis) or have occurred during some defined period should be reviewed. Corrective actions should be taken promptly to repair equipment so that the effectiveness of the treatment system is maximised.

3.5 Procedures for disposing of sludge should be reviewed to determine whether they comply with appropriate regulations (or conversely, if the disposal is prohibited).
Additionally, adequate records of sand/grease trap and other sludge disposal activities should be maintained, showing the ultimate disposal site and method of disposal (and to show compliance with regulations).

3.6 Procedures for unauthorised waste-water discharges should be reviewed.

3.7 Waste-water non-compliance notification procedures should be reviewed.

3.8 Waste-water discharge change procedures should be reviewed.

3.9 Agency right-of-entry procedures should be reviewed.

3.10 Public sewer discharge requirements should be reviewed.

4. Reporting and Recordkeeping

4.1 All the required reports that are being submitted to appropriate agencies and any dealings with the agency should be documented. It should be confirmed that:

1. The required reports are submitted to the appropriate regulatory agencies.
2. The agency is notified of non-compliance incidents.
3. All meetings with, visits by, or understandings with regulatory agencies are documented.

4.2 Records on sampling should be maintained for at least three years, or longer if specified by regulations. The sampling records should contain the following information:

- Date, exact place, method and time of sampling and the names of the person or persons taking the samples.
- The date the analysis was performed.
- Who performed the analysis
- The analytical techniques/methods used
- The result of the analysis
- Required monitoring reports

4.3 Routine calibration and other preventative maintenance on the monitoring equipment should be recorded.

4.4 Hazardous waste discharges must be notified to the appropriate authorities and records kept.

4.5 Records should be kept to verify that effluent discharges are being sampled and analysed according to regulatory requirements.

4.6 Discharge monitoring reports should be completed regularly, as required.

4.7 Waste-water sampling and analytical procedures should be reviewed and documented.

4.8 The following records should be retained for at least three years, or longer if specified by regulations,:

- All sampling and analytical records (including internal sampling data not reported);
- All original recordings from any continuous monitoring instrumentation;
- All instrumentation, calibration and maintenance records;
- All plant operation and maintenance records;
- All reports required by the waste-water authorisations; and
- All data used to complete the application for the waste-water permit.

5. Training and Awareness

Adequate training must be provided to employees who operate, maintain or manage process areas, control equipment, storage facilities or other sources of potential environmental pollution. In addition, you must ensure that:

Employees understand the need for pollution prevention, both for environmental and financial reasons.

Employees are trained to operate any new systems implemented to prevent pollution.

Systems exist for reporting failures in control mechanisms.

Information is clearly displayed e.g. using notice boards and other visual displays.

6. Continuous Improvement

6.1 Waste-water management goals should be developed each year and improvement teams assigned to specific goals. Goals should be identified for each type of waste-water event (e.g. waste-water generation, spills and energy efficiency).

6.2 Improvement teams should develop and submit plans to management for waste-water minimisation / management. This should include corrective actions to achieve environmental goals.

6.3 Review success of waste-water minimisation / management plans (% goal achievement) should be reviewed and plans modified, where necessary, to achieve goals.

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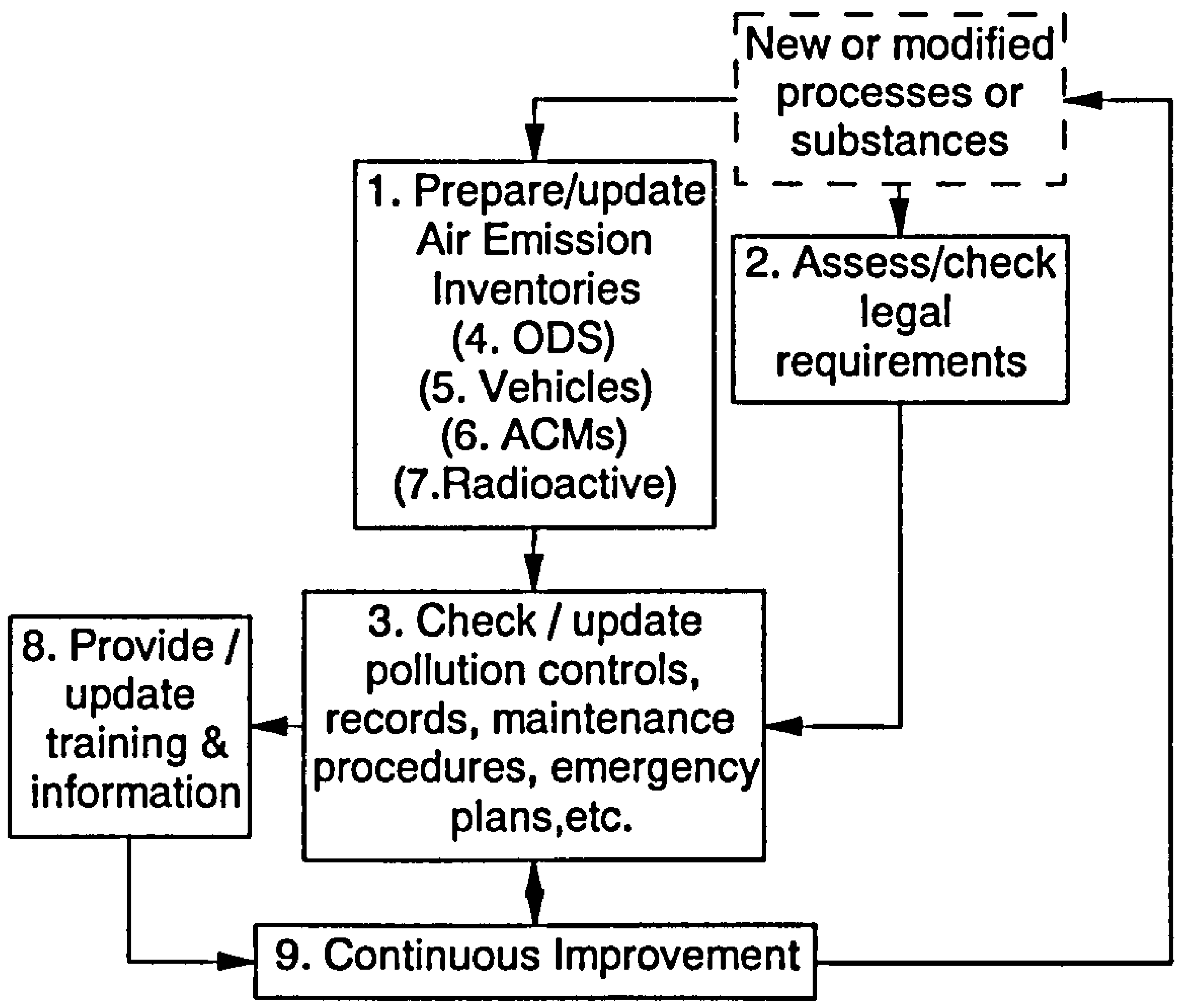
AIR EMISSION CONTROL

Introduction

As part of the integrated approach to Environmental Protection these guidelines will assist businesses to develop a programme for the control of industrial air emissions. The management aim is to characterise, manage and control air emissions in accordance with Lucas policies and standards, and applicable laws and regulations, whilst reducing the volume, quantity and/or toxicity of emissions.



1. Inventory

1.1. An inventory for air emission sources should be developed to include the following information:
- Point and fugitive emission sources;
- Location and labelling of point emission sources;
- Types and quantities of pollutants emitted;
- Air pollution control devices and removal efficiencies;
- Permit numbers for emission sources and control devices (where applicable) and
- Identification of laws applicable to specific air emissions.

2. Legal Requirements

Legal permits and authorisation may be required or controls applied to processes that have the potential to pollute the environment.
For example, in the UK, this may include:
- Part B registration with the Local Authority under the UK Environmental Protection (Prescribed Processes and Substances) Regulations.

- Part A registration with HMIP under the UK Environmental Protection (Prescribed Processes and Substances) Regulations (this will affect other environmental media as well as air).
- Nuisances: smoke, steam, smell, dust, grit, gas fumes and noise. These could result in the Local Authority serving an abatement notice. Failure to comply with an abatement notice, in the UK, can lead to a fine of up to £20,000.

2.1. If the facility is required to submit permit or registration applications for air emission sources, these applications should be checked for accuracy and completeness.

2.2 A programme to ensure timely submittal of applications for renewal or permit modification, should be developed and implemented. Consideration should be given to future expansion plans, changes in regulations and operation restrictions.

3. Control - General

3.1 Maintenance procedures should be developed for air pollution control equipment.

3.2 If Ozone Depleting Substances are still used, there must be a plan for their elimination (see 4).

3.3 Air pollution emergency plans must be in place to deal with unplanned releases. These should include:
- Air Pollution Alert Plan - how any incident will be communicated.
- Emergency Plan for Toxic Releases - what equipment and techniques must be used to control any releases of toxic gas and evacuate personnel.

3.4 Air pollution plans should be regularly updated. The plans should be reviewed for accuracy, and to incorporate pertinent changes such as business expansions or changes, equipment or process modifications, personnel changes, and changes in emissions.

4. Control - ODSs

4.1 An Ozone Depleting Substance (ODS) inventory should be developed. Items to include in the inventory are:
1. Location and type of ODS containing equipment (processes, refrigeration units, air conditioning units).
2. Quantity of ODS normally contained in each piece of equipment.
3. Type of ODS.

The inventory should be updated annually, or following new design, construction, or modification to ODS containing equipment.

4.2 A plan for management of existing ODSs should be developed to include the following elements:
1. Persons servicing ODS-containing equipment (including contractors) are competent and able to contain necessary releases during maintenance.
2. Approved refrigerant recycling equipment is used.
3. Records are maintained and retained for three years.
4. Procedures for maintaining, repairing, servicing, or disposing of ODS containing appliances are in place and used.
5. Regular checks are made to ensure that no leakage occurs.

4.3 A plan for replacement of all ODSs must be developed.

5. Control - Vehicles

5.1 A vehicle inventory should be developed, if appropriate. Items to include in the inventory are:

1. Number and type of vehicles
2. Type of fuel used.
3. Fleet fuel efficiency.

5.2 A programme to assess vehicle operational efficiency should be developed. Items to include in the programme are:

1. Scheduled maintenance and vehicle inspection.
2. Identification of opportunities to improve fuel efficiency. Evaluation of the use of alternative fuels, equipment, and maintenance procedures.
3. Fleet fuel efficiency.

Data from the inventory should be quantified annually to identify trends in energy consumption.

6. Control - Asbestos Containing Materials (ACM)

6.1 A comprehensive inventory of all asbestos containing materials (ACM) must be developed and maintained, to include:

1. Identification of type. Label or identify ACM with a marking system.
2. Record of condition of ACM (i.e. is it intact, damaged, releasing dust ?)
2. All insulation on piping, ovens, boilers, sprayed-on fire protection, floor and roof tiles etc. shall be presumed to contain asbestos unless it is known to be asbestos-free, or until testing determines otherwise.
3. Any new insulation material should be labelled with date and type of material.

6.2 A plan should be developed for the removal and management of ACM, to include the following elements:

1. Damaged ACM (or material releasing dust) is removed as soon as possible.
2. The appropriate authority (HSE in UK) is notified of ACM removal operations within required time frame.
3. Contractors are qualified to perform removal and disposal.
4. Facilities used to dispose of ACM are approved to handle asbestos.
5. ACM wastes are deposited in a proper waste disposal site.
6. Proper emission control techniques are utilised during renovation and removal operations.
7. No visible emissions are discharged to the outside air during collection, processing, packaging, or transporting of ACM wastes.
8. Containers are labelled with the required warning label.
9. Vehicles used to transport ACM wastes are properly labelled.
10. Waste Shipment Records (WSR) are returned from the disposal facility.
11. ACM WSRs are maintained and contain the required information.
12. Clearance Tests are performed as required under the Control of Asbestos Regulations.

7. Control - Radioactive Equipment

7.1 A comprehensive inventory must be developed and maintained of all radioactive substances or equipment containing radioactive substances, which could become airborne, including substances that are no longer used and require disposal. Information to be recorded in this review includes:

- Location and type of substance or device (laboratory equipment, tritium filled exit signs, etc.)

- License agreement label attached and legible.
- Radiation trefoil attached and legible.
- Condition of radioactive source.

7.2 A plan for management of radioactive substances or equipment containing radioactive substances should be developed, to include the following elements:

1. The inventory described above.
2. Review of site's specific radioactive material license for compliance.
3. Ensure that records of receipts for all radioactive devices are maintained on-file.
4. Ensure that regular maintenance is carried out on radioactive equipment.
5. Review radioactive device purchase procedures.
6. Ensure that the relevant authority (HSE in the UK) is informed of any radioactive source on site.
7. Seek advice on the correct maintenance and disposal of radioactive sources (in the UK contact the Radiation Protection Advisor (RPA). *(N.B. For Lucas UK the RPA is the National Radiological Protection Board (NRPB))*

8. Training and Awareness

Adequate training and information must be provided to employees who operate, maintain or manage process areas, control equipment, storage facilities or other sources of potential environmental pollution. In addition you must ensure that:

Employees understand the need for pollution prevention, both for environmental and financial reasons.

Employees are trained to operate any new systems implemented to prevent pollution.

Systems exist for reporting failures in control mechanisms.

Information is clearly displayed e.g. using notice boards and other visual displays.

9. Continuous Improvement

9.1 Air emission goals should be developed each year and improvement teams assigned to specific goals. Goals must be identified for each source of air emission (e.g. evaporation from tanks and storage, extraction of fumes, etc.).

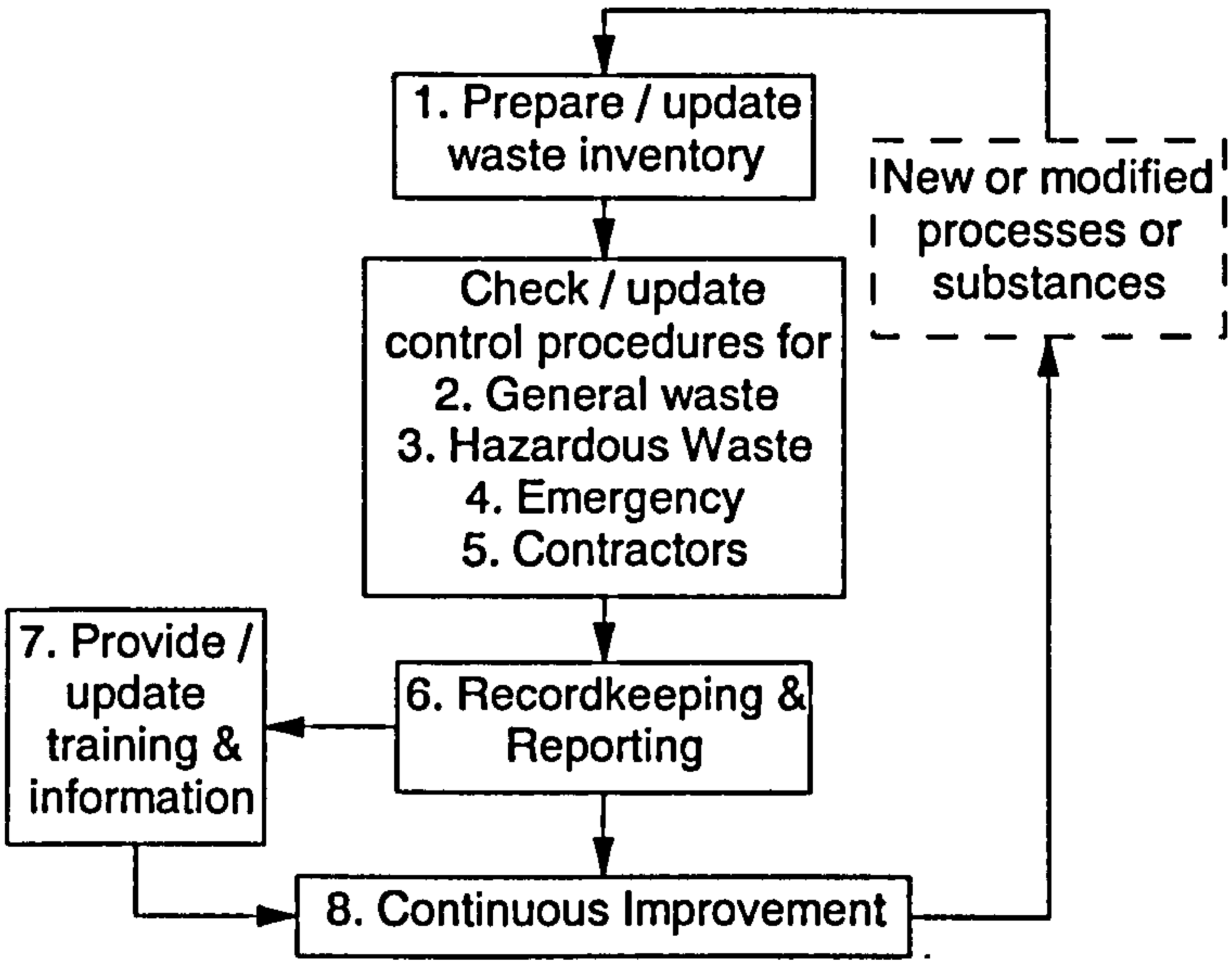
9.2 Improvement teams should develop and submit plans to management for specific air emission minimisation / management. This should include corrective actions to achieve environmental goals.

9.3 The success of air emission minimisation / management plans (% goal achievement) should be reviewed and plans modified, where necessary, to achieve goals.

WASTE MANAGEMENT

Introduction

As part of the integrated approach to Environmental Protection these guidelines will assist businesses to develop a systems of procedures for the management of waste. The management aim is to characterise, manage and control the storage, handling, and disposal of waste in accordance with Lucas policies and standards, and applicable laws and regulations, whilst reducing the volume, quantity and/or toxicity of waste.



1. Inventory

1.1. An inventory of all wastes generated from site operations should be developed. The inventory should identify whether the waste is managed as a solid waste, special waste or a hazardous waste. By compiling available information, conducting site tours and asking employees, the types, generation points and management of all wastes (including medical wastes) can be determined. The waste inventory should include at least the following information:
- Description and source of the waste;
- Quantities generated;
- Disposal and treatment facilities and methods utilised; and
- Identity of local and national laws applicable to the disposal of waste materials.

2. Control - General Procedures

2.1 Procedures must be in place to prevent the mixture of non-hazardous waste and hazardous wastes. Mixing hazardous and non-hazardous waste can result in a mixture that must be classified as hazardous waste.

2.2 Procedures should be in place to ensure that residues in empty containers or liners are properly removed. Additionally, procedures should be implemented to ensure that empty containers are not considered hazardous waste.

2.3 Hazardous waste labelling procedures should be reviewed to ensure compliance with applicable requirements. Wastes designated for transportation must be packaged, marked, and labelled accordingly.

2.4 All wastes must be disposed of in the correct manner, e.g. certain hazardous wastes are not allowed to be disposed of in landfills.

2.5 Waste contractors should be evaluated annually with respect to their compliance status. A copy of all of the permits, which the contractors are required to have for the transportation and disposal of wastes, should be obtained.

3. Control - Hazardous Waste Storage Areas

3.1 Waste storage areas should be regularly inspected. Wastes must not be accumulated on-site in excessive quantities or for time periods exceeding that legally allowed.

3.2 Hazardous waste storage practices should be regularly reviewed. Containers must be marked, stored closed and in good condition. Weekly inspections should be performed on hazardous waste storage containers and a log of inspections maintained. Waste storage practices must ensure that compatibility and storage location issues are addressed.

4. Control - Emergency Preparedness and Prevention

4.1 The site's emergency procedures and provisions for hazardous waste incidents should be regularly reviewed and evaluated. Waste storage facilities should be maintained and operated to minimise the possibility of a fire, explosion, or any unplanned sudden or gradual release of hazardous waste or hazardous waste constituents to air, soil or surface water which could threaten human health or the environment.

1. Site audits should check that equipment essential for the management of hazardous wastes is available on-site.
2. Appropriate arrangements should be made with police and fire departments, etc. This information should be reviewed to ensure that it is in place and accurate.
3. All employees must be familiar with waste handling and emergency procedures.
4. Emergency response information must be displayed at the required locations.
5. Emergency co-ordinators must be prepared to respond to emergencies.

5. Control - Contractors

5.1 Waste handling practices of on-site contractors should be reviewed to verify proper management of hazardous wastes. The same waste management standards should apply to the contractor as is applied to the site.
Contractor's waste accumulation areas should be reviewed for proper labelling, container management practices, inspections etc.
The site should ensure that the contractor is properly declaring waste and is doing business with disposal contractors who are reputable.

5.2 All solid waste transporters' and disposal facilities must be properly permitted. A list of contractors being used for collection, transportation and disposal should be prepared. Copies of solid waste transporters' and disposal facilities' permits and identification numbers should be obtained. It should be verified, in conjunction with the types of solid waste generated, that these contractors have current licenses or registrations to undertake the services rendered.

6. Recordkeeping and Reporting - General

Site files should be reviewed to ensure that waste records are maintained in a retrievable form for the prescribed time frames.

6.1 If waste is disposed of on site, e.g. via incineration, or if waste is accumulated on site for periods longer than 1 month, ascertain whether a waste management licence is required. Contact the local Waste Regulatory Authority for advice on licences and exemptions.

7. Training & Awareness

Adequate training and information must be provided to employees who produce, handle or manage wastes. In addition you must ensure that:

Employees understand the need for waste management and waste minimisation, both for environmental and financial reasons.

Employees are trained to operate any new systems implemented to manage waste.

Systems exist for reporting failures in control mechanisms.

Information is clearly displayed e.g. using notice boards and other visual displays.

8. Continuous Improvement

Waste minimisation goals should be developed each year and improvement teams assigned to specific goals. See Programme Guidelines PGe610 Resource Conservation (Waste Minimisation).

Lucas

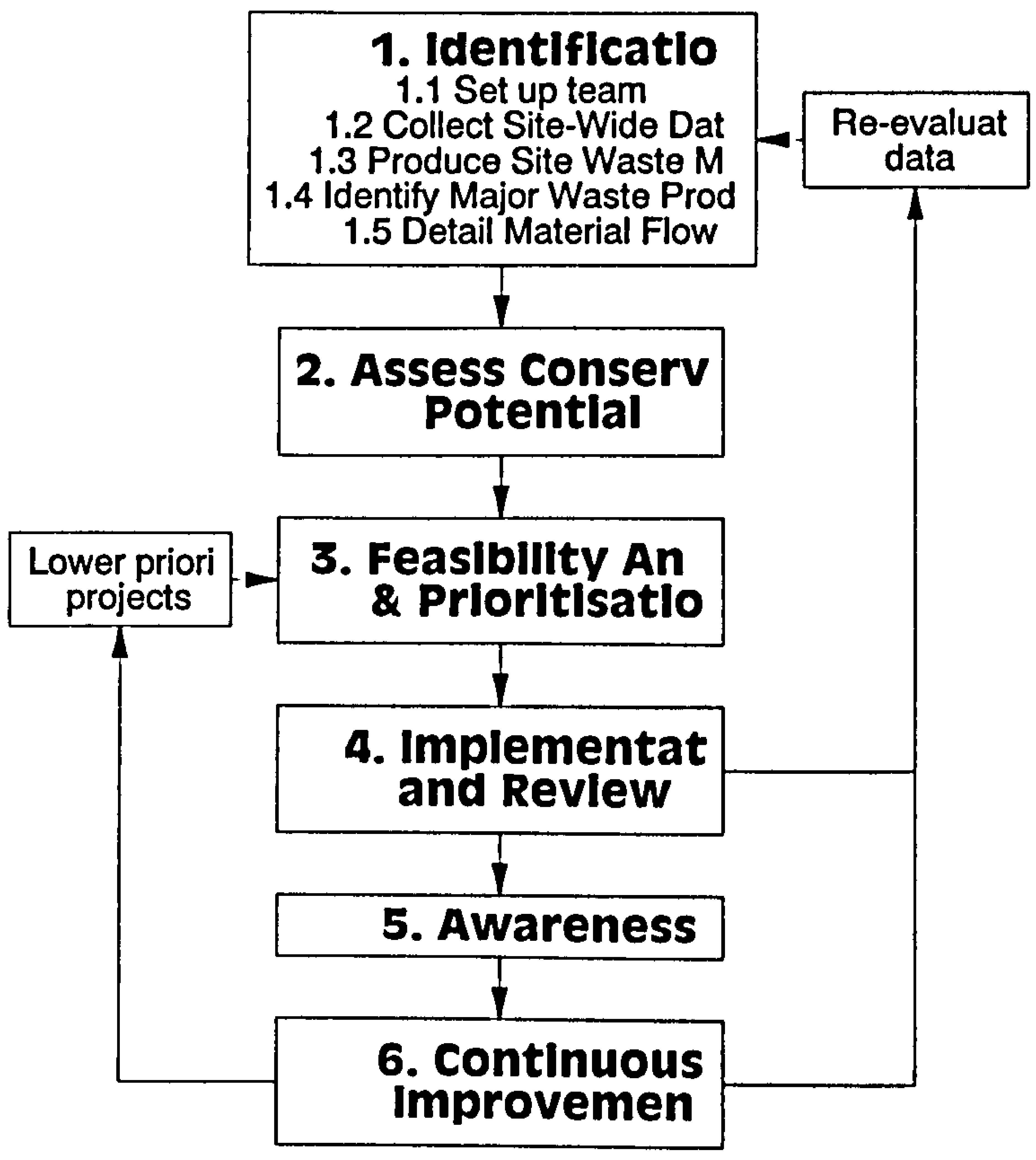
Health, Safety & the Environment PGe610
Programme Guidelines

RESOURCE CONSERVATION
(Waste Minimisation)

Introduction

These guidelines will assist businesses to develop a Resource Conservation Programme to minimise the use of resources and creation of waste. The programme should enable the businesses to characterise, analyse and minimise all sources of waste, hence conserving resources and saving money. The management aim is to optimise the use of resources, whilst considering the risks to health, the environment and the economic benefits.

Once management commitment has been obtained, a Resource Conservation Programme, following the methodology below, can be developed. A waste management system is an essential pre-requisite to any effective Resource Conservation Programme (see OGe510 Waste Management Operational Guidelines).



1. Identification

Significant material usage and waste streams must be identified. These may be characterised by volume, cost and composition. (Refer also to Environmental Protection Guidelines PGe110 and PGe110.1).

1.1 A Resource Conservation team (see Guidelines PGe610.1 "Setting up an Environmental Team") should be set up to include expertise from: Management, Environmental, QA & QC, Design, Development & Process Engineering, Operations, Production & Maintenance, Purchasing, Accounting, Health & Safety.
Ensure that the team has Terms of Reference, objectives and management commitment. Project plans and progress should be regularly reviewed by management.

1.2 Data Collection is the first task of the Resource Conservation team. The team should focus on obtaining a complete inventory of waste streams and emissions, identifying the composition and sources of the waste and quantifying the true costs of pollution control, waste storage and disposal. (The cost of pollution control includes treatment chemicals, wasted raw materials, labour costs, filters, consumables, administration etc.)

Sources of data include:

- consent to discharge documentation,
- receipts for recycled product,
- waste consignment notes,
- calculations using mass balance techniques[1].

1.3 The data should be organised to produce a Waste Map. This is a site plan showing where the types of waste are produced, the collection routes and the storage or treatment facilities.

The waste map should be prepared in two stages:

i. showing the source(s) of waste generated
ii. giving more detail on the quantity produced, and the collection and disposal facilities for the waste.

1.4 Individual processes which contribute significantly to the major waste streams should be recognised. Major wastes streams can be identified by prioritising waste with respect to the following criteria:

- value of raw material
- potential for recovery of by-products
- the quantity of waste produced
- environmental impact of emission/waste (i.e. hazardous or benign)
- cost of disposal
- compliance with legislation
- Health & Safety problems.

1.5 A detailed materials flow diagram should be produced for each process which contributes significantly to the major waste streams.
Elements on the flow diagram should include:

- inputs of material & resource (quantities)
- outputs of material & resource as product (quantities)
- outputs of solid waste, discharges and emissions (quantities & concentrations)

Sources of information could include:

- bill of materials (quantities of materials in product)
- product specifications (check design requirements match operational practice)
- process specifications (energy & water requirements, consumables etc.)
- mass balance calculations[1]

[1] Mass balance is a simple technique of equating process inputs and outputs. All inputs (material and resources) that are not turned into useful product are deemed to be waste.

2. Assess Conservation Potential

A programme to minimise the use of resources and generation of waste should be established by applying the following hierarchy:

a) **Elimination or reduction at source** can be achieved by material substitution, method and process modification and/or product re-design. You should consider:
   i. Measures to prevent the generation of waste.
   ii. Measures to reduce the volume of waste generated and / or its hazardous content, e.g. by
      - increased operator awareness and training
      - eliminating or substituting hazardous materials with less toxic form.
      - assessing efficiency by calculating the Waste Index[2] and then improving the Waste Index through process or product changes.
      - changing designs to minimise waste during production and facilitate reuse of product at end of life.

b) **Reuse** of waste can be achieved by recycling, recovery or reclamation. You should consider:
   i. Measures to recycle or reuse a waste material within the production process.
   ii. Measures to reuse waste or reclaim in part, for some other purpose e.g. by
      - avoiding mixing or contaminating waste streams
      - investigating energy recovery options if material recovery is not possible
      - buying recycled materials where possible

c) **Treatment and / or final disposal.**
   This is not considered a resource conservation measure, but the last option if elimination or recycling cannot be achieved.

3. Feasibility Analysis and Prioritisation

Options should be prioritised according to business needs, environmental risks and economic issues. Both technical and economic feasibility should be considered for the implementation and operation of a solution.

A **technical** feasibility analysis should consider:
- whether an option is compatible with current production systems.
- if an option will affect product quality.
- any additional energy, water or space requirements
- any additional maintenance or specialist labour requirements
- availability of the option
- the proven track record

The calculation of **economic** feasibility should include the following factors:
- savings of raw material(s) consumed
- present and forecast disposal costs
- compliance costs
- capital cost of the installation and process change
- process production rate and labour involvement
- energy and water consumption costs
- waste storage and handling costs
- present and forecast labour costs for operation, handling and maintenance.

[2] Waste Index = Material lost as waste divided by material in product

4. Implementation and Review

Implementation measures can be categorised into three main groups:

- Inventory Management & Housekeeping
- Modification of Production Process
- Recycling and Reuse.

Implementation plans should include

- specific targets
  e.g. cost, quantity, volume, percentage or number of hazards to be reduced by a certain date.
- measures of performance
  e.g. Volume and cost of waste disposed
  Ratio of material in product to waste generated (Waste Index[2])
  Ratio of waste generated and quantity of raw materials bought.
  Ratio of waste collected and waste generated.
  Ratio of waste recycled/reused and waste generated.
  Energy as a % of sales and ratio of energy used and budgeted for.
  Water as a % of sales and ratio of water used and budgeted for.

Once implemented, measures of performance should be monitored and reviewed to ensure that calculated benefits are being achieved.
The effectiveness of the implementation should be reviewed and any lessons learnt communicated to other implementation teams to consider.

5. Awareness

Employee awareness of resource conservation should be raised through training and effective communication. Ensure that:

- Employees understand the need for resource conservation, for both environmental and financial benefits.
- Employees are trained to operate any new systems implemented to conserve resources.
- Systems exist for reporting failures in control mechanisms.
- Information is clearly displayed e.g. using notice boards and other visual displays.

6. Continuous Improvement

Improvement opportunities should be continually evaluated and implemented.

- Measures of performance should be used to indicate where further improvements can be made, by comparing actual performance to target.
- Regular reviews of implemented actions should be carried out to ensure that they are maintained and do not fall into disuse. Preventative maintenance must be included to maintain good performance.
- Improvement groups should be set-up in all areas of the business to identify and implement resource conservation opportunities. Office resources should be included as well as production.

REPORTING

A Waste Profile summary sheet (SS500: Table A - Waste Streams and Table B - Savings) should be completed and returned to Group HS&E Department, Shirley, annually.

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[2] Waste Index = Material lost as waste divided by material in product

Appendix C

- Lucas HS&E Review Questionnaire
- Audit Assessment Sheets

LUCAS HS&E REVIEW QUESTIONNAIRE

REPORT FORMAT	see also REPORT FORMAT	Audit Qu.No:			Answer: Y, N, NA	Points	SCORE	MAX SCORE
PART 1: ATTITUDES, VALUES & MANAGEMENT PROCESSES								
1.1 POLICY								
1.1		**1.0.1**	*	**Do you have a policy that covers Health & Safety?**	y	5	5	5
1.1		**1.0.2**	*	**Does the policy recognise the company's responsibility for safeguarding the environment?**	y	5	5	5
1.1		**1.0.3**	*	**Does the policy define the HS&E organisation & allocation of responsibilities?**	n	1	0	1
1.1		**1.0.4**	*	**Is the policy signed by a senior manager?**	y	1	1	1
1.1		**1.0.5**	*	**Is a date of issue shown?**	y	1	1	1
1.1		**1.0.6**	*	**Has the policy been reviewed in the last 2 years?**				
		1.0.6	a	in the last 2 years?	y	5	5	4
		1.0.6	b	in the last 2-5 years?		1		1
		1.0.6	c	over 5 years ago?		0		0
1.1		**1.0.7**	*	**Are provisions for compliance with this policy included in the CAP?**	n	1	0	1
1.1		**1.0.8**	*	**Are provisions for compliance with this policy included in the annual budget?**	y	1	1	1
1.1		**1.0.9**	*	**Does the scope of the policy make specific reference to the following areas:**				
1.1	2.3.1/3.2.1	1.0.9	1	elimination of hazards from processes & substances?	y	1	1	1
1.1	2.1.1	1.0.9	2	improvement to workplace design & working environment?	y	1	1	1
1.1	2.1.5	1.0.9	3a	development of safe systems of work?	y	1	1	1
1.1	2.2.5	1.0.9	3b	use of safety equipment?	y	1	1	1
1.1	2.3.4	1.0.9	4	implementation of contingency plans?	y	1	1	1
1.1	2.4.1	1.0.9	5	protection & promotion of employee health?	y	1	1	1
1.1	3.1.2/3.2.1	1.0.9	6	reduction of material use, waste & emissions?	y	1	1	1
1.1	3.1.3	1.0.9	7	reduction of water use & effluent?	y	1	1	1
1.1	3.4.1	1.0.9	8	reduction of energy consumption & inefficiencies?	y	1	1	1
1.1	2.1.2	1.0.9	9	improvement of good housekeeping measures for the land & buildings?	y	1	1	1
1.1	3.5.0	1.0.9	10	environmental impact of product use & disposal?	y	1	1	1
1.1	3.5.1/4.4.3	1.0.9	11	environmental impact caused by suppliers & sub-contractors?	y	1	1	1
1.1		**1.1.1**	*	**Does the policy commit you to comply with national Health, Safety & Environmental legislation?**	y	1	1	1
1.1		**1.1.2**	*	**Does the policy commit you to comply with your own standards?**	y	1	1	1
1.1		**1.1.3**	*	**Are standards based on:**				
1.1		1.1.3	a	Lucas standards?	n	1	0	1
1.1		1.1.3	b	international best practice?	n	1	0	1
1.1	4.1.1	**1.2.1**	*	**Does the policy commit you to providing training in order to develop the competence of your employees?**	y	1	1	1
1.1	4.1.1	**1.2.2**	*	**Does the policy commit you to maintaining the competence of your employees in order to adequately address:**				
1.1	4.1.1	1.2.2	a	Health & Safety	y	1	1	1
1.1	4.1.1	1.2.2	b	Environmental issues?	y	1	1	1
1.1	4.1.0	**1.2.3**	*	**Does the policy state that the induction of all new staff, should include training on:**				
1.1	4.1.0	1.2.3	a	Health & Safety?	n	1	0	1
1.1	4.1.0	1.2.3	b	Environmental issues?	n	1	0	1
1.1	4.2.0/4.4.2	**1.3.1**	*	**Does the policy commit you to participating in the transfer of solutions to Health, Safety & Environmental problems across Lucas businesses?**	y	1	1	1
1.1		**1.4.1**	*	**Does the policy commit you to demonstrating a positive commitment to the systematic avoidance, reduction & elimination of risks?**	y	1	1	1
1.1		**1.5.1**	*	**Does the policy commit you to continually measure, monitor & inspect your performance in Health, Safety & the Environment?**	y	1	1	1
1.1		**1.5.2**	*	**Does the policy commit you to continually improving your performance in Health, Safety & the Environment?**	y	1	1	1
1.1	4.2.1	**1.6.1**	*	**Does the policy commit you to adopting a multi-disciplinary team approach to solving Health, Safety & Environmental problems, as favoured by TQOs.**	y	1	1	1

1.1	4.4.1	**1.7.1**	*	**Does the policy commit you to open & effective communications on:**					
1.1	4.4.1	1.7.1	a	policy?	n	1	0	1	
1.1	4.4.1	1.7.1	b	standards?	n	1	0	1	
1.1	4.4.1	1.7.1	c	performance in Health, Safety & the Environment?	n	1	0	1	
1.1	4.4.1	**1.7.2**	*	**Is a copy of the policy:**					
1.1	4.4.1	1.7.2	a	sent to every employee?	n	2	0	2	
1.1	4.4.1	1.7.2	b	displayed on notice-boards?	y	2	2	2	
1.1	3.5.0	**1.8.1**	*	**Does the policy commit you to developing product technologies, compatible with your Health, Safety & Environmental aims?**	na	1			
1.1	3.2.0	**1.8.2**	*	**Does the policy commit you to adopting manufacturing technologies, compatible with your Health, Safety & Environmental aims?**	y	1	1	1	
						56	43	54	80%

1.2 ORGANISATION, ARRANGEMENTS & RESOURCES

1.2		**2.0.1**	*	**Have responsibilities been allocated:**				
1.2		2.0.1	a.	for Health & Safety?	y	2	2	2
1.2		2.0.1	b.	for Environmental issues?	y	2	2	2
1.2		**2.0.2**	*	**Is there a senior manager that is responsible for:**				
1.2		2.0.2	a	identifying statutory requirements?	y	2	2	2
1.2		2.0.2	b	identifying all HS&E activities?	y	2	2	2
1.2		2.0.2	c	co-ordinating all HS&E activities?	y	2	2	2
1.2	4.3.0	**2.0.3**	*	**Are all employees aware of their responsibilities & site arrangements?**	n	1	0	1
1.2		**2.0.4**	*	**Are HS&E responsibilities outlined in job descriptions?**	n	1	0	1
1.2		**2.0.5**	*	**Has a responsible person been appointed to co-ordinate:**				
1.2	2.3.0	2.0.5	1a	identification of the extent & nature of risks from articles, processes & substances?	y	1	1	1
1.2	2.3.0	2.0.5	1b	elimination of risks from articles, processes & substances?	y	1	1	1
1.2	2.1.1	2.0.5	2a	improvement to workplace design & working environment?	n	1	0	1
1.2	2.1.0	2.0.5	2b	organisation of work?	n	1	0	1
1.2	2.1.0	2.0.5	3a	development of safe systems of work?	y	1	1	1
1.2	2.2.5	2.0.5	3b	implementation of safety equipment?	y	1	1	1
1.2		2.0.5	4	implementation of contingency plans?	y	1	1	1
1.2	2.4.4	2.0.5	5a	first aid?	n	1	0	1
1.2	2.4.3	2.0.5	5b	workplace monitoring?	y	1	1	1
1.2	2.4.2	2.0.5	5c	occupational health service?	n	1	0	1
1.2	2.4.1	2.0.5	5d	health promotion?	n	1	0	1
1.2	3.2.0	2.0.5	6	reduction of material use, waste & emissions?	n	1	0	1
1.2	3.1.3	2.0.5	7	reduction of water use & effluent?	n	1	0	1
1.2	3.4.2	2.0.5	8	reduction of energy consumption & inefficiencies?	y	1	1	1
1.2	2.1.2	2.0.5	9	improvement of good housekeeping measures for the land & buildings?	y	1	1	1
1.2	3.5.0	2.0.5	10	consideration of environmental impact of product use & disposal?	n	1	0	1
1.2	3.2.1	2.0.5	11	consideration of environmental impact caused by material suppliers?	n	1	0	1
1.2		**2.0.6**	*	**Are Health & Safety meetings:**				
1.2		2.0.6	a.	held every month?	y	5	5	5
1.2		2.0.6	b.	held every 2 months?	na	4		
1.2		2.0.6	c.	held every 3 months?	na	3		
1.2		2.0.6	d.	held every 6 months?	na	2		
1.2		2.0.6	e.	held every year?	na	1		
1.2		2.0.6	f.	never held?	na	0		
1.2		**2.0.7**	*	**Are Environmental meetings:**				
1.2		2.0.7	a.	held every month?	n	5	0	5
1.2		2.0.7	b.	held every 2 months?	n	4	0	
1.2		2.0.7	c.	held every 3 months?	n	3	0	
1.2		2.0.7	d.	held every 6 months?	n	2	0	
1.2		2.0.7	e.	held every year?	n	1	0	
1.2		2.0.7	f.	never held?	n	0	0	
1.2		**2.0.8**	*	**Does a senior manager chair:**				
1.2		2.0.8	a.	the Health & Safety meetings?	n	1	0	1
1.2		2.0.8	b.	the Environmental meetings?	n	1	0	1
1.2		**2.0.9**	*	**Have you defined the Terms of Reference for:**				
1.2		2.0.9	a.	the Health & Safety meetings?	n	1	0	1
1.2		2.0.9	b.	the Environmental meetings?	n	1	0	1
1.2		**2.0.10**	*	**Are objectives set each year, for:**				
1.2		2.0.10	a.	the Health & Safety meetings?	n	1	0	1
1.2		2.0.10	b.	the Environmental meetings?	n	1	0	1
1.2		**2.0.11**	*	**Are HS&E items routinely included on the agenda of:**				

1.2		2.0.11	a.	senior site management meetings?	n	1	0	1
1.2		2.0.11	b.	cell meetings?	n	1	0	1
1.2		**2.0.12**	*	**Are there mechanisms in place to:**				
1.2		2.0.12	a.	prioritise problems?	n	1	0	1
1.2		2.0.12	b.	resolve resource conflicts?	n	1	0	1
1.2		**2.1.1**	*	**Is there a reference manual on HS&E matters which offers guidance to managers?**	n	1	0	1
1.2		**2.1.2**	*	**Is the manual kept up to date?**	n	1	0	1
1.2		**2.1.3**	*	**Is the guidance provided in the manual based on:**				
1.2		2.1.3	a.	legislation?	n	1	0	1
1.2		2.1.3	b.	best practice?	n	1	0	1
1.2		**2.1.4**	*	**Are minutes kept for HS&E meetings?**	y	1	1	1
1.2		**2.1.5**	*	**Is there a system for recording actions agreed at HS&E meetings?**	y	1	1	1
1.2		**2.1.6**	*	**Are completion dates recorded against completed actions?**	y	1	1	1
1.2		**2.1.7**	*	**Is an attendance record kept for the HS&E meeting?**	y	1	1	1
1.2	4.1.0	**2.2.1**	*	**Are HS&E issues included in the training or career development plans of:**				
1.2	4.1.0	2.2.1	a	co-ordinators	n	1	0	1
1.2	4.1.0	2.2.1	b	managers	n	1	0	1
1.2	4.1.0	2.2.1	c	supervisors	n	1	0	1
1.2	4.1.0	2.2.1	d	engineers	n	1	0	1
1.2	4.1.0	2.2.1	e	operators	n	1	0	1
1.2	4.1.0	2.2.1	f	others	n	1	0	1
1.2	4.1.1	**2.2.2**	*	**Have competent specialists been appointed to give:**				
1.2	4.1.1	2.2.2	a	health advice?	n	1	0	1
1.2	4.1.1	2.2.2	b	first aid treatment?	n	1	0	1
1.2	4.1.1	2.2.2	c	safety advice?	y	1	1	1
1.2	4.1.1	2.2.2	d	environmental advice?	n	1	0	1
1.2	4.1.1	**2.2.3**	*	**In order to adequately address Health, Safety & Environmental issues, are there mechanisms in place to maintain the competence of:**				
1.2	4.1.1	2.2.3	a.	co-ordinators	n	1	0	1
1.2	4.1.1	2.2.3	b.	managers	n	1	0	1
1.2	4.1.1	2.2.3	c.	supervisors	n	1	0	1
1.2	4.1.1	2.2.3	d.	engineers	n	1	0	1
1.2	4.1.1	2.2.3	e.	operators	n	1	0	1
1.2	4.1.1	2.2.3	f.	EH&S engineers	n	1	0	1
1.2	4.1.1	2.2.3	g	first aiders	n	1	0	1
1.2	4.1.1	2.2.3	h	nurses	n	1	0	1
1.2	4.1.1	2.2.3	i	others	n	1	0	1
1.2	4.1.1	**2.2.4**	*	**Does the HS&E meeting agenda include review of the effectiveness of the training programme?**	n	1	0	1
1.2	4.1.0	**2.2.5**	*	**Are employees only expected to do jobs for which they are trained?**	y	1	1	1
1.2	4.1.1	**2.2.6**	*	**Are there mechanisms in place to assess the competence of sub-contractors?**	n	1	0	1
1.2	4.1.1	**2.2.7**	*	**Are there mechanisms in place to assess the competence of temporary staff?**	n	1	0	1
1.2	4.1.1	**2.2.7**	*	**Are there mechanisms in place to assess the competence of HS&E specialists?**	n	1	0	1
1.2	4.4.2	**2.3.1**	*	**Are there mechanisms in place for the transfer of technologies & solutions to HS&E problems to & from other Lucas businesses?**	n	1	0	1
1.2	4.4.2	**2.3.2**	*	**Are staff from other Lucas businesses ever invited to meetings to share HS&E information?**	n	1	0	1
1.2		**2.4.1**	*	**Are there procedures in place for the systematic identification, avoidance, reduction & elimination of risks:**				
1.2	2.2.0/2.3.0	2.4.1	1	from articles, processes & substances?	n	1	0	1
1.2	2.1.1	2.4.1	2a	in workplace design?	n	1	0	1
1.2	2.1.3	2.4.1	2b	in the working environment?	n	1	0	1
1.2	2.1.0	2.4.1	2c	in the organisation of work?	n	1	0	1
1.2	2.1.0	2.4.1	3	in systems of work?	n	1	0	1
1.2	2.2.5	2.4.1	4	in the use or misuse of safety equipment?	n	1	0	1
1.2	3.1.2/3.2.2	2.4.1	6	from material use, waste & emissions?	n	1	0	1
1.2	3.1.3	2.4.1	7	from water use & effluent?	n	1	0	1
1.2	3.4.1	2.4.1	8	from energy use?	n	1	0	1
1.2	2.1.2	2.4.1	9	in housekeeping measures for the land & buildings?	n	1	0	1
1.2	3.5.0	2.4.1	10	from product use & disposal?	n	1	0	1
1.2		2.4.1	11	caused by suppliers & sub-contractors?	n	1	0	1
1.2	4.3.0	**2.4.2**	*	**Are all employees aware of the need to report:**				

1.2	2.4.3/4.3.0	2.4.2	a	hazards, accidents & incidents that are adverse to health?	n	1	0	1
1.2	2.4.3/4.3.0	2.4.2	b	conditions & symptoms that could cause accidents & incidents?	n	1	0	1
1.2	2.3.4/4.3.0	2.4.2	c	hazards, accidents & incidents that require emergency procedures?	n	1	0	1
1.2		**2.4.3**	*	**Are adequate risk assessments carried out consistently across all activities?**	n	1	0	1
1.2		**2.4.4**	*	**Are risk assessment records kept?**	n	1	0	1
1.2	4.4.1	**2.4.5**	*	**Are assessment results communicated to the appropriate employees?**	n	5	0	5
1.2	2.3.4	**2.4.6**	*	**Are procedures in place to formulate contingency plans in the light of risk assessment results?**	n	1	0	1
1.2		**2.4.7**	*	**Do you have contingency plans in case of:**				
1.2		2.4.7	a	fire?	y	1	1	1
1.2	2.3.4	2.4.7	b	chemical spills?	y	1	1	1
1.2		2.4.7	c	flooding?	y	1	1	1
1.2	2.4.4	2.4.7	d	employee injury?	y	1	1	1
1.2	3.1.3	2.4.7	e	accidental effluent discharge?	y	1	1	1
1.2	3.1.2	2.4.7	f	gas leaks?	y	1	1	1
1.2	3.4.2	2.4.7	g	power failure?	y	1	1	1
1.2	2.2.0	2.4.7	h	major equipment breakdown?	y	1	1	1
1.2		2.4.7	i	natural disasters?	y	1	1	1
1.2		2.4.7	j	bombs?	y	1	1	1
1.2		2.4.7	k	explosions?	y	1	1	1
1.2	2.3.4	2.4.7	l	radio-active leaks?	na	1		
1.2		**2.4.8**	*	**Is loss control included on the HS&E meeting agenda?**	y	1	1	1
1.2		**2.5.1**	*	**Are senior managers responsible for setting quantifiable targets for:**				
1.2	3.2.1	2.5.1	1a	elimination of hazards from processes?	n	1	0	1
1.2	2.3.1	2.5.1	1b	elimination of hazards from substances?	n	1	0	1
1.2	2.1.1	2.5.1	2a	improvement to workplace design?	n	1	0	1
1.2	2.1.3	2.5.1	2b	improvement to working environment?	n	1	0	1
1.2	2.1.5	2.5.1	3a	development of safe systems of work?	n	1	0	1
1.2	2.2.5	2.5.1	3b	implementation of safety equipment?	n	1	0	1
1.2	2.3.1	2.5.1	4	implementation of contingency plans?	n	1	0	1
1.2		2.5.1	5a	reduction in lost time?	y	1	1	1
1.2		2.5.1	5b	reduction in Employer Liability claims?	y	1	1	1
1.2	2.4.2	2.5.1	5c	reduction in first aid attendees?	n	1	0	1
1.2	2.4.2	2.5.1	5d	reduction in occupational diseases?	n	1	0	1
1.2	2.4.2	2.5.1	5e	reduction in RTW lost time?	n	1	0	1
1.2	4.1.1	2.5.1	5f	improvements in HS&E training?	n	1	0	1
1.2	3.2.1	2.5.1	6a	reduction of material use?	n	1	0	1
1.2	3.2.2	2.5.1	6b	reduction of waste?	n	1	0	1
1.2	3.1.2	2.5.1	6c	reduction of emissions?	n	1		
1.2	3.1.3	2.5.1	7a	reduction of water use?	n	1	0	1
1.2	3.1.3	2.5.1	7b	reduction of effluent?	n	1	0	1
1.2	3.4.1	2.5.1	8a	reduction of energy consumption?	y	1	1	1
1.2	3.4.2	2.5.1	8b	reduction of energy inefficiencies?	n	1	0	1
1.2	2.1.2	2.5.1	9a	improvement of good housekeeping measures for land?	y	1	1	1
1.2	2.1.2	2.5.1	9b	improvement of good housekeeping measures for the buildings?	y	1	1	1
1.2	3.5.0	2.5.1	10a	environmental impact of product use?	na	1		
1.2	3.5.0	2.5.1	10b	environmental impact of product disposal?	na	1		
1.2		2.5.1	11a	environmental impact caused by suppliers?	n	1	0	1
1.2		2.5.1	11b	environmental impact caused by sub-contractors?	n	1	0	1
1.2		**2.5.2.**	*	**Are business objectives from the Competitive Achievement Plan (CAP) translated into specific management objectives for HS&E?**	y	1	1	1
1.2		**2.5.3**	*	**Are business level HS&E objectives cascaded down to line managers?**	n	1	0	1
1.2		**2.5.4**	*	**Are there specific targets for first line supervisors?**	n	1	0	1
1.2		**2.5.5**	*	**Do you have performance measurements for:**				
1.2		2.5.5	a	Health?	n	1	0	1
1.2		2.5.5	b	Safety?	y	1	1	1
1.2		2.5.5	c	Environment?	n	1	0	1
1.2	4.2.0	**2.5.6**	*	**Do you have a general Continuous Improvement Programme?**	y	1	1	1
1.2	4.2.0	**2.5.7.**	*	**Is Health, Safety & the Environment included in the Continuous Improvement Programme?**	n	1	0	1
1.2		**2.6.1**	*	**Have projects been set up to address the following:**				

1.2	2.3.0	2.6.1	1a	identification of risks from articles, processes & substances?	n	1	0	10
1.2	2.3.0	2.6.1	1b	elimination of risks from articles, processes & substances?	n	1	0	
1.2	2.1.1	2.6.1	2a	improvement to workplace design?	n	1	0	
1.2	2.1.3	2.6.1	2b	improvement to working environment?	n	1	0	
1.2	2.1.3	2.6.1	2c	noise reduction?	n	1	0	
1.2	2.1.0	2.6.1	3a	development of safe systems of work?	n	1	0	
1.2	2.2.5	2.6.1	3b	implementation of safety equipment?	n	1	0	
1.2	2.3.4	2.6.1	4	implementation of contingency plans?	n	1	0	
1.2	2.4.2	2.6.1	5a	reduction in lost time?	y	1	1	
1.2	2.4.2	2.6.1	5b	reduction in Employer Liability claims?	y	1	1	
1.2	2.4.2	2.6.1	5c	reduction in first aid attendees?	n	1	0	
1.2	2.4.2	2.6.1	5d	reduction in occupational diseases?	n	1	0	
1.2	2.4.2	2.6.1	5e	reduction in RTW lost time?	n	1	0	
1.2	4.1.0	2.6.1	5f	improvements in HS&E training?	n	1	0	
1.2	3.2.1	2.6.1	6a	reduction of material use?	n	1	0	
1.2	3.2.2	2.6.1	6b	reduction of waste?	n	1	0	
1.2	2.3.2	2.6.1	6c	waste disposal - duty of care?	y	1	1	
1.2	3.1.2	2.6.1	6d	reduction of emissions?	n	1	0	
1.2	3.2.3	2.6.1	6e	reduction of solvents?	y	1	1	
1.2	3.1.3	2.6.1	7a	reduction of water use?	n	1	0	
1.2	3.1.3	2.6.1	7b	recycling of process water?	n	1	0	
1.2	3.1.3	2.6.1	7c	reduction of effluent?	n	1	0	
1.2	3.4.2	2.6.1	8	reduction of energy consumption & inefficiencies?	y	1	1	
1.2	2.1.2	2.6.1	9	improvement of good housekeeping measures for the land & buildings?	y	1	1	
1.2	3.5.0	2.6.1	10 a	environmental impact of product use?	na	1		
1.2	3.5.0	2.6.1	10 b	environmental impact of product disposal?	na	1		
1.2	3.5.2	2.6.1	10 c	recycling or re-use of products & components?	na	1		
1.2		2.6.1	11	environmental impact caused by suppliers & sub-contractors?	n	1	0	
1.2		**2.6.2**	*	**Which of the following functions are represented at the HS&E meeting:**				
1.2	2.1.0/2.2.0	2.6.2	a	safety?	y	1	1	1
1.2	3.2.0	2.6.2	b	manufacturing?	y	1	1	1
1.2	2.4.0	2.6.2	c	medical?	n	1	0	1
1.2	4.4.0	2.6.2	d	personnel?	y	1	1	1
1.2	3.5.0	2.6.2	e	product engineering?	n	1	0	1
1.2	3.5.1	2.6.2	f	purchasing/supplies?	n	1	0	1
1.2		2.6.2	g	quality?	y	1	1	1
1.2	4.1.0	2.6.2	h	training?	na	1		
1.2	2.1.4	2.6.2	i	works engineering/site maintenance?	y	1	1	1
1.2	4.4.1	**2.7.1**	*	**Do you openly & effectively communicate the organisational arrangements & responsibilities for HS&E?**	n	5	0	5
1.2	4.4.1	**2.7.2**	*	**Do arrangements exist for consultation with employees?**	n	1	0	1
1.2	4.4.1	**2.7.3**	*	**Are HS&E arrangements explained to all new employees during the induction process?**	n	1	0	1
1.2	4.4.1	**2.7.4**	*	**Does the communication system facilitate:**				
1.2	4.4.1	2.74	a	participation of employees?	n	1	0	1
1.2	4.4.1	2.74	b	effective dissemination of information by managers?	n	1	0	1
1.2	4.4.1	**2.7.5**	*	**Is there a system for acknowledging & replying to suggestions received?**	n	1	0	1
1.2	4.4.1	**2.7.6**	*	**Are the Terms of Reference for the HS&E meeting openly communicated?**	y	1	1	1
1.2	4.4.1	**2.7.7**	*	**Are decisions taken at the HS&E meeting openly communicated?**	y	1	1	1
1.2		**2.8.1**	*	**Do those people who develop & adopt product technologies consider the following:**				
1.2	3.2.1	2.8.1	1	elimination of hazardous articles, processes & substances?	n	1	0	1
1.2	3.1.2/3.2.1	2.8.1	6	reduction of material use, hence waste & emissions?	n	1	0	1
1.2	3.1.3	2.8.1	7	reduction of water use, hence effluent?	n	1	0	1
1.2	3.4.1	2.8.1	8	reduction of energy consumption?	n	1	0	1
1.2	3.5.0	2.8.1	10 a	environmental impact of product use?	n	1	0	1
1.2	3.5.2	2.8.1	10 b	environmental impact of product disposal, hence recyclability?	na	1		
1.2		2.8.1	11	environmental impact caused by suppliers & sub-contractors?	n	1	0	1

1.2		**2.8.2**	*	**Do those people who develop & adopt manufacturing technologies take the following into consideration:**					
1.2	3.2.1	2.8.2	1a	elimination of hazardous articles, processes & substances?	n	1	0	1	
1.2	3.2.2	2.8.2	1b	development of clean technologies?	n	1	0	1	
1.2	2.1.1	2.8.2	2a	improvement to workplace design & working environment?	n	1	0	1	
1.2	2.1.0	2.8.2	2b	work organisation?	n	1	0	1	
1.2	2.1.4	2.8.2	2c	maintenance programmes to ensure safety & efficiency?	n	1	0	1	
1.2	2.1.0	2.8.2	3a	development of safe systems of work?	n	1	0	1	
1.2	2.2.5	2.8.2	3b	implementation of safety equipment?	n	1	0	1	
1.2	2.3.4	2.8.2	4	implementation of contingency plans?	n	1	0	1	
1.2	2.1.1	2.8.2	5	variation of human dimensions & needs?	n	1	0	1	
1.2	3.1.2/3.2.1	2.8.2	6	reduction of material use, waste & emissions?	n	1	0	1	
1.2	3.1.3	2.8.2	7	reduction of water use & effluent?	n	1	0	1	
1.2	3.4.2	2.8.2	8	reduction of energy consumption & inefficiencies?	n	1	0	1	
1.2		2.8.2	11	environmental impact caused by suppliers & sub-contractors?	n	1	0	1	
1.2		**2.8.3**	*	**Do those people who are responsible for building maintenance & site services, take the following into consideration?**					
1.2	2.3.0	2.8.3	1	elimination of hazardous articles, processes & substances?	n	1	0	1	
1.2	2.1.3	2.8.3	2	improvement to the working environment?	n	1	0	1	
1.2	2.1.0	2.8.3	3a	development of safe systems of work?	n	1	0	1	
1.2	2.2.5	2.8.3	3b	implementation of safety equipment?	n	1	0	1	
1.2	2.3.4	2.8.3	4	implementation of contingency plans?	n	1	0	1	
1.2	2.4.0	2.8.3	5	employee health?	n	1	0	1	
1.2	2.3.2	2.8.3	6a	safe storage facilities for chemicals?	n	1	0	1	
1.2	2.3.2	2.8.3	6b	physical handling of waste?	n	1	0	1	
1.2	2.3.2	2.8.3	6c	safe storage facilities for waste?	y	1	1	1	
1.2	2.3.2	2.8.3	6d	ensuring against the mixing of hazardous & non-hazardous waste?	y	1	1	1	
1.2	2.1.4	2.8.3	7a	maintenance of water supply facilities?	n	1	0	1	
1.2	3.1.3	2.8.3	7b	water-efficient equipment for toilets & washrooms?	n	1	0	1	
1.2	3.1.3	2.8.3	7c	monitoring of effluent?	y	1	1	1	
1.2	3.1.3	2.8.3	7d	separation of effluent streams?	y	1	1	1	
1.2	3.4.1	2.8.3	8a	energy efficiency of heating systems?	n	1	0	1	
1.2	3.4.1	2.8.3	8b	energy efficiency of lighting systems?	n	1	0	1	
1.2	2.2.2	2.8.3	8c	safety of energy supply facilities?	n	1	0	1	
1.2	2.1.4	2.8.3	8d	safety of water systems (e.g. against legionella)?	n	1	0	1	
1.2	2.1.2	2.8.3	8e	ventilation & in-house air quality?	y	1	1	1	
1.2	2.1.2	2.8.3	9	good housekeeping measures for the land & buildings?	n	1	0	1	
1.2		2.8.3	11a	environmental impact caused by suppliers & sub-contractors?	n	1	0	1	
1.2	2.1.0/2.2.0	2.8.3	11b	safety arrangement for sub-contractors working on-site?	n	1	0	1	
						264	67	220	30%

1.3 PLANNING & IMPLEMENTATION SYSTEMS

1.3	**3.0.1**	*	**Does justification for investment include Health, Safety & Environmental implications**	y	1	1	1
1.3	**3.0.2**	*	**Is there a formal procedure for planning the implementation of the HS&E policy?**	n	1	0	1
1.3	**3.0.3**	*	**Is there a formal procedure for implementing the HS&E policy?**	n	1	0	1
1.3	**3.0.4**	*	**Is the implementation plan broken down into identifiable projects?**	y	1	1	1
1.3	**3.0.5**	*	**Has a responsible person been appointed to co-ordinate projects?**	y	1	1	1
1.3	**3.0.6**	*	**Is a project manager appointed for each project?**	n	1	0	1
1.3	**3.0.7**	*	**Are the Lucas Project Management Procedures used for planning & implementing HS&E projects?**	n	1	0	1
1.3	**3.0.8**	*	**Are there written specifications for each project?**	n	1	0	1
1.3	**3.0.9**	*	**Does the project manager sign off the written project specification?**	n	1	0	1
1.3	**3.0.10**	*	**Do the plans include allocation of resources?**	n	1	0	1
1.3	**3.0.11**	*	**Is each project broken down into a set of measurable work packages?**	n	1	0	1
1.3	**3.0.12**	*	**Does each work package have an owner?**	n	1	0	1
1.3	**3.0.13**	*	**Are implementation milestones identified in the plan?**	n	1	0	1
1.3	**3.0.14**	*	**Do the project managers have ownership of the project budgets?**	n	1	0	1

1.3		**3.0.15**	*	**Is prioritisation applied to projects to ensure that sufficient resources are employed?**	n	1	0	1
1.3		**3.0.16**	*	**Is there a procedure to resolve any conflict between HS&E & other business activities?**	y	1	1	1
1.3		**3.0.17**	*	**Is there a formal handover to operations when implementation is complete?**	n	1	0	1
1.3	4.1.0	**3.0.18**	*	**Does the handover include training of users?**	n	1	0	1
1.3		**3.0.19**	*	**Is there any in-plant recycling of:**				
1.3	3.1.3	3.0.19	a.	water?	n	1	0	1
1.3	3.2.3	3.0.19	b.	solvents?	na	1		
1.3	3.3.1	3.0.19	c.	paper?	n	1	0	1
1.3	3.3.2	3.0.19	d.	packaging?	n	1	0	1
1.3	3.4.2	3.0.19	e.	lost heat?	n	1	0	1
1.3	3.2.2	3.0.19	f.	waste materials?	n	1	0	1
1.3	2.3.2	3.0.19	g.	cutting oils?	n	1	0	1
1.3		**3.0.20**	*	**Are there any initiatives to collect waste for recycling outside the company:**				
1.3	3.2.2	3.0.20	a.	metals?	y	1	1	1
1.3	3.2.2	3.0.20	b.	wood?	y	1	1	1
1.3	3.2.2/3.3.1	3.0.20	c.	paper?	y	1	1	1
1.3	3.2.2/3.3.2	3.0.20	d.	cardboard?	y	1	1	1
1.3	3.2.2/3.3.2	3.0.20	e.	plastics?	y	1	1	1
1.3	3.2.2/3.2.3	3.0.20	f.	solvents?	y	1	1	1
1.3	3.2.2/3.3.3	3.0.20	g.	other?	y	1	1	1
1.3		**3.1.1**	*	**Is compliance with Lucas policy a consideration when planning & implementing projects?**		1		
1.3	2.3.1	**3.1.2**	*	**Do you have inventories detailing:**				
1.3	2.3.1	3.1.2	1	all hazardous substances on site?	y	1	1	1
1.3	2.3.1	3.1.2	6a	the types of hazardous waste produced?	y	1	1	1
1.3	2.3.1	3.1.2	6b	the quantities of hazardous waste produced?	y	1	1	1
1.3		**3.1.3**	*	**Do you have assessments carried out on:**				
1.3	2.3.0	3.1.3	1a	hazardous substances (especially carcinogens)?	n	1	0	1
1.3	2.3.0	3.1.3	1b	radiation sources?	na	1		
1.3	2.3.0	3.1.3	1c	asbestos?	n	1	0	1
1.3	2.3.0	3.1.3	1d	lead?	na	1		
1.3	2.1.1	3.1.3	2a	the ergonomics of work stations?	n	1	0	1
1.3	2.1.3	3.1.3	2b	the adequacy of lighting levels?	n	1	0	1
1.3	2.1.4	3.1.3	3a	manual handling operations?	n	1	0	1
1.3	2.1.3	3.1.3	3b	noise?	y	1	1	1
1.3	2.2.0	3.1.3	3c	pressure systems?	y	1	1	1
1.3	2.2.5	3.1.3	3d	personal protective equipment?	y	1	1	1
1.3	2.3.4	3.1.3	3c	potential fire hazards?	y	1	1	1
1.3		**3.1.4**	*	**Do you have programmes to identify & eliminate:**				
1.3	3.2.1	3.1.4	1a	hazardous articles, processes & substances?	y	1	1	1
1.3	2.3.0	3.1.4	1b	known carcinogenic substances?	n	1	0	1
1.3	3.2.3	3.1.4	1c	solvents (especially CFCs)?	y	1	1	1
1.3	3.2.2	3.1.4	6f	hazardous waste?	n	1	0	1
1.3	3.1.3	3.1.4	7b	effluent streams?	n	1	0	1
1.3	3.1.2	3.1.4	8b	emissions to air?	n	1	0	1
1.3	3.3.3	3.1.4	9a	asbestos in the buildings?	na	1		
1.3		**3.1.5**	*	**Do you have programmes to minimise:**				
1.3	3.1.3	3.1.5	a.	use of water?	n	1	0	1
1.3	3.3.1	3.1.5	b.	use of paper?	n	1	0	1
1.3	3.3.2	3.1.5	c.	use of packaging?	n	1	0	1
1.3	3.4.2	3.1.5	d.	heat loss?	n	1	0	1
1.3	3.2.2	3.1.5	e.	all waste materials?	n	1	0	1
1.3	3.4.1	3.1.5	f.	energy use?	y	1	1	1
1.3	3.1.2	3.1.5	g.	external noise?	n	1	0	1
1.3	2.1.3	3.1.5	h	internal noise?	y	1	1	1
1.3	2.4.2	3.1.5	i	occupational diseases?	n	1	0	1
1.3	2.4.2	3.1.5	j	musculo-skeletal problems?	y	1	1	1
1.3	2.4.2/3.1.2	3.1.5	k	workplace emissions?	n	1	0	1
1.3		**3.1.6**	*	**Do you have systems for controlling:**				
1.3	2.3.1	3.1.6	1a	data & procedures to support assessments & Material Data Sheets?	y	1	1	1
1.3	2.3.2	3.1.6	1b	safe storage facilities for chemicals?	n	1	0	1
1.3	2.3.2	3.1.6	1c	spill overflow protection (bunding) around all liquid storage areas?	y	1	1	1
1.3	2.1.3	3.1.6	1d	employee exposure to hazardous substances?	n	1	0	1
1.3	2.3.2	3.1.6	1e	maintenance of storage areas to ensure that they remain in good condition?	y	1	1	1
1.3	2.2.1	3.1.6	2a	use of machine guarding?	y	1	1	1
1.3	2.2.1	3.1.6	2b	regular inspections of plant & equipment?	n	1	0	1
1.3	2.2.5	3.1.6	3	consistent use of safety equipment?	n	1	0	1

1.3	2.4.0	3.1.6	5a	accidents, incidents & near misses?	n	1	0	1
1.3	2.4.4	3.1.6	5b	first aid?	n	1	0	1
1.3	2.4.0	3.1.6	5c	occupational diseases?	n	1	0	1
1.3	2.4.3	3.1.6	5d	exposure limits (workplace emissions)?	n	1	0	1
1.3	2.4.0	3.1.6	5e	absenteeism?	y	1	1	1
1.3	2.4.5	3.1.6	5f	return to work?	y	1	1	1
1.3	2.3.2	3.1.6	6a	safe storage facilities for waste?	y	1	1	1
1.3	2.3.2	3.1.6	6b	segregation of waste streams?	y	1	1	1
1.3	2.3.2	3.1.6	6c	the physical handling of waste?	y	1	1	1
1.3	2.3.2	3.1.6	6d	waste disposal arrangements with quality assured contractors?	y	1	1	1
1.3	2.1.4	3.1.6	7a	inspection & maintenance of water supply facilities?	y	1	1	1
1.3	3.1.3	3.1.6	7b	separation of effluent streams?	y	1	1	1
1.3	3.1.3	3.1.6	7c	facilities to clean water before discharging it?	y	1	1	1
1.3	3.1.2	3.1.6	8	monitoring of emissions to air?	y	1	1	1
1.3	3.1.2	3.1.6	8a	actual emissions to air?	y	1	1	1
1.3	2.1.0/2.2.0	3.1.6	11	safety arrangements for sub-contractors working on-site?	n	1	0	1
1.3		**3.1.7**	*	**Do you have programmes to improve:**				
1.3	2.1.0	3.1.7	2	the working environment?	n	1	0	1
1.3	2.1.0	3.1.7	3	safe systems of work?	y	1	1	1
1.3	2.3.4	3.1.7	5a	practice of contingency plans?	n	1	0	1
1.3	2.3.4	3.1.7	5b	fire drills?	n	1	0	1
1.3	2.1.2	3.1.7	9	housekeeping measures for the land & buildings?	y	1	1	1
1.3	4.4.3	**3.1.8**	*	**In the last 2 years, have you: (-ve)**				
1.3	4.4.3	3.1.8	a.	had an informal verbal warning?	n	1	1	1
1.3	4.4.3	3.1.8	b.	had an informal written warning?	n	1	1	1
1.3	4.4.3	3.1.8	c.	had a formal written warning?	n	1	1	1
1.3	4.4.3	3.1.8	d.	been identified as contravening H&S legislation?	y	1	-1	1
1.3	4.4.3	3.1.8	e.	been identified as contravening an environmental regulation?	y	1	-1	1
1.3	4.4.3	3.1.8	f.	received a prohibition notice, stopping operations?	n	1	1	1
1.3	4.4.3	3.1.8	g.	received an improvement notice?	n	1	1	1
1.3	4.4.3	**3.1.9**	*	**Has this led to prosecution? (-ve)**	n	1	1	1
1.3	4.4.3	**3.1.10**	*	**Did the prosecution find you guilty? (-ve)**	n	1	1	1
1.3		**3.1.11**	*	**As a result of external intervention, have you taken action to prevent a reoccurence?**	y	1	1	1
1.3	2.2.0	**3.1.12**	*	**Are there change control procedures to ensure that compliance is maintained when new equipment is installed?**	n	1	0	1
1.3	2.1.0	**3.1.13**	*	**Are there change control procedures to ensure that compliance is maintained when new methods are introduced?**	n	1	0	1
1.3	4.1.1	**3.2.1**	*	**Has a training plan been implemented in order to develop & maintain the HS&E competence of:**				
1.3	4.1.1	3.2.1	a.	co-ordinators?	n	1	0	1
1.3	4.1.1	3.2.1	b.	managers?	n	1	0	1
1.3	4.1.1	3.2.1	c.	supervisors?	n	1	0	1
1.3	4.1.1	3.2.1	d.	engineers?	n	1	0	1
1.3	4.1.1	3.2.1	e.	setters?	n	1	0	1
1.3	4.1.1.	3.2.1	f.	maintenance personnel?	n	1	0	1
1.3	4.1.1	3.2.1	g.	operators?	n	1	0	1
1.3	4.1.1	3.2.1	h.	others?	n	1	0	1
1.3	4.2.1	**3.2.2**	*	**Have teams leaders received training in:**				
1.3	4.2.1	3.2.2	a.	running a project team?	y	1	1	1
1.3	4.2.1	3.2.2	b.	problem solving techniques?	y	1	1	1
1.3	4.2.1	3.2.2	c.	project management techniques?	n	1	0	1
1.3	4.2.1	3.2.2	d.	project recovery techniques?	n	1	0	1
1.3	4.2.1	3.2.2	e.	health, safety & environmental issues?	n	1	0	1
1.3	4.1.0	**3.2.3**	*	**Has at least one member of each HS&E project team received training in:**				
1.3	4.1.0	3.2.3	a	HS&E Implications & Legislation	y	1	1	1
1.3	4.1.0	3.2.3	b	Risk Assessment	n	1	0	1
1.3	2.1.1/4.1.0	3.2.3	c	Workplace design	n	1	0	1
1.3	4.1.0	3.2.3	d	Systems	y	1	1	1
1.3	4.1.0	3.2.3	e	Human Factors	y	1	1	1
1.3	4.1.0	**3.2.3**	*	**Has at least one member of each Manufacturing & Office Systems project team received training in:**				
1.3	4.1.0	3.2.3	a	HS&E Implications & Legislation	n	1	0	1
1.3	4.1.0	3.2.3	b	Risk Assessment	n	1	0	1
1.3	2.1.1/4.1.0	3.2.3	c	Workplace design	n	1	0	1
1.3	4.1.0	3.2.3	d	Systems	y	1	1	1
1.3	4.1.0	3.2.3	e	Human Factors	n	1	0	1
1.3	3.5.2/4.1.0	3.2.3	f	Environmental impact of use	y	1	1	1
1.3	4.1.0	**3.2.3**	*	**Has at least one member of each New Product/Development team received training in:**				

1.3	4.1.0	3.2.3	a	HS&E Implications & Legislation	na	1			
1.3	4.1.0	3.2.3	b	Risk Assessment	na	1			
1.3	4.1.0	3.2.3	d	Systems	na	1			
1.3	4.1.0	3.2.3	e	Human Factors	na	1			
1.3	3.5.2/4.1.0	3.2.3	f	Environmental impact of use	na	1			
1.3	3.5.2/4.1.0	3.2.3	g	Environmental impact of disposal	na	1			
1.3	3.5.1/4.1.0	3.2.3	h	Environmental impact of Production	na	1			
1.3	4.1.0	**3.2.4**	*	**When personnel changes occur, are there change control procedures in place to ensure that adequate training is given?**	y	5	5	5	
1.3	4.4.2	**3.3.1**	*	**Is there a plan to transfer technologies & solutions to Health, Safety & Environmental problems between businesses?**	n	1	0	1	
1.3	4.4.3	**3.3.2**	*	**Do you seek advice from other people?**	y	1	1	1	
1.3	4.4.2	**3.3.3**	*	**Are project results communicated to the rest of the Lucas group?**	n	1	0	1	
1.3		**3.4.1**	*	**Do you have a plan to identify risks in your business?**	y	1	1	1	
1.3		**3.4.2**	*	**Has the risk identification plan been implemented?**	n	1	0	1	
1.3		**3.4.3**	*	**Are risk assessment techniques used?**	n	1	0	1	
1.3		**3.4.4.**	*	**Does you Risk Control technique advocate a hierachy of control?**	n	5	0	5	
1.3		**3.4.5**	*	**Is there a plan to systematically avoid, reduce & eliminate risks?**	n	1	0	1	
1.3		**3.4.6**	*	**Has the risk reduction plan been carried out?**	n	1	0	1	
1.3	4.2.1	**3.5.1**	*	**Have continuous improvement groups, looking at HS&E, been implemented?**	n	1	0	1	
1.3	4.2.1	**3.5.2**	*	**Can you demonstrate the success of continuous improvement groups in implementing HS&E improvements?**	n	1	0	1	
1.3		**3.5.3**	*	**Are projects reviewed against:**					
1.3		3.5.3	a.	time scales?	y	1	1	1	
1.3		3.5.3	b.	costs?	n	1	0	1	
1.3		3.5.3	c.	objectives?	n	1	0	1	
1.3		**3.5.4**	*	**Are projects followed-up by a review of the effectiveness of the implementation?**	y	1	1	1	
1.3		**3.5.5**	*	**Are the beneficial side-effects (i.e. intangibles) of implementation identified?**	n	1	0	1	
1.3	4.2.1	**3.6.1**	*	**Is a multi-disciplinary approach adopted to Health, Safety & Environmental problems, when:**					
1.3	4.2.1	3.6.1	a.	identifying problems?	n	1	0	1	
1.3	4.2.1	3.6.1	b.	planning?	n	1	0	1	
1.3	4.2.1	3.6.1	c.	designing solutions?	n	1	0	1	
1.3	4.2.1	3.6.1	d.	implementing solutions?	n	1	0	1	
1.3	4.2.1	3.6.1	e.	reviewing the effectiveness of implementation?	n	1	0	1	
1.3	4.2.1	**3.6.2**	*	**Are full-time teams set up for design & implementation of projects?**	n	1	0	1	
1.3	4.2.1	**3.6.3**	*	**Are operators involved in:**	y				
1.3	4.2.1	3.6.3	a.	identifying problems?	y	1	1	1	
1.3	4.2.1	3.6.3	b.	planning?	n	1	0	1	
1.3	4.2.1	3.6.3	c.	designing solutions?	n	1	0	1	
1.3	4.2.1	3.6.3	d.	implementing solutions?	y	1	1	1	
1.3	4.2.1	3.6.3	e.	reviewing the effectiveness of implementation?	n	1	0	1	
1.3	4.4.1	**3.7.1**	*	**Do your implementation plans include an open & effective communications plan?**	n	1	0	1	
1.3	4.4.1	**3.7.2**	*	**Do you communicate with operators?**	n	1	0	1	
1.3		**3.7.3**	*	**Are milestone reports issued?**	n	1	0	1	
1.3	4.4.1	**3.7.4**	*	**Is experience, gained from implementation, communicated to other project teams & interested parties?**	n	1	0	1	
1.3	4.4.3	**3.7.5**	*	**Are views of the community taken into account?**	n	1	0	1	
1.3	4.4.3	**3.7.6**	*	**Do you actively inform the community about your activities?**	n	1	0	1	
1.3		**3.8.1**	*	**Are there plans, compatible with Health, Safety & Environmental aims, to:**					
1.3	3.5.1	3.8.1	a.	develop product technologies?	na	1			
1.3	3.5.1	3.8.1	b.	adopt manufacturing technologies?	y	1	1	1	
1.3	3.2.1	3.8.1	c.	avoid hazardous materials/substances?	y	1	1	1	
1.3	3.2.1	3.8.1	d.	eliminate hazardous materials/substances?	y	1	1	1	
1.3	2.2.1	3.8.1	e.	ensure easy, safe operation of plant?	y	1	1	1	
1.3	4.1.0	3.8.1	f	develop people?	n	1	0	1	
						185	68	172	40%

1.4 MEASUREMENT OF PERFORMANCE SYSTEMS

1.4		**4.0.1**	*	**Do you regularly measure & record:**				
1.4	2.4.0	4.0.1	a.	accidents?	y	1	1	1

1.4	2.4.0	4.0.1	b.	incidents?	y	1	1	1
1.4	2.4.0	4.0.1	c	occupational diseases?	y	1	1	1
1.4	2.1.0	4.0.1	d	housekeeping?	n	1	0	1
1.4	2.4.0	4.0.1	e	lost time due to injury?	y	1	1	1
1.4	2.4.0	4.0.1	f	absenteeism?	y	1	1	1
1.4	2.4.0	4.0.1	g	"return to work" after illness/injury	n	1	0	1
1.4	2.4.0	4.0.1	h	number of people under health surveillance?	n	1	0	1
1.4	2.1.3	4.0.1	i	working environment?	n	1	0	1
1.4	3.1.3	4.0.1	j	effluent?	y	1	1	1
1.4	3.1.2	4.0.1	k	emissions?	y	1	1	1
1.4	3.4.2	4.0.1	l	energy use per process?	n	1	0	1
1.4	3.4.2	4.0.1	m	energy use per department?	n	1	0	1
1.4	3.1.3	4.0.1	n	water use?	y	1	1	1
1.4	3.2.2	4.0.1	o	types of waste produced?	y	1	1	1
1.4	3.2.2	4.0.1	p	quantities of waste produced?	y	1	1	1
1.4	4.1.0	4.0.1	q	training received by employees?	y	1	1	1
1.4	2.1.4	4.0.1	r	maintenance carried out?	y	1	1	1
1.4		**4.0.2**	*	**Are specific people responsible for measuring & recording this data?**	y	1	1	1
1.4		**4.0.3**	*	**Is measuring equipment regularly calibrated?**	y	1	1	1
1.4		**4.0.4**	*	**Are measurements taken at agreed frequencies?**	y	1	1	1
1.4		**4.0.5**	*	**Are actions carried out to rectify problems as soon as these are indicated by the measurements taken?**	y	1	1	1
1.4		**4.0.6**	*	**Which of the following are managers annually assessed on?**				
1.4		4.0.6	a.	policy implementation	n	2	0	2
1.4	4.1.0	4.0.6	b.	HS&E training	n	1	0	1
1.4	2.2.1	4.0.6	c.	planned inspections	n	1	0	1
1.4		4.0.6	d.	risk assessment	n	1	0	1
1.4	2.4.0	4.0.6	e.	accident/incident investigation	n	1	0	1
1.4	2.3.4	4.0.6	f	contingency plans	n	1	0	1
1.4		4.0.6	g	adherence to procedures	n	1	0	1
1.4	2.4.0	4.0.6	h	accident/incident analysis	n	1	0	1
1.4	4.1.0	4.0.6	i	employee training	n	1	0	1
1.4	2.2.5	4.0.6	j	personal protective equipment	n	1	0	1
1.4	2.4.0	4.0.6	k	absenteeism	n	1	0	1
1.4	2.4.0	4.0.6	l	lost time	n	1	0	1
1.4	2.4.0	4.0.6	m	occupational diseases	n	1	0	1
1.4		4.0.6	n	engineering controls	n	1	0	1
1.4	4.4.1	4.0.6	o.	personal communications	n	1	0	1
1.4	4.4.1	4.0.6	p.	group meetings	n	1	0	1
1.4		4.0.6	q.	staff motivation	n	1	0	1
1.4		4.0.6	r.	hiring & placement	n	1	0	1
1.4		4.0.6	s.	purchasing controls	n	1	0	1
1.4		4.0.6	t	safety & health / loss controls	n	1	0	1
1.4		4.0.6	u	achievement of HS&E targets	n	2	0	2
1.4		**4.0.7**	*	**Is the appraisal of managers' HS&E performance documented?**	n	1	0	1
1.4		**4.1.1**	*	**Do you measure compliance with national Health, Safety & Environmental legislation?**	y	1	1	1
1.4		**4.1.2**	*	**Do you measure compliance with Lucas standards?**	n	1	0	1
1.4	4.1.1	**4.2.1**	*	**Is there a measure of the HS&E competence of employees?**	n	1	0	1
1.4		**4.2.2**	*	**Is HS&E performance taken into account when allocating annual pay reviews?**	n	1	0	1
1.4		**4.3.1**	*	**Do you have a measure of your effectiveness in solving Health, Safety & Environmental problems compared to other Lucas sites?**	n	1	0	1
1.4		**4.3.2**	*	**Do you measure yourself against competitors & other comparable businesses?**	n	1	0	1
1.4		**4.4.1**	*	**Do you have records of all risk assessments?**	n	1	0	1
1.4		**4.4.2**	*	**Do you have a measure of the severity of risks?**	n	1	0	1
1.4		**4.5.1**	*	**Is measuring & monitoring Health, Safety & Environmental performance an integral part of every business function?**	n	1	0	1
1.4		**4.6.1**	*	**Does every department have common HS&E performance measures?**	na	1		
1.4		**4.6.2**	*	**Does every department have specific HS&E performance measures?**	na	1		
1.4	4.4.3	**4.7.1**	*	**Is company performance openly & effectively communicated?**	n	1	0	1
1.4		**4.7.2**	*	**Is HS&E performance, in the following areas, recorded in annual business reports:**				

1.4	3.2.1	4.7.2	1a	quantity & cost of hazardous articles, processes & substances?	y	1	1	1	
1.4	3.2.3	4.7.2	1b	quantity and cost of solvents used (especially CFCs)?	y	1	1	1	
1.4	2.1.3	4.7.2	2	improvement to the working environment?	n	1	0	1	
1.4	2.1.5	4.7.2	3a	improvement to safety systems?	n	1	0	1	
1.4	2.4.0	4.7.2	3b	number of people trained in HS&E?	n	1	0	1	
1.4	2.3.4	4.7.2	3c	cost of HS&E training?	y	1	1	1	
1.4	2.3.4	4.7.2	3d	man-days training carried out?	n	1	0	1	
1.4	2.4.0	4.7.2	5a	accident statistics?	y	1	1	1	
1.4	2.4.0	4.7.2	5b	occupational diseases?	n	1	0	1	
1.4	2.4.0	4.7.2	5c	lost time?	y	1	1	1	
1.4	2.4.0	4.7.2	5d	absenteeism?	y	1	1	1	
1.4	3.2.2	4.7.2	6	quantity & cost of hazardous waste produced?	y	1	1	1	
1.4	3.1.3	4.7.2	7	quantity & cost of effluent streams?	y	1	1	1	
1.4	3.1.2	4.7.2	8a	quantity & cost of emissions to air?	y	1	1	1	
1.4		4.7.2	8b	quantity & cost energy used?	y	1	1	1	
1.4	3.5.1	**4.8.1**	*	**Have any measures been implemented to compare the HS&E performance of:**					
1.4	3.5.1	4.8.1	a.	different product technologies?	n	1	0	1	
1.4	3.5.1	4.8.1	b.	different manufacturing technologies?	n	1	0	1	
						75	27	73	37%

1.5 REVIEW & CHANGE CONTROL SYSTEMS

1.5		**5.0.1**	*	**Do you regularly review the HS&E performance of the business?**	y	1	1	1
1.5		**5.0.2**	*	**Are these reviews documented?**	y	1	1	1
1.5		**5.0.3**	*	**Do you regularly review the HS&E performance of the following functions:**				
1.5		5.0.3	a	operations?	n	1	0	1
1.5		5.0.3	b	engineering?	n	1	0	1
1.5		5.0.3	c	purchasing?	n	1	0	1
1.5		5.0.3	d	personnel?	n	1	0	1
1.5		**5.0.4**	*	**Are these reviews documented?**	n	1	0	1
1.5		**5.0.5**	*	**Do you regularly review the HS&E performance of suppliers?**	n	1	0	1
1.5		**5.0.6**	*	**Are these reviews documented?**	n	1	0	1
1.5	2.1.2	**5.0.7**	*	**Do senior managers undertake unscheduled workplace inspections?**	y	1	1	1
1.5		**5.0.8**	*	**Are actions from reviews followed up?**	y	1	1	1
1.5		**5.0.9**	*	**Do you review the effectiveness of implementation?**	n	1	0	1
1.5		**5.1.1**	*	**Do you have a mechanism for reviewing new legislation?**	y	1	1	1
1.5		**5.1.2**	*	**Do you have a change control mechanism for updating systems & procedures to comply with new legislation or standards?**	y	1	1	1
1.5	4.1.1	**5.2.1**	*	**Is HS&E competence reviewed, for:**				
1.5	4.1.1	5.2.1	a	managers?	n	1	0	1
1.5	4.1.1	5.2.1	b	module leaders?	n	1	0	1
1.5	4.1.1	5.2.1	c	supervisors?	n	1	0	1
1.5	4.1.1	5.2.1	d	operators?	n	1	0	1
1.5	4.1.1	**5.2.2**	*	**Is this information used to plan the personal development of:**	n			
1.5	4.1.1	5.2.2	a	managers?	n	1	0	1
1.5	4.1.1	5.2.2	b	module leaders?	n	1	0	1
1.5	4.1.1	5.2.2	c	supervisors?	n	1	0	1
1.5	4.1.1	5.2.2	d	operators?	n	1	0	1
1.5	4.1.1	**5.2.3**	*	**Is competence reviewed when the following employees change jobs or tasks?**				
1.5	4.1.1	5.2.3	a	managers?	n	1	0	1
1.5	4.1.1	5.2.3	b	module leaders?	n	1	0	1
1.5	4.1.1	5.2.3	c	supervisors?	n	1	0	1
1.5	4.1.1	5.2.3	d	operators?	n	1	0	1
1.5	2.4.3	**5.2.4**	*	**Is the need for health surveillance reviewed when employees change jobs or tasks?**	n	1	0	1
1.5	4.4.2	**5.3.1**	*	**Do you review technologies & solutions to Health, Safety & Environmental problems in other Lucas businesses?**	n	1	0	1
1.5	4.4.2	**5.3.2**	*	**Do you review technologies & solutions to Health, Safety & Environmental problems outside Lucas?**	n	1	0	1
1.5		**5.4.1**	*	**Is there a system for reviewing HS&E risks?**	n	1	0	1
1.5		**5.4.2**	*	**Is there a change control procedure for implementing risk reducing measures?**	n	1	0	1
1.5		**5.4.3**	*	**Do you re-assess risks after implementing improvement measures?**	n	1	0	1
1.5		**5.5.1**	*	**Is there a regular review of measures of performance for:**				

1.5		5.5.1	a	Health & Safety?	y	1	1	1	
1.5		5.5.1	b	the Environment?	y	1	1	1	
1.5		**5.5.2**	*	**Is there a mechanism for introducing changes in performance measures?**	n	1	0	1	
1.5		**5.6.1**	*	**Is there an effective method for ensuring that all functions are aware of changes?**	n	1	0	1	
1.5	4.4.1	**5.7.1**	*	**Do you regularly review the effectiveness of HS&E communications?**	n	1	0	1	
1.5	4.4.1	**5.7.2**	*	**Are communications an integral part of any change process?**	n	1	0	1	
1.5	4.4.1	**5.7.3**	*	**Do you have a mechanism for communicating organisational changes?**	y	1	1	1	
1.5		**5.7.4**	*	**Do you review the effect of organisational changes?**	y	1	1	1	
1.5	3.5.0	**5.8.1**	*	**Do you employ Environmental impact or Life cycle assessments in order to review the Environmental performance of product & manufacturing technologies?**	na	1			
1.5	3.5.0	**5.8.2**	*	**Is there a comprehensive procedure for introducing change in product & manufacturing technologies?**	y	1	1	1	
1.5		**5.8.3**	*	**Before it is purchased, is all new plant reviewed, with respect to:**					
1.5	2.2.1	5.8.3	a	Health & Safety?	y	1	1	1	
1.5	3.2.0	5.8.3	b	the Environment?	y	1	1	1	
1.5		**5.8.4**	*	**Before it is purchased, is all new plant tested, with respect to:**					
1.5	2.2.1	5.8.4	a	Health & Safety?	y	1	1	1	
1.5	3.2.0	5.8.4	b	the Environment?	y	1	1	1	
1.5		**5.8.5**	*	**Before it is purchased, is all new plant approved by a nominated person, with respect to:**					
1.5	2.2.1	5.8.5	a	Health & Safety?	y	1	1	1	
1.5	3.2.0	5.8.5	b	the Environment?	y	1	1	1	
						48	17	47	36%

SUMMARY OF REVIEW RESULTS

Example

PART 1

		Points	CALC'D SCORE	MAX SCORE	% SCORE
SECTION 1: POLICY	s1	56	43	54	80%
SECTION 2: ORGANISATION, ARRANGEMENTS AND RESOURCES	s2	264	67	220	30%
SECTION 3: PLANNING AND IMPLEMENTING	s3	185	68	172	40%
SECTION 4: MEASURING PERFORMANCE	s4	75	27	73	37%
SECTION 5: REVIEWING PERFORMANCE & CHANGE CONTROL	s5	48	17	47	36%

TOTAL FOR PART 1: MANAGEMENT SYSTEMS	P1				45%
TOTAL FOR PART 2: HEALTH & SAFETY	P2	167	64	159	40%
TOTAL FOR PART 3: ENVIRONMENT	P3	118	49	95	52%
TOTAL FOR PART 4: PEOPLE	P4	160	36	151	24%

M1: Policy, Objectives and Targets

Management Aim

Level	1 (0-20%)	2 (21-40%)	3 (41-60%)	4 (61-80%)	5 (81-100%)	%	ACTIONS
Overall implementation of standard	The company does not have specific HS&E objectives and targets. Emergency driven approach.	The company has objectives and targets to meet the minimum legal requirements. Reactive approach to the management of risks and compliance.	The company is developing objectives and targets to meet legal requirements and policy standards.	The company has objectives and targets to meet legal requirements and policy standards, integrated into its business plan.	Integrated objectives and targets are continually reviewed for improvements. Well understood at all levels within the company.		•

Performance Expectations

Level	1 (0-20%)	2 (21-40%)	3 (41-60%)	4 (61-80%)	5 (81-100%)	%	ACTIONS
1. Register of significant effects.	Unaware of legal requirements. Unaware of health and safety hazards, effects and consequences. Unaware of environmental risks and consequences.	Partial knowledge of legal requirements. Knowledge of HS&E hazards and effects limited to specialists.	Informal list of legal requirements. In process of preparing list of hazardous activities and HS&E effects.	Legal requirements formally documented, but not reviewed. Hazardous activities and HS&E effects documented but not reviewed.	Legal requirements well documented and regularly reviewed. Hazardous activities and HS&E effects well documented, communicated and reviewed.		•
2. Defined priority issues.	No priorities. Emergency driven.	Informal system for prioritisation, limited to specialists.	Priorities based on legal requirements. In process of defining other priorities.	Priorities based on risks, legislation, performance and financial implications.	Priority factors well understood, communicated and regularly reviewed.		•
3. Specified objectives.	No HS&E objectives at any level within the company.	Informal system for setting objectives.	Objectives being developed, based on priority issues.	Objectives set at all levels, linked to priority issues.	Objectives set at all levels, regularly reviewed and well communicated.		•
4. Established targets.	No specific targets.	Some targets set, but lacking in clarity and significance.	Targets being developed, based on significance of set objectives.	Targets set for all objectives with clear and specific results, costs and timescales.	Targets set for all objectives, regularly reviewed and well communicated.		•
5. Integration into Business Plan.	HS&E planning and budgeting carried out only when imposed.	HS&E planning carried out in isolation of business plan.	Plans to meet objectives and targets being developed.	HS&E included in Business Plan.	HS&E included in Business Plan, communicated to all levels and subject to monitoring.		•
6. Commitment to policy.	No policy.	Policy document available	Policy with signed statement.	Signed statement contains objectives and targets.	Signed statement contains objectives and targets. HS&E performance reported.		•
7. Communications	None.	Limited to specialists.	Policy distributed to all employees.	Policy and statement distributed to all employees.	Policy and statement distributed to all employees and shareholders.		•
8. Awareness.	None	Limited to specialists.	Some awareness at management levels.	Duties and rights of employees documented.	All employees show understanding of duties.		•

M2: Organisational Arrangements

Management Aim

Level	1 (0-20%)	2 (21-40%)	3 (41-60%)	4 (61-80%)	5 (81-100%)	%	ACTIONS
Overall implementation of standard	The company has not appointed HS&E responsibilities.	The company relies on one specialist to deal with HS&E compliance..	The company has started to allocate responsibilities for HS&E.	The company has appointed a senior manager to be responsible for HS&E and has a steering group to manage HS&E issues.	HS&E issues and responsibilities are integrated into all job roles and well understood at all levels within the company.		•

Performance Expectations

Level	1 (0-20%)	2 (21-40%)	3 (41-60%)	4 (61-80%)	5 (81-100%)	%	ACTIONS
1. **Organisational arrangements. a) Senior Manager.**	No senior manager appointed.	Senior manager appointed to deal with compliance issues when they occur.	Senior manager appointed to be responsible for all HS&E issues.	Senior manager appointed to co-ordinate HS&E and other managers nominated to implement programmes.	All managers incorporate HS&E considerations into business functions.		•
1. **Organisational arrangements. b) Steering Group.**	No steering group.	Specialists used to solve HS&E problems.	HS&E steering group being developed.	HS&E steering group established. All business functions represented.	HS&E steering group integrated into business management meetings.		•
1. **Organisational arrangements. c) Resources.**	No resources allocated.	Specialists allocated to deal with HS&E issues.	Some resources allocated to deal with HS&E issues.	All HS&E projects fully resourced.	HS&E issues resolved by continuous improvement groups.		•
1. **Organisational arrangements. d) HS&E Manual.**	No HS&E Manual or documentation available.	HS&E documentation exists, where legally required	Site HS&E Manual being developed.	Site HS&E Manual contains all current documentation and programme progress.	Site HS&E Manual integrated and audited as part of the Quality System.		•
2. **Competent individuals**	No competent individuals available for HS&E	Competent individuals appointed to deal with legal Health and Safety requirements.	Competent individuals appointed to deal with Health, Safety and Environmental issues.	Experts identified for all prioritised HS&E issues..	Experts identified for all potential HS&E issues. Competence reviewed regularly. Relevant persons known by all employees.		•
3. **Employee competence and participation.**	No HS&E training or information given to employees.	Minimal information provided to ensure compliance with legislation.	HS&E included in induction training. Specific HS&E training given when needed.	HS&E Training given to all employees and records kept. Employees participate when required.	HS&E integrated into all training. Competence of employees regularly assessed. All employees participate.		•
4. **Continuous improvement**	None.	Improvement sought when non compliance occurs.	Improvement projects starting.	Improvement projects set up to achieve targets.	HS&E included in all continuous improvement activities.		•

M3: Operational Management Systems

Management Aim

Level	1 (0-20%)	2 (21-40%)	3 (41-60%)	4 (61-80%)	5 (81-100%)	%	ACTIONS
Overall implementation of standard	The company has no systems for managing HS&E. Emergency driven approach.	The company plans to meet the minimum legal requirements. Reactive approach to the management of risks and compliance.	The company is developing systems for managing HS&E programmes..	The company has formal systems for planning, implementing, measuring and controlling programmes and activities required to achieve targets	Management of HS&E is integrated into business project management systems. Progress is monitored and regularly reported.		•

Performance Expectations

Level	1 (0-20%)	2 (21-40%)	3 (41-60%)	4 (61-80%)	5 (81-100%)	%	ACTIONS
1. **Programmes.**	No HS&E programmes	Programmes set up to meet legal requirements.	Programmes to achieve objectives being established.	HS&E programmes set up to meet all objectives and targets.	Projects and actions prioritised according to risks, costs and benefits and integrated into all business processes.		•
2. **Responsibilities.**	No responsibilities allocated.	HS&E specialist responsible for ensuring compliance.	Programmes allocated to senior managers.	All programmes allocated to senior managers. Each programme has clear objectives and specific milestones.	Programmes integrated into business processes. Objectives and milestones well communicated and regularly reviewed.		•
3. **Project Plans.**	No project plans.	Project plans, but not documented.	Project plans being produced.	Project plans well documented.	Project plans well documented, communicated and regularly reviewed.		•
4. **Training and information**	No training or information provided.	Minimal training and information provided.	Training begun for those responsible for undertaking actions.	Project teams trained in project management. Information and technical support available.	All employees trained in project management techniques. Information and progress regularly communicated.		•
5. **Control Measures**	No control measures.	PPE predominantly used as control measure.	Control measures such as work permits used.	Engineering controls generally used as control measures.	Elimination & substitution always considered first as control measures.		•
6. **Documentation**	No documentation	Minimal documentation held.	Company is starting to collect together all relevant HS&E documentation.	Projects, assessments, training, procedures and actions all documented.	All documentation is well maintained, regularly reviewed and accessible.		•
7. **Failure investigation**	No mechanisms to identify or investigate failures.	Superficial investigations of major system failures.	Investigations carried out but underlying causes not identified.	Thorough investigations carried out, identifying underlying causes for major system failures.	All system failures identified and investigated as part of continuous improvement approach.		•
8. **Monitoring and recording compliance.**	No systems to monitor and record compliance.	Minimal monitoring and recording systems to ensure compliance.	Monitoring and recording of legal compliance and some for standards.	Compliance with all requirements monitored and recorded.	Compliance monitoring integrated into business systems & well maintained		•
9. **Progress reported as & when required.**	No systems for reporting progress.	Progress reported if necessary.	Progress reported as & when required.	Progress reported regularly.	Progress reported as continuous improvement.		•

M4: Self-assessment and Audit Systems

Management Aim

Level	1 (0-20%)	2 (21-40%)	3 (41-60%)	4 (61-80%)	5 (81-100%)	%	ACTIONS
Overall implementation of standard	The company has no systems for reviewing HS&E management and identifying opportunities for improvement.	The company reviews performance if necessary to meet legal requirements.	The company is developing audit systems and has started to identify opportunities for improvement.	The company carries out regular self audits against Lucas policy and standards.	Review of HS&E performance is integrated into quality audits. Improvement opportunities are identified by through CI		•

Performance Expectations

Level	1 (0-20%)	2 (21-40%)	3 (41-60%)	4 (61-80%)	5 (81-100%)	%	ACTIONS
1. Periodic Reviews.	No reviews carried out.	Compliance issues reviewed when necessary.	Some informal reviews carried out.	Regular formal reviews carried out.	Formal, regular reviews carried out by all business functions.		•
2. Review of issues, objectives and targets.	No registers of issues, objectives or targets.	Legal compliance issues reviewed when necessary.	Register of issues being developed. Objectives and targets being set.	Issues reviewed annually against external changes. Objectives and targets assessed for adequacy & scope	Issues reviewed whenever changes occur. Objectives and target		•
3. Review of arrangements.	No HS&E arrangements	Minimal arrangements, as required to meet legal compliance. Not reviewed	Arrangements, procedures and systems being reviewed informally.	Arrangements, procedures and systems regularly reviewed.	Arrangements, procedures and systems continually reviewed for effectiveness.		•
4. Review of achievements.	No achievements.	Achievements reviewed against compliance.	Achievements against objectives and targets being reviewed informally.	Achievements against objectives and targets regularly reviewed.	Achievements against objectives and targets continually reviewed and communicated.		•
5. Incorporation of legal changes and business priorities.	No means of identifying changes in legal requirements.	Legal changes incorporated when essential. Reactive approach.	Legal changes and business priorities being reviewed informally.	Legal changes and business priorities regularly reviewed.	Legal changes and business priorities continually reviewed and communicated.		•
6. Investigation	No mechanism to investigate incidents.	Superficial investigation carried out for major incidents.	Investigation carried out for all incidents, but underlying causes not always identified.	Investigation carried out for all incidents, underlying causes identified and actions taken to prevent re-occurrence.	Investigation carried out for all incidents and near misses, underlying causes identified, actions taken to prevent re-occurrence & changes communicated.		•
7. Management Appraisals.	No management appraisals carried out.	Occasional management appraisals carried out.	Management informally appraised against HS&E performance.	Management regularly and formally appraised against HS&E performance.	HS&E performance of all employees is appraised continually.		•

E1: Environmental Protection Programme

Management Aim

Level	1 (0-20%)	2 (21-40%)	3 (41-60%)	4 (61-80%)	5 (81-100%)	%	ACTIONS
Overall implementation of standard	The company does not have any means of minimising environmental pollution. Emergency driven approach.	The company meets the minimum legal requirements. Reactive approach to the management of risks and compliance.	The company is beginning to develop an environmental protection programme.	The company has an environmental protection programme which is minimising environmental pollution and associated costs.	Environmental protection is integrated into all business processes. It is well understood at all levels within the company.		•

Performance Expectations

Level	1 (0-20%)	2 (21-40%)	3 (41-60%)	4 (61-80%)	5 (81-100%)	%	ACTIONS
1. **Environmental Protection Programme.**	No environmental protection programme exists.	Environmental protection measures implemented where necessary to comply with legislation.	An Environmental Protection Programme is being implemented to cover major environmental risks.	An Environmental Protection Programme has been implemented to cover all environmental risks.	Environmental Protection is integrated into all business processes. All employees understand the environmental risks.		•
2. **Control and management of environmental pollution sources.**	No control or management of environmental pollution.	Pollution control and management measures implemented where necessary to comply with legislation.	Major sources of environmental pollution are being controlled and managed.	All sources of environmental pollution are being controlled and managed.	Prevention of pollution is considered in all business decisions. Control and management of pollution sources is continually being improved.		•
3. **Development and implementation of systems and procedures.**	No systems have been developed.	Some systems and procedures have been implemented, but are generally inadequate.	Inventories, systems and procedures are being developed.	Environmental and legislative inventories are complete. Control equipment & procedures have been implemented.	Inventories are regularly updated. Procedures are continually reviewed for effectiveness.		•
4. **Awareness, information and training.**	There is no awareness, information or training for employees.	Information is available but training is not provided.	Some training and information is provided to some employees.	Adequate training and information is provided to most employees.	Adequate training and information is provided to all employees on a regular basis.		•
5. **Documentation.**	There is no documentation or record keeping.	Some documentation is kept, but record-keeping is inadequate.	Documentation and record-keeping is fairly well maintained but not kept up to date.	Documentation and record-keeping is mostly well maintained and periodically up dated.	Documentation and record-keeping is very well maintained and continually updated .		•
6. **Improvement opportunities.**	Improvement opportunities are not sought or implemented	Improvement opportunities are not sought but obvious ones are evaluated and implemented	Some improvement opportunities have been sought and implemented.	Improvement opportunities are periodically sought and implemented.	Improvement opportunities are continually sought and implemented by all employees.		•

Appendix D

Minutes from Manual Workshop

To: B Bonsall
T Lambourne
J Stevens
A Gilbert
D Forbes
T Hamann
N Mann / C Forrester
L Warrick

cc P Hockley (York Road)
K Toomer (EUI)

cfi G Frid,
E Hough

From
J Guzman-Bello
G Allcock
N Lawson

18th August 1995

HS&E Manual Workshop - 10th August 1995

Thank you for attending the HS&E Manual Workshop on Thursday 10th August, we found it a very useful exercise. The following points were raised during the discussions:

It was agreed that **the manual should be:**
- Short and concise
- A description of the HS&E management system - i.e. what it is and where to find it.
- A tool to integrate HS&E into other business processes and systems (e.g. ISO 9000)
- A document to demonstrate effective management of HS&E
- A record of performance
- Kept live

It was agreed that **the manual should NOT be:**
- A reference manual *(although reference material will need to be kept somewhere)*
- A collection of procedures *(procedures and work instructions will be kept in other places, e.g. in the Quality Manual, in Department procedures etc.)*
- A bureaucratic exercise *(it should not duplicate existing documentation)*

It was agreed that the **structure of the manual** should cover the first few management standards, i.e.
- M1 - Policy, Objective and Targets *(what improvements the site is committing itself to. To include a statement of the businesses HS&E effects and the objectives and targets related to these significant effects)*
- M2 - Organisational Arrangements *(who is responsible for implementation of the standards and what systems and procedures exist)*
- M3 - Operational Management Systems *(what programmes are in place, who is responsible for them, what are the timescales, what progress is being made and how other procedures are related to)*
- M4 - Self Assessment and Audit *(how the HS&E management systems will be reviewed and what performance indicators are being used to monitor improvement)*

Procedures and detailed plans will be kept outside the manual (but will be referred to).

There is a need to **keep the manual live.** It was suggested that the Steering Committee should review progress against programmes regularly (6 monthly), a one page progress statement can then be entered into the manual after this review. In addition they should review significant issues at least annually, or when a change in process or legislation causes a change to the significant issues.

Integration was highlighted as essential. Implementation of the manual should encourage integration. A matrix of standards against business function (see appendix) was accepted as a useful way of allocating responsibilities for implementation of the standards. The matrix approach can also be utilised to compare legislation against procedures etc.

ACTIONS:

1. Provide Guidelines on how to compile a manual and what the minimum contents should be (include guidance on integration with quality systems). **NL/GGA**
   Target Draft by 31st August 1995
   Complete Guideline by 30 September 1995

2. Modify Handbook presentation to emphasise implementation of Manual: **JGB**

3. Persuade Managing Directors of need for Manual: **JGB**

4. Set targets for implementation (from MDs) once "tools" are ready: **JGB**

5. Implement in stages, i.e. a few sites to complete the manual, then use the experience to help others. **Holford, Hemel, Newcastle, York Road (?)**

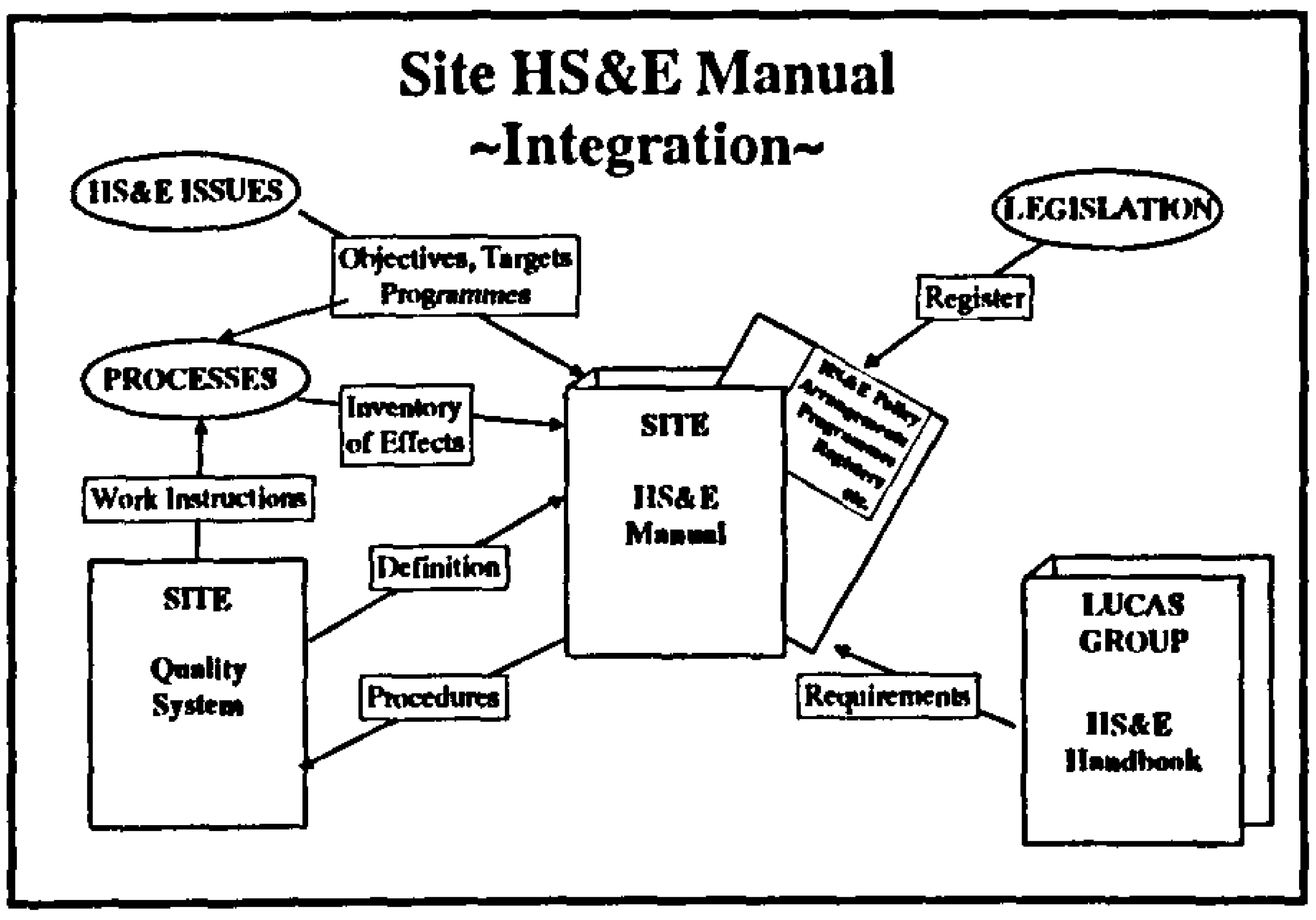
Included with these notes:

- Diagram showing HS&E management manual and integration with quality systems[1]
- Example matrix of HS&E Standards v. Business functions
- Copy of ISO 14001 (latest draft)

---

[1] **Site HS&E Management:** The HS&E Management process includes the steps shown: Policy, Objectives and Targets formulation, Arrangements, Programmes for Improvement and Performance Measures. All these need regular auditing and reviewing.
The definition of this management process will be within the Site Quality System. HS&E will also be incorporated into procedures held in the quality system.
The manual will contain all "live" documentation pertaining to the Management of HS&E, it will refer to procedures held in the Quality System and other reference material.

Site HS&E Management


Site HS&E Manual
~Integration~
HS&E ISSUES
LEGISLATION
Objectives, Targets
Programmes
Register
PROCESSES
Inventory
of Effects
SITE
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Manual
Work Instructions
Definition
SITE
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LUCAS
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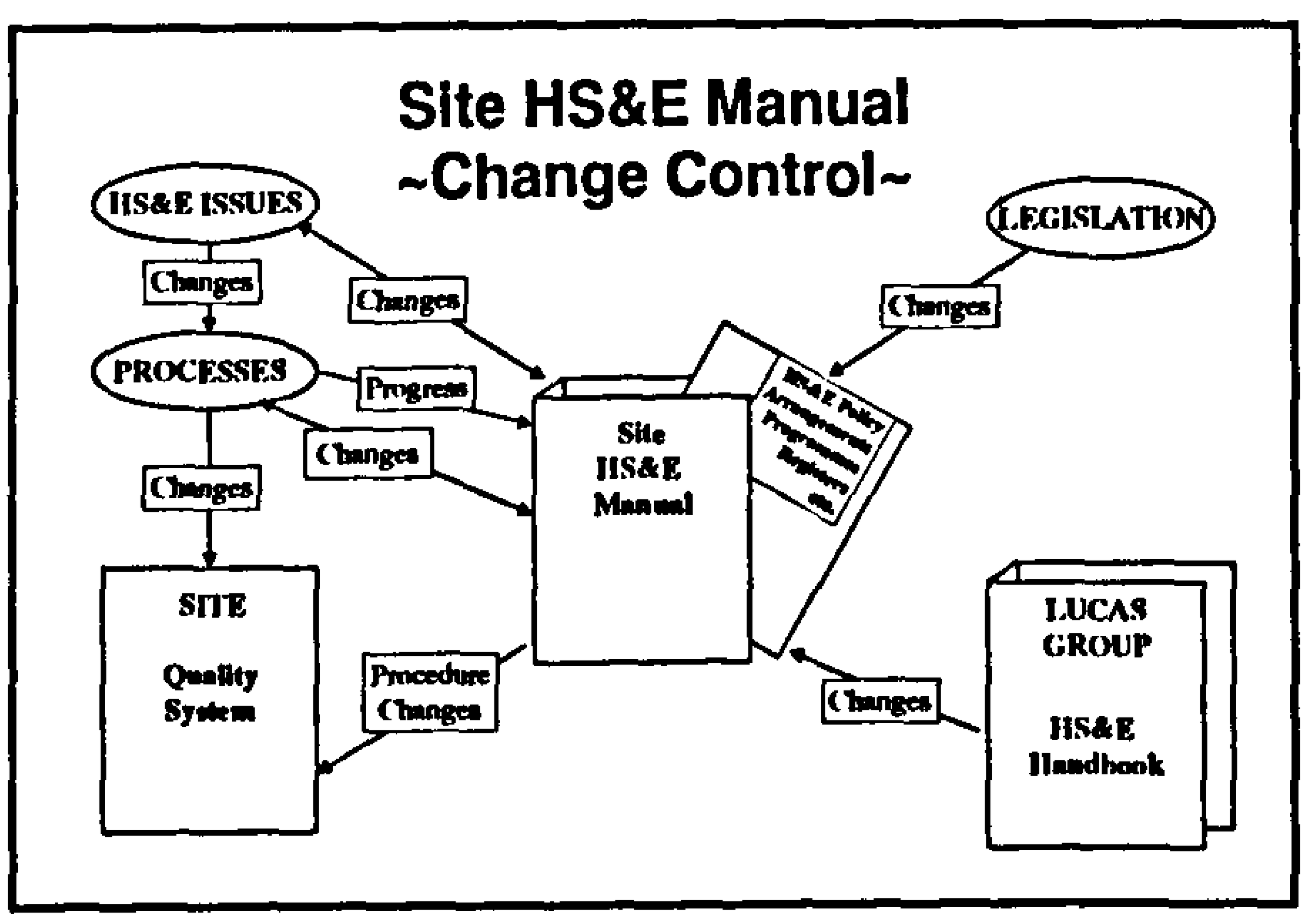
HS&E
Handbook
Procedures
Requirements


Site HS&E Manual
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HS&E ISSUES
LEGISLATION
Changes
Changes
Changes
PROCESSES
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Changes
Site
HS&E
Manual
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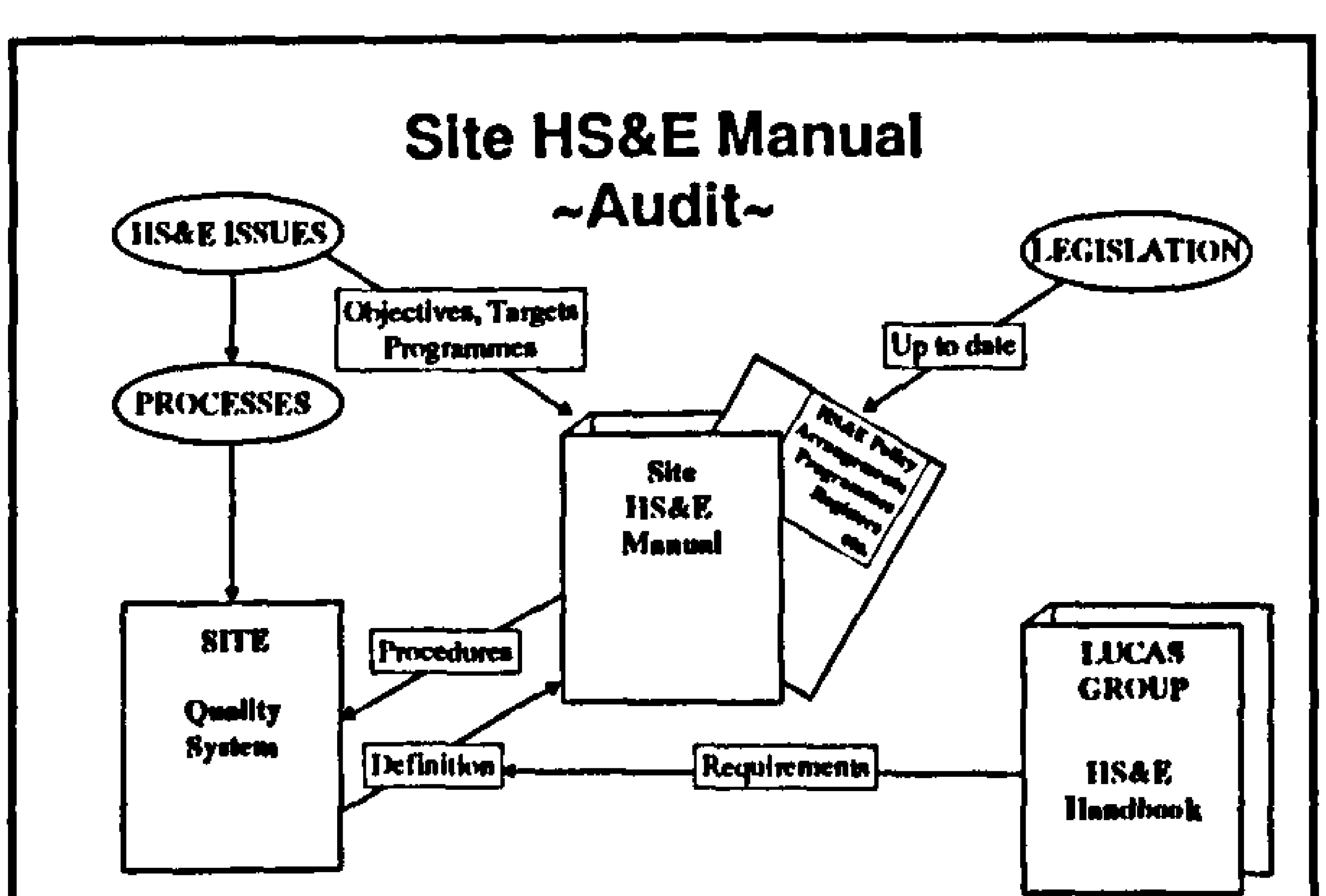
SITE
Quality
System
LUCAS
GROUP
HS&E
Handbook
Procedure
Changes
Changes


Site HS&E Manual
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HS&E ISSUES
LEGISLATION
Objectives, Targets
Programmes
Up to date
PROCESSES
Site
HS&E
Manual
SITE
Quality
System
Procedures
LUCAS
GROUP
HS&E
Handbook
Definition
Requirements

NL:Stdvdept.xls (Aug 95)		**Business Functions**										
LUCAS HS&E STANDARDS	No.	Business Management	Facilities Engineering	Finance	HS&E	Human Resources	Manufacturing Engineering	Manufacturing Operations	Product Design	Purchasing	Quality	Sales & Marketing
Policy, objectives and targets	m1	A		C	B	C		C				
Organisational arrangements	m2	A			B	B						
Operational management systems	m3	A			B			B				
Self-assessment and audit systems	m4	A						B			C	
Emergency procedures and contingency plans	m5	A	B					B				
Product design and development	m6								A			B
Changes in equipment, working practices and facilities	m7	A	B		C	B	B	B				
Environmental protection programme	e1	B	A				B	B				
Ground and ground water protection	e2	B	A				B	B				
Effluent management	e3	C	B					A				
Air emission control	e4	C	B					A				
Waste management	e5	C	B					A				
Resource conservation	e6	C	B	B		C	B	A	B	B	B	
Energy management and conservation	e7	C	A	B		C		B	B	B		
Risk elimination and control programmes	s1		B			B	B	A		B		
Management & control of hazardous substances	s2					B	C	A		B		
Workplace design, construction and maintenance	s3		B				A	B				
Management and control of noise	s4		B			B	B	A		B		
Manual handling and ergonomics	s5					B	A	B	C			
Use of personal protective equipment	s6					B		A				
Internal transport & powered handling equipment	s7		B					A				
Safe electrical equipment and installations	s8		B				A	B				
Special procedures and safety devices	s9		B				A	B				
Safety management of contractors	s10		B			B		A				
Occupational health programmes	h1					A						
Occupational health care delivery	h2					A						
Health surveillance programmes	h3					A	B	B				
Fitness for work assessments	h4					A		B				
Health records	h5					A		B				
Emergency medical care	h6					A		B				
Smoking at work	h7					A		B				
Alcohol and substances of abuse	h8					A		B				

A = "Owner" responsible for implementation of standard
B = Major Input
C = Minor Input

Appendix E

Summary of HS&E Performance Measurement

Group HS&E Measures of Performance

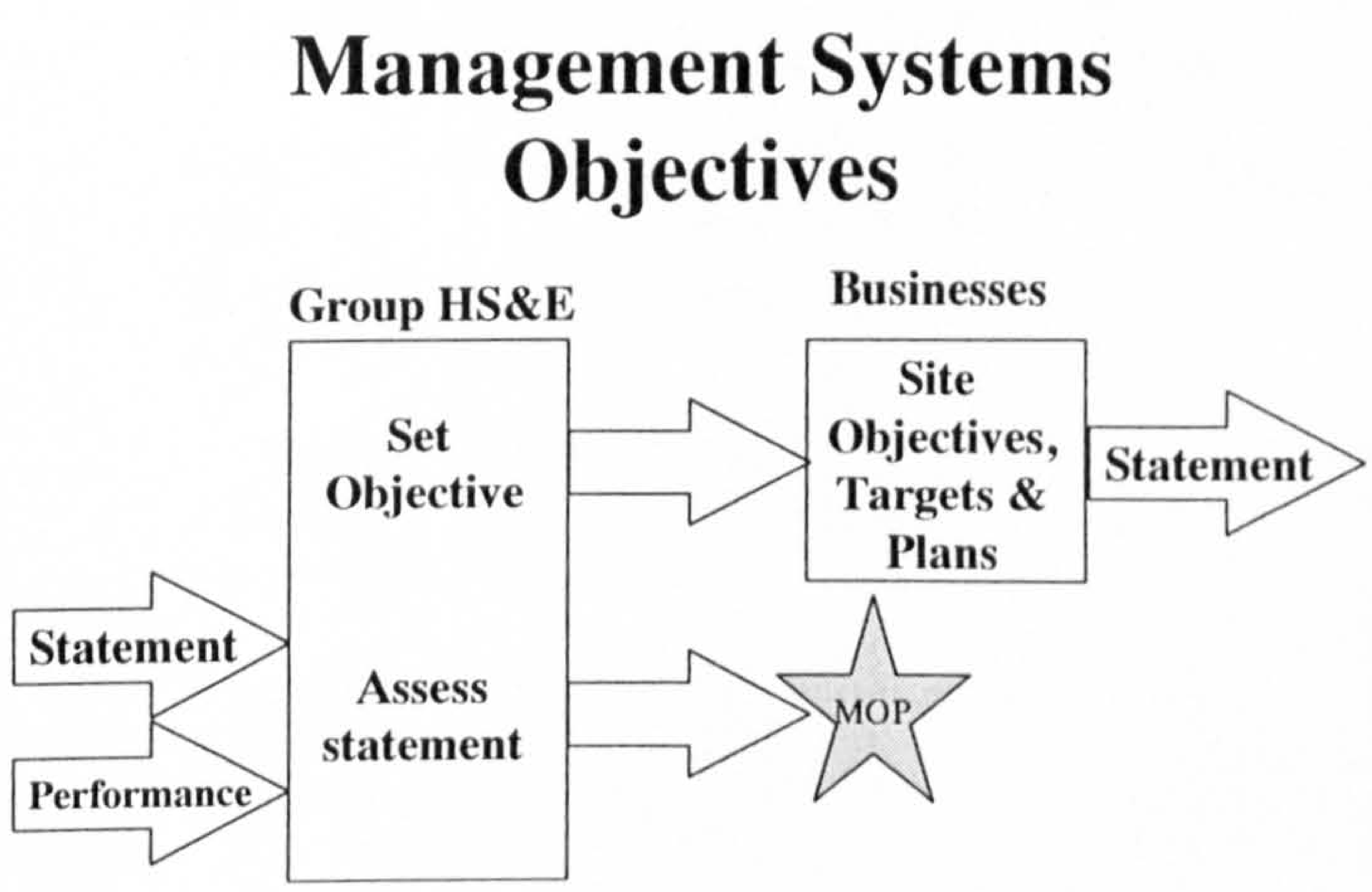
It is generally recognised that in order to achieve improvements, performance needs to be measured. It is proposed to introduce a set of HS&E Measures of Performance which will be reported annually by the Lucas businesses and compiled and reviewed at Group level.

The Measures will cover the following subject areas:

1. Management Systems
2. Review Programme
3. Competence
4. Health & Safety
5. Environment

1. Management Systems

The setting of objectives, targets and improvement plans is a crucial part of an HS&E Management System and a requirement of the HS&E Management standards.



Each business will be expected to submit an annual statement detailing its HS&E objectives, targets and plans for improvement.

The statements will be assessed by Group HS&E and Divisional HS&E Representatives against Review results and other business performance indicators.

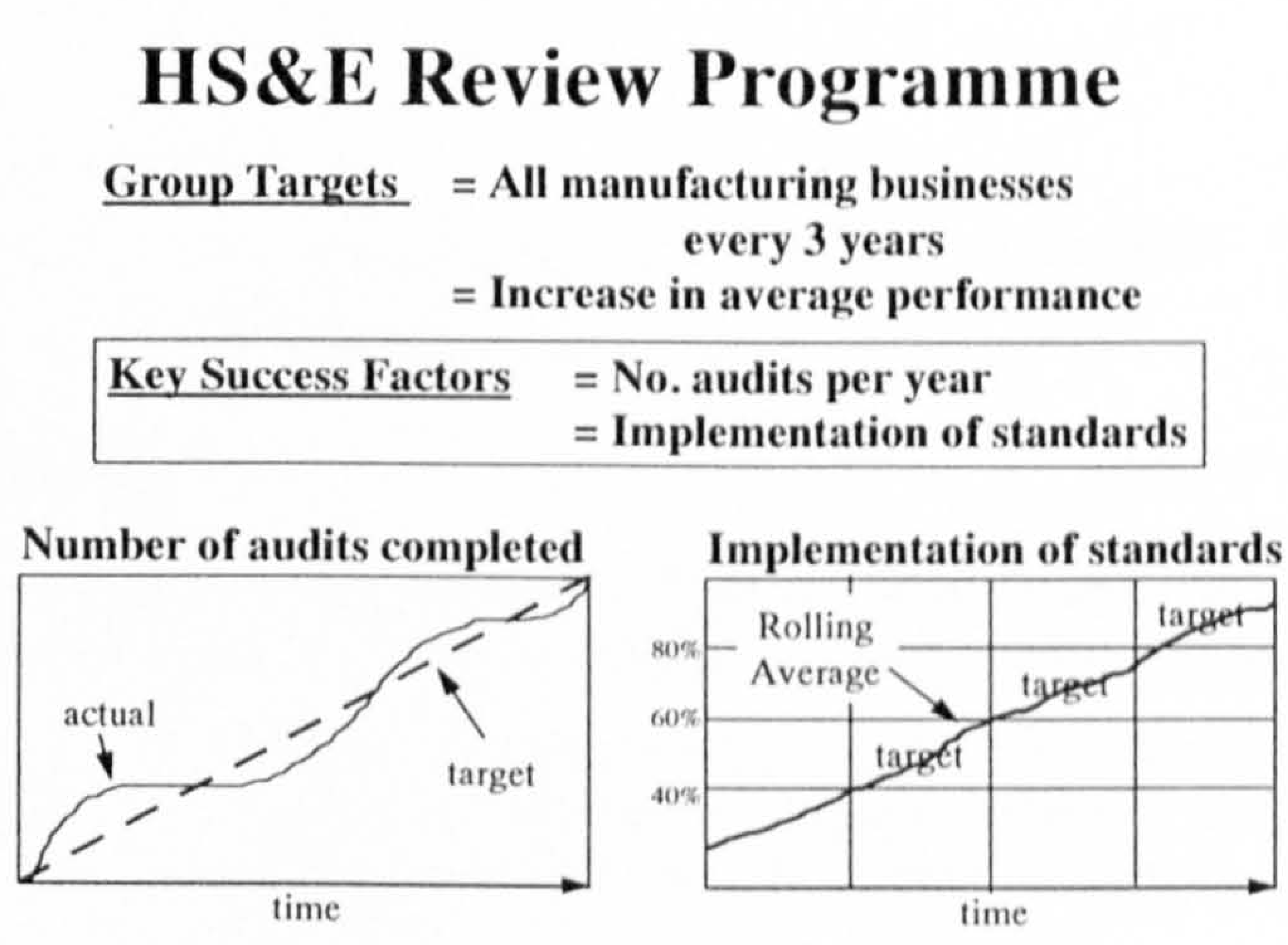
Progress against the plans should also be reviewed by Managing Directors.

2. HS&E Review Programme

The Group HS&E targets are:

- to review all manufacturing businesses every three years,
- to show an increase in average performance across the Group.

Performance will be measured by plotting the actual number of targets completed against the number planned and tracking the rolling average audit scores over time.



3. HS&E Competence

HS&E Competence

	No.Trained	Hours/Year
Managers		
Supervisors		
Employees		
Practitioners		

One of the aims of the HS&E programme is to increase the competence of employees at all levels. It is the responsibility of business managers to identify areas of weakness and ensure that the training needs of their employees are met. Although true competence can only be assessed on an individual basis, a good indicator of performance will be the number of people trained and the hours of training given per year, at various levels within the organisation: managers, supervisors, employees and practitioners.

4. Environmental Performance

Every activity in a business has an impact on Environmental Performance and therefore for performance to be measured with any confidence, a wide variety of data will be required.

However, the data chosen to measure environmental performance in this case should already be available:

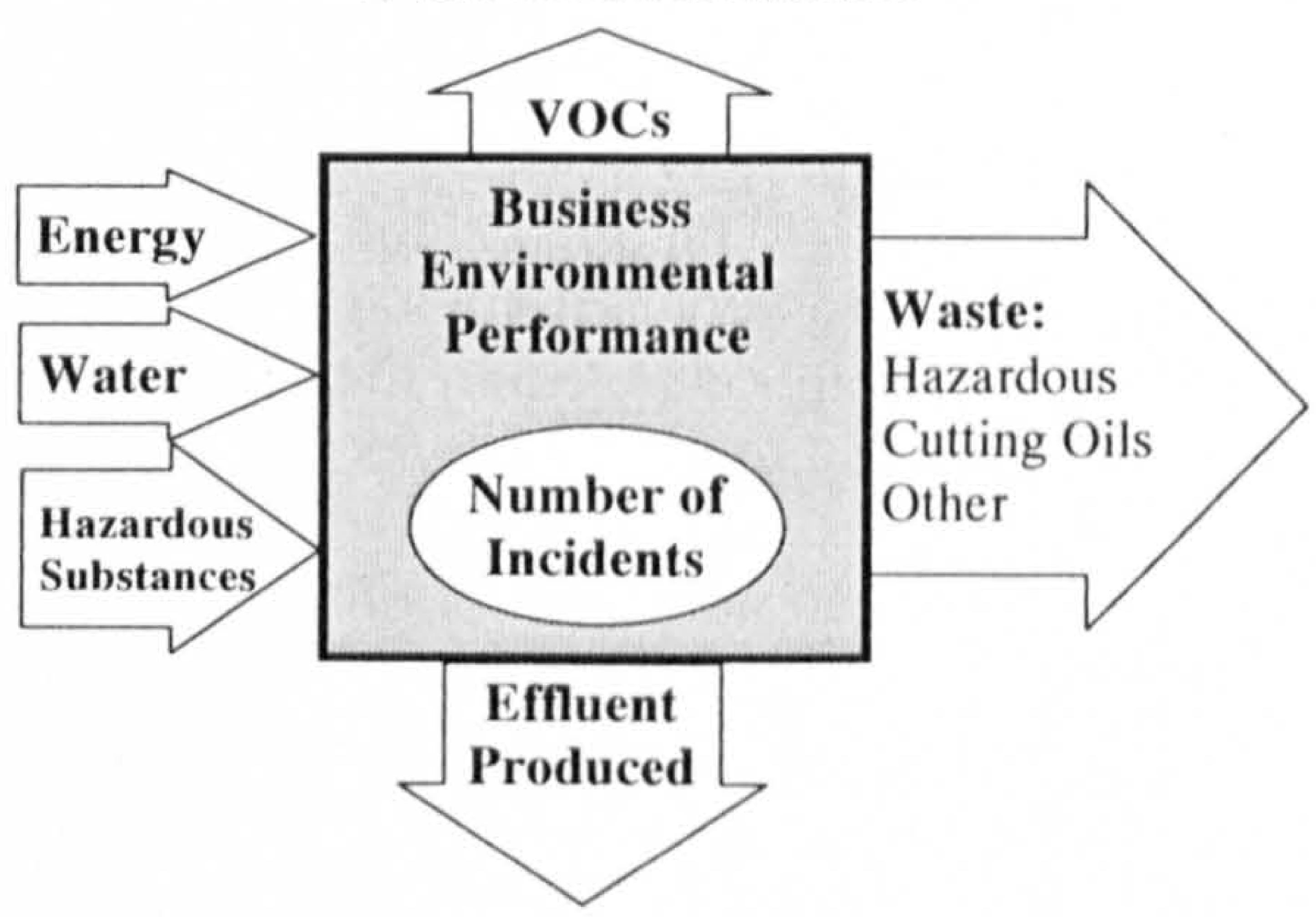
- Inputs : Consumption of Energy, Water and Hazardous Substances
- Outputs : Emissions of VOCs, Effluent Discharged and Wastes (Hazardous, Cutting Oils, and other waste).
- Incidents: The number of environmental accidents and incidents:

    a) That have led to prosecution

    b) That have involved intervention of regulatory authorities, but no prosecution

    c) Spillages and other unplanned releases of substances.

Business Environmental Performance

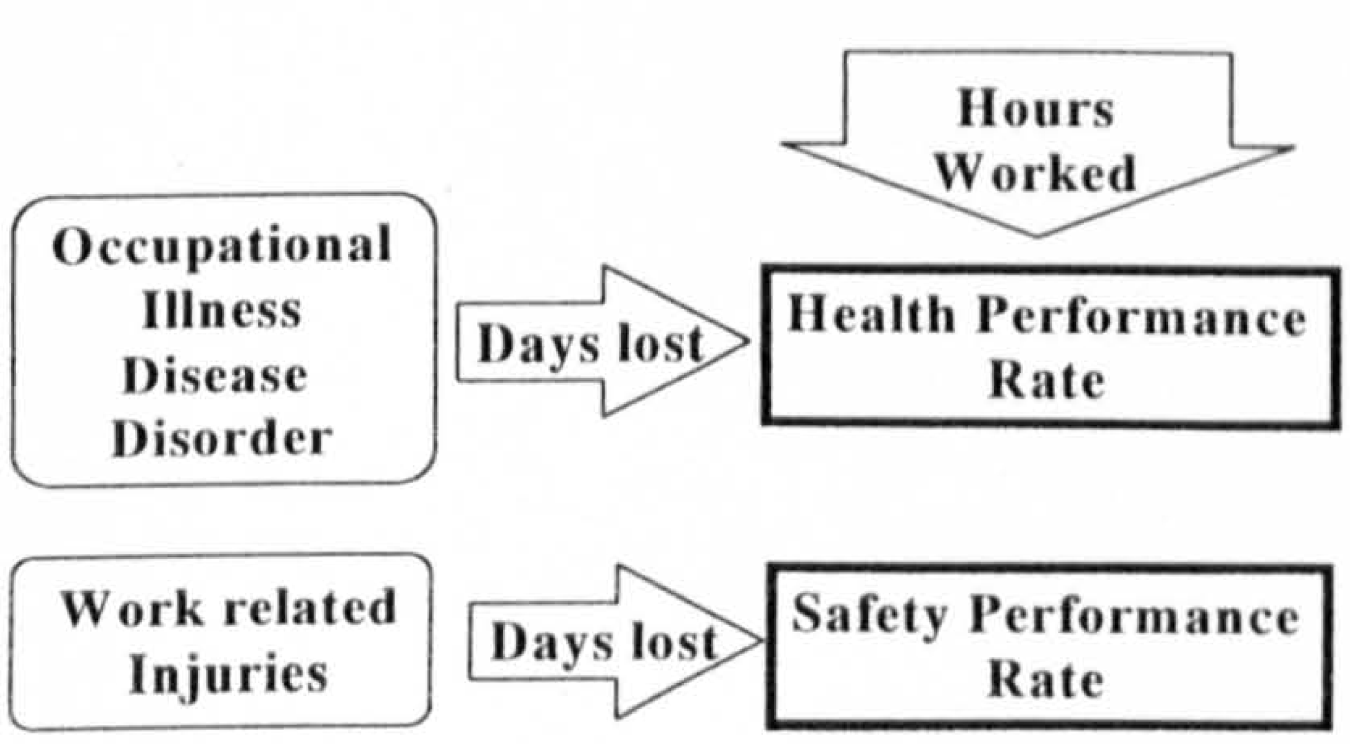


5. Health & Safety Performance

In order to have Health and Safety performance indicators that are comparable with other major businesses, it will be necessary to calculate Health and Safety Performance Rates.

These involves comparing the days lost through Occupational illness, disease, disorder and work related injuries with the total employee hours worked.

Business Health & Safety Performance



Context

In order to put HS&E performance into context, businesses will also be asked to supply details which will indicate any changes in business size, i.e. number of employees, turnover and added-value (product value less purchasing costs).

Logistics

Selected businesses are being asked for their comments on these proposed measures of performance.

Once accepted, the Measures will be applied to all Lucas businesses for a trial period (or a few Lucas businesses for a trial period - then applied to all businesses after the initial pilot is proven ?)

A reporting format will be provided to the businesses, in order that information is reported in a consistent manner.

Appendix F

Supplier Audit Protocol and training material

Supplier Auditor Protocol - Environmental Issues

PART 1 : OBSERVATIONS

Things to look for	Low Risk	Medium Risk	High Risk
Housekeeping			
Gangways *(clear of boxes, trolleys, trailing leads etc.).*	No obstructions	Some obstructions	Many obstructions
Floors *(clear of boxes, trolleys, trailing leads etc.)*	No obstructions	Some obstructions	Many obstructions
Fire doors and exits clear	No obstructions	Some obstructions	Many obstructions
Work stations tidy	Very tidy	OK	Very untidy
Leakage from machines *(oil)*	No leaks	Some leaks	Many leaks
Outside the building	Very tidy	OK	Very untidy
Working Conditions			
Space *(and layout)*	Spacious	Variable	Overcrowded
Light *(in working areas)*	Good/natural light	Variable	Poor lighting
Noise *(in working areas)*	Minimal	Noticeable	Loud
Air quality / ventilation	Fresh	Variable	Odours / oil mist
Maintenance of buildings	Good repair	Variable	Poor repair
Sprinklers and smoke alarms	In all areas	In some areas	None seen
Condition of machines & equipment	New / well maintained	Variable	Old / poorly maintained
Chemicals			
Total amount of chemicals *(number of containers / tanks)*	No / few chemicals	Moderate	Many / large volume
Type of chemicals *(look for hazard labels)*	No hazardous or flammable chemicals	Some hazardous and/or flammable chemicals	Many hazardous and/or flammable chemicals
Storage areas - security	Secure & demarcated	Not secure but demarcated	Not secure or demarcated
Storage areas - housekeeping	Tidy & organised	Inconsistent	Untidy
Storage areas - organisation	Different chemical hazards separated	Some segregation	No segregation for different hazards
Storage areas - flammable substances	Separate, secure flammable stores	Some flammable stores.	No separate or secure stores
Storage areas - location of containers, drums, bulk tanks.	Away from drains.	Inconsistent	Near to drains.
Ground protection in storage areas *(bunding, impermeable membranes, drip trays)*	Ground protection provided	Inconsistent	No evidence of ground protection
Leakage from tanks & drums (outside and inside)	No leaks	Some leaks	Many leaks
Containers - labelling *(description of chemical and proper hazard labels)*	All containers labelled	Some containers not labelled	No / few labels
Containers - suitability & management *(have chemicals been decanted ?)*	Strong / kept closed	Inconsistent	Inappropriate / not sealable
Inventory *(list of chemicals and where stored)*	Inventory displayed	Inventory, but not displayed	No known inventory
Handling of chemicals *(e.g. is acid carried in an open bucket!)*	Suitable equipment provided	Some suitable equipment provided	No suitable equipment provided

Things to look for	Low Risk	Medium Risk	High Risk
Waste			
Amount of waste *(materials, packaging & office waste)*	Very little waste	Does not appear excessive	Excessive waste
Types of waste *(office waste / packaging only or chemicals?)*	Non-hazardous waste	Various	Hazardous waste
Containers *(enclosed skips or uncovered heap ?)*	Suitable	Variable	Unsuitable
Wastes separated *(allows for recycling & easier disposal)*	All waste kept separate	Some waste separated	All waste mixed together
Fire risk *(are combustible wastes away from ignition sources ?).*	No fire risk	Some fire risk	Significant fire risk
Outside waste storage areas	Very tidy	Variable	Very untidy
Containment *(can waste leak/escape and contaminate ground or neighbouring sites?)*	All waste areas bunded and / or ground protection provided	Some bunding and containment.	No bunding or ground protection provided
Evidence of pollution outside *(signs of distressed vegetation, stained concrete etc.?)*	No staining or distressed vegetation	Some staining / minimal distressed vegetation	Severe staining / much distressed vegetation
Processes			
Packaging *(e.g. returnable plastic or disposable cardboard)*	Returnable packaging used	Some returnable packaging used	Only disposable packaging used
Machining - Coolants	No machining	Few machines & coolants used.	Many machines & coolants used.
Surface Treatment / Plating	None	One / few processes	Many processes
Effluent Treatment - requirement	None - not needed	Simple effluent treatment (pH, settlement).	None - but needed OR Complex / chemical process.
Effluent Treatment - management	New / clean / well managed	Variable	Old / dirty / poorly managed
Heat Treatment	None	One / few processes	Many processes
Notices and Information			
Visibility of Signs	Clearly visible	Some obscured	Mostly obscured / missing
Fire Protection signs & equipment	All exits, routes & extinguishers identified.	Not all exits, routes & extinguishers identified	No signs seen / no extinguishers seen.
No smoking signs displayed	No evidence of smoking	Some evidence of smoking	Blatant evidence of smoking
Drains *(identification of different drains and what can be disposed of).*	All drains labelled and/or colour coded.	Some drains labelled	No drains labelled
Instructions and procedures *(operating and emergency procedures - e.g. spillage/fire)*	Displayed at place of work	Some instructions displayed	No instructions displayed
External			
Type of neighbours	None / industrial	Mixed	Residential
Proximity of water courses	None seen	Stream / river in locality	Stream / river on boundary

PART 2 : BACK-UP INFORMATION

Things to check

Policy	Strong and covers HS&E	Weak or only covers H&S	None
Objectives & targets	Comprehensive	Some	None
Responsibilities	Clearly defined	Unclear	Not defined
Documentation *(records etc.)*	Comprehensive	Fair	None
Training *(records etc.)*	Comprehensive	Some	None
Emergency procedures	Comprehensive	Some	None
Measures of Performance	Comprehensive	Some	None
Self assessment	Comprehensive	Some	None

Things to ask about

Policy	Displayed, communicated & understood	Displayed, not understood	None
Objectives & targets	Displayed, communicated & understood	Displayed, not understood	None
Responsibilities	Known & understood	Unclear	Not known
Documentation	Known / used / understood	Inconsistent standards	None
Training / competence *(ask operators about tasks)*	Good understanding	Inconsistent standards	Little understanding
Measures of Performance	Understood and motivational.	Some or ineffective.	None
Self assessment	Carried out regularly. Formal system.	Carried out occasionally / informally.	None
Environmental Management Systems (BS7750, EMAS, ISO 14000, Company system)	Accredited / Registered	Intention to implement a system	Never heard of / no intention
Underground Tanks	None	Few	Many
Emergency procedures *(do people know what to do in an emergency e.g. fire / spillage)*	Known, understood, practised.	Some	None
Past prosecutions *(non-compliance/ pollution incident)*	None	Improvement notice	One / more

Conclusions

Attitude of management	Proactive	Reactive	Negative
Competence of people	Highly skilled	Variable	Poor
Willingness to improve	Enthusiastic	If required	Reluctant

Overall Environmental Risk	**Low**	**Medium**	**High**
ACTION	**No further action required.**	**Set targets for improvement.**	**Comprehensive HS&E audit and action plan required.**

HS&E Auditing of Suppliers

What implications does the Lucas HS&E policy have for suppliers?

The policy states:	Implications:
Total Quality	→ Everything we do
Every activity has an impact	→ Including Supply
Integrated approach	→ Includes Suppliers
Invest in the future	→ Buying things that won't give us future problems
Best Practice	Other companies are auditing their suppliers
Minimise risk	→ Buy less hazardous substances. Buy from well managed suppliers.
Minimise Waste	Buy refillable, reusable, recyclable
Optimise Energy usage	→ Buy efficient equipment

HS&E / Supplier Audit Presentation
SUPAUDIT.PPT

Lucas

Why worry about our suppliers' environmental performance ?

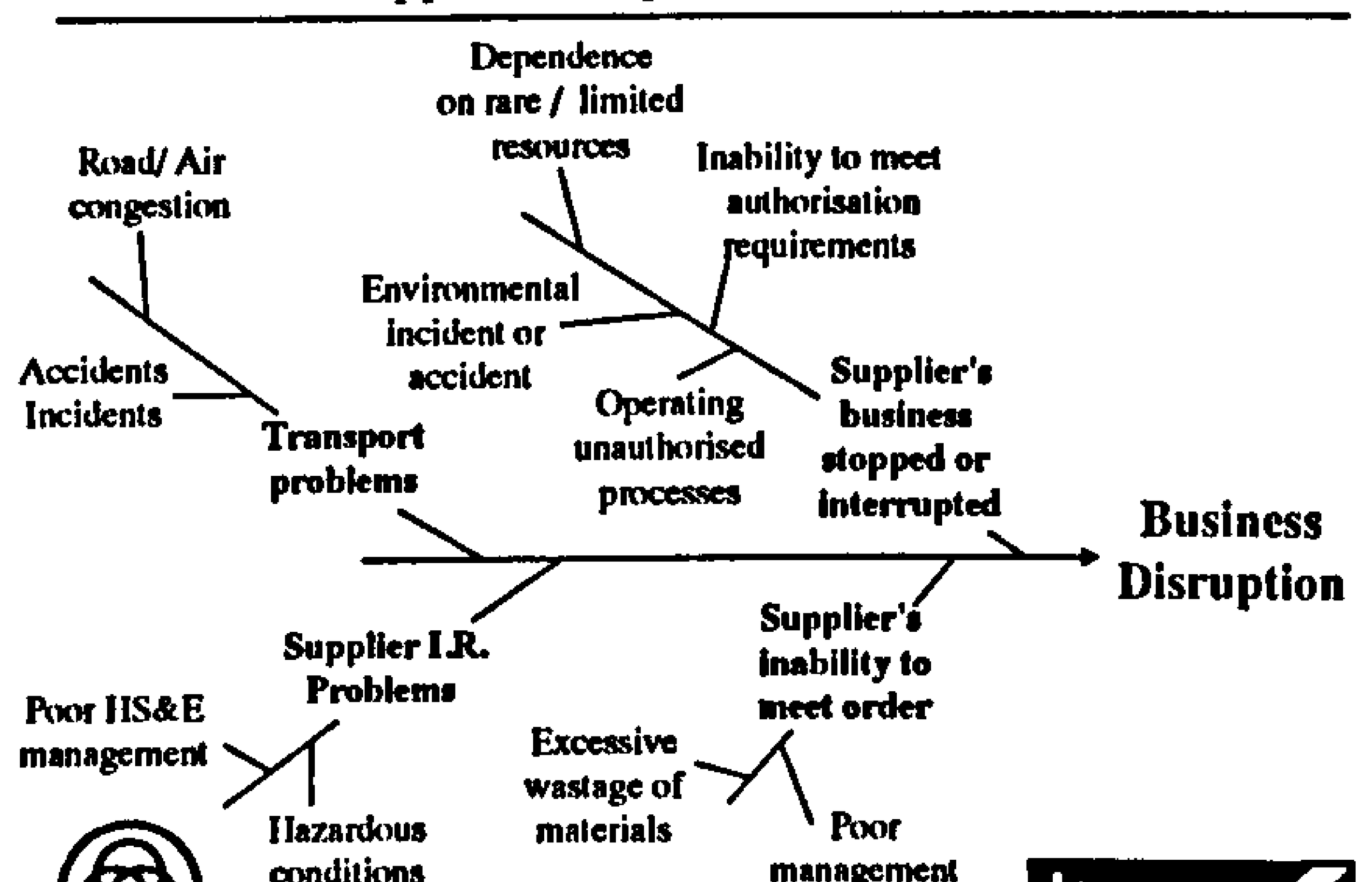
Poor environmental performance could lead to:

- Interruption of supply and consequential business disruption
- Increase in supplier costs.

HS&E / Supplier Audit Presentation
SUPAUDIT.PPT

Lucas

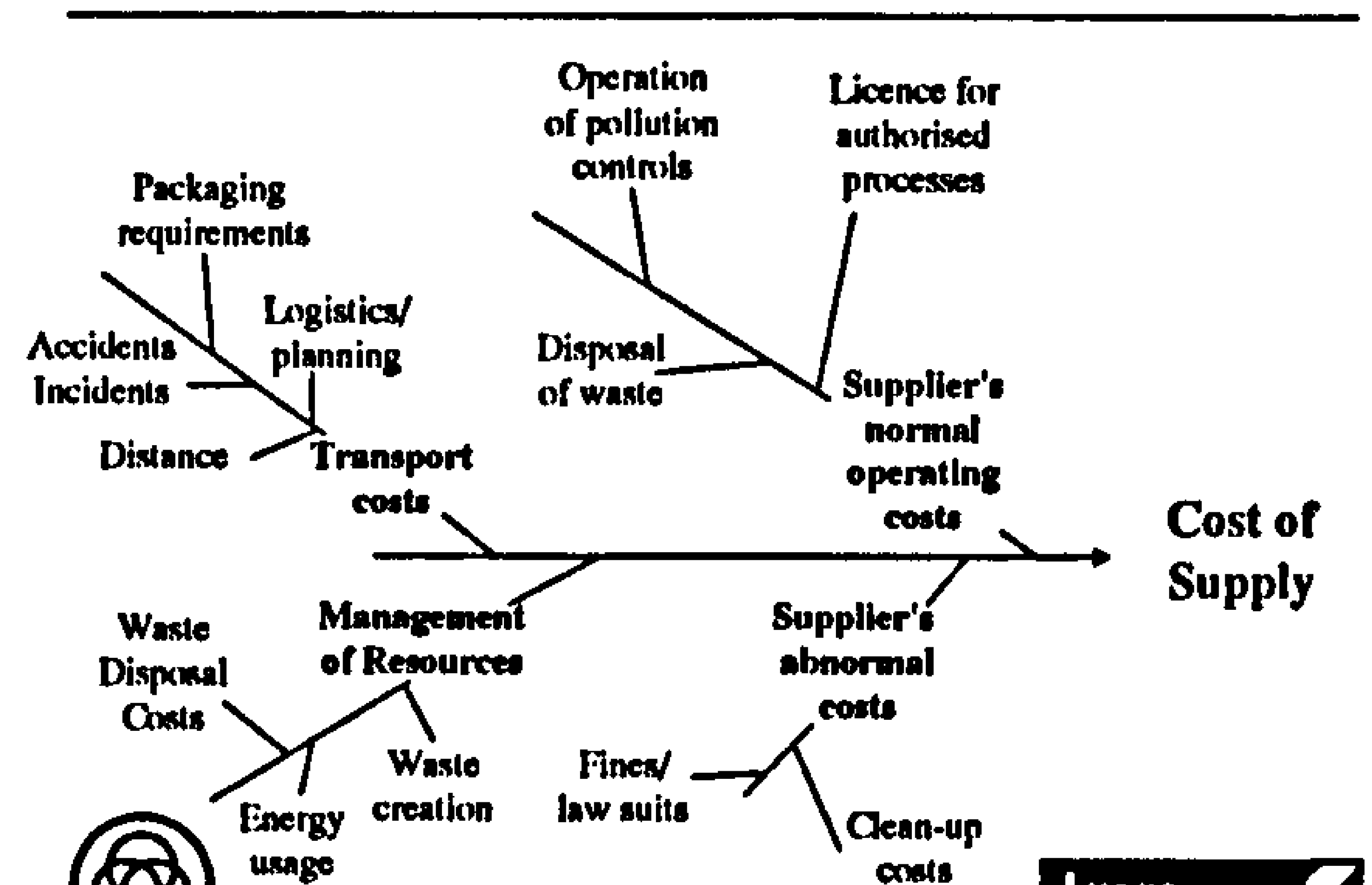
How could a supplier disrupt our business ?



HS&E / Supplier Audit Presentation
SUPAUDIT.PPT

Lucas

Why would environmental factors increase costs ?



HS&E / Supplier Audit Presentation
SUPAUDIT.PPT

Lucas

Supplier Auditors can spot potential problems..

Pollution - Does the supplier know the current and future legislation?

Are their processes under control or are they likely to be fined or shut down ?

Do they produce excess waste and have high disposal costs ?

Processes - Are they operating any that will be restricted or banned?

Are they operating unsafely?

HS&E / Supplier Audit Presentation
SUPAUDIT.PPT

Lucas

Supplier Auditors can spot potential problems....

Attitude - Good Environmental management means good control of resources, attention to detail, caring and responsible attitude.

Do managers lead by example ?

Does the company have suitable equipment ?

People - Are employees properly trained for the activities ?

Do management understand the issues ?

Are rules and procedures adhered to ?

HS&E / Supplier Audit Presentation
SUPAUDIT.PPT

Lucas

HS&E Auditing of Suppliers

Supplier Auditor Protocol - Things to look for (1):

- **Housekeeping** - an indicator of attitude and control. *An untidy workplace is more likely to be a potential fire risk and pollution may go unnoticed.*
  - Are gangways and floors clear of obstructions ?
  - Are fire exits and routes clear ?
  - Are workstations tidy ?
  - Is there leakage from machines *(potential ground contamination, waste of oil, slippage) ?*
  - Are the grounds outside the building tidy ?

Lucas

Supplier Auditor Protocol - Things to look for (2):

- **Working Conditions** - an indicator of management attitude and investment. *Poor working conditions and maintenance leads to poor morale and potential pollution incidents.*
  - Is their sufficient space, light and ventilation?
  - Is there too much noise ?
  - Are buildings well maintained ?
  - Are sprinklers and smoke alarms installed ?
  - Are machines and equipment well maintained ?

Lucas

Supplier Auditor Protocol - Things to look for (3):

- **Chemicals** - potential pollution and fire risk.
  - Are there a lot of hazardous or flammable chemicals ?
  - Are Storage areas secure, well organised and located away from drains ?
  - Are containers suitable for the purpose and clearly labelled, is ground protection provided ?
  - Are chemicals well managed & controlled, is there sufficient documentation, are handling methods and equipment suitable ?

Lucas

Supplier Auditor Protocol - Things to look for (4):

- **Waste** - costs & compliance.
  - Is a lot of waste produced, is any of it recycled ?
  - Are waste storage areas secure, well organised and located away from drains ?
  - Are containers suitable for the purpose and clearly labelled ?
  - Is waste well managed & controlled, is there sufficient documentation, are handling methods and equipment suitable ?
  - Is waste polluting the ground outside ?

Lucas

Supplier Auditor Protocol - Things to look for (5):

- **Processes** - potential pollution and compliance.
  - Is a lot of disposable packaging used ?
  - Do machining operations use a lot of coolant ?
  - Is surface treatment done in-house ?
  - Does the site have an effluent treatment plant ?
  - Are there any heat treatment processes ?

Lucas

Supplier Auditor Protocol - Things to look for (6):

- **Notices and Information** - do people know what to do, are they aware of the hazards ?.
  - Are signs visible and complied with ?
  - Are fire exits and equipment clearly marked ?
  - Are drains identified ?
  - Are instructions and procedures available at the work place ?

Lucas

HS&E Auditing of Suppliers

Supplier Auditor Protocol - Things to check:

- **Back-up Information** - are systems in place to ensure good management of environmental issues ?
  - Is there an environmental policy ?
  - Have management set objectives and targets for improvement ?
  - Have responsibilities been allocated ?
  - Is documentation kept up-to-date ?
  - Is performance measured and reviewed ?

Supplier Auditor Protocol - Things to ask about:

- **Back-up Information** - how well do the systems work ?
  - Do people understand the environmental policy ?
  - Do people understand their responsibilities ?
  - Is the company aware of environmental management systems?
  - Are performance measures and reviews carried out regularly ?
  - Has the site ever been prosecuted ?

Supplier Auditor Protocol - Conclusions

- **Overall conclusions** - how do you feel the company is managed ?
  - Does management have a positive, proactive attitude ?
  - Are employees competent to carry out the tasks ?
  - How willing are they to improve, do they have a continuous improvement approach ?

Risk Rating and Action

Visually assess the information recorded on the protocol:

- **High Risk** → Recommend that a comprehensive HS&E audit is carried out, resulting in an action plan.
- **Medium Risk** → Using the protocol to identify areas of high risk, set targets for improvement.
- **Low Risk** → No further action required.

Appendix G

Notes on how to conduct the Significance Exercise

Nicolette Lawson
HS&E, Lucas Industries
SIGNFMGT.doc
26 July 1995

Environmental Issues - Significance Exercise

What issues are "significant" to the business?
What does the management team believe is important?

In a workshop
List all issues important to them, e.g.
- noise
- cyanide
- waste
- oil leaks
- energy

Then check against a list of criteria, e.g.
- legislation - is it a legal requirement?
- customer - is it a customer requirement (Order qualifying, order winning)?
- money - will it cost us money if we don't deal with it, or save money if we do?
- neighbours - have there been complaints?
- business disruption - if unresolved could this issue disrupt the business?
- employees - is this issue likely to harm our employees or cause IR problems?

1. Draw up a matrix and check each issue against the factors
2. Weight the factors in terms of significance to the business (10=highest)
3. Add up the total weighting for each issue.

	Environmental significance						
ISSUES	Legislation	Customer	Money	Neighbour	Disruption	Employees	TOTAL
noise	✓			✓		✓	23
cyanide	✓	✓	✓		✓	✓	38
waste	✓		✓	✓			22
oil leaks			✓			✓	11
energy			✓				5
WEIGHT	10	8	5	7	9	6	**45 max**

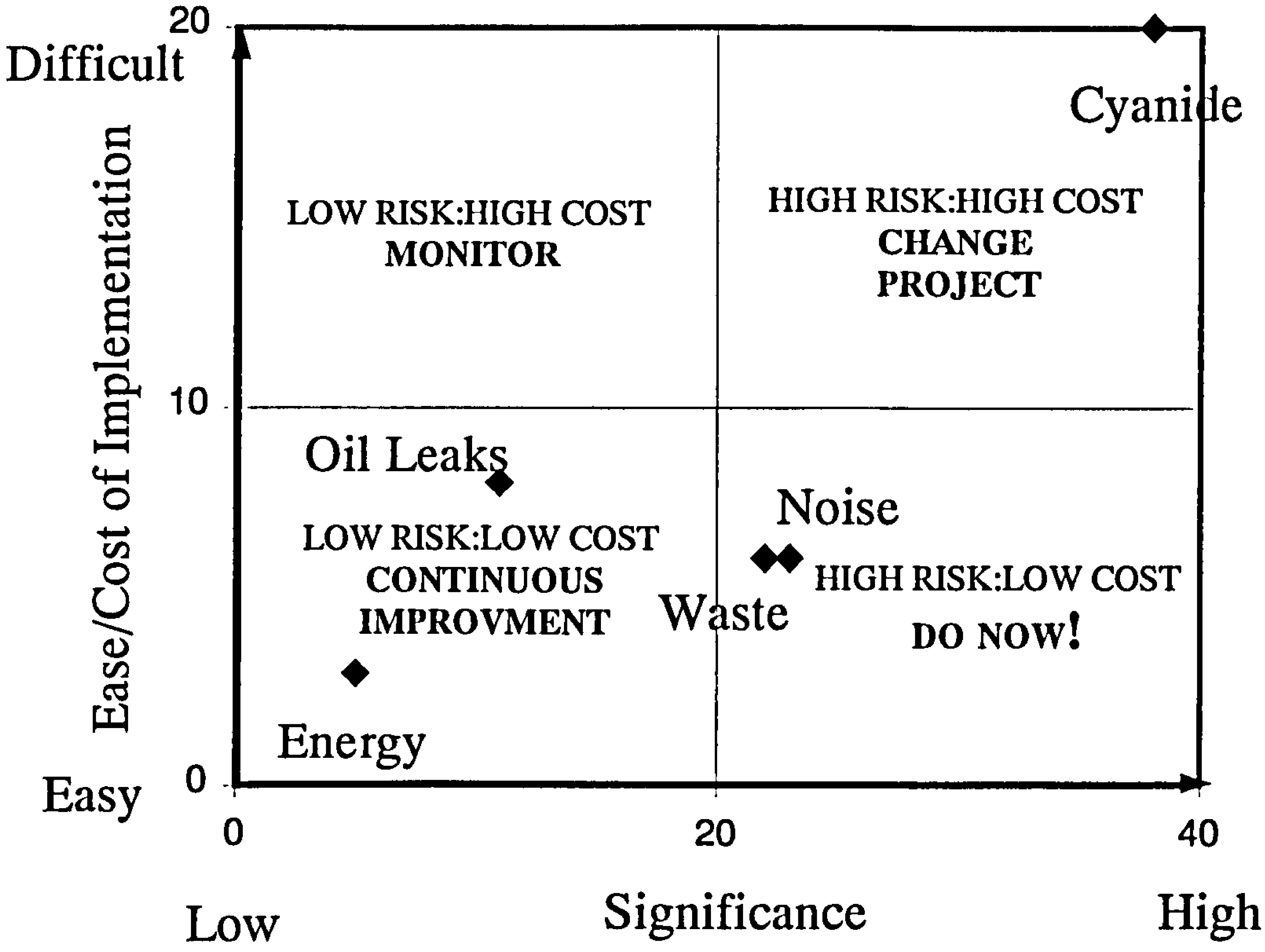
This gives a significance rating. In this case the order of "significance" is
1. cyanide
2. noise
3. waste
4. oil leaks
5. energy

However, all these items are issues which need addressing, but the approaches and the effort required may be different.

A second assessment should then be carried out to assess ease and cost of implementation. Where easy is 1 and difficult is 10. Cost should be assessed similarly.

	Implementation		
ISSUES	Ease	Cost	TOTAL
noise	2	4	6
cyanide	10	10	20
waste	3	3	6
oil leaks	5	3	8
energy	2	1	3

The two sets of results can then be plotted on a Boston Matrix type graph:



- If an issue falls into the top-right quadrant (High Risk: High Cost) its implementation will require a Change Project approach.
- If an issue falls into the top-left quadrant (Low Risk: High Cost), it is not in the business' interests to do anything, other than monitor the issue to make sure it does not move into the high risk area.
- If an issue falls into the bottom-right quadrant (High Risk: Low Cost) the business has no excuse not to act immediately.
- If an issue falls into the bottom-left quadrant (Low Risk: Low Cost), the issue should be addressed by continuous improvement techniques and can be allocated to individuals or small teams to implement.

Nicolette Lawson
Programme Manager, Environment
Group HS&E, Lucas Industries.
0121-627 4309

Appendix H

Copy of AMIEMgt certificate

INSTITUTE OF
ENVIRONMENTAL
MANAGEMENT

This is to certify

N. P. Lawson

has satisfied the criteria for
Associate Membership established
by the Institute of Environmental Management
and has been admitted as an

ASSOCIATE MEMBER

of the

INSTITUTE OF ENVIRONMENTAL MANAGEMENT

Date: 12th September 1995

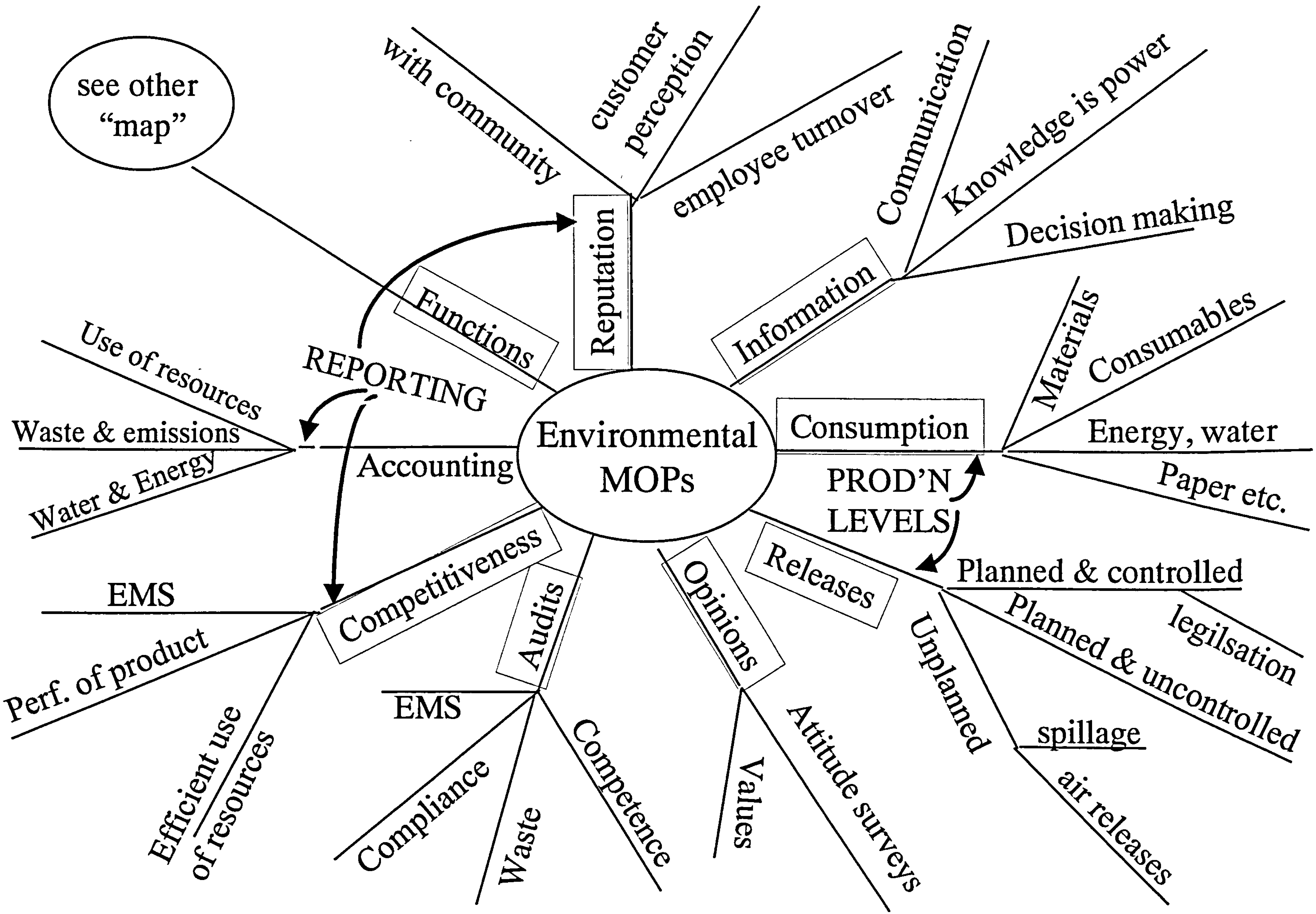
Signed:

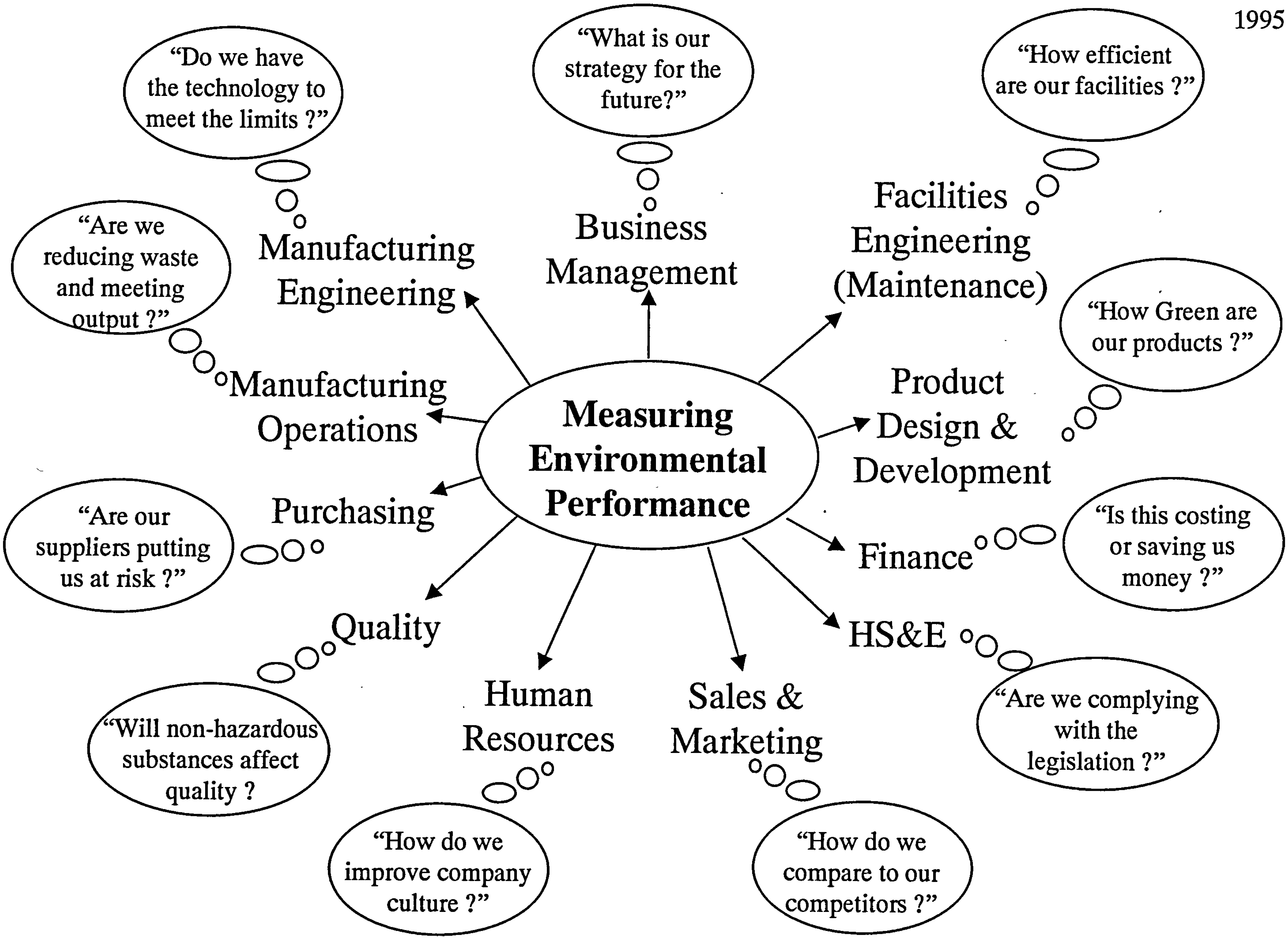
for and on behalf of the Executive Committee

58/59 Timber Bush, Edinburgh EH6 6QH Tel: 0131-555 5334 Fax: 0131-555 5217

Appendix I

Environmental MOPs - Mind Map


Environmental MOPs
Reputation
with community
customer perception
employee turnover
Information
Communication
Knowledge is power
Decision making
Consumption
Materials
Consumables
Energy, water
Paper etc.
PROD'N LEVELS
Releases
Planned & controlled
legilsation
Planned & uncontrolled
Unplanned
spillage
air releases
Opinions
Values
Attitude surveys
Audits
EMS
Compliance
Waste
Competence
Competitiveness
EMS
Perf. of product
Efficient use of resources
Accounting
REPORTING
Use of resources
Waste & emissions
Water & Energy
Functions
see other "map"


Measuring Environmental Performance
Business Management
"What is our strategy for the future?"
Manufacturing Engineering
"Do we have the technology to meet the limits ?"
Manufacturing Operations
"Are we reducing waste and meeting output ?"
Purchasing
"Are our suppliers putting us at risk ?"
Quality
"Will non-hazardous substances affect quality ?
Human Resources
"How do we improve company culture ?"
Sales & Marketing
"How do we compare to our competitors ?"
HS&E
"Are we complying with the legislation ?"
Finance
"Is this costing or saving us money ?"
Product Design & Development
"How Green are our products ?"
Facilities Engineering (Maintenance)
"How efficient are our facilities ?"

Appendix J

- HS&E Audit Report - Revised Format
- Example Executive Summary

NL\repfmat.doc
9-Jan-96

HS&E AUDIT REPORT

TO: Programme Managers (MJM, FPR, SW, SB)

FROM: NL

Please find below, rough outline of revised audit report, as discussed Monday 8/1/96.

• COVER PAGE	To include name of site, team Leader, team members, date of audit, etc.
• INTRODUCTORY PAGE + AUTHORISATION	Standard text explaining purpose of audit, the fact that the business should prepare an action plan and that Group HS&E is available to support the formulation of the plan and/or the implementation. Includes authorisation signature for issue (from MJM) and accepted signature (from General Manager).
• EXECUTIVE SUMMARY	Contains 3 statements on the performance of the business: 1. General statement on performance versus risk, highlighting any key issues (H, S or E) 2. Statement on performance versus standards in the form of a bar graph, from the results of the 7 GEMI's, plus an overall (average) compliance score. 3. A statement describing the progress made since the last audit and hence an estimate of whether the business is on target to meet the CEO's 80% compliance target by end of July 1998, and if not, where extra effort will be required.
• CONTENTS	For Audit findings and Appendices
• AUDIT FINDINGS	4 Sections: Management Systems, Environment, Safety and Health. Each with a list of priority issues; the relevant GEMI assessment sheets with back-up SWOT; observations for the remaining standards (in numerical order) and related photos.
• APPENDICES	Any additional material referenced in report.

Please return any comments or amendments to NL.

EXECUTIVE SUMMARY

1 PERFORMANCE VERSUS RISK

- The business operates several processes which present HS&E risks. These include product testing, utilising fuel and producing air emissions; plating; heat treatment [including cyanide] and use of cleaning solvents.
- Major HS&E risks are understood in terms of legal requirements and are generally well managed. Lesser risks are not so well understood and managed. It is this lack of formality in assessing, prioritising and recording risks, which leads to the relatively low assessment score (below). Commitment to the implementation of the Environmental Management System will help to formalise the management and control of HS&E issues.
- Documentation and record keeping is very good, but lacks overall co-ordination. Accountability for issues is currently being delegated to Production Units and this will help to integrate HS&E into all of the business functions.
- A positive approach from management has lead to major organisational changes which will provide opportunities for improved participation and increased ownership of HS&E issues and their solutions.

2 PERFORMANCE AGAINST STANDARDS:

The following graph summarises the results for Standards M1, M2, M3, M4, H1, S1 and E1, which are presented in more detail in the Audit Findings section of this report.

	General description of standard of performance for this level				
	(0-20%)	(21-40%)	(41-60%)	(61-80%)	(81-100%)
Standards	**POOR** The company fails to meet policy standards and legal requirements. There is a lack of adequate arrangements, procedures and systems.	**MINIMALIST** The company meets the minimum legal requirements. Management have a reactive approach to the management of risks and compliance.	**STARTER** The company is starting to implement systems and procedures to meet legal requirements and policy standards.	**GOOD** The company has formal systems and procedures to meet legal requirements and policy standards. These are integrated into the business activities	**BEST PRACTICE** The integrated management systems are continually reviewed for improvements. There is participation at all levels within the company.
M1: Policy				68	
M2: Arrangements				66	
M3: Systems				72	
M4: Self Assessment				58	
H1: Occ.Health				61	
S1: Risk Control				68	
E1: Env. Protection			55		
OVERALL				64	

3 PROGRESS TOWARDS COMPLIANCE WITH STANDARDS:

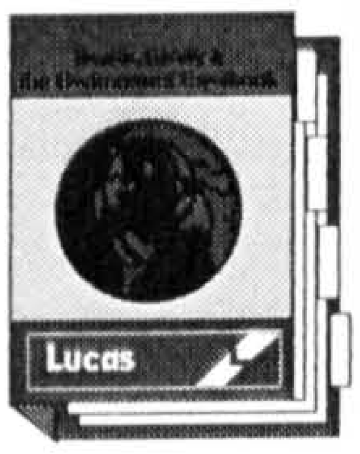
- Many improvements have been made to the facilities since the last HS&E Review in 1994. Recent actions are reducing the major risks on the site.
- Implementation of the **priority** recommendations in this report will ensure that the business will achieve the LucasVarity Example objective of 80%, by January 2000 i.e. from GOOD to BEST PRACTICE.

Appendix K

HS&E Self-Assessment System - presentation handouts

HS&E Self-Assessment System

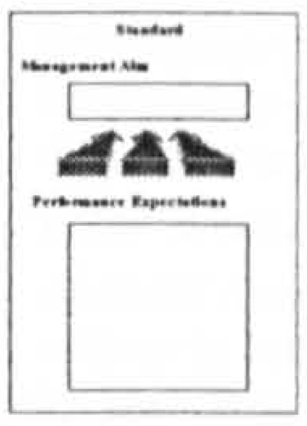
The HS&E Handbook



- Contains the Lucas Policy, Standards and Arrangements
- Worldwide Application
- Benchmark
- Achieve 80% by 1998

Lucas

What are the Standards ?



- Simple statements of HS&E management principles
- Policy ➡ Basic aims
- Set of Requirements
  - Management Systems
  - Health
  - Safety
  - Environment

Lucas

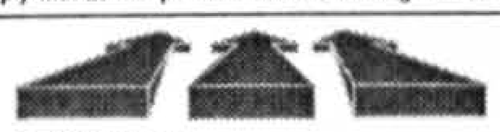
For Example:

M1

Policy, Objectives and Targets

Management Aim

To set health, safety and environmental objectives and targets in order to comply with Lucas policies and relevant legislation.



Performance Expectations

1. Each business must create a register of all those activities which either have or potentially have a significant effect on the health and safety of employee and/or the environment.
2. Each business must define its priority issues, based on the level of risk, legal requirements, levels of performance and financial implications.
3. Each business must specify objectives, with demonstrable links to priorit issues, to manage, improve and monitor the requirements of the Lucas HS& policies and standards.
4. Targets will be established, for the achievement of the set objectives, with specific results, resources allocated and timescales.
5. Health, safety and environmental objectives and targets must be integrated into the overall business plan.
6. Senior management must make a public statement of their commitment to the implementation of the Lucas policy and achievement of objectives and targets.
7. Policies, objectives and performance will be communicated openly to employees, customers, suppliers and other stakeholders.
8. Employees must be made aware of their role, rights and responsibilities.

Lucas

How do we know when we have achieved 80% ?

- HS&E Audit or Self Assessment
- Self Assessment Sheets for key standards:
  - M1 - Policy, Objectives & Targets
  - M2 - Organisational Arrangements
  - M3 - Operational Management Systems
  - M4 - Self-assessment and Audit Systems
  - E1 - Environmental Protection Programmes
  - S1 - Risk Elimination and Control Programmes
  - H1 - Occupational Health Programmes

Lucas

Self Assessment Sheets

- Performance measured against:
  - Management Aim
  - Each Performance Expectation
- 5 levels of achievement:
  - 0-20% = Poor
  - 21-40% = Minimalist
  - 41-60% = Starter
  - 61-80% = Good
  - 81-100 = Best Practice

Lucas

Levels of Achievement

- Poor
  - Business fails to meet legal requirements
  - Lack of arrangements, procedures & systems
- Minimalist
  - Business meets minimum legal requirements
  - Reactive approach
- Starter
  - Starting to implement systems and procedures
- Good (80% target)
  - Formal systems and procedures in place
  - Integrated into business processes
- Best Practice
  - Totally integrated
  - Continuous Improvement & Participation

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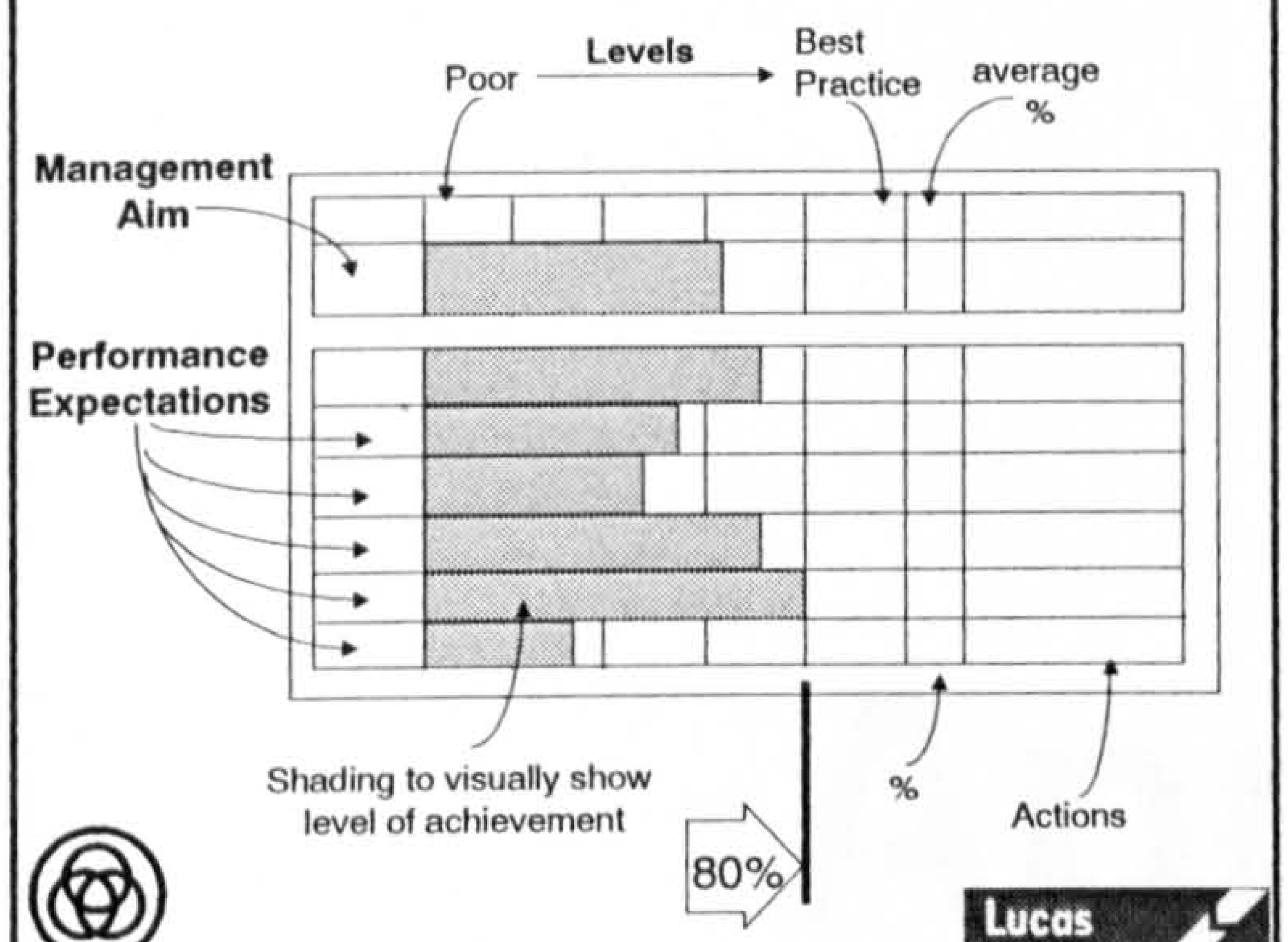
HS&E Self-Assessment System

Self-Assessment Sheets



How to carry out an assessment

- **Assess** which statement from each Performance Expectation best corresponds to the **current business position**. Business can be part way through a level.
- Enter **% score** (minimum 5% increments)
- Allocate average of Performance Expectation scores to Management Aim to give **overall score** for standard.
- Make a note of any **actions** required to achieve 80% in each Performance Expectation.

For more details......

- Contact:
  - Nicolette Lawson, Programme Manager, Lucas HS&E Department at Shirley 0121-627 4777.

Appendix L

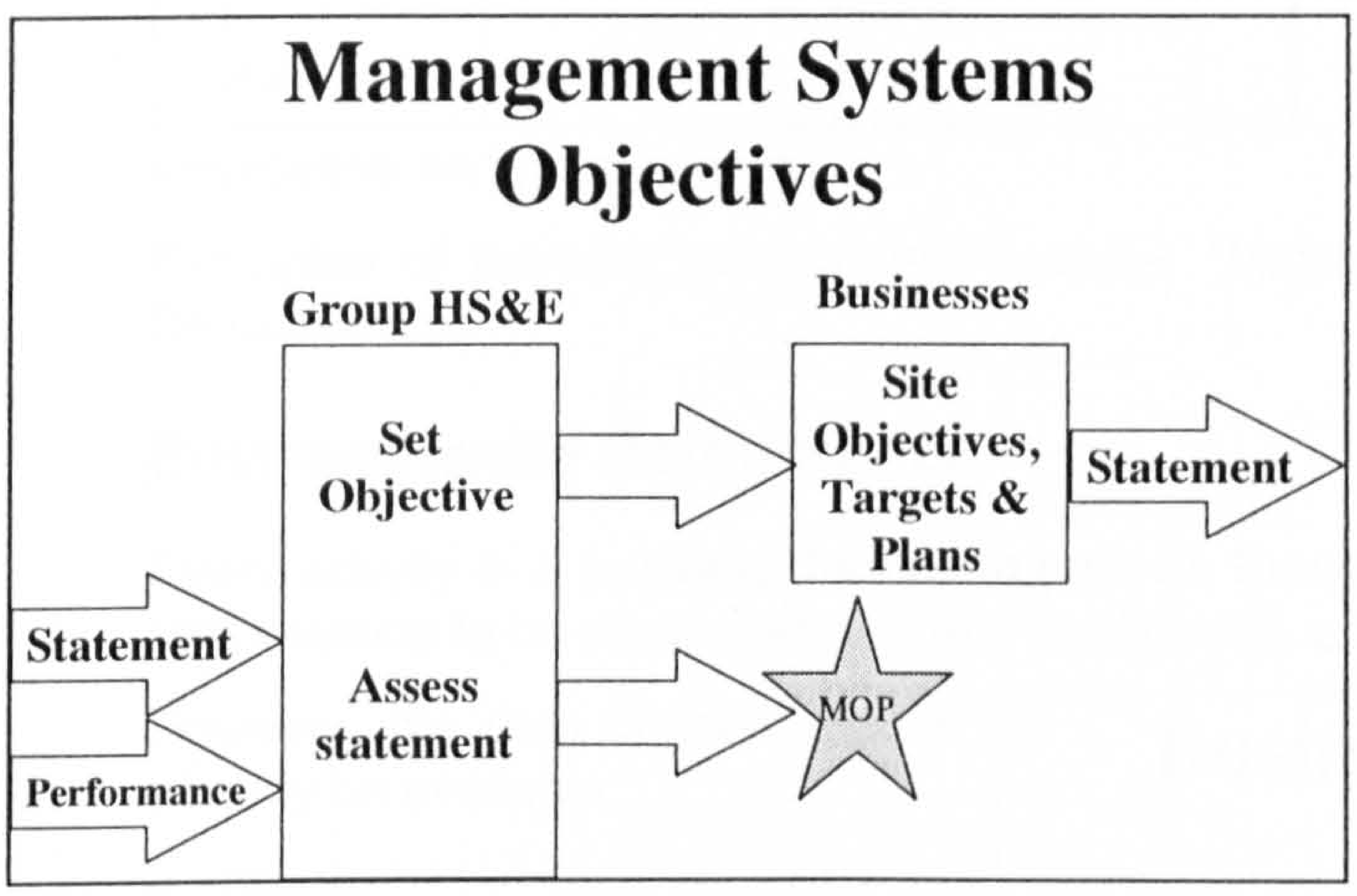
Group HS&E Measures of Performance document

Group HS&E Measures of Performance

It is generally recognised that in order to achieve improvements, performance needs to be measured. It is proposed to introduce a set of HS&E Measures of Performance which will be reported annually by the Lucas businesses and compiled and reviewed at Group level.

Management Systems

The setting of objectives, targets and improvement plans is a crucial part of an HS&E Management System and a requirement of the HS&E Standards which are contained in the Lucas HS&E Handbook.

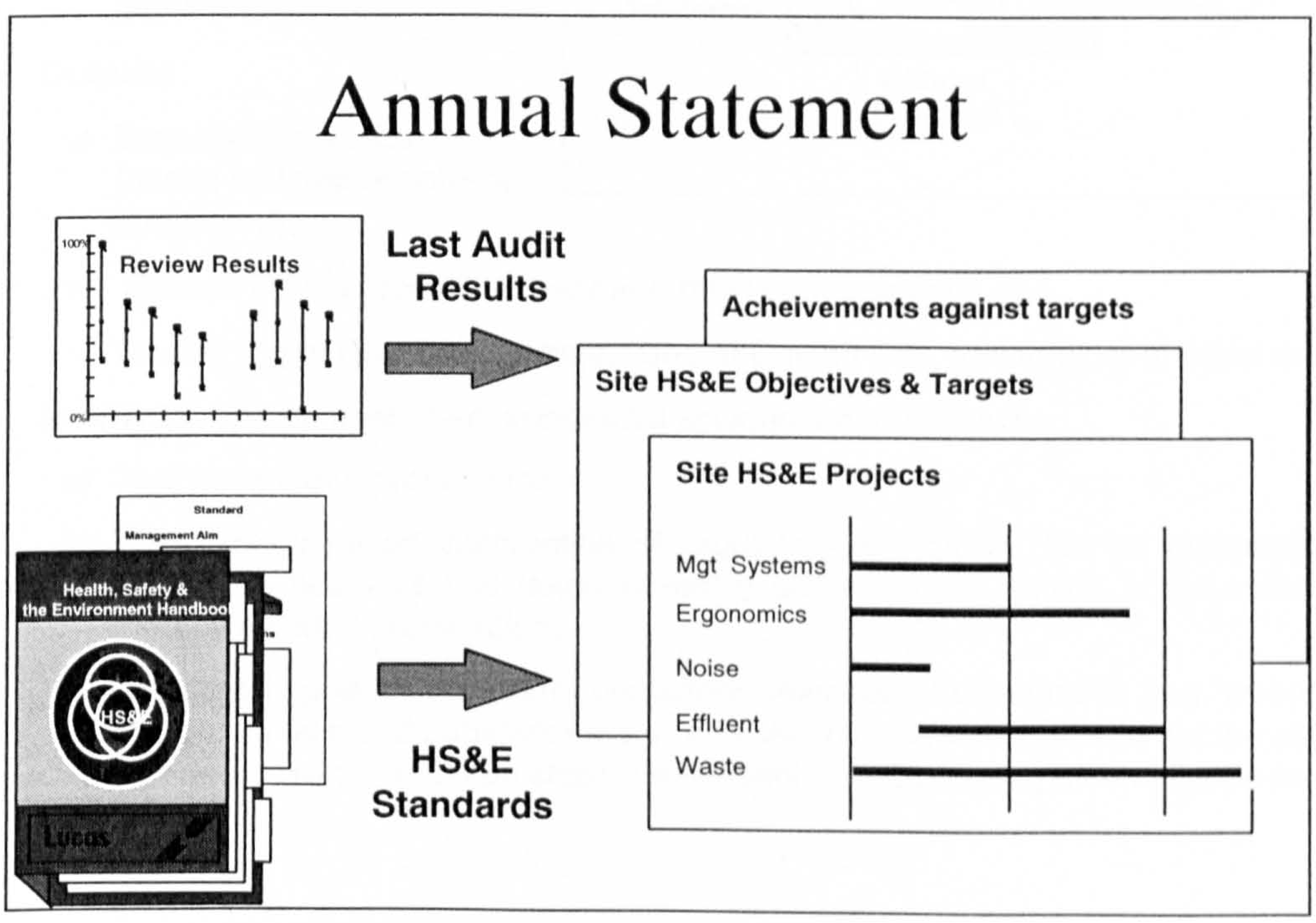


Each business will be expected to prepare an annual statement detailing its HS&E objectives, targets and plans for improvement. The statement should be based on the HS&E Standards and the outcome of the latest audit (review).

In second and subsequent years, achievement against last years targets and effectiveness of programmes and arrangements should also be assessed

The statement will be assessed by Group HS&E and Divisional HS&E Representatives against Review results and other business performance indicators.

Progress against the plans will be monitored regularly by the Divisional Managing Directors as part of the normal review of business performance.



The annual statement should include the following Measures of Performance:

HS&E Competence

HS&E Competence

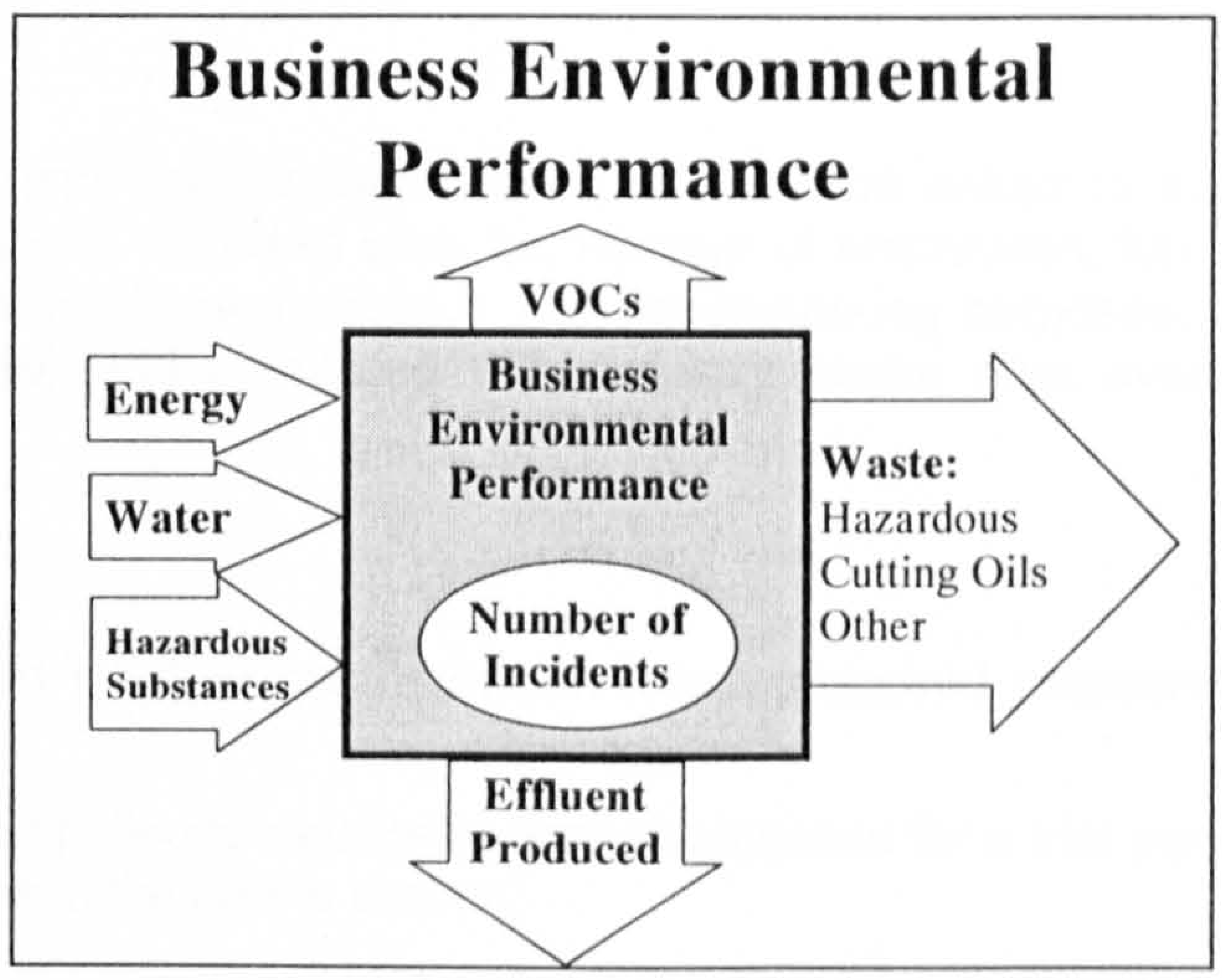
	No.Trained	Hours/Year
Managers		
Supervisors		
Employees		
Practitioners		

One of the aims of the HS&E programme is to increase the competence of employees at all levels. It is the responsibility of business managers to identify areas of weakness and ensure that the training needs of their employees are met. Although true competence can only be assessed on an individual basis, a good indicator of performance will be the number of people trained and the hours of training given per year, at various levels within the organisation: managers, supervisors, employees and practitioners.

Examples of learning programmes include: "Managing Safely", Induction Training, HS&E Seminars etc.

Environmental Performance

Every activity in a business has an impact on Environmental Performance and therefore for performance to be measured with any confidence, a wide variety of data will be required.

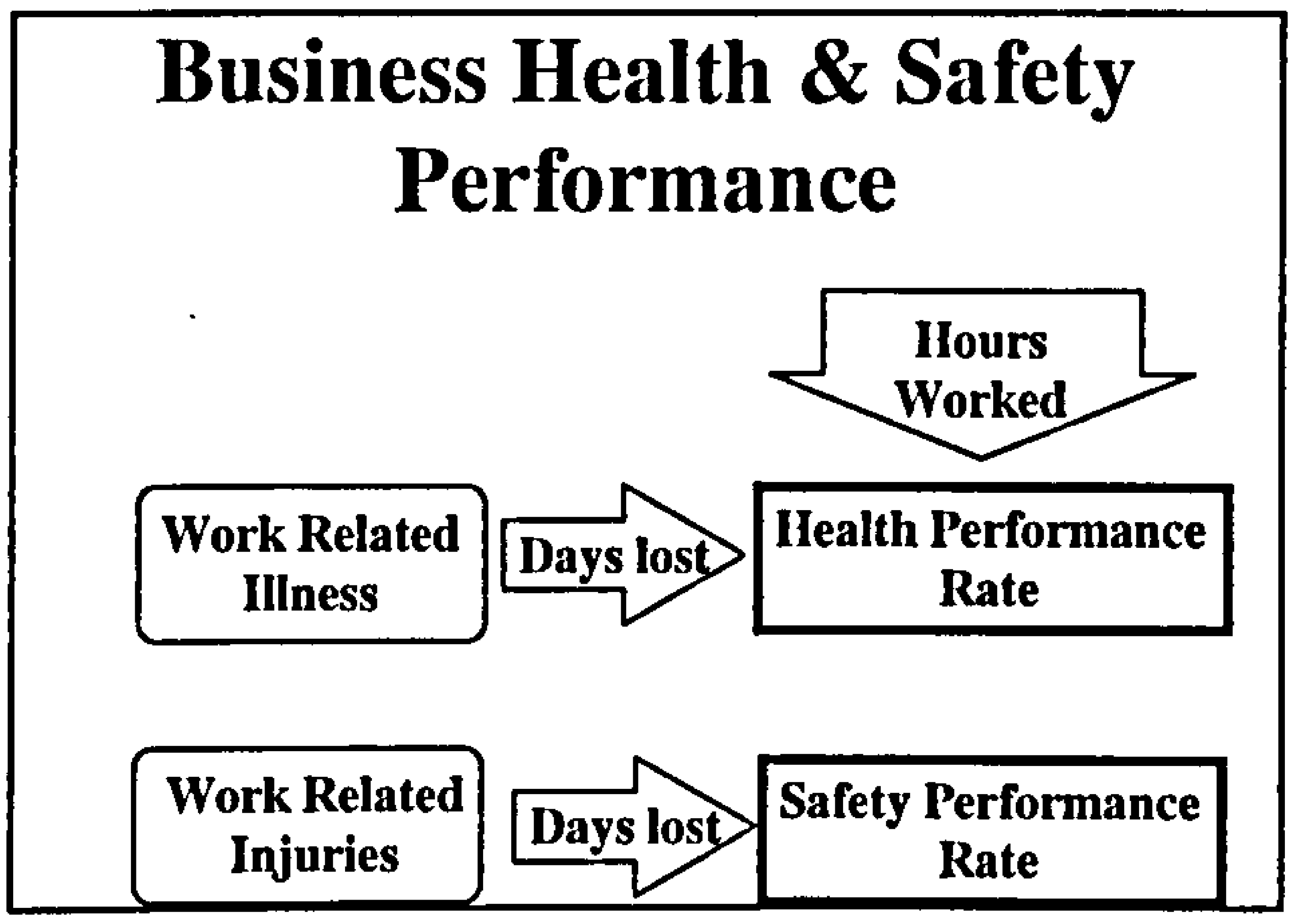


However, the data chosen should already be available:

- **Inputs** :
  - ⇒ Consumption of Energy (Gas, Oil and Electricity in kWh per year),
  - ⇒ Water (litres/year) and
  - ⇒ Hazardous Substances (kg/year).
- **Outputs** :
  - ⇒ Emissions of VOCs (based on litres of solvent purchased),
  - ⇒ Effluent Discharged (litres/year and main contaminants) and
  - ⇒ Wastes (kg of Hazardous waste, litres of Cutting Oils, and total kg of other waste).
- **Incidents**: The number of environmental accidents and incidents:
  a) That have led to prosecution,
  b) That have involved intervention of regulatory authorities, but no prosecution (e.g. where the business has taken remedial action on the advice of an authority and thereby avoided prosecution).
  c) Accidental spillages and other unplanned releases of substances (e.g. where control equipment fails and substances are released into the environment, but the size of the spill or the response taken stops the incident from becoming a compliance issue).

Health & Safety Performance

In order to have Health and Safety performance indicators that are comparable with other major businesses, it will be necessary to calculate Health and Safety Performance Rates.



These involve comparing the days lost through work related illness and injuries with the total employee hours worked.

Context

In order to put HS&E performance into context, businesses will also be asked to supply details which will indicate any changes in business size, i.e. number of employees, turnover and added-value (product value less purchasing costs). For benchmarking purposes, data may be combined (where applicable) and compared with industry sector data available outside the company.

Logistics

Selected businesses are being asked for their comments on these proposed measures of performance.

Once accepted, the Measures will be applied to selected Lucas businesses for a trial period - then applied to all businesses after the initial pilot is proven.

A reporting format will be provided to the businesses, in order that information is reported in a consistent manner.

Appendix M

Book Review 01: Alternative Economic Indicators.

Book Review 01:

Alternative Economic Indicators
Victor Anderson
Routledge Lon/NY 1991
HC79 15A53

Anderson (1991) This book describes economic indicators (e.g. GDP/GNP) and discusses the inadequacies of the system and the problems of assuming that these indicators can adequately describe the health and wealth of a nation.
For instance GDP/GNP does not include factors such as unpaid domestic labour and non-money transactions, distribution of income, different needs and circumstances, leisure time and quality of life. It considers that environmental resources are "free" and that all economic activity is good.
GNP favours expensive ways of providing services and short-term decisions rather than long-term provisions.
The book questions the concept of growth and progress - what is it? is it measurable and should it be based on money?

Anderson (1991) Chapter six discusses the characteristics of a good indicator:
- An indicator does <u>not</u> have to have automatic evaluation e.g. increase is good
- An indicator should <u>not</u> correspond to a political instrument i.e. requires easy action
- An indicator does <u>not</u> have to be new
- An indicator should <u>not</u> be based on assumptions that something is true or false.

Anderson (1991) describes seven criteria for good indicators:
1. They should be readily available - easily and cheaply
2. They should be relatively easy to understand (seem real and significant = "fact")
3. They should be about something measurable
4. They should measure something believed to be important in its own right
5. There should be a short time lag between the state of affairs and the availability of the indicator (to give early warning)
6. They should be based on information which can be used to compare different groups, so that distribution can be shown.
7. They should be comparable (e.g. in different countries)

In addition, indicators should focus on priorities (not everything can, or should, be measured).

Anderson (1991) also discussed subjective indicators, using the public's perception of significance. For subjective indicators, the public should rate importance and then judge if there has been an improvement. Correlations should be sought between subjective and objective indicators and the subjective used to weight the objective indicators (however, this can be distorted by the amount of information available or the publicity received by the subject).

Chapter eight discussed how environmental indicators can be used to describe Global issues like a statement of accounts, i.e.

<u>Starting conditions</u> (e.g. area of forest, level of pollution)
<u>minus</u> the amount used / pollution added
<u>plus</u> the amount regenerated / cleaned up
<u>equals</u> the conditions at the end of the period.

Anderson (1991) concludes that there are:
- Indicators of causes (population growth, energy intensity),
- Indicators of effects (deforestation, CO_2, nuclear reactors)

Anderson (1991) describes a list of needs, in order to improve performance indicators:
- more accurate and comprehensive collection of data

- publicity for priority indicators
- development of different sets of performance indicators that reflect different regional priorities
- organisations to make lists of own priority indicators
- development of social and environmental auditing and accounting
- development of social indicators to measure hard-to-define factors (e.g. participation, subjective feelings)
- changes in the machinery of government (organisational systems) to reflect more than just economics in financial terms
- monitor and criticise policies, activities of international organisations
- support and pressure to change existing frameworks (short-term solution, new frameworks = long term solution)

He concludes that financial criteria has ruled too long and it is now time to bring human and environmental realities into the picture.

How ideas support Thesis:

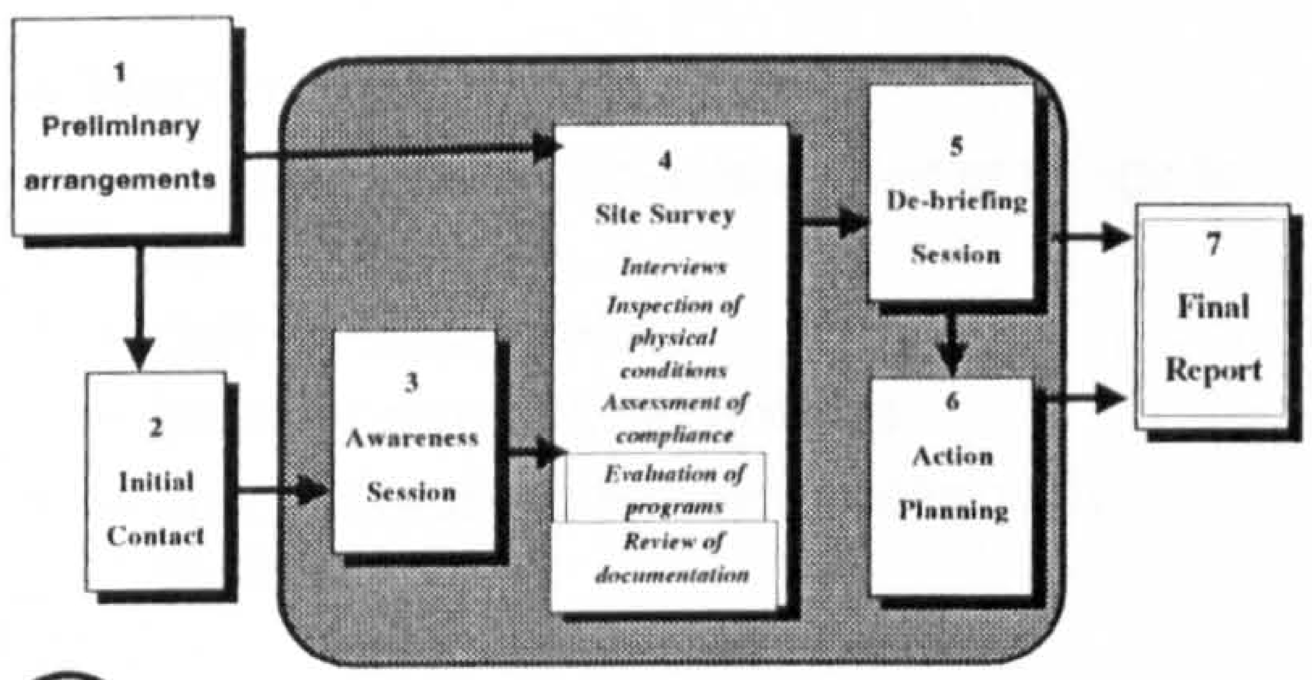
- Question whether economic and traditional business indicators are appropriate - what are their limitations and dangers ?
- Consider whether the seven criteria for good indicators can be applied.
- How can subjectivity be accounted for ?
- Can industrial environmental performance be described in terms of its contribution to Global Issues ?
- Indicators can be separated into those measuring causes and those measuring effects.
- Are the needs for national economic indicators also the needs for industrial environmental performance indicators ?

Appendix N

Practicalities of Auditing - presentation handouts

Practicalities of Auditing - Nicolette Lawson

The Review Process



Lucas

1. Preliminary Arrangements

- Planning
  - Dates, team members, contacts
  - Availability of managers
  - Meeting times
- Information
  - Pre-audit questionnaire (first time)
  - Address and map

Lucas

2. Initial Contact

- Meet with Liaison
  - explain role of liaison
  - explain scope & purpose of audit
  - specify who you need to see
- Walk site
  - assess size and complexity
  - understand processes

Lucas

3. Awareness Session

- To all managers
  - reasons for audit
  - what they can expect
  - you are there to help
- Scope
  - pressures on business
  - benefits of Environmental management

Lucas

5

4. Site Survey

- Interviews
  - cross section
- Documentation
  - compliance
  - plans, programmes, procedures...
- Evidence
  - visual, photographic
  - reports, letters

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6

5. Debriefing Session

- To management team
  - Strengths, weaknesses & opportunities for improvement
  - Use specific examples (photos)
  - Define root causes
  - Propose a way forward
  - Prioritise the risks and issues

Lucas

6. Action Planning

- Recommendations
  - programmes & projects not list of things to fix.
  - define responsibilities
  - build on current programmes
  - agree objectives and timescales with business

Lucas

7. Report

- Format
  - short and specific
  - measure against a known benchmark
- Style / Tone
  - be positive
  - put into perspective
  - prioritise issues

Lucas

Practicalities

- Use of Questionnaires / Protocols
- Working Papers
- Tape recorders
- Cameras
- Interviews

Lucas

5

General Do's & Don'ts

- Do
  - remember the audit is a management tool
  - recommend practical solutions
  - give good examples
  - explain why an issue could be a problem
  - encourage & motivate
  - highlight system weaknesses
- Don't
  - criticise at the expense of praise
  - criticise & offer no alternatives
  - be vague
  - get things out of proportion
  - chastise (unless all else fails)
  - blame individuals

Lucas

6

Appendix O

- Group HS&E Measures of Performance, Results Proforma -*Example*

Group HS&E Measures of Performance Results Proforma

Example

Management Systems

What were your HS&E Programmes, Objectives, targets and Achievements for the past year (1995/96) ?

HS&E Programmes	Objectives	Targets	Achieved✓ Not ×
Management Systems	*To put organisational arrangements in place*	• *Appoint Manager responsible for HS&E by Sept. 1995.* • *Hold monthly Steering Group meetings from Oct. 95*	*✓ Mr Smith* ✓
Environmental Protection	*To reduce the risk of surface water pollution*	• *Colour code external drains by Dec. 1995*	*× delayed*
Waste Management	*Improve Management of Waste*	• *Complete & implement Waste Management Procedures by Jan 1996.* • *Train waste handlers by Jan 96*	✓ *× 50%*

What are your HS&E Programmes, Objectives and Targets for the coming year (1996/97) ?

HS&E Programmes	Objectives	Targets
Management Systems	*To implement HS&E Management Systems in order to gain accreditation to ISO14001.*	• *Complete Inventories by September 1996.* • *Write and implement waste management procedures by October 1996.*
Environmental Protection	*To reduce the risk of ground contamination*	• *Repair bulk storage bunds by August 1996.* • *Train all operators in spillage procedure by August 1996.*
Waste Minimisation	*To reduce packaging waste to a minimum.*	• *Recycle 100% cardboard packaging by Oct. 1996.* • *Introduce 50% returnable packaging by April 1998.*
Skin Care	*To reduce cases of dermatitis*	• *Train all operators in correct handling and hygiene techniques by Sept. 1996* • *Implement engineering improvements by July 1997.*

The annual statement should include the following Measures of Performance:

Commitment to HS&E Competence

Learning Programme	Supplier	Managers		Supervisors		Employees		Practitioners	
Aug. 1995-July 1996		No.	Hrs/ea	No.	Hrs/ea	No.	Hrs/ea	No.	Hrs/ea
Managing Safely (for Supervisors)	*Group HS&E*			*36*	*40*			*2*	*40*
Managing Safely (for Managers)	*Group HS&E*	*12*	*8*						
Induction Training	*In-house*					*120*	*8*	*1*	*8*
Waste Minimisation	*I.Chem.E*							*1*	*4*
Noise Measurement	*Group HS&E*							*1*	*8*
Skin Care	*In-house*			*24*	*1*	*240*	*1*	*2*	*1*

Environmental Performance

Inputs :

TOTAL SITE RESOURCES (Aug. 95-Jul. 96)	£	kWh	Cu.m	Litres
Consumption of Gas per year	*£ 1,625*	*128,654*	*10,523*	
Consumption of Heating Oil per year	*£ 6,598*	*698,883*		*66,057*
Consumption of Electricity per year	*£ 208,409*	*407,439*		
Consumption of Water per year	*£ 12,680*		*12,596*	

Hazardous Substances	Kg / year Purchased	Kg / year Disposed	Processes used in:
Asbestos	*0*	*0*	
Cadmium	*0*	*0*	
Chromium 6	*0*	*0*	
Cyanide	*0*	*0*	
Phospates	*0*	*0*	
Lead	*0*	*0*	
Nickel	*0*	*0*	
Metal Cutting Fluids	*8300 litres*	*6700 litres*	

Outputs :

TO AIR

Volatile Organic Compound (VOC)* Emissions **Aug. 95 - Jul. 96**	**Litres /year Purchased (A)**	**Litres /year Disposed of (B)**	**VOCs emitted / yr (A-B)**	**Processes used in:**
CFCs (list types)	*0*	*0*	*0*	
Non-CFCs (list types) • *Trichloroethylene*	*3,500*	*2,450*	*1,050*	*Degreasing prior to plating.*

* include adhesives, thinners, cleaning solvents etc.

TO DRAIN

Effluent **Aug. 95 - Jul. 96**	**Cu m /year Disposed of**	**Main Contaminants**
Effluent - Treated	*300*	*Suspended solids, detergent*
Effluent - Untreated	*0*	

TO WASTE DISPOSAL

Waste Disposal **Aug. 95 - Jul. 96**	**Total Disposal Costs £**	**Cu m /year Disposed of**	**Litres /year Disposed of**	**Main Constituents**
Total Special Wastes	*£ 950*		*335*	*Isocyanate, containers & rags*
Cutting Oils - neat	*neutral*		*1200*	*Mineral Oil*
Cutting Oils -soluble	*£ 1,200*		*5500*	*Soluble Oil, Wash water etc.*
Other Liquid Waste				
General Waste	*£ 2,500*	*500*		*Cardboard, office waste etc.*

Incidents: The number of environmental accidents and incidents:

CATEGORY A: ENVIRONMENTAL INCIDENTS THAT HAVE LED TO PROSECUTION

Description	No. of Occurrences	Outcome (e.g. fine)
None		

CATEGORY B: ENVIRONMENTAL INCIDENTS THAT HAVE INVOLVED INTERVENTION OF REGULATORY AUTHORITIES, BUT NO PROSECUTION

Description	No. of Occurrences	Action Carried Out
Exceeded effluent pH consent	*3*	*Letters received from Water Co.* *Maintenance procedure checked*

CATEGORY C: (OPTIONAL - IF DATA AVAILABLE) ACCIDENTAL SPILLAGES AND OTHER UNPLANNED RELEASES OF SUBSTANCES (NOT A COMPLIANCE ISSUE)

Description	No. of Occurrences	Action Carried Out
50 gallon drum of oil damaged by forklift in external loading bay.	*1*	*Spill cleaned up - oil prevented from entering drain.*

Health & Safety Performance

1-8-95 to 31-7-96	Total Days lost (N)	Total Actual Employee Hours Worked (EH)	Expected Hours Worked by 100 Full Time Employees (C)	RATE = $\frac{N \times C}{EH}$
OH Performance : Work related illness	*42*	*240,000*	*182,400*	*31.92*
Safety Performance : Work related injuries	*27*	*240,000*	*182,400*	*20.52*

To put this information in context:

Site Specific Information	No. / £	Comments
Number of Full Time Employees	*224*	
Turnover	*£ 26m*	
Total Added-Value	*£ 12m*	*Trading profit + depreciation + payroll costs*

* please define (e.g. Trading profit + depreciation + payroll costs)

Your Comments on this exercise:

Please answer the following questions:	Yes	No	Comments
Was this information already available within the business ?	✓		*But, not normally reported to management*
Has collecting / compiling this information helped to focus the management team on the issues ?	✓		*Except, we have some more detailed data for our priority issues.*
Are the management team all aware of this information ?		✓	*Not currently, but intending to report to management team regularly on these measures.*
Please list any other HS&E data that you collect that could be easily included ?			
Do you have any other comments ?			

Site contact (in the event of clarification)

Name	Title	Phone
Arthur Brown	*HS&E Co-ordinator*	*7 212 3456*

Appendix P

HS&E Measures of Performance - Workshop

Presentation handouts

HS&E Measures of Performance - Workshop

Group HS&E Measures of Performance
~ Results of Pilot Study ~

- **Introduction** - Why measure ?
- **Background** - How did we get this far ?
- **Pilot Study Results**
- **Lessons Learnt** - What does it all mean ?
- **Going Forward** - The Future......

HS&E MOPs   Lucas VARITY

Introduction....

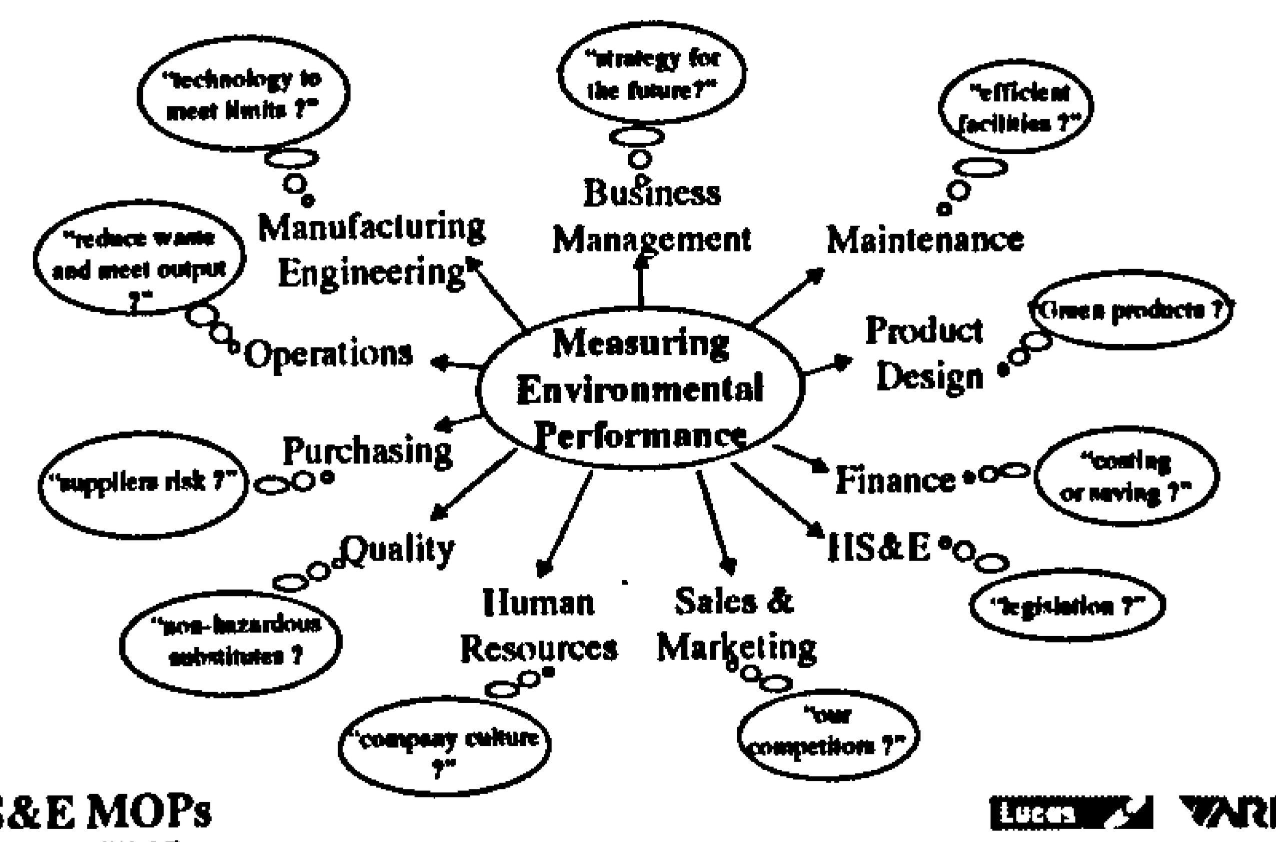
Why Measure HS&E Performance ?

- To Monitor Improvement
- Expectations of Managers
- To make the business case
- To demonstrate that resources are being applied to best effect
- To help set priorities

HS&E MOPs   Lucas VARITY

Introduction....

Involve All Functions



HS&E MOPs   Lucas VARITY

Background....

HS&E Measures in Lucas

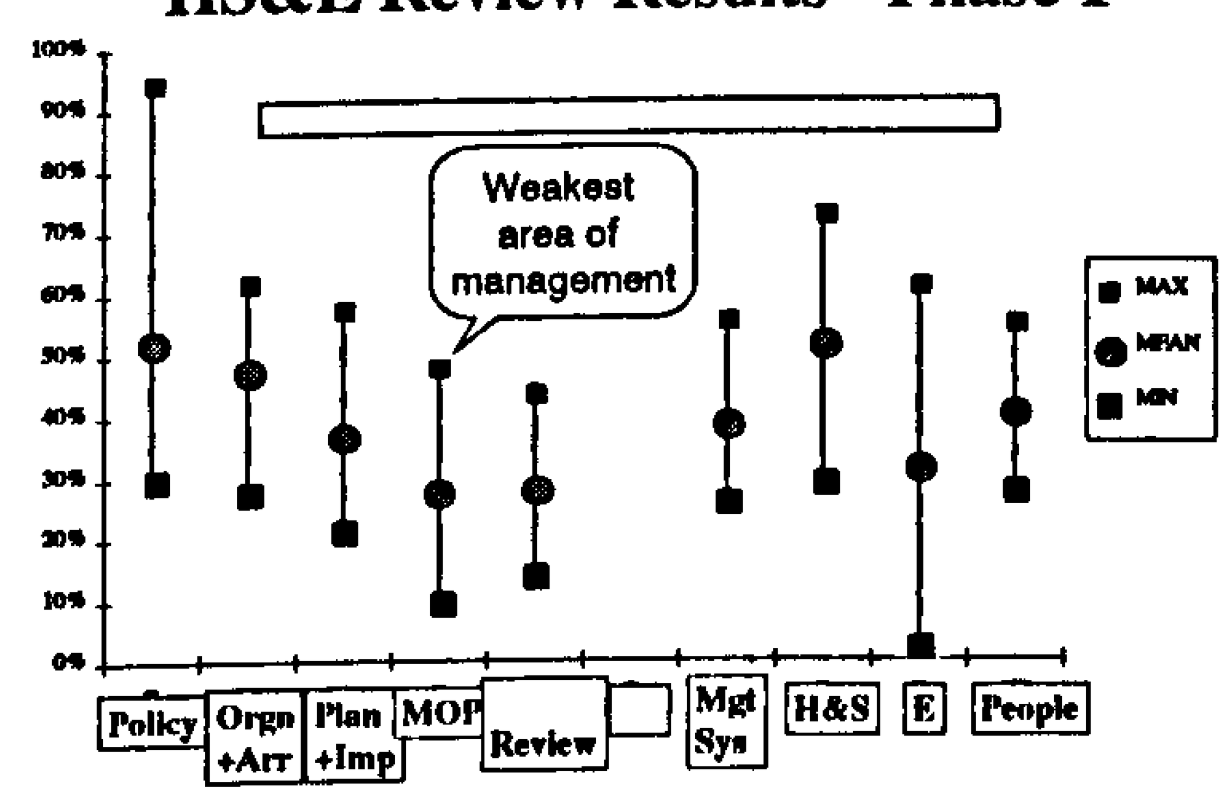
<u>Prior to Group HS&E</u>
- Insurance - premium & claims
- Accident statistics

<u>After Group HS&E</u>
- Insurance - premium & claims
- Accident statistics
- Occ. Disease statistics
- Audit results:
  - Management Systems
  - Health
  - Safety
  - Environment

HS&E MOPs   Lucas VARITY

Background....

HS&E Review Results - Phase 1



HS&E MOPs   Lucas VARITY

Background....

Known Costs of HS&E

- Health and Safety 1992
  - UK insurance costs = £ 2 million
  - Hidden costs = £13 million
- Environmental Resources 1990
  - Energy, water, effluent = £11 million
    - (based on 13 European sites)

<u>**Total**</u>   <u>**= £ 26 million**</u>

HS&E MOPs   Lucas VARITY

11 March 1997

HS&E Measures of Performance - Workshop

Background....

HS&E Data Systems

- No formal HS&E reporting systems except accident rates
- Feedback to Group ad-hoc or one-off studies
- Good practice implemented, but no benefits measured
- No information for setting Group targets
- No Group data to answer external queries

MOP System needed

Background....

HS&E MOPs - Pilot Study

- Test feasibility and usefulness of HS&E Measures of Performance at six Pilot Sites -
  - Holford
  - York Road
  - Ladywood
  - Sudbury
  - Newcastle
  - Koblenz
- Data for 1995/96
  - All results returned

Results....

Analysis of Results

- **Programmes, Objectives & Targets**
  - All businesses have programmes
  - Varying levels of detail
  - Varying subjects
  - Difficult to compare and analyse
  - ⇨ Use Standards in Future (SAS score & programmes against standards)

Results....

Commitment to Competence

- Training in HS&E
  - Variable subjects and amounts
  - Number of courses = 1 to 17, average 6
  - Hours per FTE = 0.43 to 5.44, average 1.89
  - Training Intensity = 7% to 249%, average 73%
  - More indirects than directs trained

(see analysis page 1)

Commitment to Competence

Short comings

- Quality of courses ?
- Systems in place to allow use of knowledge and skills gained through training ?

Results....

Consumption of Resources

- Gas, Heating Oil, Electricity and Water
- Costs given (not all recorded quantity)
- Total Cost of Resources = + £4 million
- Average Cost per FTE = £650
  - of which, Electricity = £ 540
- 1% of Turnover
- 1.6% of Added Value

(see analysis pages 1 & 2)

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HS&E Measures of Performance - Workshop

Consumption of Resources

Short comings

- No consistent quantities
  - not able to calculate CO_2 (external benchmark)
  - not able to compare environmental impact of different fuels
  - not able to compare consumption across businesses (prices vary regionally)

HS&E MOPs

Results....

Hazardous Substances

- No sites use Asbestos, Cadmium, Cyanide or Nickel
- 1 uses Chromium (in Zinc Plating) - 310 kg
- 2 use Phosphates - 7,680 kg
- 3 use Lead in Solder - 2,530 kg (Could be more)
- 4 use Metal Cutting Fluids - 288,898 litres

(see analysis page 3)

HS&E MOPs

Hazardous Substances

Short comings

- Lead in solder given - % unknown
- Destination of hazardous waste not requested (i.e. recycled, treated or disposed of)
- No differentiation between metal cutting fluids (neat v. soluble)

HS&E MOPs

Results....

Emissions to Air - Volatile Organic Compounds

- 2 sites still using CFCs
  - 8,509 litres purchased, 5,034 kg emitted
- All sites using other VOCs
  - 200,016 litres purchased, 105,520 kg emitted
- Average 17 kg/FTE emitted (max.. 169)
- At £3 per litre, losses = £331,662 (conservative)

(see analysis page 3)

HS&E MOPs

Emissions to Air - Volatile Organic Compounds

Short comings

- Costs not requested (losses estimated).
- Volatile % of substance not requested.
- Environmental impact not calculated because GWP and ODP of individual substances unknown.

HS&E MOPs

Results....

Emissions to Drain

- 4/6 release Trade Effluent
- Total Water consumed = 349,314 Cu.m
- Total Trade Effluent = 198,323 Cu.m (56% of water consumed)
- Average 30 Cu.m per FTE
- Excludes domestic effluent (24 Cu.m/FTE)

(see analysis page 4)

HS&E MOPs

11 March 1997

HS&E Measures of Performance - Workshop

Emissions to Drain
Short comings

- Effluent charges not known
- Cost of in-house treatment not known (consumption of chemicals, sampling, record keeping, labour, maintenance etc.)

Results....

Emissions to Land (Waste)

- Special Waste = £87,319 (29% of total)
- Liquid Waste (inc.Cutting Oils) = £122,282 (41% of total)
- General Waste = £91,201 (30% of total)

TOTAL WASTE DISPOSAL COST = £300,802

– i.e. £46.30/FTE

(see analysis page 4)

Emissions to Land (Waste)
Short comings

- Costs known, quantities not well recorded
- Poor differentiation between liquid wastes
- More detail on quantities and material types needed for new legislation (e.g. packaging regulations)

Results....

Total Environmental Costs

- Resources = £4,126,058
- Waste = £ 300,802
- VOCs = £ 331,662

⇨ Minimum Env. costs = £ 4,758,552

⇨ or £750 per FTE

- 1.25% of Turnover
- 1.88% of Added Value

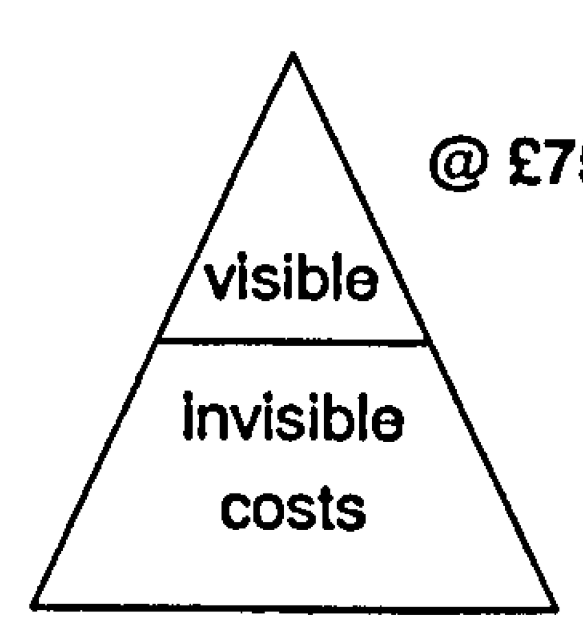
(see analysis page 4)

Total Environmental Costs
Short comings

- Loss of Material - unknown
- Loss of Added Value - unknown
- Authorisations, etc. - unknown
- Cost of clean-ups and near misses unknown
- Cost of associated labour unknown

Results....

Group Projections
(assume 50,000 employees)



@ £750 x 50,000 employees

= £ 37.5 million.

= £ ???? million.

11 March 1997

HS&E Measures of Performance - Workshop

Results....

Safety and Health Lost Time

- 2 sites unable to supply data.
- 1 site used data based on 4 months figures
- 1 site combined Health & Safety data
- Health (occ.disease) rates from 0 to 5.87
- Safety (injury) rates from 0 to 23.50

➡ Lost time from injuries 5 x greater than occupational diseases

HS&E MOPs

LucasVarity

Results....

Safety and Health Lost Time

Short comings

- Data not easily available
- Occupational injuries and diseases account for <9% of absenteeism
- 40% of non-occupational absenteeism categorised as Psychosocial (stress!).

HS&E MOPs

LucasVarity

Results....

The cost of absence

- Cost of absenteeism estimated at £1.47/FTE per day (employment costs only - Sudbury figures)
- = £73,500 for LucasVarity per day
- @ 200 working days per year

  = **£14.7 million**

HS&E MOPs

LucasVarity

Results....

COMMENTS on Pilot Study

- useful exercise, raised awareness
- data generally available, but not in right format
- Other MOPs suggested could include:
  - Material recycled
  - Risk Analysis & COSHH

HS&E MOPs

LucasVarity

Lessons Learnt....

Uses for Performance Measures

★Target sites for training and improvement projects
★Understand cost of losses
★Use data to set best practice targets
★Compare site performance over time
★Develop indicators to indicate efficiency
★Collect data for internal & external reporting

HS&E MOPs

LucasVarity

Lessons Learnt....

Summary of Lessons Learnt

- Management Systems
  - self assessment score & programmes against standards
- Commitment to Competence
  - Quality of courses & Use of learnt skills
- Environmental
  - Record quantities & Costs substantial
- Health & Safety
  - Hidden costs
- General - Data collection systems needed !

HS&E MOPs

LucasVarity

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HS&E Measures of Performance - Workshop

Going forward....

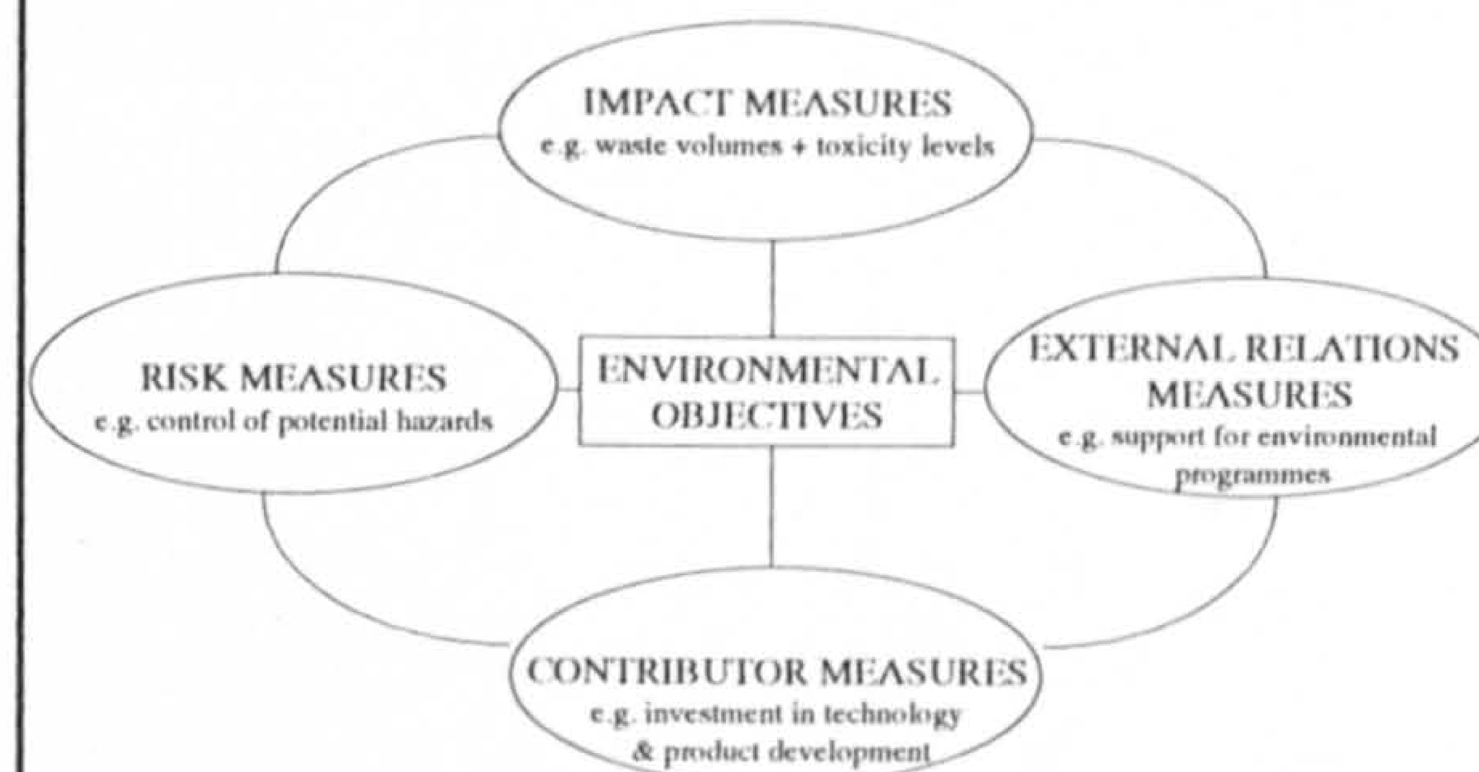
ISO14000 / EMAS

- Need to measure performance and have sufficient environmental knowledge, in order to:
  - assess significance,
  - set targets and objectives,
  - drive continuous improvement

HS&E MOPs

Going forward....

A Balanced Range of Measures



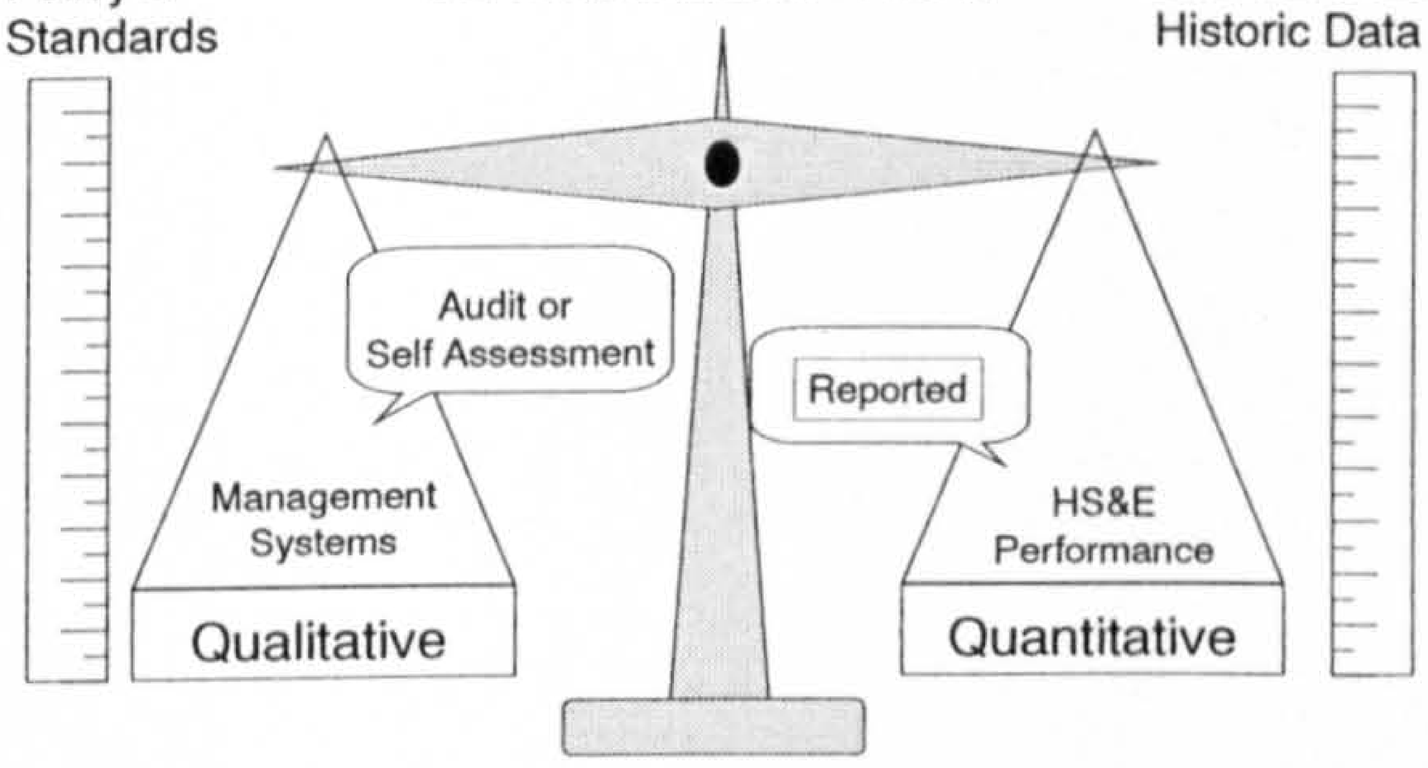
HS&E MOPs

Going forward....

A Balanced View

Measure against Policy & Standards

Measure against External Data Historic Data



HS&E MOPs

Going forward....

Different Data .... Different Views

PROGRESS

MANAGEMENT & CONTROL

	Absolute	Relative
Qualitative	Milestones achieved	Audit of Mgt Systems against Standards
Quantitative	Total figures e.g. total waste, total energy	Normalised e.g. waste/FTE, energy/product

IMPACT

EFFICIENCY

HS&E MOPs

Conclusions...

Management of HS&E improves EVA

Increase Profit

- eliminate wasted materials and resources
- control HS&E costs
- improve throughput with ergonomics
- continuously improve
- reduce absenteeism
- avoid fines & clean-ups

Use Less Capital

- eliminate polluting processes & abatement equipment
- reduce inventories of hazardous substances
- preventative maintenance to prolong asset life & improve energy efficiency
- reuse and recycle
- eliminate/replace inefficient processes

HS&E MOPs

Conclusions...

Conclusions

- Measuring HS&E Performance:
  - is part of good management
  - is essential for targeting areas for improvement
  - is important for raising awareness
  - is a broad and complex subject
  - should be integrated into all functions

HS&E MOPs

11 March 1997

HS&E Measures of Performance - Workshop

Conclusions...

Without systems and procedures in place to recognise and manage HS&E concerns, then improvement in HS&E performance is impossible

11 March 1997

Appendix Q

Book Review
- Extracts from "Corporate Environmental Strategy", Piasecki

BOOK REVIEW - Extracts from:

Corporate Environmental Strategy
Bruce W. Piasecki (1996)
John Wiley & Sons

Chapter8

page 117

"If we are to achieve results never before accomplished, we must expect methods never before attempted" - Sir Francis Bacon

page 123 Figure 17 Current Ways to Measure Environmental Excellence

Source: President's Commission Report, 1993 Appendix C, p.94 assembled by Kirsten Weaver for AHC Group.

Demonstration Project	**Metrics Used**	**Results**
AT&T	SARA 313 TCA (lbs/yr)	Elimination of TCA forecast for end of 1993; estimated annual savings of $200,000
Dow Chemical	Waste in effluent (lbs/yr), fugitive emissions (lbs/yr & lbs/component)	Reduced fugitive emissions of ethylene oxide by 29%; Reduced lab waste by 67%.
Du Pont	Ammonium sulfate (lbs/yr)	Reduced by more than 60 million lbs/yr, saved $1 million/yr in manufacturing costs.
Ford	Trichloroethylene (lbs/part cleaned)	Replaced TCE with aqueous detergent.
GE	Chemicals used (lbs/yr), water consumption (gal/wk)	Reduced 1,1,1 trichloroethane by 95%, reduced water consumption by 300,000 gallons/week.
International Paper	Raw Material Usage	Reduced fiber lost to sewage by 50%
Merck	SARA 313 releases and off-site transfers for disposal (lbs/yr)	Reduced by 1.5 million lbs in 1992 and estimate to reduce by 4.8 million lbs in 1993 (using 1990 baseline)
Procter & Gamble (OH)	Product in wastewater stream (lbs/yr)	Reduced wastewater effluent discharges by 30% in second half 1992.
Procter & Gamble (OH)	Total waste management (raw materials lost, production losses, treatment costs, etc.)	Elimination of chlorine, reduction in sulfur dioxide, ammonia, chloroform releases; solid waste minimisation efforts are saving $25 million/yr.

Chapter 9: Epilogue: Measuring Environmental Excellence

page 123 Figure 18 Measures of Environmental Excellence

Source: LAW Companies Environmental Policy Center, Westinghouse Productivity and Quality Center.

<table>
<tr><td>Environmental Stewardship</td><td colspan="10">Common Effort</td></tr>
<tr><td>Stakeholder orientation</td><td colspan="5">Transfer of technology</td><td colspan="5">Advice to Customers</td></tr>
<tr><td>Human Resource excellence</td><td colspan="3">Employee education</td><td colspan="4">Prior education</td><td colspan="3">Emergency Preparedness</td></tr>
<tr><td>Product / process leadership</td><td colspan="2">Products & Services</td><td colspan="2">Facilities & Operations</td><td colspan="2">Research</td><td colspan="2">Precautionary Approach</td><td colspan="2">Suppliers</td></tr>
<tr><td>Management Leadership</td><td colspan="2">Corporate priority</td><td colspan="2">Integrated Management</td><td colspan="2">Process of Improvement</td><td colspan="2">Compliance & Reporting</td><td colspan="2">Openess to concerns</td></tr>
</table>

page 130 Figure 19 The Pressures of Strategic Plausibility

Source: B. Piasecki for the AHC Group (1995).

What's Possible

- Public and governmental expectations
- Pending court cases
- Pending regulations

What's Probable

- Benchmarking your strategy against internal institutional constraints of staff, title functions
- Benchmarking your strategy against product mix and pricing of competitors
- Benchmarking your public image against a dynamically changing world.

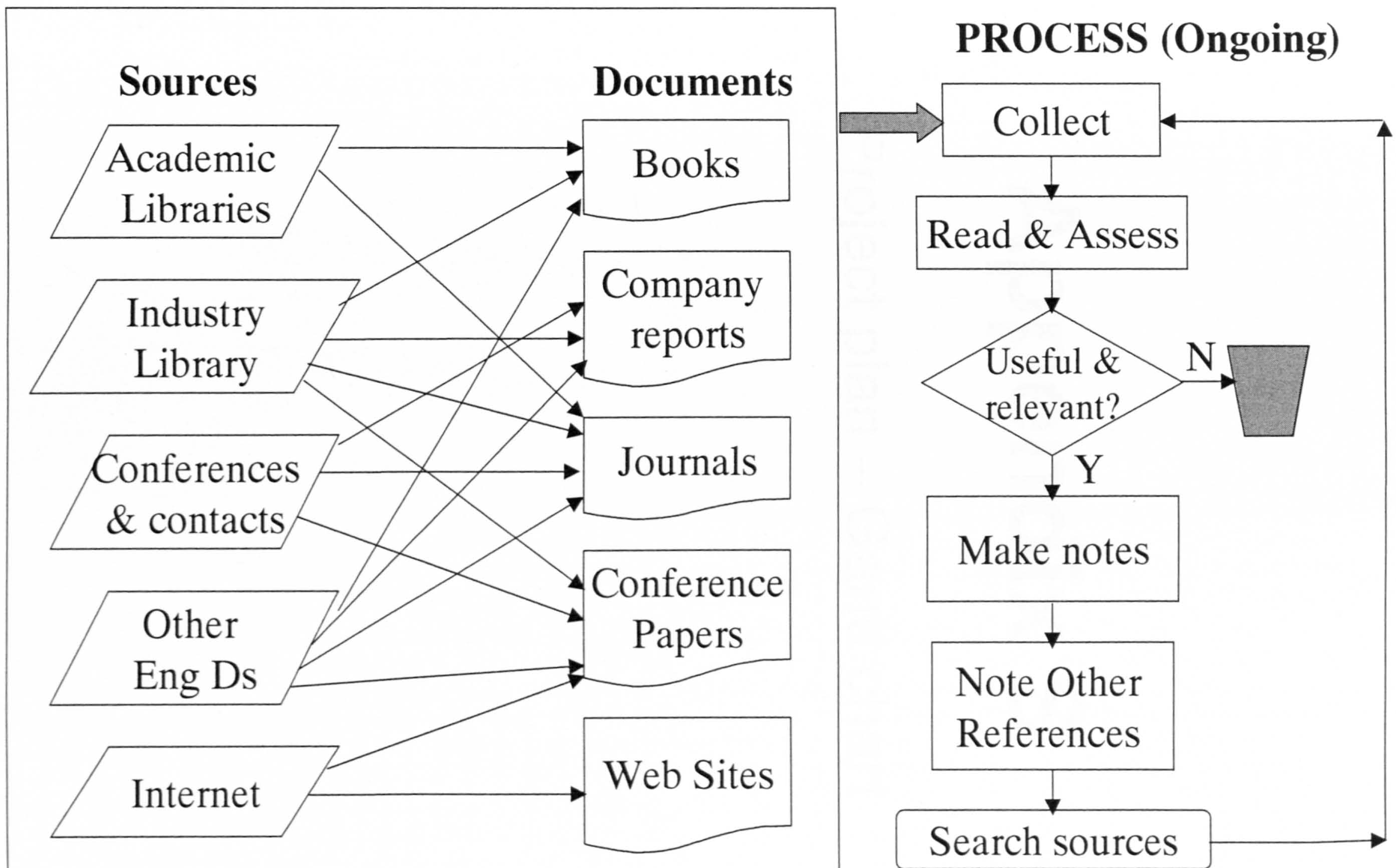
What's Profitable

- Blending successfully performance numbers and insights ,
- Blending the art and science of strategy
- Using the public and law to support your strategy

Appendix R

Literature survey strategy diagram

Literature Survey Strategy



Appendix S

Project plan – Gantt chart

NICOLETTE LAWSON

Eng D Plan: Years 3 & 4

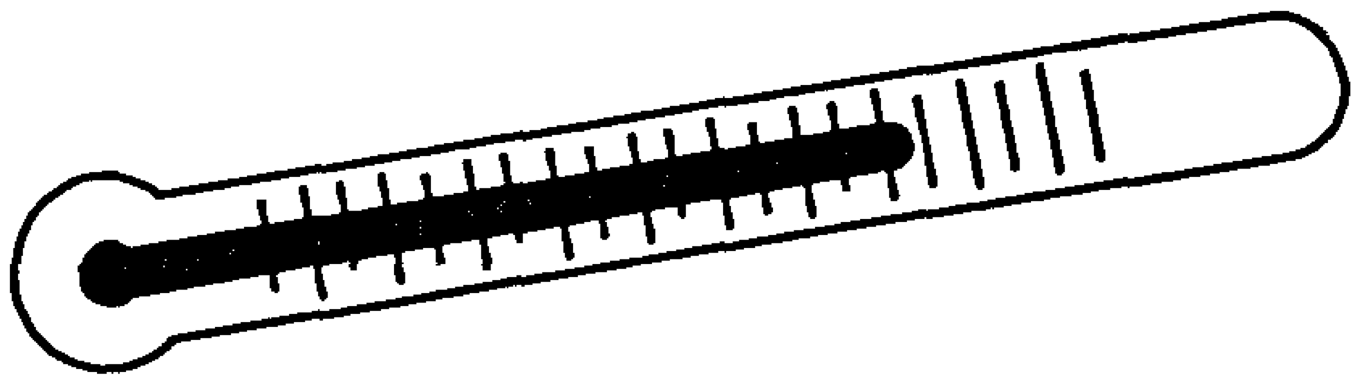
Project: **Measurement of Environmental Performance**	Sheet 1 of 1	Issue No. 1 Date **1 Oct 97**	*Industrial Supervisor* Dr. Mike McKiernan
			Company LucasVarity plc, HS&E Dept.
			Academic Supervisor Dr.Chris France, Brunel Uni.

	1997			1998												1999											
Month #	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Task	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Research:																											
Ongoing Literature Survey																											
Analysis of Env. Reports																											
C.f. Sus.Dev. Measures																											
Assess LucasVarity measures																											
Understand Bal.Scorecard																											
EPI integration proposal.																											
Develop EPI methodology																											
Test EPI methodology																											
All level integration model																											
Analyse results returned																											
Prepare internal report																											
Write/submit Papers																											
Finalise Portfolio																											
Courses & Assignments:																											
Leadership Assignmt																											
Media Course 27/10/9	x																										
Risk Mgt Course 10/03/98						x																					
Progress reports etc.																											
Project Review meetings	x			x			x			x			x			x			x			x			x		
Dissertation & Viva (month 24)																											
Progress Report (month 30)							!																				
Progress Report (month 36)													!														
Progress Report (month 42)																			!								
Mock Viva (month 46)																							?				
Final Progress Report																											
Final Viva Voce (month 49/50)																										?	?
Holidays																											

Appendix T

Company report “Group HS&E Measures of Performance – Results of Pilot Study”

Group HS&E Measures of Performance



Results of Pilot Study

Presented 11th March 97

Nicolette Lawson
LucasVarity plc
Group HS&E Dept
NL\moprept1.doc

Group HS&E Measures of Performance
Results of Pilot Study

Contents

Introduction

Performance Indicators are an important part of HS&E Management. They are necessary to monitor improvement, to make the business case for HS&E policies and action, to demonstrate that resources are being applied to the best possible effect, to help set priorities for action and because Managers expect performance to be measured.

Performance in many areas of business is typically expressed as an achievement against an objective which is either absolute, relative or time related.

LucasVarity requires a balanced range of measures to demonstrate that HS&E achievements have been made. It should be noted that performance cannot be indicated by a single measure. Past experience has shown that single measures can be manipulated and "good results" achieved at the detriment of other, equally important factors.

Targets and performance indicators for LucasVarity must be realistic, functional, motivational and useful. Measurement systems must be compatible with business objectives and existing management systems. They should ensure that consistent and accurate data is collected from all businesses in the Group allowing for meaningful reporting on HS&E performance in the future.

As with other areas of business, HS&E performance will need to be measured at different levels, consistent with management responsibilities and objectives. This introduces the requirement for a hierarchy of measures (Group, division, site, department, process), each level down requiring more precise details.

A comprehensive range of HS&E data is not currently reported at Group level. Therefore, it is proposed to introduce a set of HS&E Measures of Performance which would be reported annually by the LucasVarity businesses and compiled and reviewed across the Group. However, HS&E performance measurement is a relatively young subject and it is necessary to devise measures and implement systems to meet the Company's own needs. These can be developed and improved over time as data collection systems become more robust and sophisticated.

Background

In November 1991, Lucas Industries set up a corporate Health, Safety and Environment (HS&E) Department. The department built on an existing Health and Safety structure, adding expertise in Total Quality, Manufacturing and Management Systems to bring a new approach and to incorporate Environmental issues.

The application of quality management principles to HS&E management meant that companies had to redefine their corporate strategies. At Lucas, a new Policy and Audit system was developed and launched in July 1992. By March 1995, 52 audits have been completed by the team, covering all the major UK and European sites and some of the North American sites.

By mid 1993 the audit results indicated that consistent targets ("Commitments to Progress") were needed across all the businesses in order to raise the minimum level of performance. These targets included reduction of Musculo-skeletal disorders, elimination of Ozone Depleting Substances, compiling an inventory of environmental impacts, preparation of a waste map and reduction of energy and water consumption by 10%.

HS&E Performance indicators to date have been

- the audit results which benchmark the businesses against the policy/standards
- feedback from the Commitments to Progress 1994,
- "directly measurable" such as energy and water consumption
- ad hoc response from sites,

However, data received from sites has been inconsistent and effective systems are not in place to collect and collate data. The problem is what to measure and how to put systems in place to indicate HS&E performance in the manufacturing businesses. Targets and performance indicators need to be realistic, functional, motivational and useful, allowing for meaningful reporting in the future.

Traditional HS&E measures of performance have concentrated on accident statistics, which are after-the-event, reactive measures, and environmental performance was not recorded at all.

When the Group HS&E Department was set up five years ago, the Company had no idea of the costs involved in managing HS&E. One of the most visible costs was the Lucas Employer Liability insurance premium, which in 1992 was £2 million for the UK. In America, Workers Compensation was costing $4 million and Social Security in France was 8 million Francs. A study into the hidden costs of accidents for Lucas in the UK estimated that a further £13 million (6.5 times the visible cost) was being spent on:

- industrial relations
- material damage
- lost production
- quality
- morale
- lost time
- administration
- replacement
- investigation
- prevention
- transport
- first aid
- training

Another study into the cost of resources at 13 European sites in 1990 found the following:

- energy = £ 9.8 million
- water = £ 540 thousand
- effluent = £ 625 thousand
- TOTAL = nearly £ 11 million

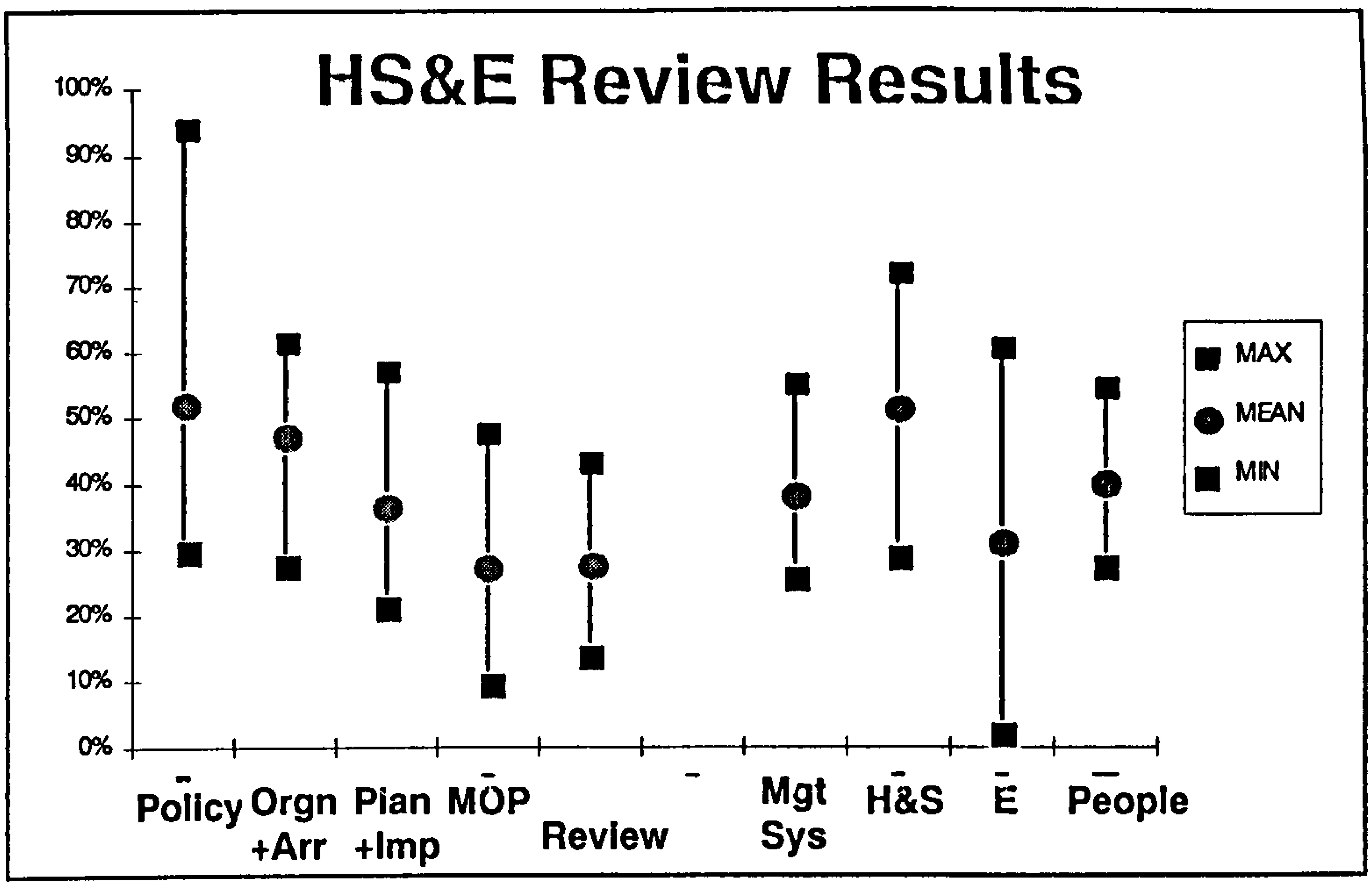
Group HS&E identified a 5-step strategy for the implementation of HS&E management:

1. Policy
2. Organisation
3. Planning and implementing
4. Measuring Performance
5. Reviewing Performance.

Having implemented the policy, put the organisation in place, planned and implemented various programmes, it was then necessary to measure and review performance across the Group.

Measuring the performance of the businesses was initially carried out by auditing the businesses against the policy and giving them a percentage score for each of the five steps. (See Appendix 1 for explanation).

Figure 1: Review Results



The results were plotted on a graph showing the average as well as the maximum and minimum site scores. The first five bars measure the five steps to HS&E management systems as described above. The second four bars show the range of performance in four areas:

1. Management Systems - the average of the first five results
2. Health and Safety
3. Environment
4. People (awareness, competence, communications etc.).

The results tended to follow a typical profile, with measures of performance consistently the weakest area. Hence the need to improve this area was identified early in the process.

Businesses themselves were also asking about measures of performance and the need for standards against which to compare themselves. Thus, the HS&E Handbook, containing standards on Management Systems, Environment, Safety and Heath issues was produced and issued to all Lucas businesses as a best practice benchmark.

The second phase of audits then measured businesses against the standards and gave them a percentage score towards best practice. This system was also adopted as a Self-Assessment System (SAS) which sites could use to benchmark themselves between audits. (See Appendix 2).

However, it was recognised that additional, quantifiable, performance indicators were required to back-up this systems approach to measuring performance and provide a balanced picture.

It is intended that systems should be in place to measure HS&E performance consistently across the businesses, all managers should be convinced of the value of measuring HS&E performance and that within three years sufficient data will have been collected to prepare an external HS&E report for the Company.

Pilot Study 1996

The proposed Measures covered the following subject areas:

1. Management Systems
2. Commitment to HS&E Competence
3. Environmental Performance
4. Health & Safety Performance

These are explained in more detail in Appendix 3.

These Measures have been trialled by six Lucas businesses, in order to assess their feasibility and usefulness and their ability to be applied to all businesses.

The six businesses which took part in the pilot study and submitted data for the year 1995/1996 were:

Business	Division	Location	Abbreviation
Ignition & Components	Electrical & Electronics	Holford	H
Car Braking Systems	Brakes	Koblenz	K
Remanufacturing	Aftermarket	Ladywood	L
Wiring Systems	Electrical & Electronics	Newcastle-under-Lyme	N
Diesel Injection	Diesel Systems	Sudbury	S
Electronics	Aerospace	York Road	Y

A reporting format was provided to the businesses, in order to obtain information in a consistent manner. (See Example Results Proforma in Appendix 4).

Comments on results received

All six businesses submitted the data and answered the following questions:

• Was this information already available within the business ?	⇒ 4 businesses (66%) said yes, most of it was readily available.
• Has collecting/compiling this information helped to focus the management team on the issues ?	⇒ 4 businesses (66%) said yes it had been of benefit.
• Are the management team all aware of this information ?	⇒ All businesses (100%) answered yes.
• Please list any other HS&E data that you collect that could be easily included.	⇒ One site suggested the number of risk assessments and COSHH assessments ⇒ One site suggested recycled material.
• Any other comments ?	⇒ "It will be easier when the manual is in place." ⇒ "Health and Safety data was difficult to compile" ⇒ "£ were OK, quantities were not so easy to obtain." ⇒ "Data was available but not collated."

The consensus then was that it was a useful exercise and that the data was generally available but not necessarily in the right format. Following the implementation of HS&E management systems it will be much easier to collect and analyse this data and use it to progress improvement plans.

Analysis of results

See Appendix 5 for results data.

Management Systems

The HS&E department has taken the view that management systems need to be in place in order to achieve good HS&E performance. To this end, the Group audit system has concentrated on measuring management systems, as defined by the Group HS&E Standards.

Based on the GEMI[1] approach, the SAS (Appendix 2) has been developed to translate progress towards qualitative objectives into quantitative measures. This format enables comparison, reduces (not eliminates) subjectivity and ensures that the exercise is repeatable. The goal is for all businesses to achieve 80% by 1998. Development of the system from Good (80%) to Best Practice (100%) will then be achieved through continuous improvement programmes.

- All businesses in the pilot study submitted their HS&E programmes, objectives and targets for the previous and future years. However, the level of detail varied greatly between businesses making this an almost impossible area to analyse.

For comparison reasons it would probably have been more appropriate to record programmes, objectives and targets against the Lucas standards, or ask the sites to submit their current SAS score.

Commitment to Competence

It is recognised that Competence of all employees is an important HS&E issue. However it is a notoriously difficult area to measure. Training is an easier subject to measure but it does not in itself ensure competence. For these reasons, this measure of performance was entitled "Commitment to competence", since we can measure the inputs towards competence but not the output, competence itself.

In this section businesses were asked to record HS&E training, stating the number of hours received by category of employee (e.g. managers, supervisors, employees, practitioners.).

- The number of courses and the subjects varied greatly. The number of courses provided ranged from 1 to 17, with an average of 6.
- The annual hours provided per Full Time Employee (FTE) varied from 0.43 to 5.44 with an average of 1.89.
- To obtain an indicator, which I shall describe as "Training Intensity" the number of people trained was compared to the number of FTEs. This ranged from 7% to 249% with an average of 73%. Where the percentage is greater than 100% this indicates that each employee has been on more than one training course.
- In addition, the number of indirects trained was compared to the number of directs. This illustrates whether training has been predominantly for managers & engineers or has been cascaded to all employees. In two out of the six sites, more indirects had been trained than directs, indicating that HS&E awareness is likely to be very limited amongst shopfloor employees. These results back up the department's assumption that more training is needed for shopfloor employees. It is anticipated that Supervisors who have been on the approved Managing Safely course will be able to deliver this training.

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[1] Global Environmental Management Initiative

The two main issues surrounding these measures are:

1. the quality of training courses. Sites deliver both internally and externally sourced courses. The quality of these courses cannot be assured unless they are in some way approved (as with the Managing Safely course).

2. Use of knowledge and skills gained through training. Training in itself is not sufficient. Unless the business has structures in place to allow trainees to put their learning into practice, the training given will have no positive effect on the performance of the company.

Environmental Performance

Environmental Performance has never previously been comprehensibly measured at a Corporate level. The range of possible information is also very wide, from Inputs (Consumption of Energy, Water and Hazardous Substances) and Outputs(Emissions of VOCs, Effluent Discharged and Wastes) to Incidents (the number of environmental accidents and incidents).

The most detailed part of the required data, this section, which was initially thought to be too difficult for businesses to answer, was completed by all businesses with few problems. The main data weaknesses seem to be in the reporting of quantities (e.g. for energy, waste etc.), but all businesses were able to report on costs. This has limited the level of analysis possible, but has still produced some useful information.

Consumption of Resources

One of the greatest environmental impacts that industry has is its consumption of resources, particularly non-renewable fossil fuels and previously regarded "free" resources such as water. Obviously there are many resources and materials used by industry that could be measured, but for the purpose of this exercise "Consumption of Resources" refers specifically to Gas, Heating Oil, Electricity and Water.

- The total cost of these resources across the six sites came to £4.2 million, an average of £650 per FTE, of which electricity accounts for £540.
- Compared to Turnover and Added Value, the Consumption of Resources accounts for approximately 1% and 1.6% respectively (one of the businesses did not supply Turnover and Added Value information).

The aim of all businesses should be to reduce their consumption of resources, by eliminating non-value added processes, inefficient and wasteful equipment, recycling process heat and water and ideally using renewable forms of energy and recycled materials. Not only will this make good environmental sense but it will undoubtedly bring process improvements and financial benefits as well.

If reliable quantities had been available from all sites, total CO_2 could have been calculated. CO_2 is the only common denominator between the various fossil fuels. This would indicate our contribution towards Global Warming and could then have been compared to national figures, or used for benchmarking across the businesses and against other industries.

Quantity is also a more useful figure than cost (although cost is obviously a business and EVA issue), since the price of resources varies from country to country and even between sites in the same country. Prices can rise or fall over time and will therefore not give a clear indication of improvement in efficiency.

At site level further analysis would be possible by normalising energy against different variables. For example, separating out electricity used for lighting and comparing it to the number of hours worked, or measuring process electricity and comparing it to production levels. Sites that employ activity based costing (ABC) could also break down energy costs to individual cost centres and enable a more accurate allocation of this "overhead".

Hazardous Substances

Our use of Hazardous Substances is of concern not only because of the health risk it poses to our employees, but also the potential to contaminate the Environment, be it land, water or air. Obviously the more hazardous substances that are in use, the higher the potential risk that environmental damage could occur. In addition, the cost of management and control measures will be increased.

In order to understand this potential risk, 8 hazardous substances (taken from the "Red" or Prescribed Substances Lists) were identified which Lucas businesses have been known to use. All these substances (except metal cutting fluids) should be eliminated if possible. Both the purchase and disposal quantities were requested.

- None of the pilot sites uses Asbestos, Cadmium, Cyanide, or Nickel.
- One site uses Chromium in Zinc plating (310 kg - this is all deposited on the product so there is no waste)
- 2 sites use Phosphates (a total of 7,680 kg used and 5,530 kg waste).
- None of the sites use Lead specifically, but 3 sites use Lead in solder (a total of 2,530 kg used and 1,937 kg waste). *N.B. Solder was not specifically asked for, so it is possible that other sites also use solder.*
- 4 of the sites use Metal Cutting Fluids (a total of 288,898 litres used and 517,558 litres waste. This includes soluble oils which are bought in neat, but disposed of when diluted with water).

Emissions to Air (VOCs)

Emissions to air could include combustion gases such as CO_2, SOx and NOx, smoke, particulates etc. For the purposes of this study we chose Volatile Organic Compounds (VOCs), since they are known to be used in various processes across the majority of Lucas businesses and Environmental Legislation dictates that they need to be controlled because of their contribution to Global Warming, Ozone Depletion and low level smog.

The most important VOCs are CFCs - the Ozone Depleting Substances which are being phased out due to the Montreal Protocol. Manufacture of CFCs has now ceased (in those countries party to the Montreal Protocol) and all Lucas businesses were asked to eliminate the use of these substances in line with the Montreal Protocol phase out timescales.

- Two of the pilot sites are still using CFCs. A total of 8,509 litres was used and 3,475 litres were disposed of or recycled. The balance (59%), represents the emissions that have evaporated to air - 5,034 kg.

Other VOCs include cleaning solvents, thinners, varnish, paint etc.

- All the sites use other VOCs. A total of 200,016 litres was used and 94,496 litres were disposed of or recycled. The balance (52%), represents the emissions that have evaporated to air - 104,441 kg.
- The total VOCs emitted to the atmosphere for these six sites was 109,475 kg. An average of 17 kg per FTE (although the maximum was 169 kg/FTE).
- At a conservative estimate of £3 per litre this represents a financial loss of over £300,000 (a negative impact on EVA!). The actual costs of the individual substances were not obtained, but it is likely that the total cost could be higher.

Some confusion arose with the collection of this data. Some substances are 100% volatile, whilst others, such as paint, resins etc. have a lower percentage of volatile compounds. In this case our simple assumption that Usage minus Disposal equals Emissions is not accurate. For these substances, the non-volatile part of the substance, is deposited on the product, or gets trapped in filters (becoming solid waste!). A recalculation of emissions, incorporating these percentages, for one site resulted in a 7% reduction in the emission figures. In future data collection the % of volatile compounds should also be recorded.

In order to assess the true environmental impact, the Global Warming Potential (GWP) and Ozone Depletion Potential (ODP) for the different substances would also be required and this could then be compared to the GWP of CO_2, attributed to the use of Fossil Fuels.

Emissions to Drain

Since every site has some domestic waste water (from toilets and washrooms) the emissions of concern environmentally are the trade effluents (from processes) which leave the site either treated or untreated. Both types of effluent will be subject to a consent to discharge either to foul sewer or surface drain.

The use of domestic water could be a very wasteful area (as found by several Lucas sites), so this water still needs to be monitored and minimisation options sought.

- Two of the sites had no trade effluent.
- Three sites emit treated trade effluent (via an on-site effluent treatment works), a total of 108,646 cubic metres.
- Two sites emit untreated trade effluent (e.g. wash water, cooling water etc.) totalling 89,677 cubic metres.
- The total water consumed by these six sites amounts to 349,314 cubic metres and over £180 k. Effluent amounts to an average 56% of water consumed (the rest is domestic).

Trade effluent can be reduced by process improvements (both equipment and procedures), recycling water and finding alternative processes that do not use water.

The shift from solvent cleaning processes to aqueous washes is likely to have had an adverse effect on water consumption (although no historic figures have been collected to substantiate this assumption).

Emissions to Land (Waste)

Every site produces waste. Businesses were asked to report on the disposal costs and quantities of waste in 5 categories.

1. Total Special wastes (special wastes must be separated for disposal, and are dealt with separately to other wastes).
2. Cutting Oils - neat
3. Cutting Oils - soluble
4. Other Liquid Waste
5. General Waste (everything else!)

All businesses were able to supply disposal costs, but not all could supply quantities. Quantity is a better environmental indicator than cost, because cost can vary greatly across sites and increase over time, or with changes in legislation (e.g. the landfill tax). Cost cannot therefore be relied on as a sole indicator of improvement. Although it might be a motivator for improvement, particularly in terms of EVA.

None of the sites were able to differential between the three liquid wastes (2,3, & 4). If systems were in place to separate these wastes, this would increase the opportunity for recycling and therefore minimise disposal costs (potentially returning a profit). Where soluble oil is disposed of, 90% of the liquid could be water. Sites producing a significant amount of soluble oil waste may find it more cost effective to install a filtration unit to separate the oil and water prior to disposal.

- The total cost of waste disposal came to over £300,000, an average of £46 per FTE. (Assuming there are 50,000 employees in LucasVarity, Group waste disposal costs could be around £2.3 million)

- Special Waste accounted for 29%, Liquid Wastes (including oil) for 41% and General Waste 30% of the total cost.

The value of the wasted materials is not known, but is likely to be at least 10 times the cost of waste disposal. If this is the case, waste costs these businesses over £3 million. (£23 million for the Group).

Summary of Environmental Costs

In the data analysis, all the known environmental costs have been added together:

+ Cost of Resources (energy & water - including effluent costs)
+ Waste (disposal costs)
+ VOCs (estimated at £3 per litre)

The total environmental costs measured come to £4.8 million (£750 per FTE), or 1.25% of Turnover. These are just the costs we were able to obtain easily.

Applied to the whole of Lucas Varity,

visible environmental costs ≅ £750 x 50,000 employees = <u>£ 37.5 million.</u>

Further "invisible" environmental costs, not taken into account include:

⇒ Materials and resources wasted

⇒ Abatement equipment and its maintenance (e.g. filters, extraction, chemicals for effluent treatment etc.)

⇒ Labour to handle waste, operate effluent treatment, change filters etc.

⇒ Applications for process authorisation

⇒ Investigation and clean-up after pollution incidents

⇒ Training

Health & Safety

The aim of the Health and Safety measures was to

⇒ develop a standardised approach (currently different definitions are used in different countries),

⇒ enable international comparisons,

⇒ benchmark against other companies (this is a standard industry approach),

⇒ track all the causes of lost time

⇒ encourage better management of lost time for occupational injury and disease

⇒ determine the costs of lost time

⇒ target opportunities for improvement

Two businesses were unable to supply any of the necessary data required for the Health and Safety Rates to be calculated, one site used data based on four months figures and another site combined the rates into one figure. From the data that was obtained:

- Health (Occupational Disease) Rates ranged from 0 to 5.87.
- Safety (Occupational Injury) Rates ranged from 0 to 23.50

These rates alone have very little meaning. In order to gauge the significance of the figures they would need to be compared to industry standards, and for each site over time.

A separate pilot study into Health and Safety Measurements in Lucas Diesel systems has been carried out and some further conclusions can be drawn from this work.

The Diesel Systems study was initiated against a background of the current collection of:

- Notifiable accident statistics
- Statutory requirements in France and Germany
- Accident recording over 1 day in USA
- and a growing number of disease cases

The approach taken was, to:

1. Collect data and measure lost time due to:
   A. Non-occupational illness/injury/disease
   B. Work related injury
   C. Occupational ill health, disease or disorder
2. Calculate injury(safety) and disease (health) performance rates

Results were received from Gillingham (12 months data) and Sudbury (7 months data).

⇒ The average Safety Rate (B) for these sites was 45.65

⇒ The average Health Rate (C) for these sites was 9.39

⇒ What was more noticeable was that these accounted for only 7% and 1.4% respectively, of the total absenteeism rate.

⇒ The remaining 91.5% of absenteeism (average 3.4%), was attributed to non-occupational sickness classified under the following categories: Psychosocial, Musculoskeletal, Respiratory, Cardiovascular, Gastrointestinal and other.

⇒ In addition, Sudbury were able to provide figures for the cost of absence. These covered 4 months and costs ranged from £16,000 to over £36,000 per month. The number of working days per month varied, so an average figure would be: £1,559 per working day. This equates to £1.47 per FTE per day. Taken at Group level (50,000 employees) this represents a loss of £ 73,500/day or £14.7 million per year (assuming 200 working days). These costs are just the employment costs and as such represent the visible tip of a much larger iceberg.

Lessons learnt / Conclusions

Management Systems

In order to compare businesses and compile information at Group level, sites should:

1. submit their current SAS score. - to show progress towards the 80% target
2. list their programmes, objectives and targets against the Lucas standards - to indicate the areas of activity at different businesses.

Commitment to Competence

Recording the hours spent on HS&E training is a justifiable (and quantifiable) measure, but ideally it should be backed up with some complementary data to indicate quality of training and implementation of training skills.

Quality of training could be shown as the number of employees attending, and passing, approved courses (e.g. the Managing Safely course).

Implementation of training skills is difficult to measure directly, but some measure could be obtained by asking attendees of approved training courses to complete a questionnaire at a defined interval following the course. The questionnaire could include questions asking whether they had been able to put their skills into practice and whether they had cascaded the information to other employees.

Environmental

Much of the environmental data is easily quantifiable and directly related to costs. Data collection systems generally need developing in order to improve the quality and integrity of the data and allow meaningful analysis to be carried out.

The new legislation on packaging waste (Producer Responsibility Regulations 1997) requires businesses to collect data, assess their obligations and monitor compliance on an ongoing basis. The future Solvent Directive, which will affect all businesses using 1 tonne of solvent, will also require the submission of data. This legislation signals the start of a trend towards measuring, presenting data and proving compliance. Therefore, for future compliance and cost-effectiveness, comprehensive and effective data collection systems will be needed.

The Advisory Committee on Business and the Environment (ACBE), has recently published (Feb.1997) an approach to Good Practice for "Environmental Reporting and the Financial Sector". The guide describes the trend for environmental information to be included in financial, annual or separate environmental reports. It is clear that ACBE wishes to encourage more widespread dissemination of environmental affairs and businesses would be well advised to prepare for the time when discretionary disclosures of environmental performance become common practice not just best practice.

Health and Safety

The greatest cause of absenteeism (over 90%) is due to non-occupational sickness. Of this, the largest cause (40%) is known to be Psychosocial (stress). This implies that more effort should be put into educating employees and tackling the causes of stress.

However, occupational diseases and injuries cannot be ignored, because we have a legal obligation to address these issues, and any increase could be costly in terms of insurance premiums and claims.

The hidden cost of absenteeism needs to be examined further. The Health and Safety Executive's Guide HS(G)96 "The Costs of Accidents at Work" looks at 5 case studies and identifies that the hidden cost of accidents was between £8 and £36 for every £1 spend on insurance. Section 5 of HS(G)96 sets out a methodology that businesses could use to collect data and determine the size of their own hidden costs.

General

HS&E costs have a great effect on profitability and hence EVA. Many businesses have found that effort put into cutting the costs associated with waste, energy, accidents and incidents is more cost-effective than alternative means of improving profits, such as increasing sales or reducing labour.

Targeting and managing these costs cannot however happen without systems for collecting data and measuring performance.

APPENDICES

Appendix 1

The five steps to HS&E management

The effectiveness and efficiency of site activities related to the management of Health, Safety and the Environment were compared against best practice, as defined by the Lucas policy. The results indicate the adequacy, effectiveness and efficiency of the site management processes as a whole (**Mgt Sys**) and a breakdown of its performance by the five key processes:

Policy:

Policy - its intent, scope and adequacy.

Managers and employees awareness and understanding of the policy.

The new Lucas Policy is used as a benchmark.

The influence of the policy in all other business activities and decisions.

Orgn+Arr:

Organisation, Arrangements and Resources - their adequacy and acceptance.

The acknowledgement by managers and employees of their responsibilities.

The level of resources allocated to the management of HS&E.

The emphasis on participation and involvement at all levels within the company.

The visibility of the leadership provided by senior management.

The effectiveness of communications.

The level of competence of all employees.

Plan+Imp:

Planning and Implementation Systems- their effectiveness, efficiency and adherence.

The overall control of the HS&E activities.

The adequacy and relevance of priorities and targets.

The adequate resourcing of activities and projects.

The extent of compliance with best practice in risk management.

The long term improvement plans.

MOPs:

Measurement of Performance Systems - their adequacy and relevance.

The emphasis on prevention and continuous improvement.

The visibility to all employees.

The integration with other business key performance parameters.

The identification of cost benefits.

Reviews:

Review and Change Control Systems- their effectiveness and integrity.

The ability to learn from experience.

The identification of where and when action is needed.

The maintenance of procedures and practices.

The effective investigation of accidents, identifying root causes and their implications.

The frequency of reviews and the company response time to changes.

The level of participation of employees in the review process.

Appendix 2

Self Assessment System (SAS)

This is reproduced in EngD Portfolio Appendix C

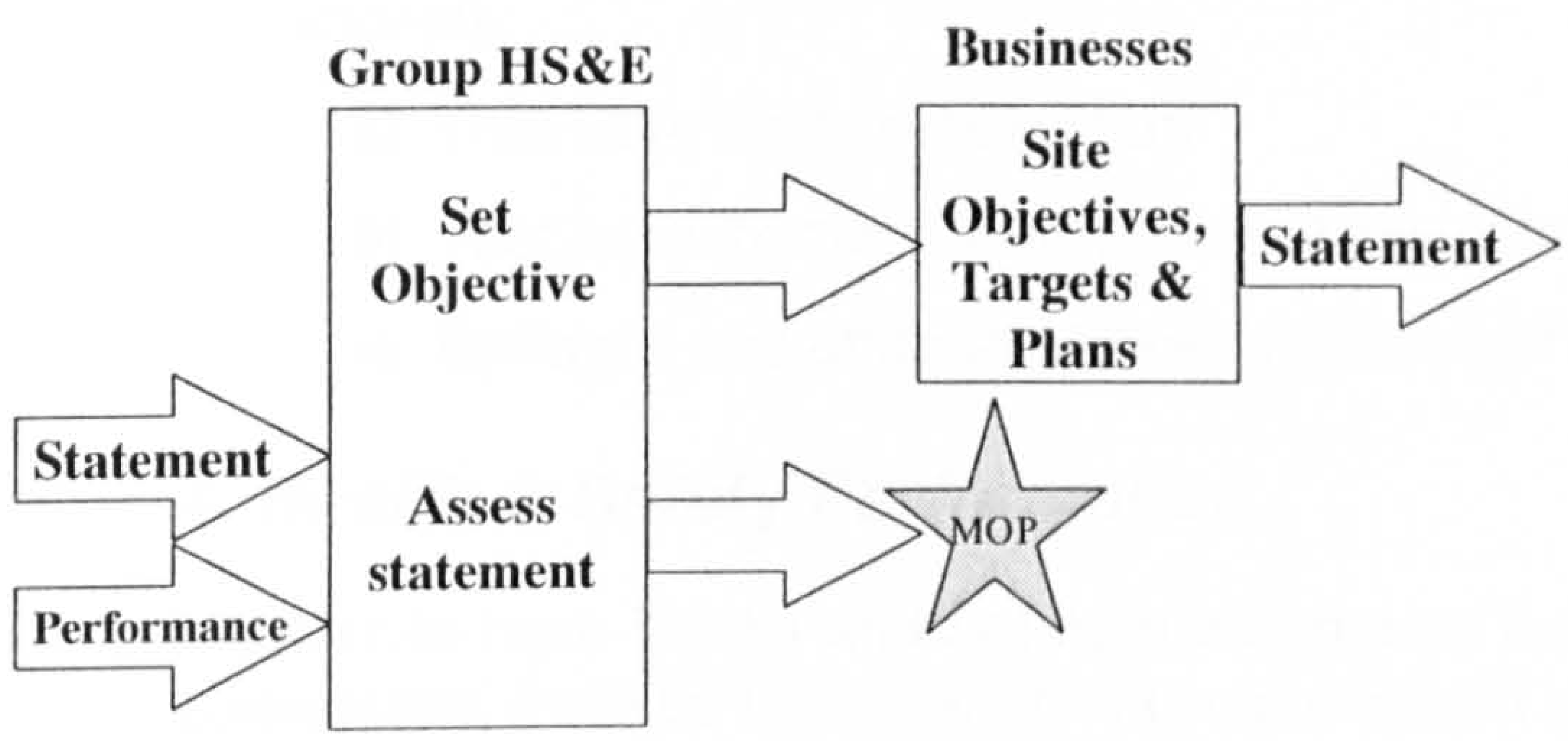
Appendix 3

Proposed HS&E Measures

1. Management Systems

The setting of objectives, targets and improvement plans is a crucial part of an HS&E Management System and a requirement of the HS&E Management standards.

Management Systems Objectives



Each business will be expected to submit an annual statement detailing its HS&E objectives, targets and plans for improvement.

The statements will be assessed by Group HS&E and Divisional HS&E Representatives against Review results and other business performance indicators.

Progress against the plans should also be reviewed by Managing Directors.

2. HS&E Competence

HS&E Competence

	No.Trained	Hours/Year
Managers		
Supervisors		
Employees		
Practitioners		

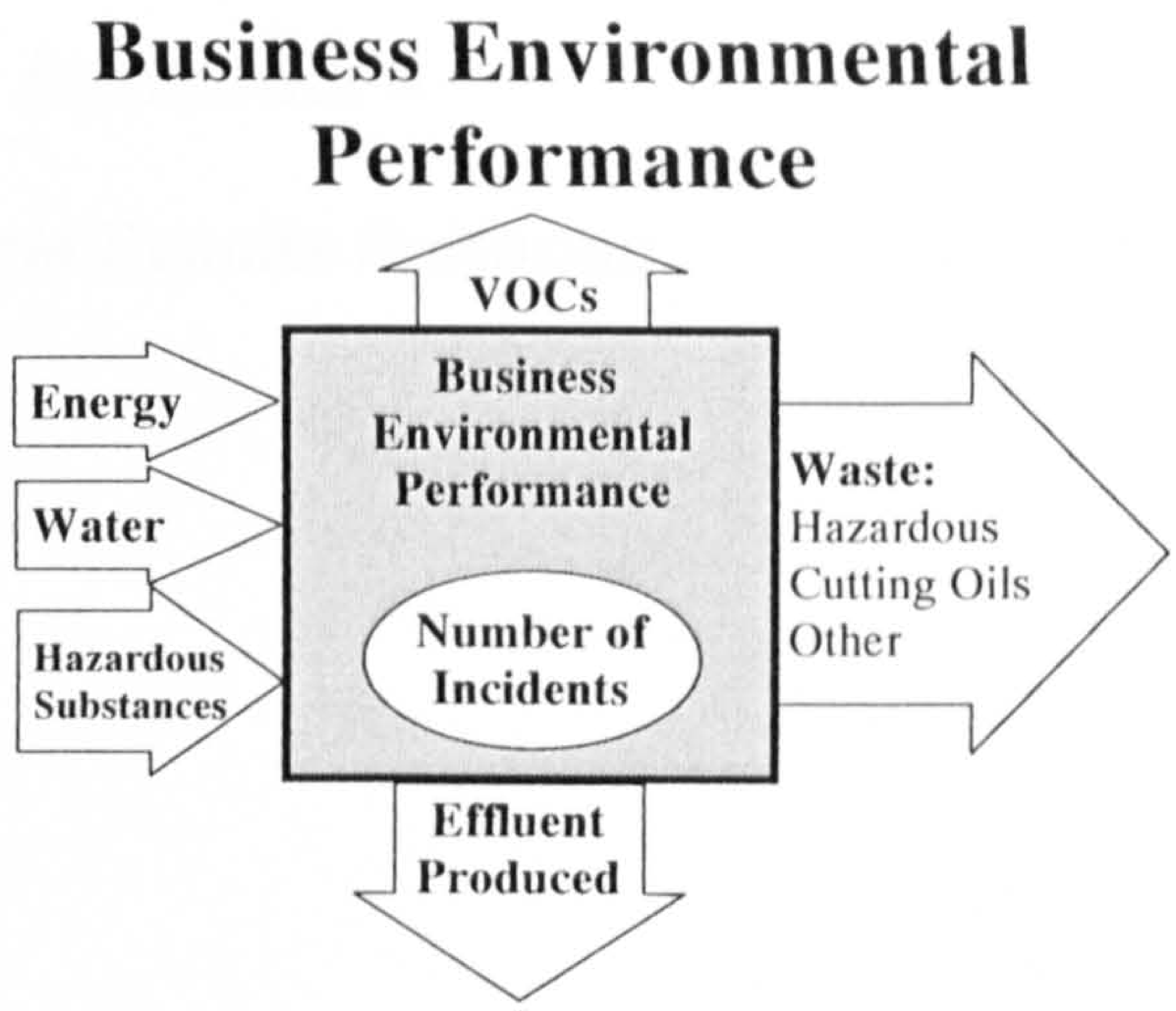
One of the aims of the HS&E programme is to increase the competence of employees at all levels. It is the responsibility of business managers to identify areas of weakness and ensure that the training needs of their employees are met. Although true competence can only be assessed on an individual basis, a good indicator of performance will be the number of people trained and the hours of training given per year, at various levels within the organisation: managers, supervisors, employees and practitioners.

3. Environmental Performance

Every activity in a business has an impact on Environmental Performance and therefore for performance to be measured with any confidence, a wide variety of data will be required.

However, the data chosen to measure environmental performance in this case should already be available:

- Inputs : Consumption of Energy, Water and Hazardous Substances
- Outputs : Emissions of VOCs, Effluent Discharged and Wastes (Hazardous, Cutting Oils, and other waste).
- Incidents: The number of environmental accidents and incidents:



a) That have led to prosecution

b) That have involved intervention of regulatory authorities, but no prosecution

c) Spillages and other unplanned releases of substances.

4. Health & Safety Performance

In order to have Health and Safety performance indicators that are comparable with other major businesses, it will be necessary to calculate Health and Safety Performance Rates.

These involves comparing the days lost through Occupational illness, disease, disorder and work related injuries with the total employee hours worked.

Context

In order to put HS&E performance into context, businesses will also be asked to supply details which will indicate any changes in business size, i.e. number of employees, turnover and added-value (product value less purchasing costs).

Logistics

Selected businesses are being asked for their comments on these proposed measures of performance.

Once accepted, the Measures will be applied to all Lucas businesses for a trial period (or a few Lucas businesses for a trial period - then applied to all businesses after the initial pilot is proven ?)

A reporting format will be provided to the businesses, in order that information is reported in a consistent manner.

Appendix 4

Example Results Proforma

This is reproduced in EngD Portfolio Appendix O

Appendix 5

Tables of results

Company confidential information

Appendix 6

Improving EVA through the management of HS&E

Both EVA and HS&E MOPs

- enables us to make proper decisions about how and where to allocate resources.
- focus efforts into business opportunities that can earn a return greater than our cost of capital.
- assist in making long-term investment decisions.
- will help us to set goals, make decisions and gauge success.
- will enable us to perform our jobs better and operate our business more efficiently.

Ways to increase EVA	through HS&E	MOPs
• **increase profit** without using more capital	⇒ eliminate wasted materials and resources	• types, quantities & cost of waste • waste : raw material ratio
	⇒ control HS&E costs	• absenteeism • cost of accidents, incidents, clean-up etc. • training
	⇒ increase throughput with better ergonomic design	• work-related upper limb disorders
	⇒ do it right first time, continuously improve	• measure in order to identify areas of improvement and to show improvement has occurred.
• use **less capital**	⇒ eliminate polluting processes and therefore abatement equipment	• emissions • cost of abatement equipment and maintenance
	⇒ reduce inventory levels of hazardous substances requiring special storage and handling	• quantities of hazardous substances. • cost of disposal (especially obsolete stock).
	⇒ prolong asset lives and energy efficiency of plant through preventative maintenance	• energy use, by department and/or process. • waste created by department / process.
	⇒ use what we already have before buying anything new (i.e. reuse/recycle equipment and materials)	• quantities of materials recycled.
	⇒ eliminate assets with inadequate returns (poor efficiency, excess waste)	• energy use, by process. • waste created by process.
• invest capital in high-returns projects	⇒ energy efficiency & low waste processes	• quantity and costs of energy, water and waste

Appendix U

Eng.D. Conference Paper 1997

"A Measure of Success?"

A MEASURE OF SUCCESS?

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ABSTRACT

Performance Indicators are an important part of HS&E Management. They are necessary to monitor improvement, to make the business case for HS&E policies and action, to demonstrate that resources are being applied to the best possible effect and to help set priorities for action. Managers expect performance to be measured and that it will encourage a positive response.

This paper describes the results of a pilot project to introduce a set of HS&E Measures of Performance, which would be reported annually by the LucasVarity businesses and compiled and reviewed across the Group.

Environmental Performance had not previously been comprehensibly measured at a corporate level. The pilot study, involving six sites, describes the method employed and the results give an indication of the impact and business cost of some of the environmental issues facing the company.

Key Words: Environmental Performance Indicators, Measures of Performance, Environmental Management Systems

1 Introduction

> *"When you can measure what you are speaking of and express it in numbers, you know that on which you are discoursing, but when you cannot measure it and express it in numbers, your knowledge is of a very meagre and unsatisfactory kind"* Lord Kelvin[1]

BiE and KPMG (1992) state that

> "Environmental Performance measurement is fundamental to the successful implementation of environmental policy and strategy because it implies a commitment to environmental improvement and provides a basis for sound external and internal reporting"[2].

Since 1992 Lucas Industries (and now LucasVarity) has stated, through its HS&E Policy (1992, 1995 & 1997)[3], that it is committed to continually improving its HS&E performance, will comply with legislation world-wide and seek to implement best practice standards.

The Company believes that robust Management Systems need to be in place in order to achieve this level of performance and has defined the minimum requirements in its HS&E Standards.[4]

It was recognised that in order to monitor compliance with these Standards, performance indicators would need to be established against which achievements could be regularly evaluated and benchmarked. McKiernan (1997) asserts that "These indicators should be valid, legitimate and functional, reinforcing the Company's commitment to safety and environmental responsibility"[5]. They should ensure that consistent and accurate data is collected from all businesses in the Group allowing for meaningful reporting on HS&E performance in the future.

A comprehensive range of HS&E data had not previously been reported at Group level, since it had not been considered to be of strategic business importance. Therefore, in order to address the growing pressures, both internally and externally, and to ensure that the Company was improving its environmental performance, it was proposed to introduce a set of HS&E Measures of Performance. These would be reported annually by the LucasVarity businesses and compiled and reviewed across the Group.

BiE and KPMG (1992) underline that Environmental performance measurement is a relatively young subject and it is necessary to devise measures and implement systems to meet the Company's own needs[2]. These can then be developed and improved over time as data collection systems become more robust and sophisticated.

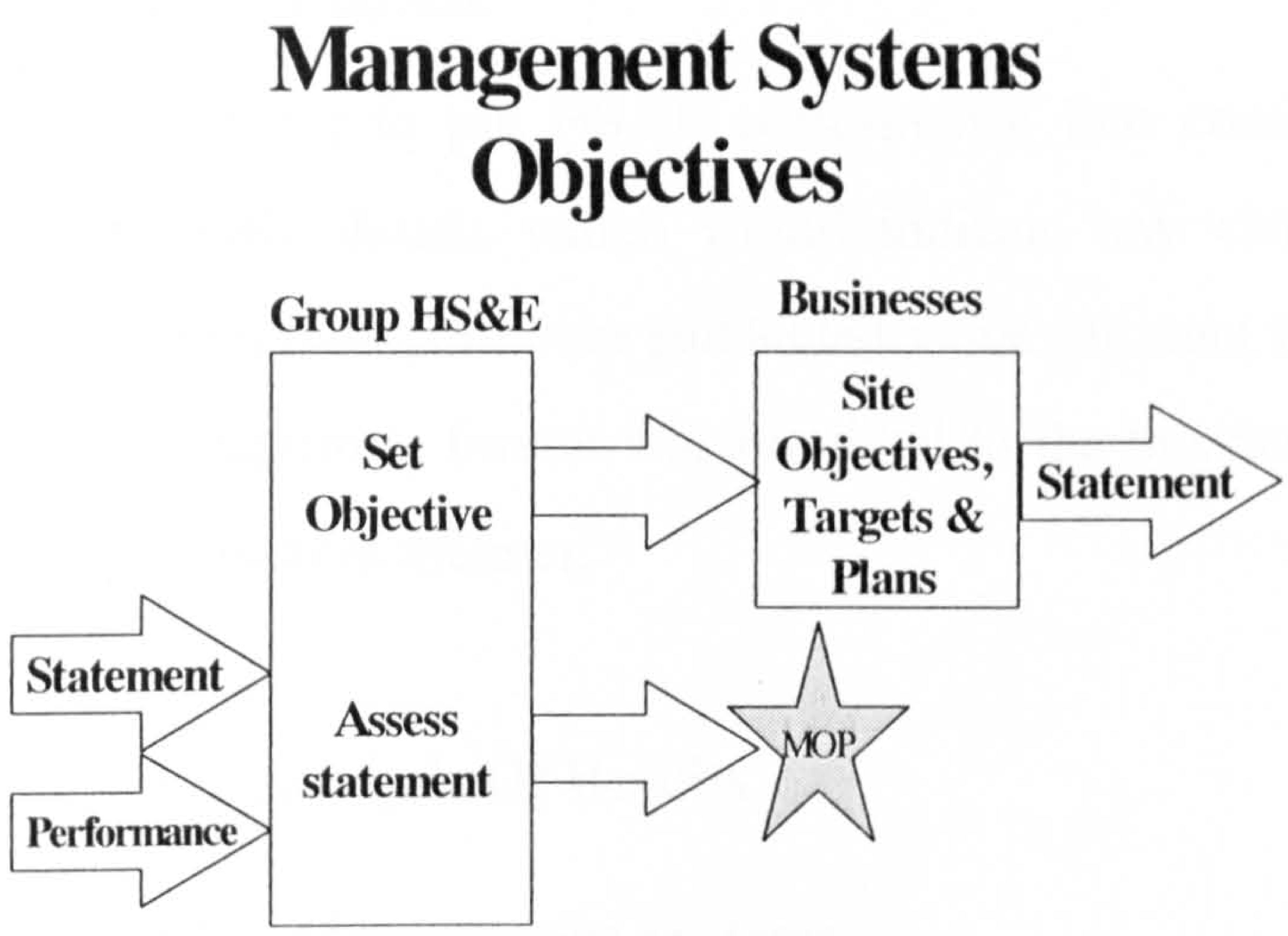
In 1995/96 a pilot study was undertaken with six Lucas businesses to test the feasibility of collecting HS&E data and to understand the cost implications of environmental performance on the business. In order to obtain a representative sample, at least one business from each Division was invited to take part. Each was asked to monitor HS&E performance for the financial year 1995/96.

2 Pilot Study 1996

The Measures proposed covered the following subject areas:

2.1 Management Systems

The setting of objectives, targets and improvement plans is a crucial part of an HS&E Management System, a requirement of the Lucas HS&E Standards and the international standard ISO14001[6].



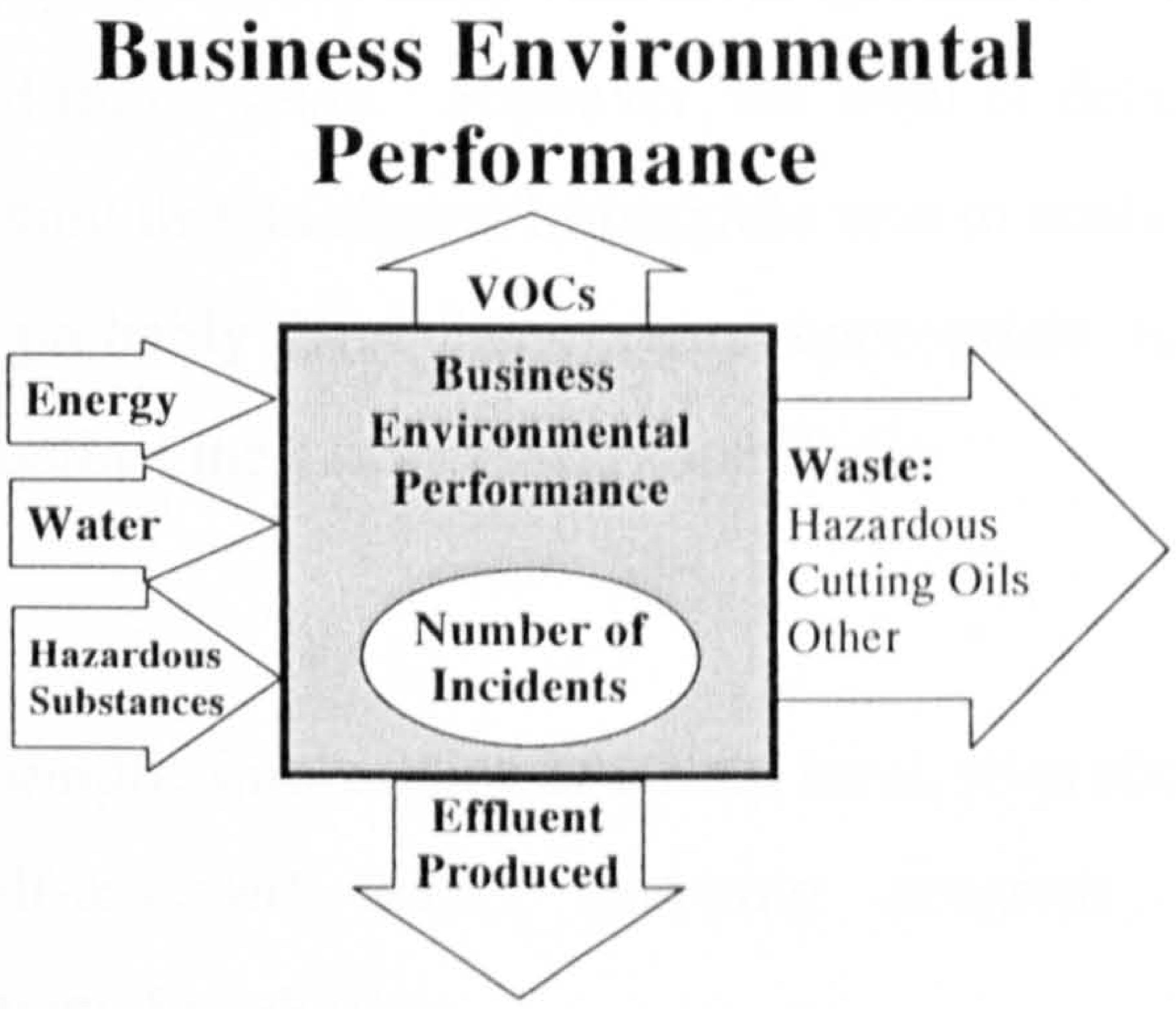
It was proposed that each business would submit an annual statement detailing its HS&E objectives, targets and plans for improvement.

Group HS&E and Divisional HS&E Representatives would then assess the statements against Review results and other business performance indicators. Divisional Managing Directors would also review progress against the plans.

2.2 Environmental Performance

Every activity in a business has an impact on Environmental Performance[3] and therefore for performance to be measured with any confidence, a wide variety of data would be required.

The data chosen to measure environmental performance in this case should already be available:



- **Inputs**: Consumption of Energy, Water and Hazardous Substances.
- **Outputs**: Emissions of VOCs, Effluent Discharged and Wastes (Hazardous, Cutting Oils, and other waste).
- **Incidents**: The number of environmental accidents and incidents:
  a) That have led to prosecution
  b) That have involved intervention of regulatory authorities, but no prosecution
  c) Spillages and other unplanned releases of substances.

2.3 Context

In order to put HS&E performance into context, the businesses were also asked to supply details which would indicate any changes in business size, i.e. number of employees, turnover and added-value (product value less purchasing costs).

A reporting format was provided to the businesses, in order to obtain information in a consistent manner.

3 Analysis Of Results

3.1 Management Systems

The HS&E department has taken the view that management systems need to be in place in order to achieve good HS&E performance [4]. To this end, the Group audit system has concentrated on measuring management systems, as defined by the Lucas HS&E Standards [4].

- All businesses in the pilot study submitted their HS&E programmes, objectives and targets for the previous and future years. However, the level of detail varied greatly between businesses making this an almost impossible area to analyse.

For comparison reasons it would probably have been more appropriate to record programmes, objectives and targets against the Lucas HS&E Standards.

3.1.1 Lessons Learnt

In order to compare businesses and compile information at Group level, sites should:

1. submit their current self-assessed score, showing progress towards implementation of the Company Standards.
2. list their programmes, objectives and targets against the Lucas HS&E Standards, to indicate the areas of activity at different businesses.

3.2 Environmental Performance

Environmental Performance had never previously been comprehensibly measured at a corporate level. The range of possible information is also very wide, from Inputs (Consumption of Energy, Water and Hazardous Substances) and Outputs (Emissions of VOCs, Effluent Discharged and Wastes) to Incidents (the number of environmental accidents and incidents).

This section was the most detailed part of the required data, which Senior Managers initially thought would be too difficult for businesses to answer. However, it was completed by all businesses with few problems. The main data weaknesses seem to be in the reporting of quantities (e.g. for energy, waste etc.), but all businesses were able to report on costs (probably because the financial accounting systems are the only integrated data systems that all the businesses have). This has limited the level of analysis possible, but has still produced some useful information, as described in the following sections.

3.2.1 Consumption of Resources

One of the greatest impacts that industry has on the environment is its use of energy resources, particularly non-renewable fossil fuels as well as previously regarded "free" resources such as water. For the purpose of this exercise "Consumption of Resources" refers specifically to Gas, Heating Oil, Electricity and Water.

- The total cost of these resources across the six sites came to £4.2 million, an average of £650 per FTE, of which electricity accounts for £540.
- Compared to Turnover and Added Value, the Consumption of Resources accounts for approximately 1% and 1.6% respectively (one of the businesses did not supply Turnover and Added Value information).

If reliable quantities had been available from all sites, total CO_2 could have been calculated. CO_2 is the only common denominator between the various fossil fuels. This would indicate the contribution towards Global Warming and could then have been compared to national figures, or used for benchmarking across the businesses and against other industries.

Quantity is also a more useful figure than cost (although cost is obviously a business driver), since the price of resources varies from country to country and even between sites in the same country. Prices can rise or fall over time and will therefore not give a clear indication of improvement in efficiency.

At site level further analysis would be possible by normalising energy against different variables. For example, separating out electricity used for lighting and comparing it to the number of hours worked, or measuring process electricity and comparing it to production levels. Sites that employ activity based costing (ABC) could also break down energy costs to individual cost centres and enable a more accurate allocation of this "overhead".

3.2.2 Hazardous Substances

The company's use of Hazardous Substances is of concern not only because of the health risk it poses to employees, but also the potential to contaminate the Environment, be it land, water or air. Obviously the more hazardous substances that are in use, the higher the potential risk that environmental damage could occur. In addition, the cost of management and control measures will be increased.

In order to understand this potential risk, 8 hazardous substances (taken from the "Red" or Prescribed Substances Lists) were identified which Lucas businesses have been known to use. All these substances should be eliminated if possible. Both the purchase and disposal quantities of these hazardous substances and metal cutting fluids (known to be used in great volume by the businesses) were requested.

- None of the pilot sites uses Asbestos, Cadmium, Cyanide, or Nickel.
- One site uses Chromium in Zinc plating (310 kg - this is all deposited on the product so there is no waste)
- 2 sites use Phosphates (a total of 7,680 kg used and 5,530 kg waste).
- None of the sites use Lead specifically, but 3 sites use Lead in solder (a total of 2,530 kg used and 1,937 kg waste).
- 4 of the sites use Metal Cutting Fluids (a total of 288,898 litres used and 517,558 litres waste. This includes soluble oils, which are bought in neat, but disposed of when diluted with water).

3.2.3 Emissions to Air (VOCs)

For the purposes of this study we chose Volatile Organic Compounds (VOCs), since audits have revealed that these are the most significant air emissions (largest quantity and greatest environmental impact) expelled by Lucas businesses. Environmental Legislation dictates that VOCs need to be controlled because of their contribution to Global Warming, Ozone Depletion and low level smog.

The most important VOCs are CFCs - the Ozone Depleting Substances that are being phased out due to the Montreal Protocol. Manufacture of CFCs has now ceased (in those countries party to the Montreal Protocol) and all Lucas businesses were asked to eliminate the use of these substances in line with the Montreal Protocol phase out timescales.

- Two of the pilot sites are still using CFCs for cleaning. A total of 8,509 litres was used and 3,475 litres were disposed of or recycled. Since these solvents were 100% volatile, the balance (59%), represents the emissions that have evaporated to air - 5,034 kg.

Other VOCs include cleaning solvents, thinners, varnish, paint etc.

- All the sites use other VOCs. A total of 200,016 litres was used and 94,496 litres were disposed of or recycled. In simplistic terms the balance (52%), should represent the emissions that have evaporated to air - 104,441 kg, but in reality some of the substances are not 100% volatile and therefore a proportion will have been deposited on the product or on filters.
- The total VOCs emitted to the atmosphere for these six sites was 109,475 kg. An average of 17 kg per FTE (although the maximum was 169 kg/FTE).
- At a conservative estimate of £3 per litre this represents a financial loss of over £300,000. The actual costs of the individual substances were not obtained, but it is likely that the total cost could be higher.

Some confusion arose with the collection of this data. Some substances are 100% volatile, whilst others, such as paint, resins etc. have a lower percentage of volatile compounds. In this case our simple assumption that Usage minus Disposal equals Emissions is not accurate. For these substances, the non-volatile part of the substance, is deposited on the product, or gets trapped in filters (becoming solid waste!). A recalculation of emissions, incorporating these percentages, for one site resulted in a 7% reduction in the emission figures. In future data collection the % of volatile compounds should also be recorded.

In order to assess the true environmental impact, the Global Warming Potential (GWP) and Ozone Depletion Potential (ODP) for the different substances would also be required and this could then be compared to the GWP of CO_2, attributed to the use of Fossil Fuels.

3.2.4 Emissions to Drain

Every site has domestic waste water (from toilets and washrooms) and many have trade effluents (from processes) which leave the site either treated or untreated. Both types of effluent will be subject to a consent to discharge either to foul sewer or surface drain. Although effluent is the main area of environmental concern (in terms of pollutants), the use of domestic water could be a very wasteful area (as found by several Lucas sites), so this water still needs to be monitored and minimisation options sought.

- Two of the sites had no trade effluent.
- Three sites emit treated trade effluent (via an on-site effluent treatment works), a total of 108,646 cubic metres.
- Two sites emit untreated trade effluent (e.g. wash water, cooling water etc.) totalling 89,677 cubic metres.
- The total water consumed by these six sites amounts to 349,314 cubic metres and over £180 k. Effluent amounts to an average 56% of water consumed (the rest is domestic).

The shift from solvent cleaning processes to aqueous washes is likely to have had an adverse effect on water consumption (although no historic figures have been collected to substantiate this assumption).

3.2.5 Emissions to Land (Waste)

Every site produces waste. Businesses were asked to report on the disposal costs and quantities of waste in 5 categories.

1. Total Special wastes (special wastes must be separated for disposal, and are dealt with separately to other wastes).
2. Cutting Oils - neat
3. Cutting Oils - soluble
4. Other Liquid Waste
5. General Waste (everything else!)

All businesses were able to supply disposal costs, but not all could supply quantities. Quantity is a better environmental indicator than cost, because cost can vary greatly across sites and increase over time, or with changes in legislation (e.g. the landfill tax).

Cost cannot therefore be relied on as a sole indicator of improvement. Although it might be a motivator for improvement.

None of the sites were able to differentiate between the three liquid wastes (2,3, & 4). If systems were in place to separate these wastes, this would increase the opportunity for recycling and therefore minimise disposal costs (potentially returning a profit). Where soluble oil is disposed of, 90% of the liquid could be water. Sites producing a significant amount of soluble oil waste may find it more cost effective to install a filtration unit to separate the oil and water prior to disposal.

- The total cost of waste disposal came to over £300,000, an average of £46 per FTE. (Assuming there are 50,000 employees in LucasVarity, Group waste disposal costs could be around £2.3 million)
- Special Waste accounted for 29%, Liquid Wastes (including oil) for 41% and General Waste 30% of the total cost.

3.2.6 Summary of Costs Relating to Environmental Issues

In order to explain to managers the strategic importance of managing environmental issues, all the known environment-related costs have been added together, i.e.:

+ Cost of Resources (energy & water - including effluent costs)
+ Waste (disposal costs)
+ VOCs (estimated at £3 per litre)

The total environment-related costs measured come to £4.8 million or 1.25% of Turnover. That is an average of £750 per Full-Time-Employee. Assuming that this average figure is representative, then applied to the whole of LucasVarity, visible environment-related costs could be

$$\cong £750 \times 50{,}000 \text{ employees} = \underline{£\,37.5 \text{ million.}}$$

These costs are typically accepted as necessary fixed overheads and not something that is normally managed and scrutinised for savings as variable production costs might be. However, measurement and regular monitoring could produce significant efficiency savings, as one Lucas business discovered when it fitted 33 extra water meters to monitor departmental consumption. By taking daily meter readings and reporting results back to the responsible department managers, water usage dropped by 50% in just a few months[7].

The point here is that, by motivating managers with potential cost savings, environmental performance improvements will also be made, through reduced consumption of resources and related emissions.

The costs discussed so far were just those that were easy to obtain. Further "invisible" environmental costs, not taken into account include:

- ⇒ Materials and resources wasted
- ⇒ Abatement equipment and its maintenance (e.g. filters, extraction, chemicals for effluent treatment etc.)
- ⇒ Labour to handle waste, operate effluent treatment, change filters etc.
- ⇒ Applications for process authorisation
- ⇒ Investigation and clean-up after pollution incidents
- ⇒ Training

The DOE, through its Environmental Technology Best Practice Programme[8] reports that hidden costs identified during waste minimisation case studies have shown that the true cost of waste can be 5-20 times the cost of disposal (the normal visible cost). Clearly it would be interesting to identify these hidden environment-related costs for LucasVarity, since 5 to 20 times the costs that we have identified (£37.5m) would be £187.5m to £750m – enough to make any manager sit up and take notice. What managers need to realise is that many of these hidden costs could be eliminated, if efficiencies were made and environmentally benign processes and substances were chosen.

4 COMMENTS ON RESULTS RECEIVED

All six businesses taking part in the pilot exercise also answered the following questions:

Was this information already available within the business?	⇒ 4 businesses (66%) said yes, most of it was readily available.
Has collecting/compiling this information helped to focus the management team on the issues?	⇒ 4 businesses (66%) said yes, it had been of benefit.
Is the management team aware of this information?	⇒ All businesses (100%) answered yes.
Please list any other HS&E data that you collect that could be easily	⇒ One site suggested the number of risk assessments and COSHH assessments

included.	⇒ One site suggested recycled material.
Any other comments?	⇒ "It will be easier when the manual is in place." ⇒ "£ were OK, quantities were not so easy to obtain." ⇒ "Data was available but not collated."

The consensus from the pilot sites was that it was a useful exercise and that the data was generally available but not necessarily in the right formats. Following the full implementation of HS&E management systems it will be much easier to collect and analyse this data and use it to progress improvement plans.

4.1 General Lessons Learnt

Much of the environmental data is easily quantifiable and directly related to costs. The "invisible" costs are also clearly significant and should be identified where possible. Data collection systems generally need developing in order to improve the quality and integrity of the data and allow meaningful analysis to be carried.

5 Conclusions

Measuring environmental performance is an essential part of Environmental Management. It is a broad and complex subject area, which senior managers have been reluctant to embrace, believing it to be too much effort for too little gain. Hopefully, the pilot exercise has proved that the costs related to environmental performance are significant enough to be treated as a strategic business issue.

Lucas has identified that environmental performance indicators are needed to raise awareness and focus employees on the main issues requiring improvement. Managers are used to the concept of Performance Indicators and Measures of Performance and expect them to be applied to any issue that is to be managed seriously, but the company culture is one of caution, where old habits die-hard. Without a high-level Environmental Champion, the only option for implementation of such a measuring system across the Company is one of gradual development and incremental change.

Environmental performance indicators are important for all business functions and should be integrated into business processes. However, the change must start now and the pressure must be continually applied in order to turn incremental change into a step change that will ensure that Business can continue to operate within the limits of the earth's resources in the future.

Alas, the efforts of business may be valiant, but the irony may be that it is all too little, too late. Hawken (1996) writes that current environmental efforts "are about as effective as bailing out the *Titanic* with teaspoons"[9]. My view is that we still have to try, but not everyone has yet realised that the boat is sinking and that a fast and radically different approach is needed. Measuring Environmental Performance should help to visualise the situation and inspire people to act.

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Appendix V

Eng.D. Conference Paper 1995

“The Need For Environmental Performance Indicators In Management Systems”

THE NEED FOR ENVIRONMENTAL PERFORMANCE INDICATORS IN MANAGEMENT SYSTEMS

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ABSTRACT

This paper describes work done in the first year of a joint project between Brunel University and Lucas Industries corporate Health, Safety and Environment (HS&E) Department in Solihull. The research engineer has worked in the HS&E Department since its inception in November 1991. The background to environmental management systems and performance measurement in Lucas is explored. All activities have an impact on the environment and the integration of environmental performance indicators into all business functions is discussed with a particular focus on Purchasing.
This project aims to devise and implement environmental targets and performance indicators across the businesses and functions, which are realistic, functional, motivational and useful, allowing for meaningful reporting in the future.

1. INTRODUCTION

1.1 Company Background

Lucas Industries is a British-owned international company with 45,000 employees and more than 80 manufacturing sites world-wide. Lucas designs and manufactures mainly automotive and aerospace components and some industrial products.

1.2 Environmental Management

In November 1991, Lucas Industries set up a corporate Health, Safety and Environment (HS&E) Department. The department built on an existing Health and Safety structure, adding expertise in Total Quality, Manufacturing and Management Systems to bring a new approach and to incorporate environmental issues.

A new Policy and Audit system was developed and launched in July 1992 to a meeting of 130 European Managers. By December 1994, 50 audits had been completed by the team, covering all the major UK and European sites and some of the North American sites.

1.2.1 Environmental Measurement

By mid 1993 the audit results indicated that consistent targets ("Commitments to Progress") were needed across all the businesses in order to raise the minimum level of performance. Environment targets for each site included elimination of Ozone Depleting Substances (ODS), compilation of an inventory of environmental impacts, preparation of a waste map and reduction of energy and water consumption by 10%.

Performance indicators to date have been

- the audit results which benchmark the businesses against the policy,
- feedback from the Commitments to Progress,
- direct measurables, such as energy and water consumption

- ad hoc responses from sites,

However, data received from sites is inconsistent and effective Group-wide systems are not in place to collect and collate data. The problem is what to measure and how to put systems in place to indicate environmental performance in the manufacturing businesses. Targets and performance indicators need to be realistic, functional, motivational and useful, allowing for meaningful reporting in the future.

Bennett and James[2] state that "the scale of the challenge is such that even the simplest measures are better than nothing at all. Immediate action of almost any kind can signal a serious intention to the world, make some reduction of environmental impacts, reduce risks of negative reactions by regulators, customers and stakeholders and provide a platform for further action. The overriding necessity is to begin the process of continuous improvement of environmental performance".

Table 1, below, shows the steps that have been taken towards environmental performance measurement, compared to the eight key stages defined by Bennett and James [2]:

Eight key stages:	Lucas steps taken:
1. Define environmental context & objectives	HS&E Department set up (1991) and Policy written (1992). Review programme devised to compare businesses to policy.
2. Identify potential measures	Policy requirements, results of HS&E Reviews (1992-1993) and review of claims and compliance issues.
3. Select measures	Environmental areas highlighted for measurement were: elimination of ODS, compilation of an inventory of environmental impacts, preparation of a waste map and reduction of energy and water consumption, for each business.
4. Set targets	By the end of 1994: eliminate ODS, compile an inventory of environmental impacts, prepare a waste map and reduce energy and water consumption by 10% (compared to 1993).
5. Implement Measures	Above "Commitments to Progress" were communicated to all businesses early in 1994.
6. Monitor and communicate results	Progress monitored quarterly by return of progress chart to Group HS&E. Results reviewed at Group HS&E Committee
7. Act on results	Guidelines written to help businesses having difficulty in meeting targets, and help provided where needed.
8. Review	STRENGTHS: Targets had the desired effect of causing businesses to focus on HS&E issues. WEAKNESSES: Timescales were not realistic for all businesses. Targets were not separated into "must do" and "should do". Progress towards target reported rather than actual figures. OPPORTUNITIES: Good response to target concept therefore foundation for future measurement. Set objectives at group level and allow businesses to set timescale targets. THREATS: Lack of follow-up could de-motivate and lose credibility. Measures must be simple, relevant and useful.

Table 1: Steps taken towards environmental performance measurement.

2. LUCAS APPROACH

Lucas has taken a Total Quality Approach to environmental management and has stated these values in the Company HS&E policy.

2.1 The Policy

The HS&E policy incorporates the following principles:

- Total Quality
- Every activity has an impact
- Integrated Approach
- Invest in the Future
- Best Practice
- Minimise Risk
- Minimise Waste
- Optimise Energy Use

2.1.1 Total Quality

Lucas has taken a Total Quality approach to manufacturing with quality being absorbed into all activities. Employees understand the concept of Total Quality and the part they play within it. Total Quality encompasses everything we do and naturally should include environmental activities. The Total Quality approach entails extensive use of Measures of Performance (MOPs). Lucas is familiar with MOPs and understands their importance in achieving improvement.

2.1.2 Every activity has an impact

Just as every activity can affect quality, every activity has an impact on the environment. This means that every person in every business function should be aware of the effect they have and what action they can take to reduce that effect.

2.1.3 Integrated Approach

Environmental activities need to be integrated into all our business processes. Consideration for the environment must be a natural part of every thing we do, not an add-on or "optional extra". Environmental issues are usually linked to other issues - business risk, finance, compliance with legislation, customer requirements - and therefore all business functions will be interested in some of these Environmental Performance Indicators.

2.1.4 Invest in the Future

In making decisions now we should be aware of what will happen in the future. Will legislation change? Will customer requirements change? We need to understand the trends and be ready for any change when it comes. Any investment must satisfy forthcoming environmental and business needs.

2.1.5 Best Practice

Lucas HS&E practices have been benchmarked against external companies perceived to be best in this field, and standards reflect current best practice. Table 2 shows the companies and International standards used as benchmarks.

Policy	Audit Process	Management standards
Alcan	Allied Signal	BS 7750
British Aerospace	Amoco	EMAS
British Gas	AT&T	ISO 1400
Pilkington	Boeing	
Rolls Royce	Digital	
Rover	Du Pont	
	Proctor & Gamble	
	Union Carbide	

Table 2: External companies and standards against which Lucas has benchmarked itself.

The performance of Lucas companies has been compared against best practice and against each other. A minimalist approach is not sufficient and will not sustain the business in the future.

2.1.6 Minimise Risk

Business needs to take steps to minimise the risk of pollution, risk of harm to employees or the community and subsequent risk to profitability and reputation.

Risk is difficult to measure but the components that contribute to risk can be identified and controlled. This implies that, among other things, we need to reduce the use of hazardous materials, prevent and protect against pollution, buy components and services from well managed suppliers, ensure employees are well trained and be aware of environmental liabilities when we acquire new businesses and property.

2.1.7 Minimise Waste and Optimise Energy Use

Waste of materials and resources is a double environmental problem - use of resources as well as production of waste and emissions. We need to buy efficient equipment, ensure that it is well maintained and examine ways of reducing waste, water and energy use.

3. BUSINESS DRIVERS

Mudie[4] explains the business case for improved environmental performance and how a balanced range of measures is needed to demonstrate that achievements have been made. He states that "environmental performance measurement is a relatively young subject and there is scope for originality and for companies to tailor measures to their own needs."

3.1 Drivers for Environmental Performance Indicators

The external drivers are now well known by businesses undertaking environmental action, they include legislation, international standards, customer requirements and shareholder concerns.

Internal drivers for implementing Environmental Performance Indicators in Lucas are very similar to those defined by Bennett and James [1] :

- to monitor improvement of business environmental performance over time and to compare Lucas businesses with each other
- expectations from Managers - if targets are set, performance will be measured
- to make the business case for environmental policies and action
- to demonstrate that resources are being applied to the best possible effect and show the advantages of managing Environmental Issues
- to help set priorities for action.

The rest of this paper will discuss why all business functions should be aware of environmental performance measures and how they can get involved.

4. ENVIRONMENTAL PERFORMANCE INDICATORS FOR ALL BUSINESS PROCESSES

As already discussed, Lucas believes that every activity has an impact on the environment and that environmental issues should be integrated into all business processes. Porter [5] talks about developing an "environmental value chain". The functions for measurement include stages of the "Product Chain" which converts resources into products and then disposes of them, and "Support Functions" which control product chains and link internal actions with external demands. Porter's product chain incorporates Design, Raw Material, Operations, Marketing and Distribution, Product Use, Product Disposal, Transport and Environmental Management. His support functions include External Relations, Human Resources Management, Science and Technology, Procurement and Premises. Management systems are then used to integrate all the Company's different environmental systems. Figure 1 shows how typical Lucas business functions fall into these categories. Raw materials, use and disposal fall outside the control areas of the company although business functions, predominantly Product Design and Purchasing, will have a marked indirect effect on these aspects.

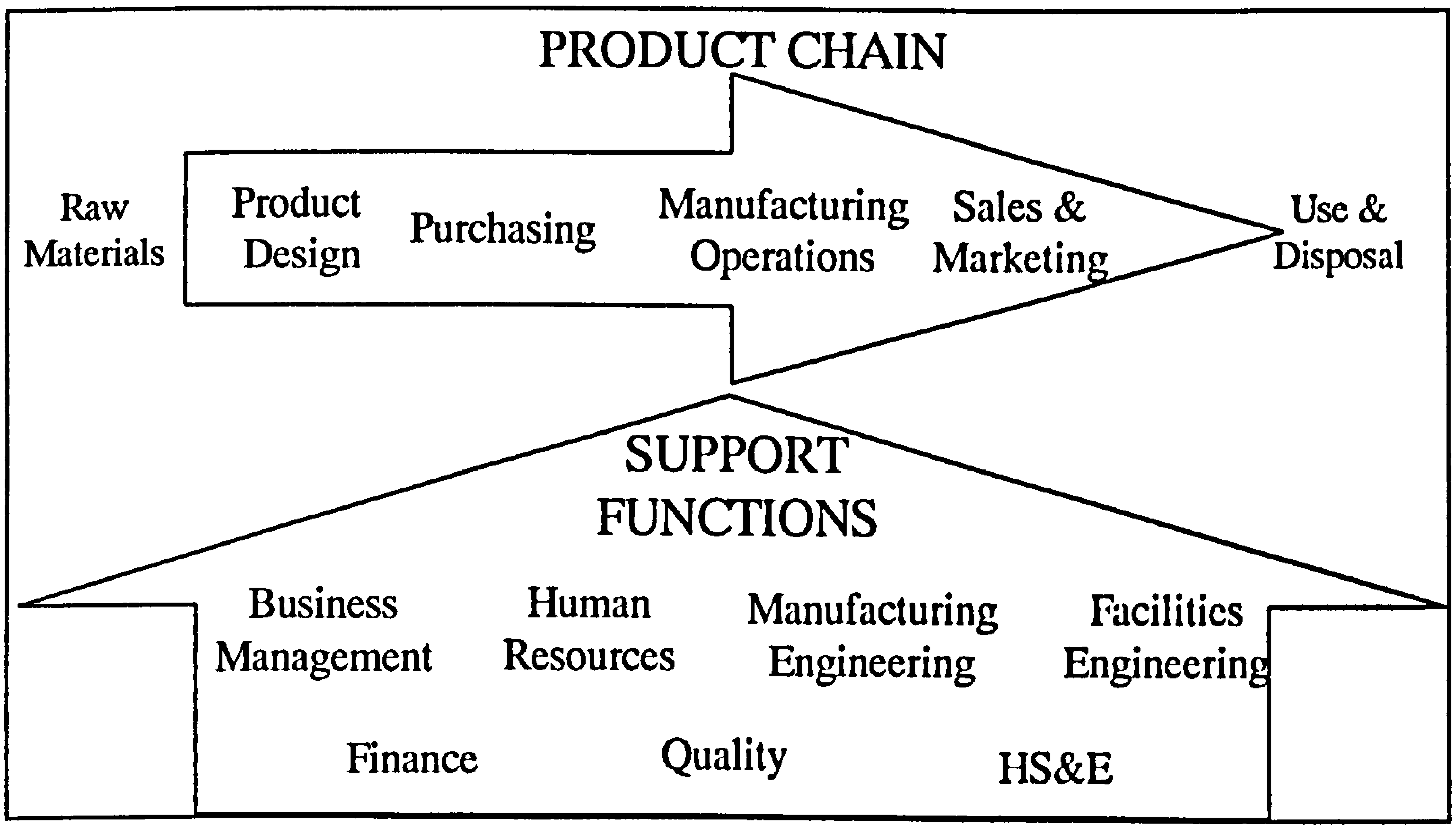

Figure 1 Business Functions in the supply chain and support functions

If all business functions are involved in the environmental value chain, how can they be motivated to implement environmental objectives? Houldin [5] explains that "developing mechanisms to make environmental management more tangible to all personnel is key. In general there is an underlying willingness by individuals to take environmental management seriously - what is needed is a framework within which they can effectively do so."

The author has considered what kind of environmental concerns may be important to different business functions (see Figure 2). Getting different people involved however requires focused tactics. The motivation and language will be different for each function. Environmental performance must be explained in terms of how it can affect their output or risks.

The environmental manager needs to understand the specific drivers which will incite different people into action. The extrinsic drivers, those pressures imposed on a function, are usually defined by business management. The intrinsic drivers however are their own values, belief and interests. At management levels, where responsibility for business performance is important, the extrinsic drivers, such as cost, will predominate. On the other hand, lower down the organisation, intrinsic drivers are more likely to motivate. For example, a labourer may not be interested in the fact that spillage is costing the company money, but he may be concerned that it could potentially contaminate local water supplies.

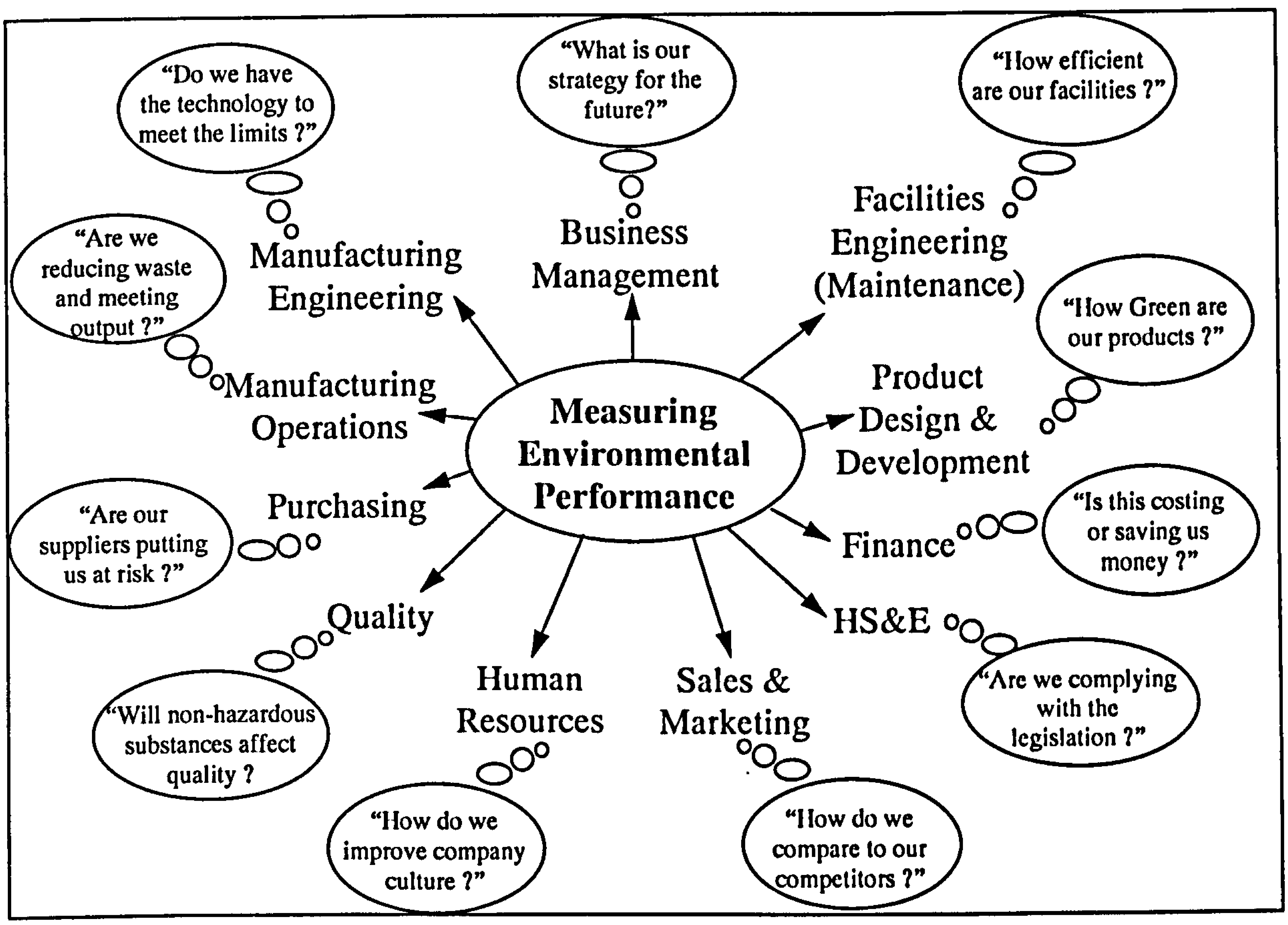

Figure 2 Why All Business Functions Need To Measure Environmental Performance

4.1 The Purchasing Function

Purchasing has been used as our starting point for the integration of environmental considerations into business functions. Purchasing is known to have a significant effect on our environmental performance. As Figure 3 illustrates, they are the gatekeepers, controlling the incoming materials and associated hazards and the quality of service that we receive from suppliers.

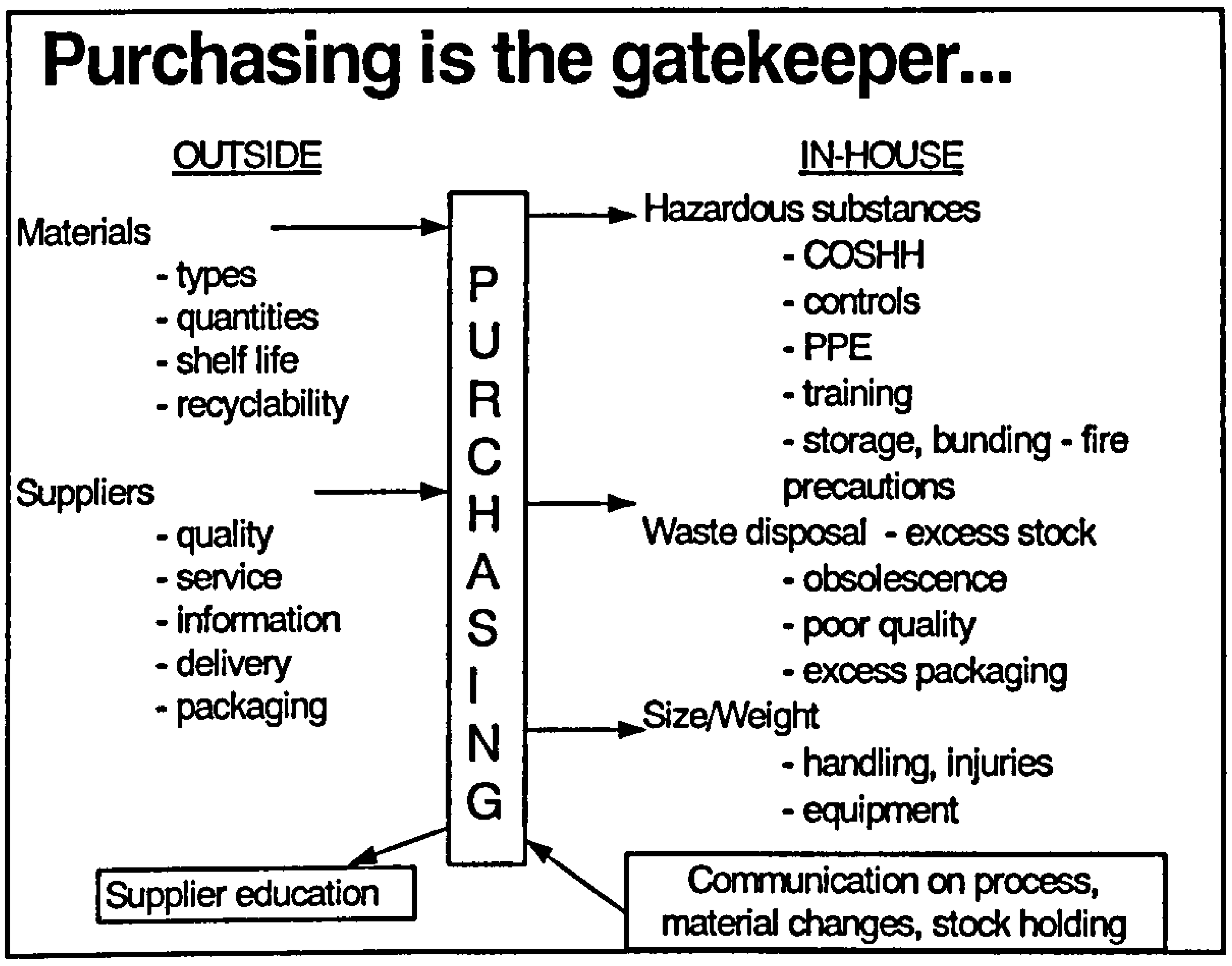

Figure 3: Purchasing is the Gatekeeper

Choice of materials, not just its hazardous nature, but also the quantities and packaging, will have an effect on the controls we need to have in place, the storage, the training and the equipment.

Suppliers services, such as their quality, information, delivery and packaging methods will have an effect on our waste and how materials are handled.

Unwittingly, the decisions made by purchasing people can have a profound effect on our business.

4.1.1 The Purchasing Drivers

Purchasing operations must meet two basic requirements Cost and Continuation of supply. Our dialogue with Purchasing people has therefore concentrated on the theme that poor environmental performance by suppliers can lead to 1) interruption of supply and consequential business disruption and 2) increase in supplier costs, which could be passed on to us.

Figure 4: How could a supplier disrupt our business?

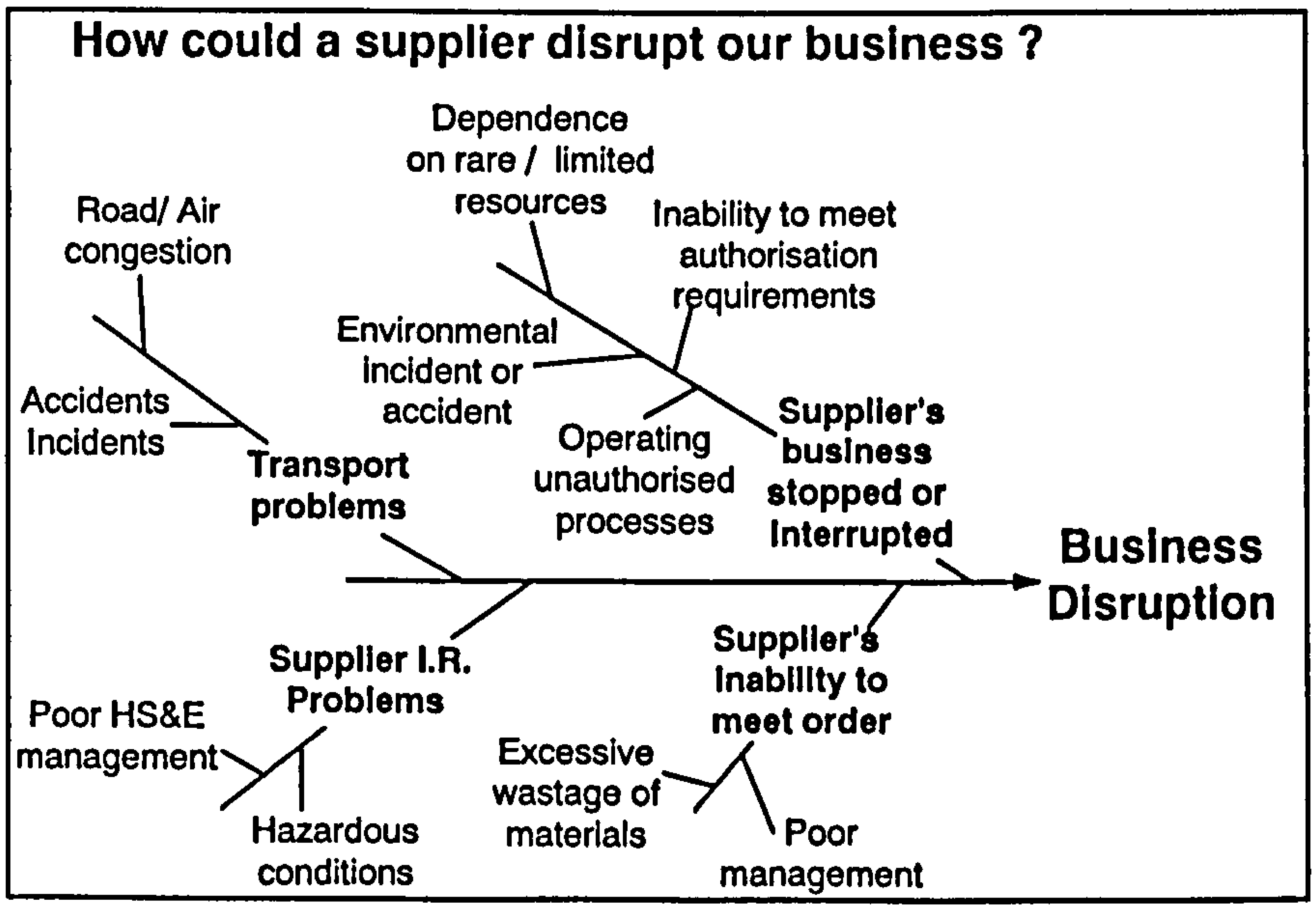

Figure 4 shows a cause and effect diagram which explains how poor environmental performance on the part of a supplier could cause business disruption.

Figure 5: Why would environmental factors increase costs?

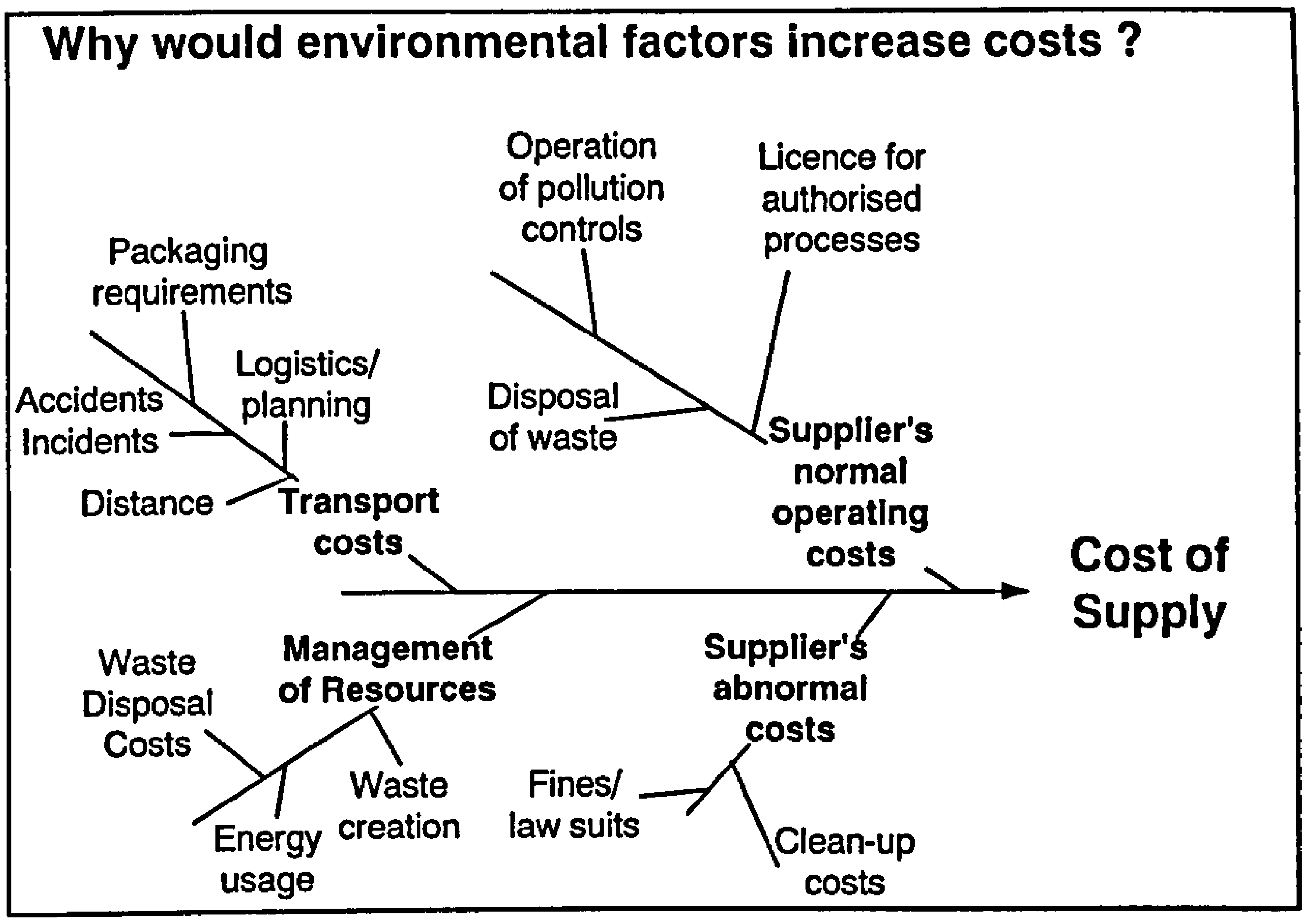

Figure 5 shows a similar cause and effect diagram resulting in increased cost of supply.

However, as well as increasing their own costs, poor supplier performance and poor purchasing decisions can also increase our own in-house costs, as shown in figure 6.

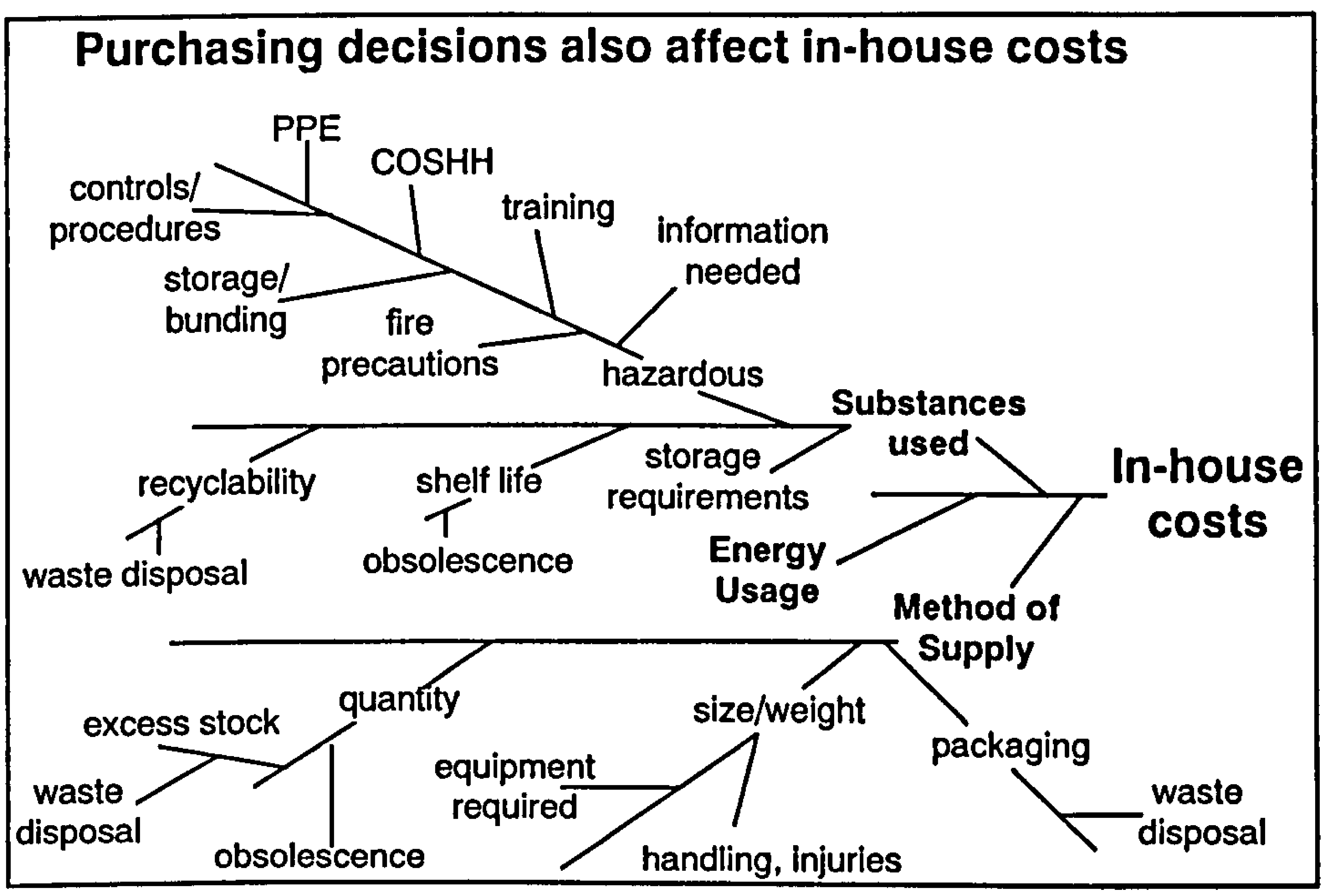

Figure 6: Purchasing decisions also affect in-house costs

Even within the purchasing function, we identify three critical groups, who have different needs and requirements: Group purchasing (strategic sourcing), Purchasing/supplies managers and supplier quality auditors.

4.1.2 Group purchasing (strategic sourcing),

At Group level, senior purchasing managers make strategic sourcing decisions that affect Group contracts. This group needs to understand HS&E issues before embarking on strategic sourcing exercises and therefore understand the consequences of any decisions made. For instance, a Group contract may reduce purchase price but increase transport distances. This will in turn have an adverse effect on response times, minimum order quantities and packaging requirements.

4.1.3 Purchasing/supplies managers

At divisional or business level, purchasing managers need to understand the environmental implications of purchasing decisions such as quantity, delivery frequency, packaging and "shelf-life" of products.

4.1.4 Supplier Quality Auditors.

Supplier quality auditors have direct contact with suppliers, visit their premises and audit their operations. These people need to be able to spot the tell-tale signs that a supplier is not managing environmental risks adequately and could therefore pose a risk to continuation of supply due to fire or a pollution incident.

4.2 What next?

This method of addressing purchasing's impact on the environment has been thought provoking and has stimulated a request from senior purchasing people for training for their supplier auditors. A simple audit protocol has been devised and training material prepared to educate supplier auditors in what visual environmental performance indicators to look for when auditing a supplier. The protocol asks auditors to look out for housekeeping (this section of the protocol is shown in Table 3), working conditions, chemicals, waste, processes, notices and information and external neighbours.

HOUSEKEEPING			
Things to look for	**Low Risk**	**Medium Risk**	**High Risk**
Gangways *(clear of boxes, trolleys, trailing leads etc.).*	No obstructions	Some obstructions	Many obstructions
Floors *(clear of boxes, trolleys, trailing leads etc.)*	No obstructions	Some obstructions	Many obstructions
Fire doors and exits clear	No obstructions	Some obstructions	Many obstructions
Work stations tidy	Very tidy	OK	Very untidy
Leakage from machines *(oil)*	No leaks	Some leaks	Many leaks
Outside the building	Very tidy	OK	Very untidy

Table 3: Extract from Supplier Auditors Environmental Protocol.

The condition of each item is described as Low, Medium or High Risk. Having ticked the appropriate response, the auditor can then use the pattern of responses as a visual indicator of the overall risk. A High Risk outcome would indicated the need for a more comprehensive audit to be carried out. Medium Risk would require improvement targets to be set and Low Risk, no further action.

In addition to this training for Supplier Auditors, a Purchasing policy and procedures need to be developed. This will be developed with Purchasing personnel so that it will be "owned" by the function.

5. CONCLUSIONS

Measurement of environmental performance is an important part of environmental Management. It is a broad and complex subject area that will have to be developed gradually.

Lucas has identified that environmental performance indicators are needed to raise awareness and focus employees on the main issues requiring improvement. Managers are used to the concept of Performance Indicators and Measures of Performance and expect them to be applied to any issue that is to be managed seriously.

Environmental performance indicators are important for all business functions and can be integrated into business processes, provided the ground work is carried out and the right approach taken to ensure ownership. The change to a fully integrated system however, is part of a long-term plan!

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1) **Bennett, M. and James, P.** (1994), "Environment Performance Measurement", Croner's Environmental Management - Special Report. Issue 7, November 1994.

2) **Bennett, M. and James, P.** (1994), "Environment-Related Performance Measurement in Business: From Emissions to Profit and Sustainability?", Ashridge Management Research Group

3) **Houldin, M** (1994), Establishing Workable Environmental Objectives", Institute of Environmental Managers Journal, Vol.2, Issue 3, Autumn 1994.

4) **Mudie, P.** (1995), "Profiting From Improved Environmental Performance", Eco-Management and Auditing, Vol.2, 71-75 (1995)

5) **Porter, M** (1985), "Competitive Advantage", New York: Free Press

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- "B&Q and the Environment" - Policy leaflet
- "Buying into the Environment", Business in the Environment publication
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Appendix W

Revised timing plan for years 3 and 4 (months 30-50).

NICOLETTE LAWSON

Eng D Plan: Years 3 & 4: from month 30

Project: **Measurement of Environmental Performance**	Sheet 1 of 1	*Industrial Supervisor*	Dr. Mike McKiernan
	Issue No. **2**	*Company*	LucasVarity plc, HS&E Dept.
	Updated **1 Apr 98**	*Academic Supervisor*	Dr.Chris France, Surrey Uni.

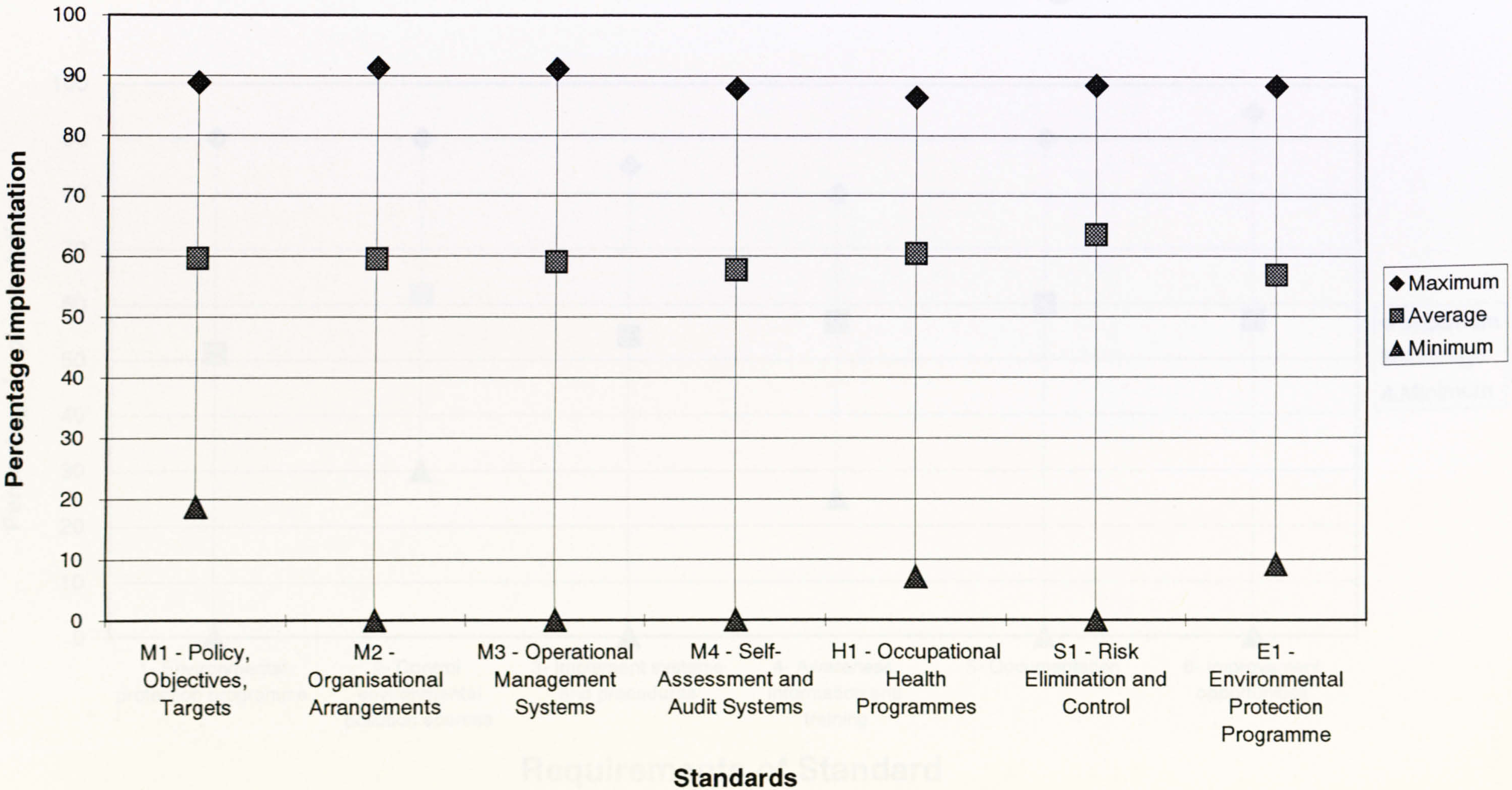
	1998									1999											
Month #	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Task	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Research:																					
Ongoing Literature Survey																					
Analysis of Env. Reports																					
Assess LucasVarity measures																					
Analyse LV results returned																					
Develop EPI methodology																					
Test EPI methodology																					
All level integration model																					
Prepare internal report																					
Write/submit Papers																					
Finalise Portfolio																					
Courses & Assignments:																					
Risk Mgt Course 10/03/98																					
Conf. Paper & Poster 14/09/98		!	!																		
MIEMgt Application																					
Progress reports etc.																					
Project Review meetings	x			x			x			x			x			x			x		
Dissertation & Viva (month 24)																					
Progress Report (month 30)	!																				
Progress Report (month 36)							!														
Progress Report (month 42)													!								
Mock Viva (month 46)																	?				
Final Progress Report																					
Final Viva Voce (month 47-50)																		?	?	?	?
Holidays																					

Appendix X

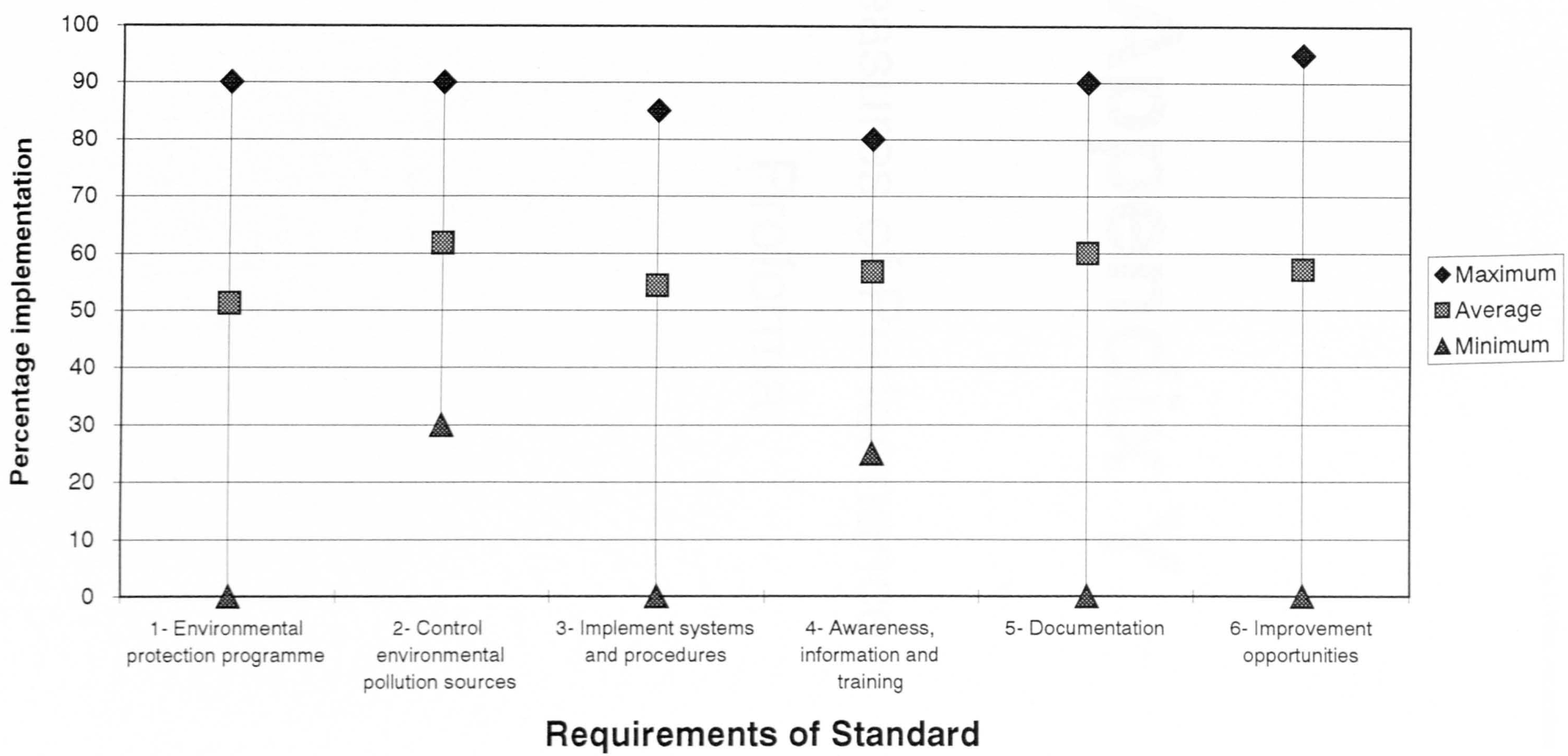
Lucas Aerospace

Self-Assessment graphs

All Standards



E1 - Environmental Protection Programmes



Appendix Y

Measures of Performance

Proforma

Lucas Aerospace HS&E
Measures of Performance
Results Proforma

To be completed for the previous Lucas month
Return to: **Terry Bridgewater.** Fax: 0121-707 8826
by 2nd Monday of the new month.

Submitted by Site:		**Date:**
Contact Name	**Title**	**Phone**

1. To put this information in to context:

Site Specific Information	**No. / £**
Number of Employees (Full Time Equivalents including long-term contractors/temporary staff)	
Annual Turnover £ (current annual budget)	

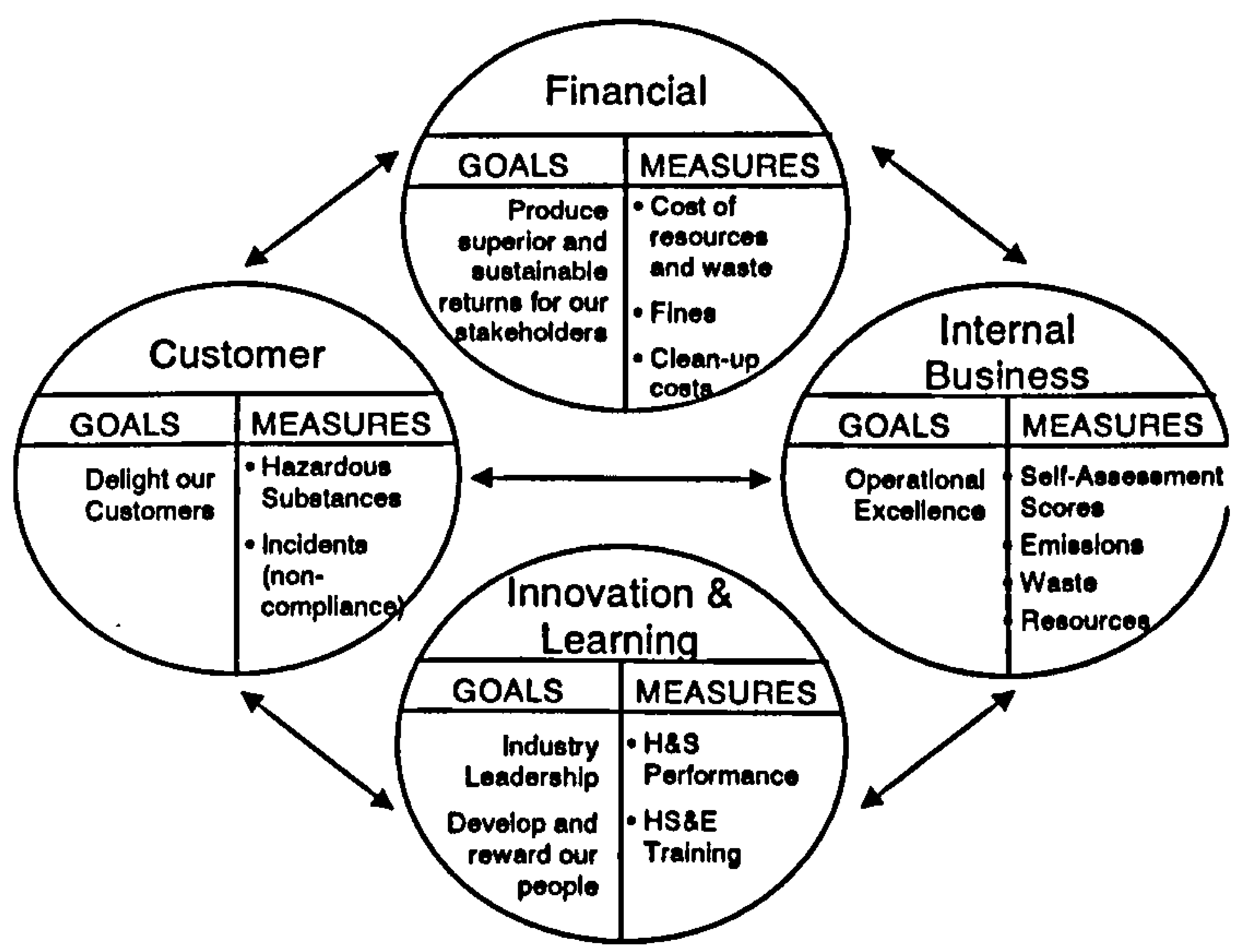
HS&E Balanced Scorecard

Vision

In all activities we are committed to safety and environmental responsibility.

Business Plan

To achieve 80% compliance with LucasVarity HS&E criteria.



2. Management Systems

Current Self-Assessment Scores:

Standard	% Score
M1: Policy, Objectives and Targets	
M2: Organisational Arrangements	
M3: Operational Management Systems	
M4: Self-Assessment & Audit Systems	
E1: Environmental Protection Programme	
S1: Risk Elimination & Control Programme	
H1: Occupational Health Programme	

3. Emissions To Air

Volatile Organic Compound (VOC)* Emissions (list types)	**Litres Purchased (A)**	**Cost per Litre £**	**% Volatile (B)**	**Litres Disposed of (C)**	**Disposal Route** (e.g. landfill, incinerator recycled etc)	**VOCs emitted (A-C) x B%**

VOC's include adhesives, thinners, cleaning solvents etc.

4. Emissions To Drain

Effluent	**Cu m Disposed of**	**Cost of disposal**	**Main Contaminants**
Effluent - Treated			
Effluent - Untreated			

5. Emissions To Land (Waste)

Waste Disposal	Total Disposal Costs £	Cu m Disposed of	Litres Disposed of	Main Constituents	Amount Recycled (kg/litres)
Total Special Wastes*					
Cutting Oils – neat*					
Cutting Oils –soluble*					
Other Liquid Waste*					
Metals*					
Paper & Cardboard*					
Other Waste*					

* Provide details separately, if available

6. Consumption of Resources

TOTAL SITE RESOURCES	£/$*	KWh[1]	Cu.m	Litres
Consumption of Gas				
Consumption of Heating Oil				
Consumption of Electricity				
Consumption of other Fossil Fuels				
Consumption of Water				

* Delete as appropriate

1. Provide quantity in KWh <u>or</u> Cu.m or litres

7. Use of Hazardous Substances

Hazardous Substances	Kg Purchased	Kg Disposed	Disposal Route
Asbestos			
Cadmium			
Chromium 6			
Cyanide			
Phosphates			
Lead (if Solder state % lead)			
Nickel			
Metal Cutting Fluids			

8. Environmental Incidents

CATEGORY A: ENVIRONMENTAL INCIDENTS THAT HAVE LED TO PROSECUTION

Description	No. of Occurrences	Outcome (e.g. fine)

CATEGORY B: ENVIRONMENTAL INCIDENTS THAT HAVE INVOLVED INTERVENTION OF REGULATORY AUTHORITIES, BUT NO PROSECUTION

Description	No. of Occurrences	Action Carried Out & Cost

CATEGORY C: ACCIDENTAL SPILLAGES AND OTHER UNPLANNED RELEASES OF SUBSTANCES (NOT A COMPLIANCE ISSUE)

Description	No. of Occurrences	Action Carried Out & Cost

9. Health & Safety Performance

** do not include day of accident*

	Number of occurrences	Total Days Lost* (if absent > 1 day)	Total Employee Days Worked
Work related illness			
Work related injuries			

10. HS&E Training

Learning Programme	Senior Managers		Managers & Supervisors		Other Employees	
(To be answered by personnel)	Total	No. trained	Total	No. trained	Total	No. trained

If you have any problems please phone **Terry Bridgewater** on **0121-707 7111 x 5354**

Notes to Accompany Lucas Aerospace HS&E MoPs Revision 2

Reasons for change

Frequency

To align the Lucas Aerospace HS&E MoPs more closely to the LucasVarity MoPs, the frequency of reporting has been reduced so that data only needs to be reported 4 times per year (not monthly, as previously requested). Actual figures should be reported in the quarter in which they occur, do not use averaged or "smoothed" figures.

Order

The items to be reported remain the same (with some minor changes), but the Proforma has been reorganised so that the items reported appear in the same order as that required by LucasVarity.

Minor Changes and Points of Clarification

2. Safety Performance and 3.Health Performance

- Number of occurrences – only report injuries and illnesses that have resulted in absence of one day or more (excluding the day of the accident)
- Total Employee Days Worked – this is the total number of employee days worked for the whole site (i.e. number of employees x number of working days in quarter). This will be used to obtain a "rating", which can be compared over time.

4. HS&E Training

We recognise that this section very difficult to answer and we will be providing extra guidance in time.

- Total = total number of Senior Managers; Managers & Supervisors; Others. These three totals should add up to the total number of Full Time Employees reported in section 1.
- No. trained = Number of these people that have been trained, not the hours spent on training.

5 Environmental Performance

5.1 Consumption of Resources

- Gas – includes heating, cooking and process gas.
- KWh – please convert gas, oil, electricity and other fuels to KWh (most bills provide this information) if possible.
- Water – 1 m^3 (1 Cu.m) = 1000 litres

5.2 Emissions to Land

- The waste referred to here, is all waste that is taken away from the site, for disposal to landfill or recycling etc. It includes liquid waste that is taken away for treatment or disposal and not liquids that are disposed of to drain.
- Oils (neat and soluble) – include any waste hydraulic or lubricating oils as well as cutting oils
- Disposal Costs are just those costs that you pay to the waste Disposal Company, it does not include internal handling costs etc.

- The units have been changed from Cu.m to kg. All waste to landfill in the UK now incurs a landfill tax based on weight, so invoices from disposal companies should include the weight of waste taken away. If not, ask your disposal company if they can estimate the weight of waste per skip.
- The amount of waste disposed of does not include any waste that goes for recycling, please record this separately in the end column.

5.3 Emissions to Air

- Please report Volatile Organic Compounds, grouped by type. This will necessitate providing average **cost** and average **% volatile.**
- If you prefer to report this in more detail, i.e. by substance name, please provide the information separately, but make it clear what type of substance each product is.
- Litres disposed of in this case includes any that are sent for recycling.

6. Management Systems

- Overall –an average of the 7 self-assessment scores.

7. Health, Safety and Environmental Incidents

- This section now includes Health and Safety incidents that have resulted in legal action or intervention by regulatory authorities. We are particularly interested in the cost of any fines or penalties incurred. Report the incident in the quarter in which the cost occurs.

8. Use of Hazardous Substances in Product Manufacture

- Cutting Oils have been deleted from this section since they are included in section 5.2.
- Do not include hazardous substances from buildings (e.g. asbestos)

If any further clarification is required, please contact Terry Bridgewater or Nicolette Lawson at Shaftmoor Lane (5354).

Appendix Z

Revised timing plan for year 4 (months 36-50).

NICOLETTE LAWSON

Eng D Plan: Years 3 & 4: from month 36

Project:	Sheet 1 of 1	Dr. Mike McKiernan
Measurement of Environmental Performance	Issue No. **3**	LucasVarity plc, HS&E Dept.
	Updated **1 Oct 98**	Dr.Chris France, Surrey Uni.

	1998			1999										
Month #	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Task	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Research:														
Ongoing Literature Survey														
Assess LucasVarity measures														
Analyse LV results returned														
Develop EPI methodology														
Test EPI methodology														
Write/submit Paper(s)														
Finalise Portfolio														
Progress reports etc.														
Project Review meetings	x			x			x	x	x	x				
Progress Report (month 36)	!													
Progress Report (month 42)							!							
Final Progress Report									possible slippage					
Mock Viva								?						
Final Viva Voce									?					
Graduation										X				
Holidays		h	h					h				h		

Appendix AA

- Lucas Aerospace HS&E Measures of Performance Report 1

- Lucas Aerospace HS&E Measures of Performance Report 2

Reports commissioned and edited by:

Terence Bridgewater, Lucas Aerospace Divisional HS&E Manager

Lucas Aerospace HS&E Mops 1998 1st Quarter's Results

Did you know?

In the first three months of 1998:

- Lucas Aerospace used over 56,000,000 kWh of energy.
- Energy cost the company over £1.5 million.
- Lucas Aerospace used over 190,000,000 litres of water, that's over 28,500 litres per employee!
- The site that paid the most for their water used less than any other site! The high water costs are due to their location in a capital city.
- Lucas Aerospace disposed of over 2,280,000 kg of waste, that's 343kg per employee.
- 22% of waste produced was recycled.
- Lucas Aerospace released 166,000,000 litres of effluent down the drain.
- The cost of waste and effluent disposal was over £96,000.
- At least £205,000 was lost as more than 89,000 litres of solvents evaporated into thin air.

Terry Bridgewater
HS&E Manager
April 1998

Data compiled by Nicolette Lawson

Introduction
This is the first time that Health, Safety and Environment data has been collected from all Lucas Aerospace sites.
Although some of the data is incomplete, there is sufficient data to make some interesting observations and draw some conclusions. This report contains the information generated as a result of analysing of this data.
This information is required in order to facilitate a comprehensive analysis of our performance, which will be essential in improving the management of Health, Safety and the Environment within Lucas Aerospace.

Extracts from this data analysis will be presented as part of our mandatory reporting requirement to LucasVarity.

Time Frame
Data covers the three months of January, February and March 1998. It was collected and analysed during April and will be presented to LucasVarity HS&E committee in May 1998.
Subsequent data collection will occur each quarter.

Notes
- This is the first time HS&E data has been collected and there are therefore no trends.
- The detail collected allows us to "drill down" and focus on areas of interest.
- Some of the data was incomplete because sites do not have systems in place to collect it, or it is difficult to access.
- The authors of this report have already highlighted and corrected obvious errors in the data, however, some of the data provided may still be inaccurate due to misinterpretation of requirements or simple arithmetic or conversion errors.
- LucasVarity, including Lucas Aerospace, has yet to define its training requirement for HS&E and thus performance data was not collected.
- Data was requested about prosecutions but, as none were reported, none are presented.

Some sites have questioned the need to report this data and therefore we would like to know:
- what is useful information and what is not?
- what other information, based on this data, would you like to see presented?
- Is there any other data that we should be collecting

Please send your comments back to Terry Bridgewater, c/o Shaftmoor Lane.

Contents

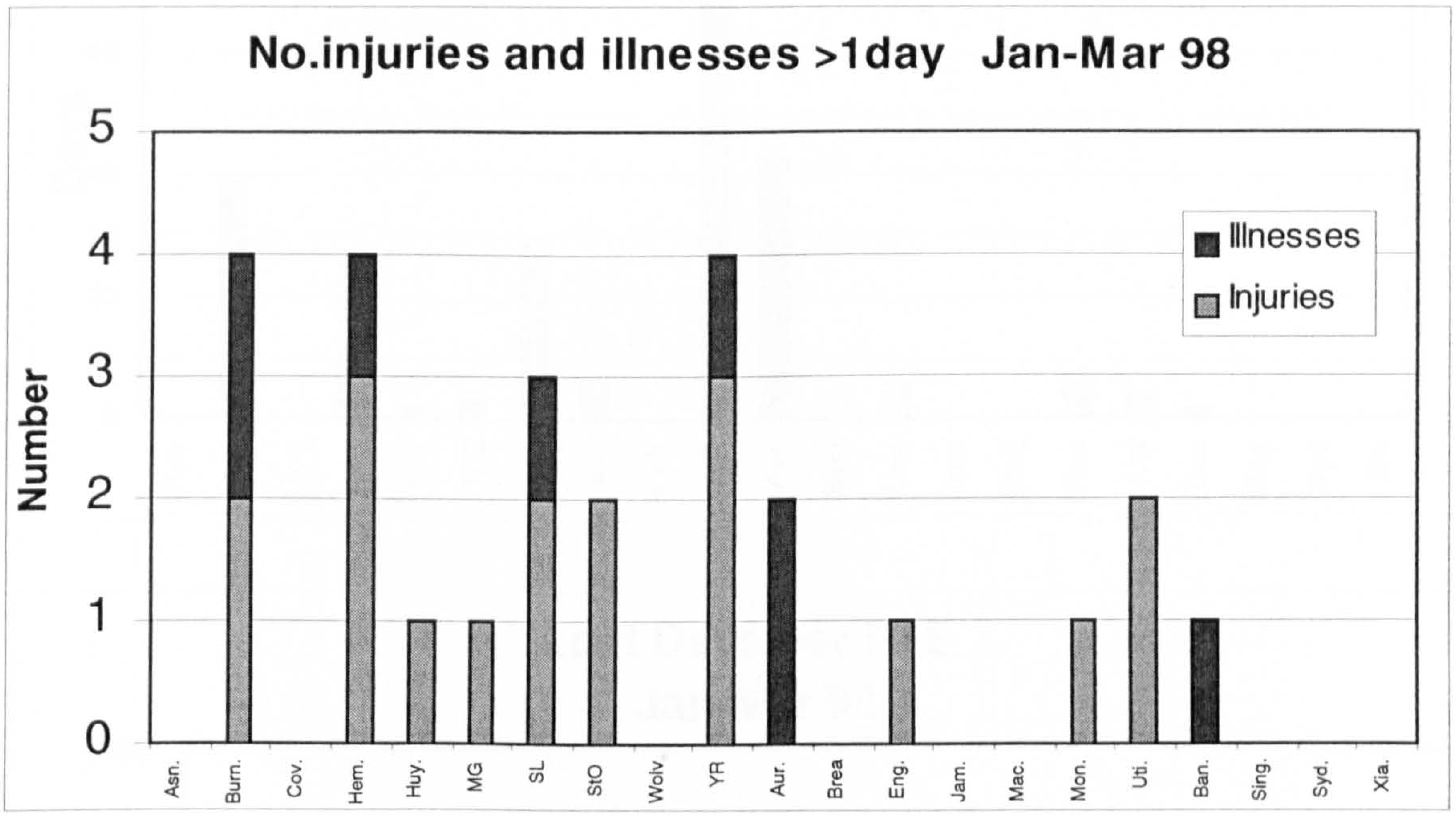
Data compiled by Nicolette Lawson

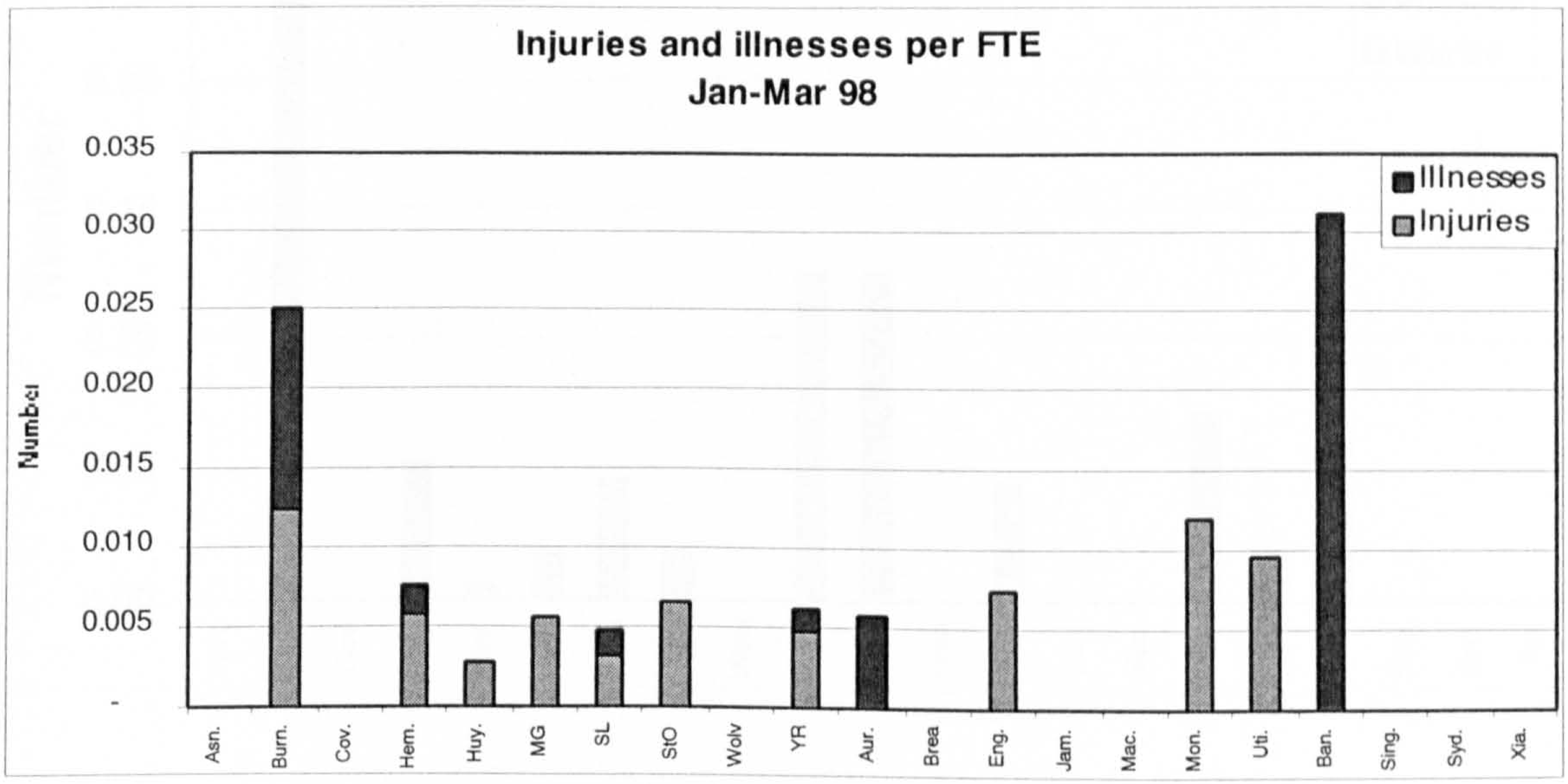
Health and Safety (1)

Why?
This information is collected in order to track the number of work-related illnesses and injuries occurring in our factories and the associated lost time. Only illnesses and injuries that resulted in more than one day's absence have been recorded.

Comments on the number of work-related injuries and illnesses
This information is for the record only - it will take time to gather trends.

- 3 sites had 4 (max) injuries and illnesses resulting in more than 1day's absence.
- 9 sites had no work-related absences.
- The site with the highest rate of illness and injury per employee (0.03) has the smallest workforce and only 1 occurrence of illness! This shows that we have to be careful how we interpret the statistics.

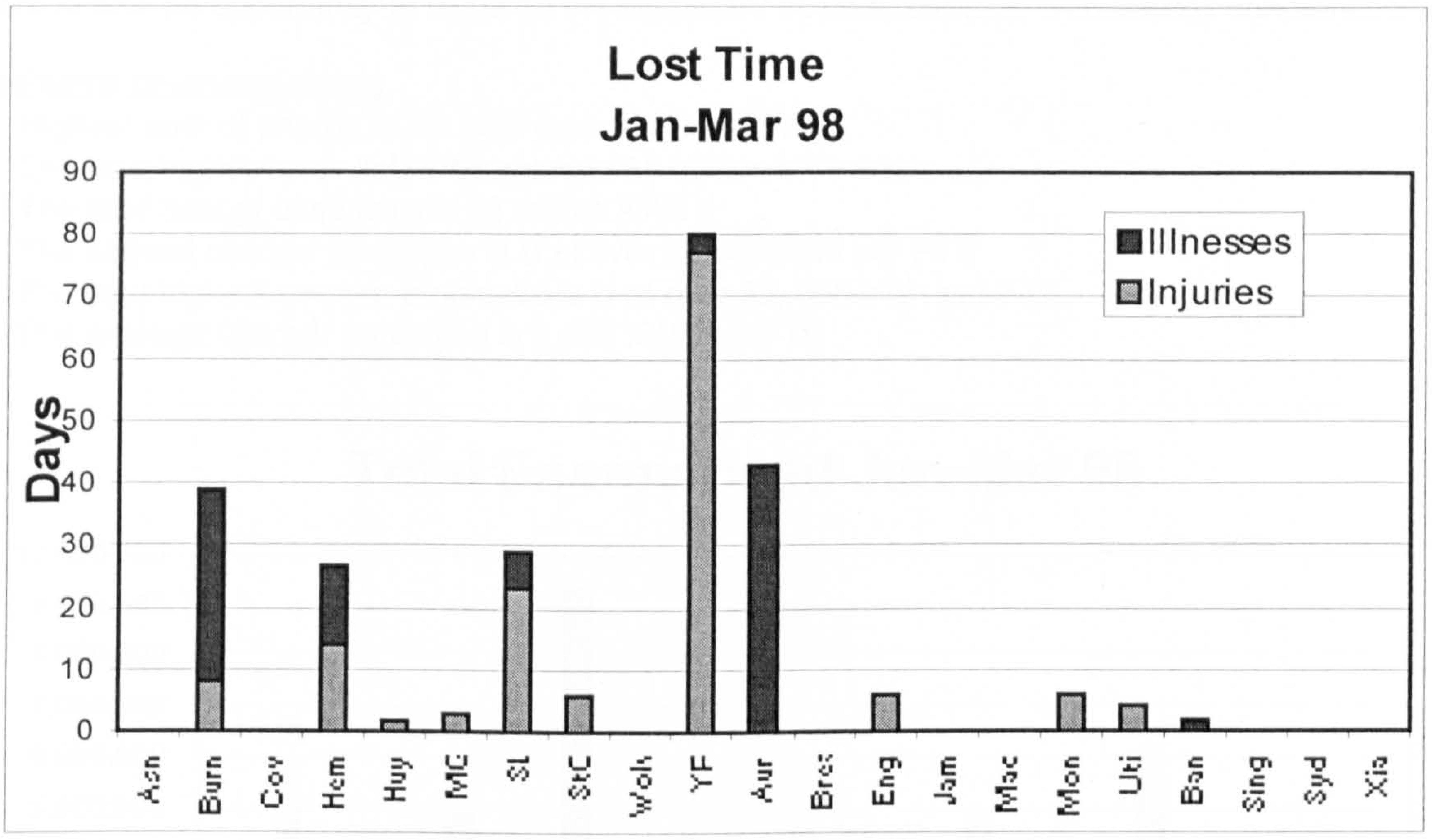


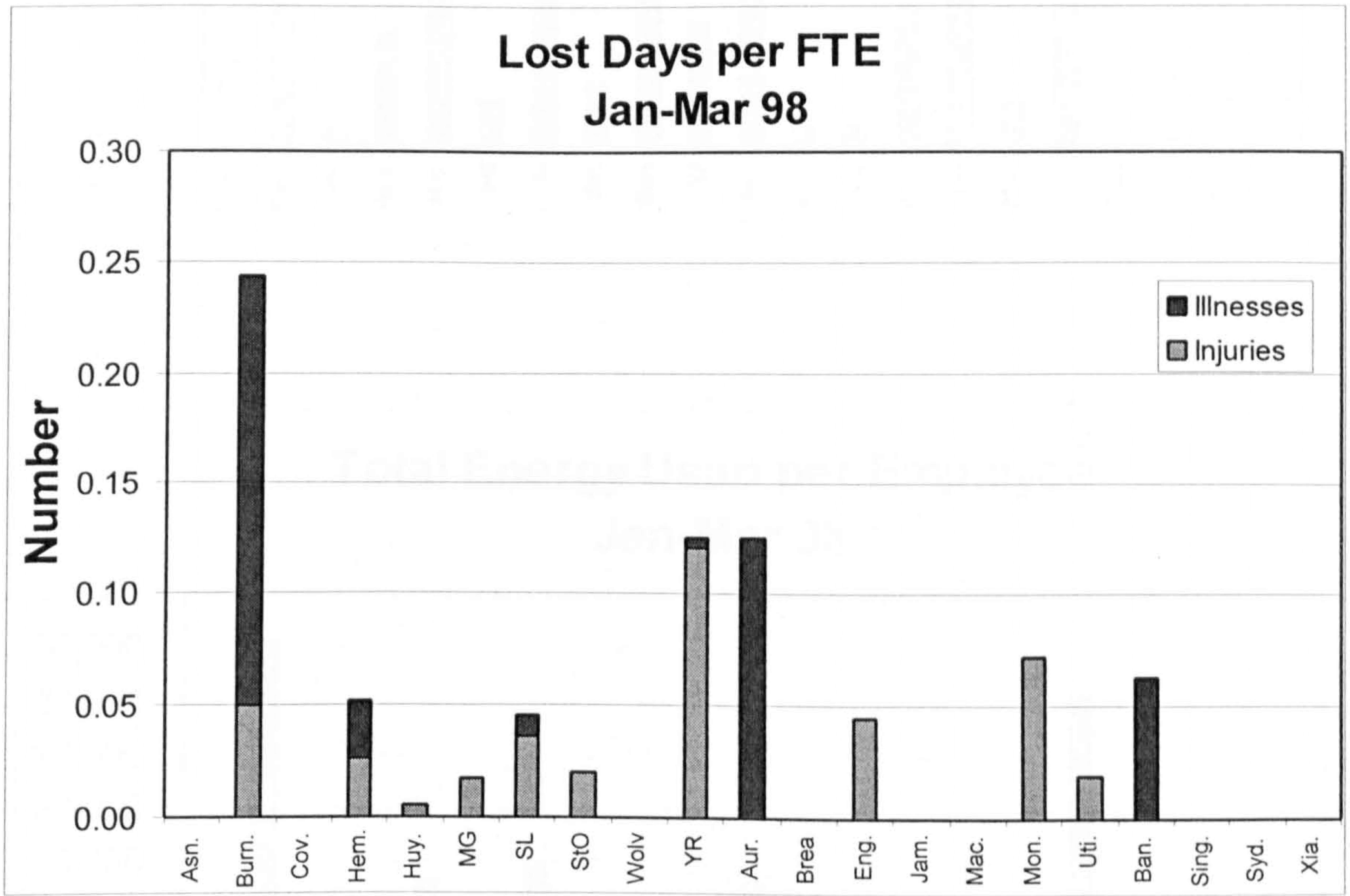


Health and Safety (2)

Comments on the lost time due to work-related injuries and illnesses
This information is for the record only - it will take time to gather trends.

- 1 site 80 days
- 2nd highest - 42 days
- 9 sites with no lost time





Energy (1) (Energy here includes gas, oil, electricity and other fossil fuels)

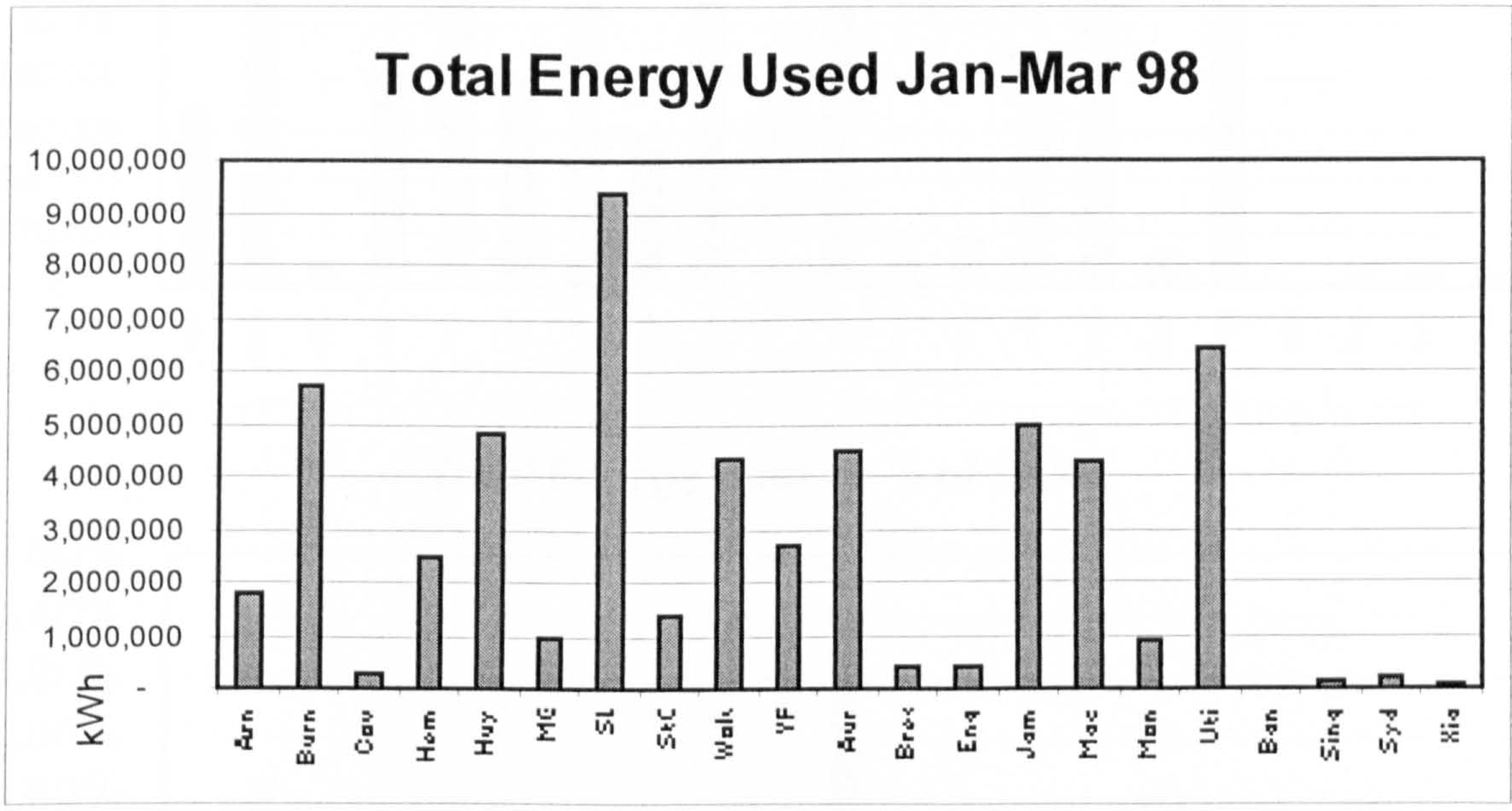
Why?

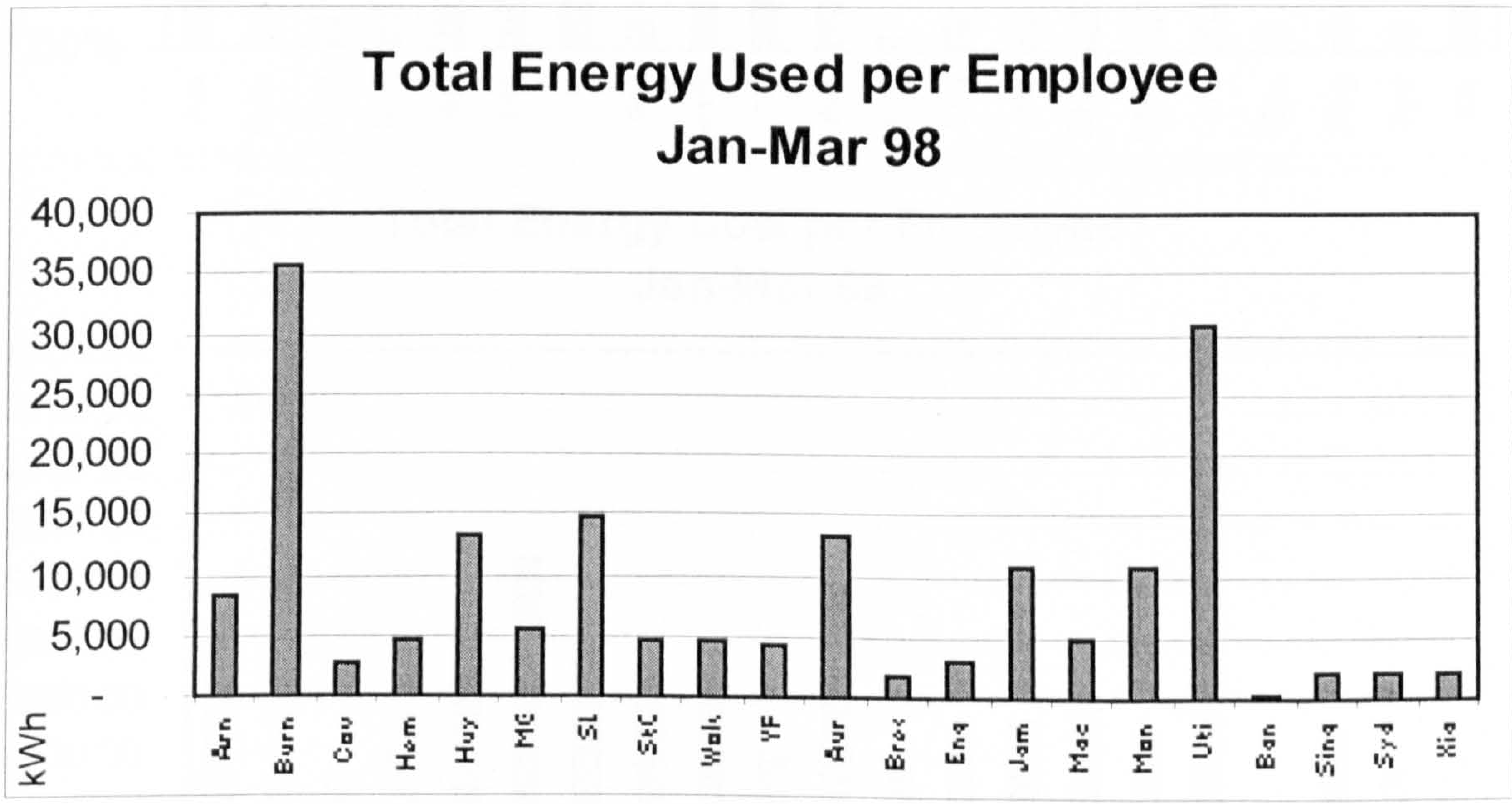
This information is collected in order to understand the amount of energy used and the costs involved. The use of fossil fuels (gas, oil, and coal) to produce heat and electricity has a very significant environmental impact. Not only are we depleting non-renewable resources, the burning of these fuels produces CO2, the most significant contributor to Global Warming. Burning fossil fuels also contributes to acid rain and local air pollution.

There is also an opportunity to focus on the significant costs associated with energy consumption.

Comments on energy usage

- Highest user of energy is S L with over 9 million kWh.
- The next highest user is U with approx. 6.5 million kWh each.
- The total energy used is over 56 million kWh !!
- The highest use per employee is B at over 35,000 kWh per FTE
- The next highest use per employee is U at over 30, 000 kWh per FTE
- The average use per employee is 8,456 kWh per FTE



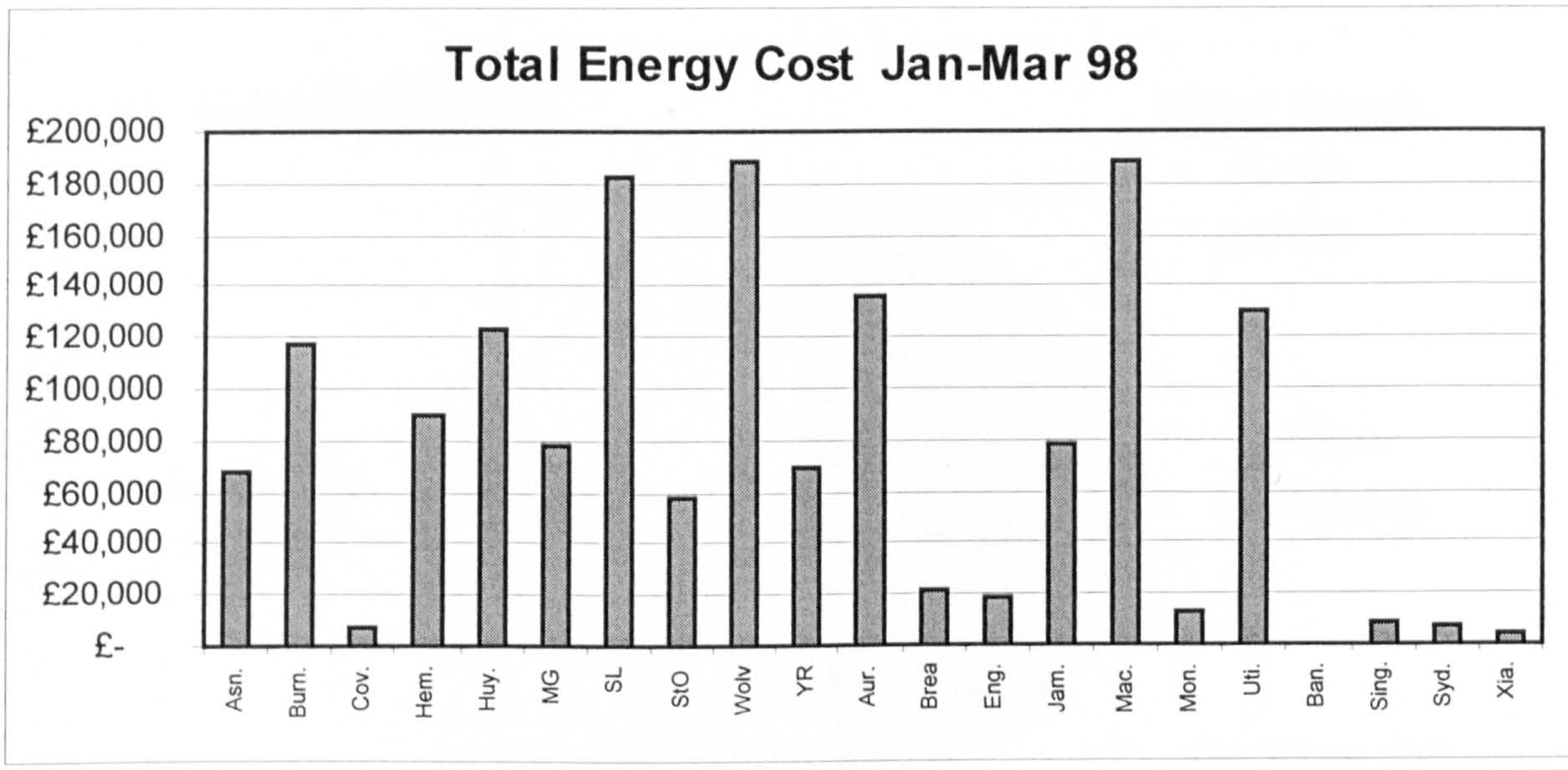


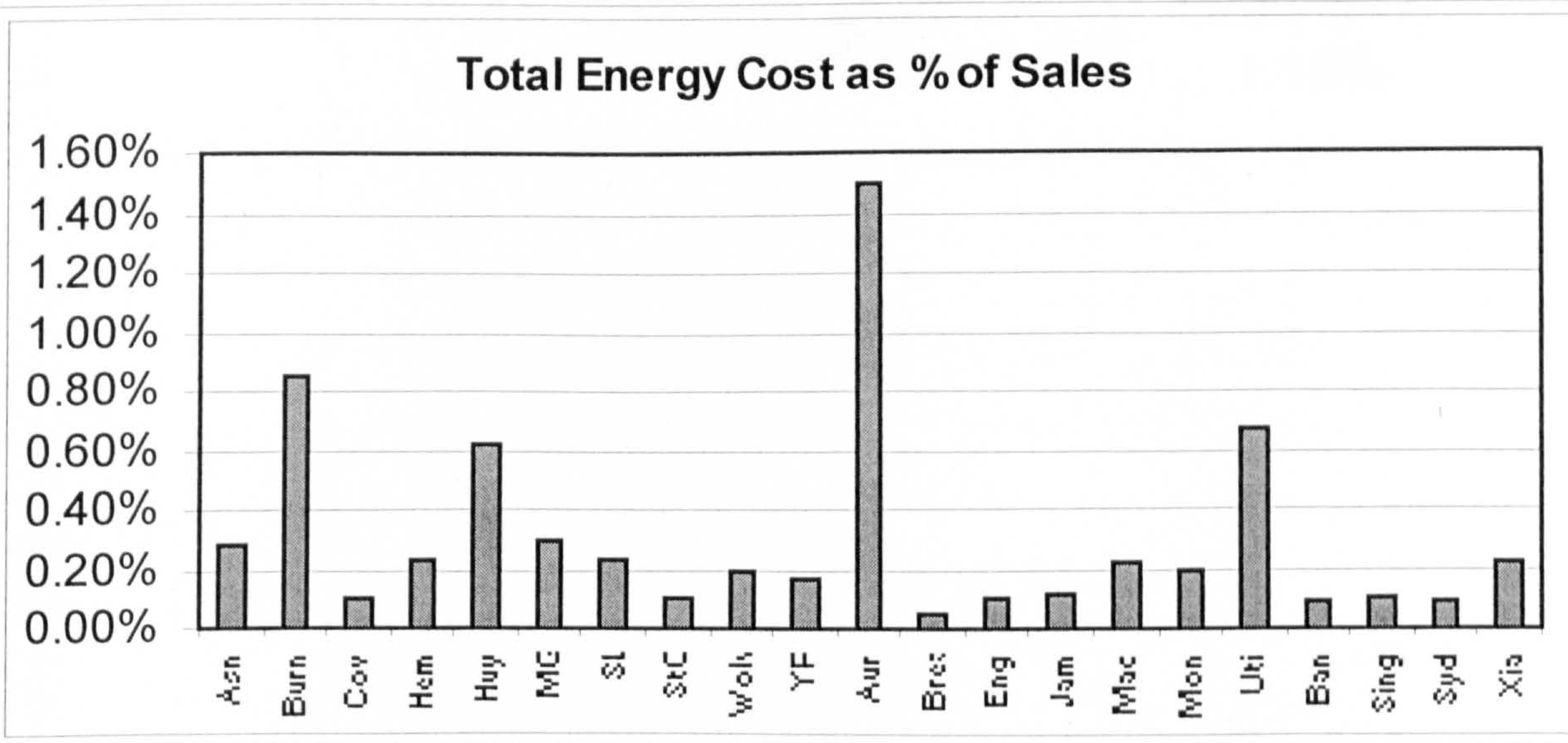
Data compiled by Nicolette Lawson

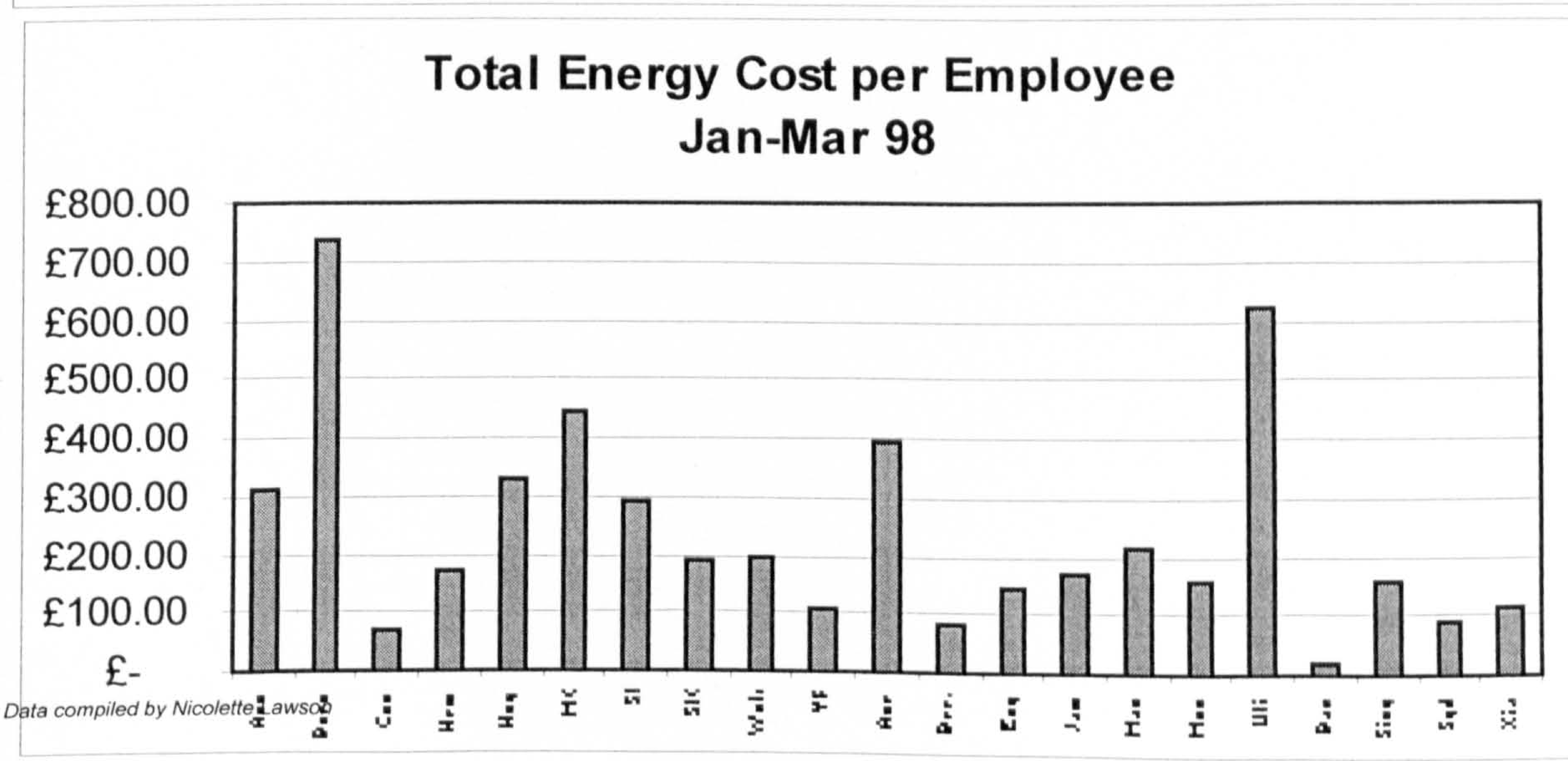
Energy (2)

<u>Comments on energy costs</u>

- Total Energy Cost is £1.592 million
- 3 sites spent over £180,000 for the quarter
- A has the highest Total Energy Cost as % of Sales at 1.5%
- The average Total Energy Cost as % of Sales is 0.22%
- B has the highest Total Energy Cost at over £700 per person
- The average Total Energy Cost per Employee is £239 per person





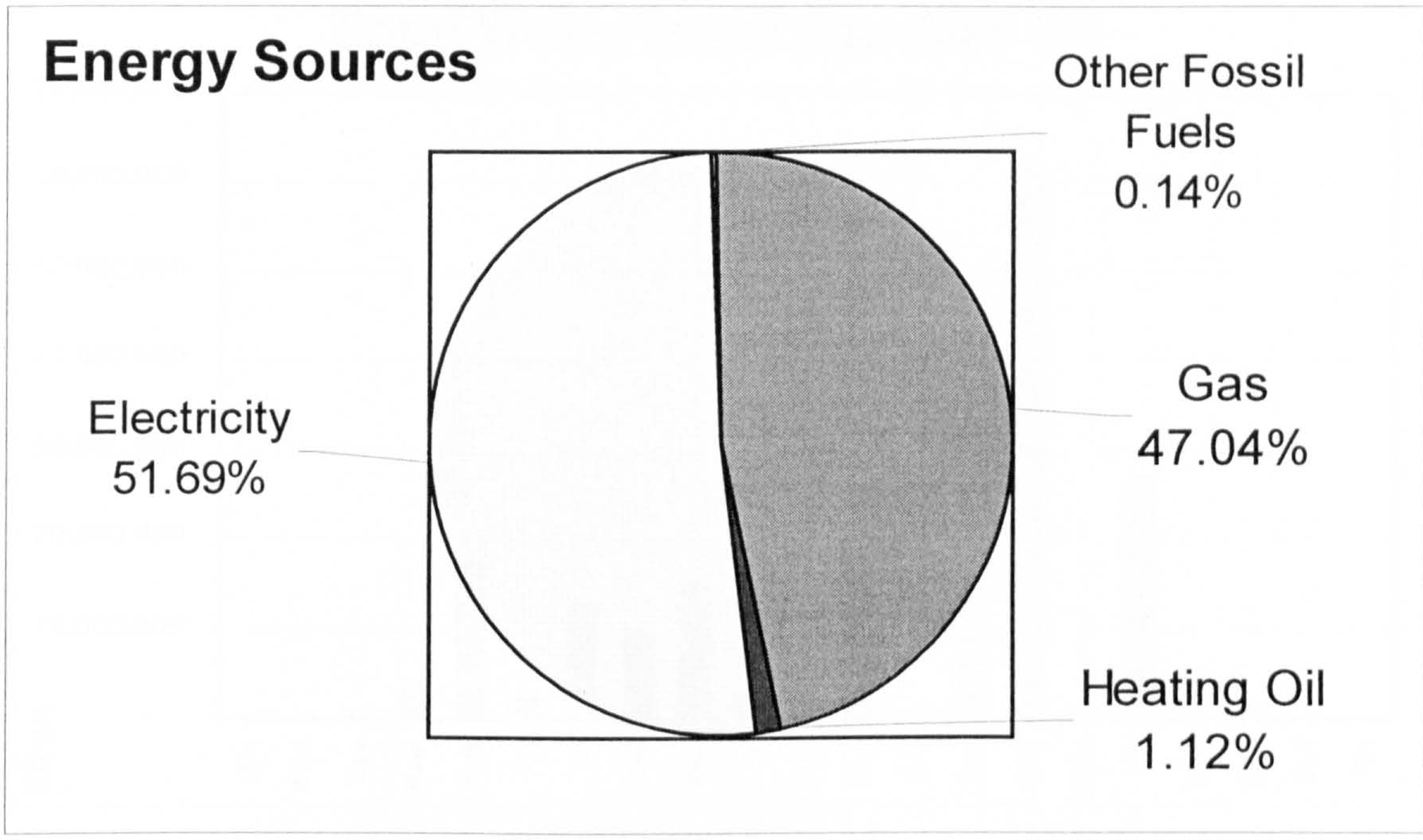


Data compiled by Nicolette Lawson

Energy (3)

Comments on energy sources

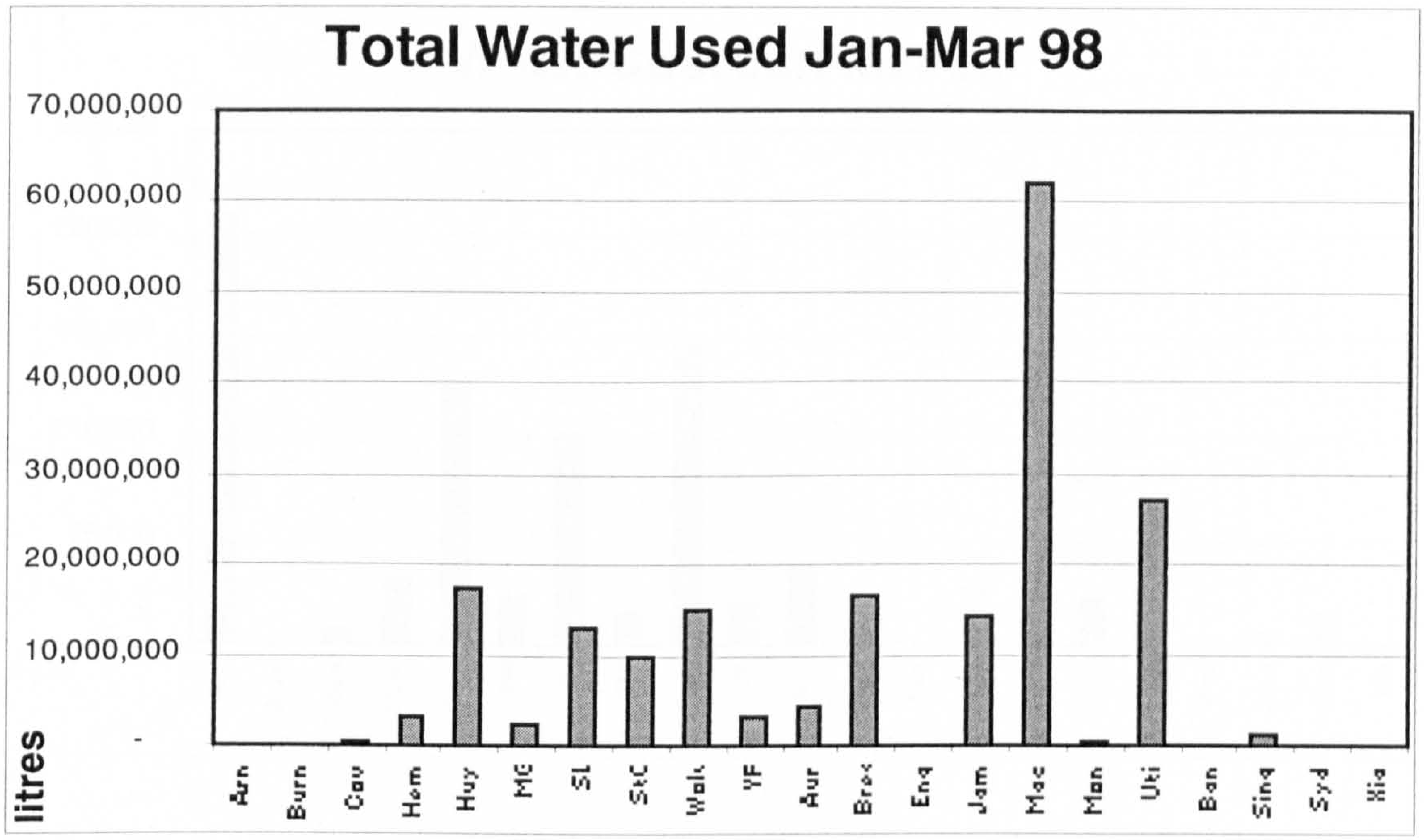
- The majority of energy used is electricity - over 29,000,000 kWh
- Gas, used for space heating and processes, is the next largest energy source – over 26,000,000 kWh.
- Heating Oil is used in a few places (631,877 kWh) as well as some other fossil fuels (80, 315 kWh).

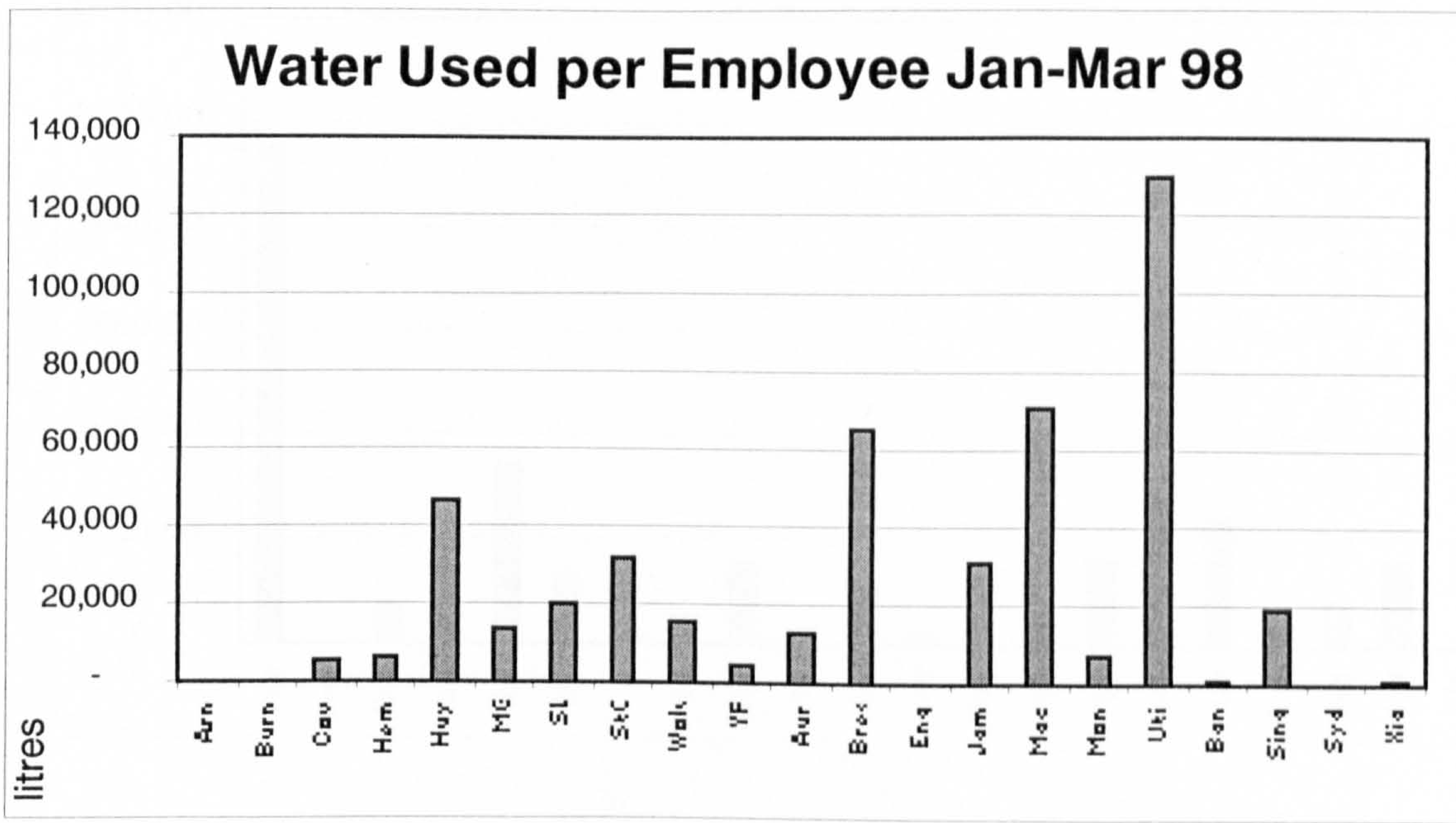


Water (1)

<u>Comments on water usage</u>

- The greatest user of water is M at over 60 million litres
- The total water used by Lucas Aerospace was 190 million litres
- U used the most water per employee at 130,000 litres per person.
- The average was 28,551 litres per person

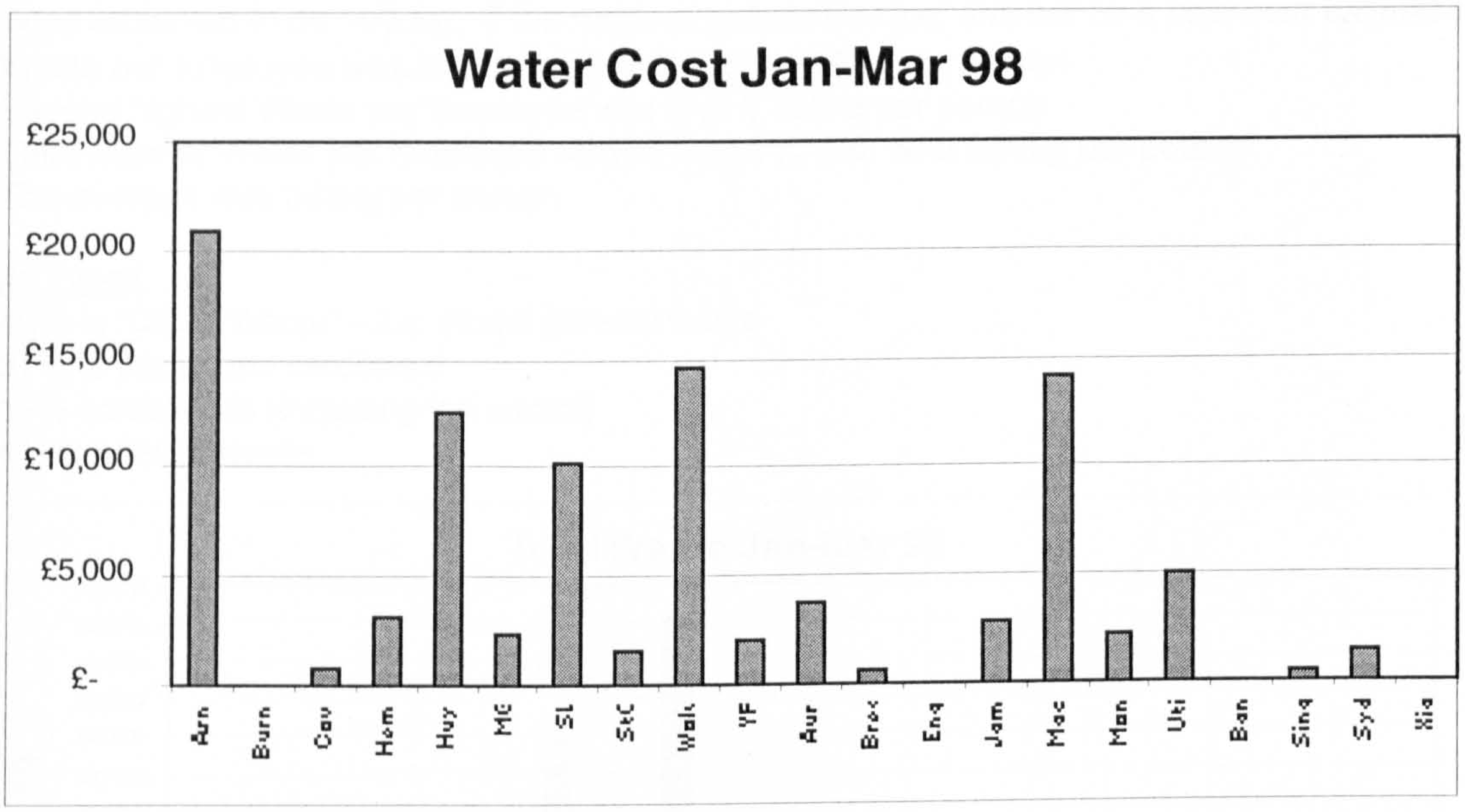


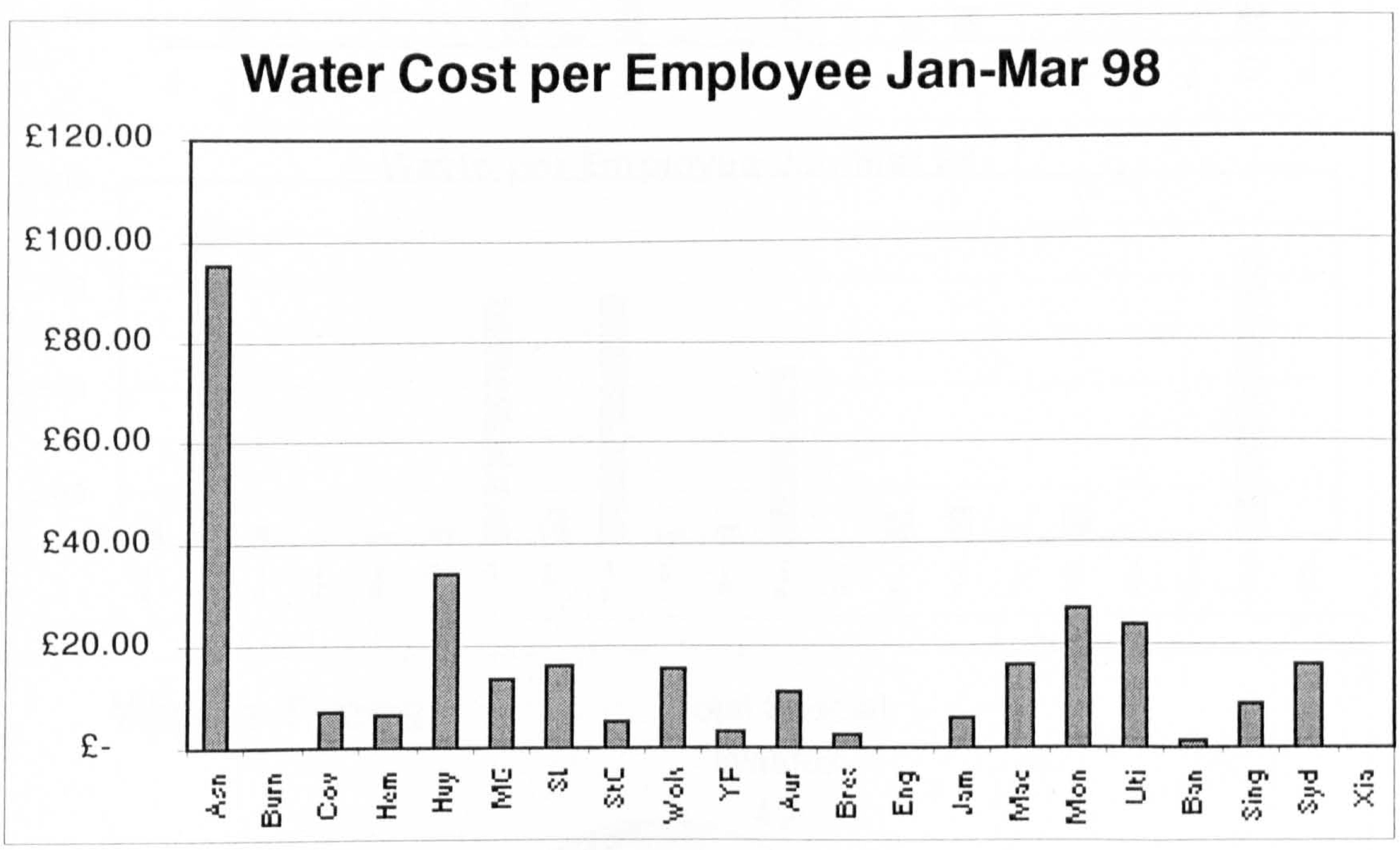


Water (2)

<u>Comments on water cost</u>

- Here A has the highest cost, although it has the lowest consumption
- The total water costs for Lucas Aerospace was £98,969
- M's costs are comparable to W although is consumes over 3 times as much!
- Average Water Cost per Employee is £14.87 per person
- Again A is the highest at £95 per person (needs checking)





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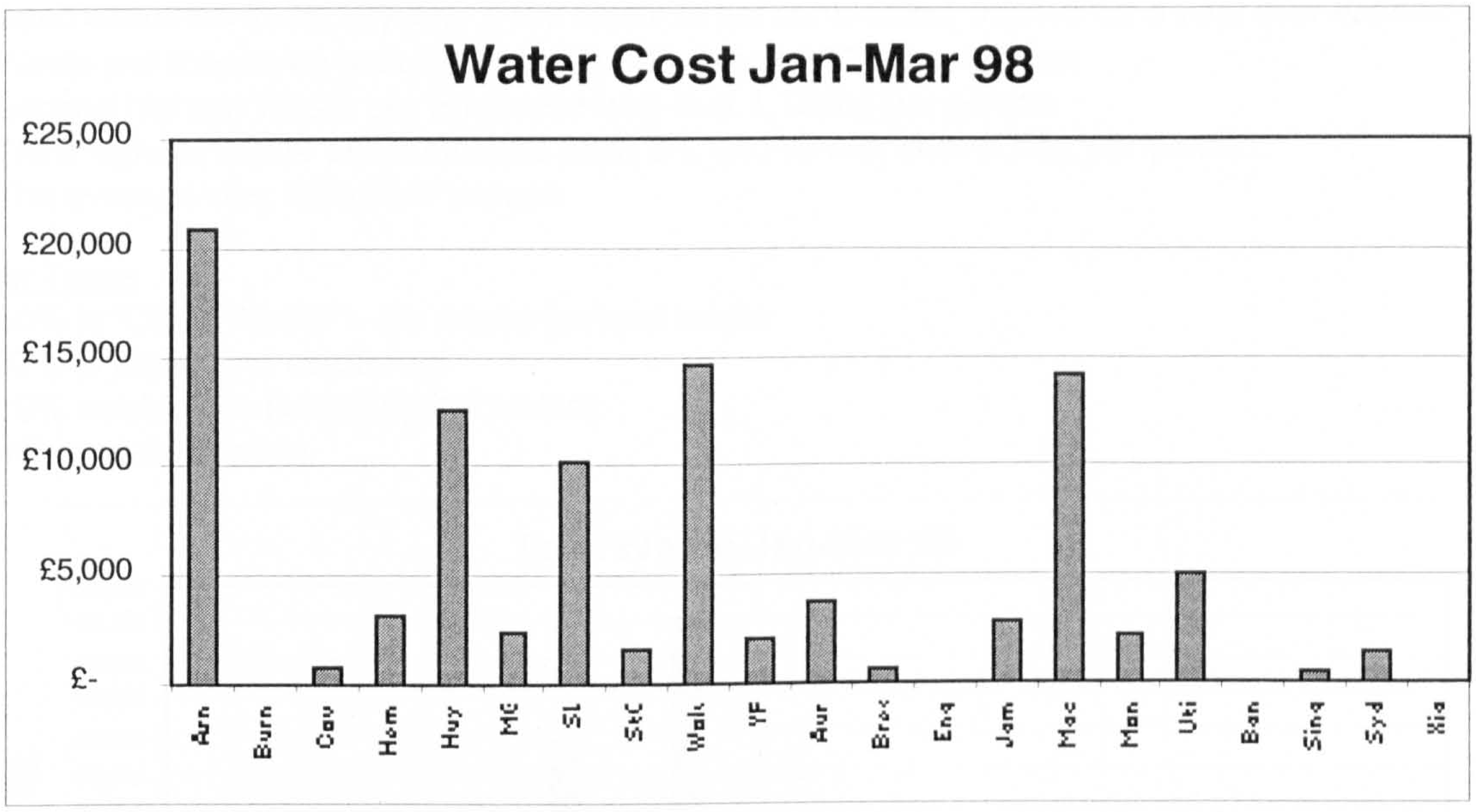
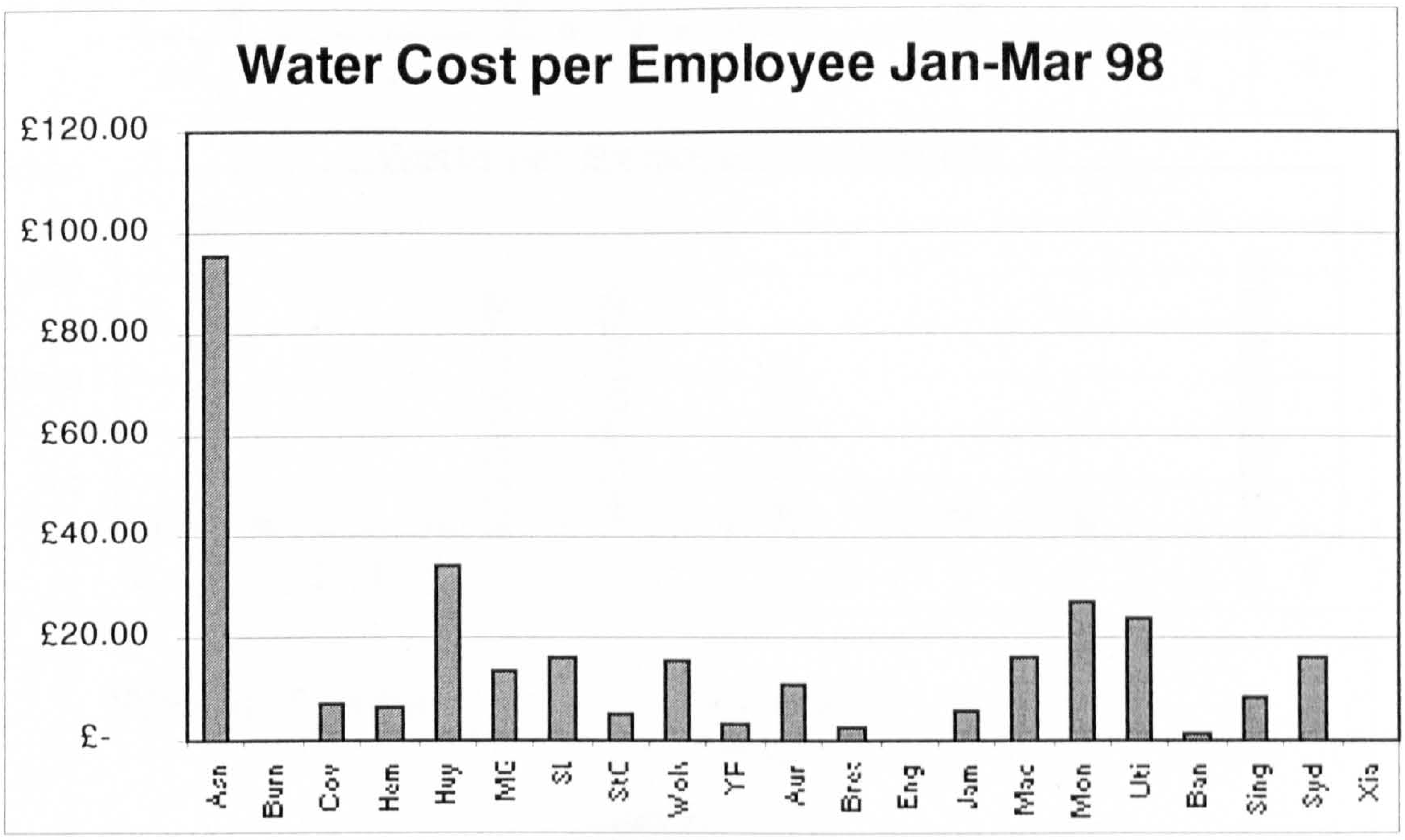




Waste (1)

Comments on waste disposed of (excluding recycled waste)

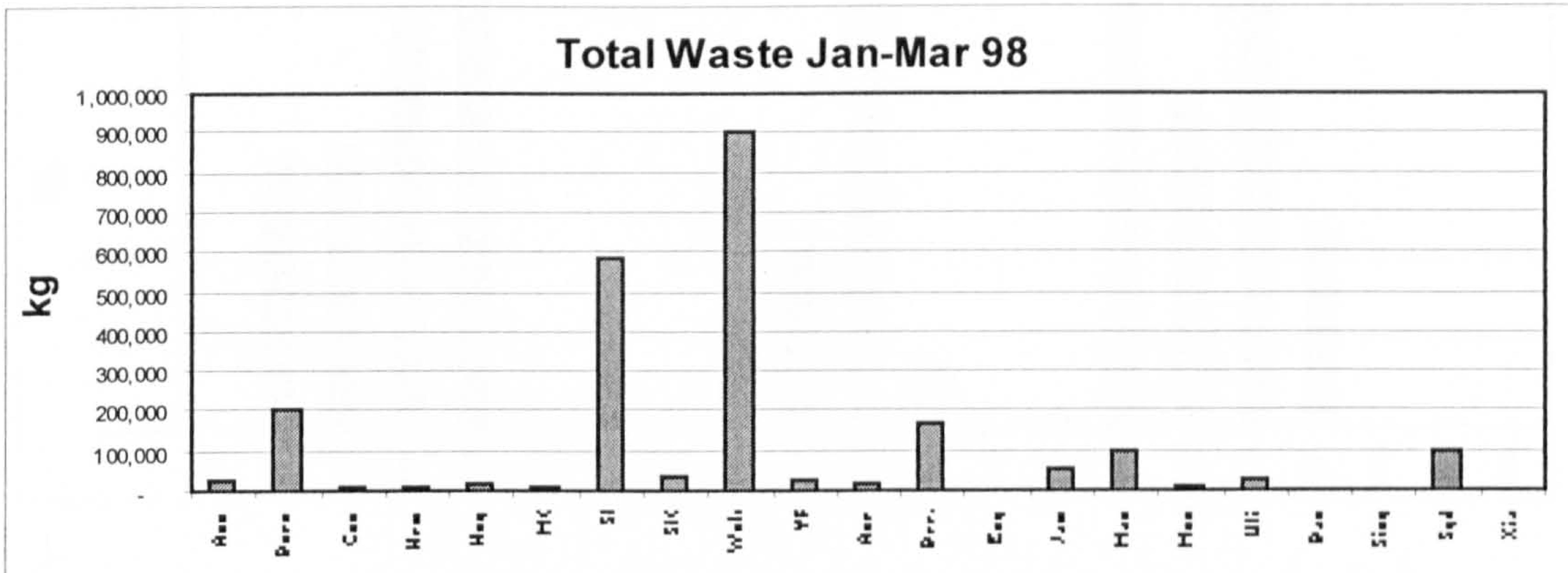
- In total Lucas Aerospace disposed of over 2.2 million kg of waste (this included "special waste", neat and soluble oils, other liquid waste, metals, paper and cardboard and other general and mixed wastes)
- W disposed of the most waste at 900,000 kg (although it is known that they have one of the best waste reporting systems)
- Next came SL with nearly 600,000 kg

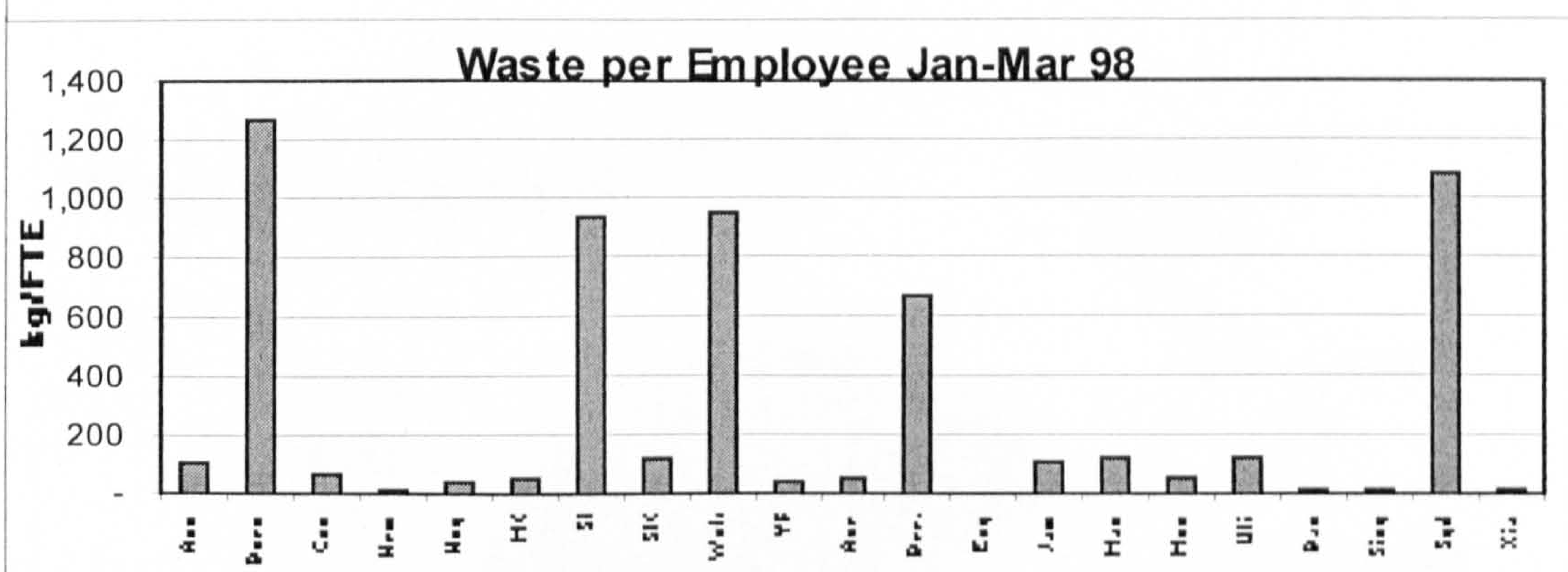
It should be noted that some sites submitted incomplete data and where volume was given 1 cu.m. has been assumed to be 1000kg. If the waste is not compacted, this will be a vast over estimation.

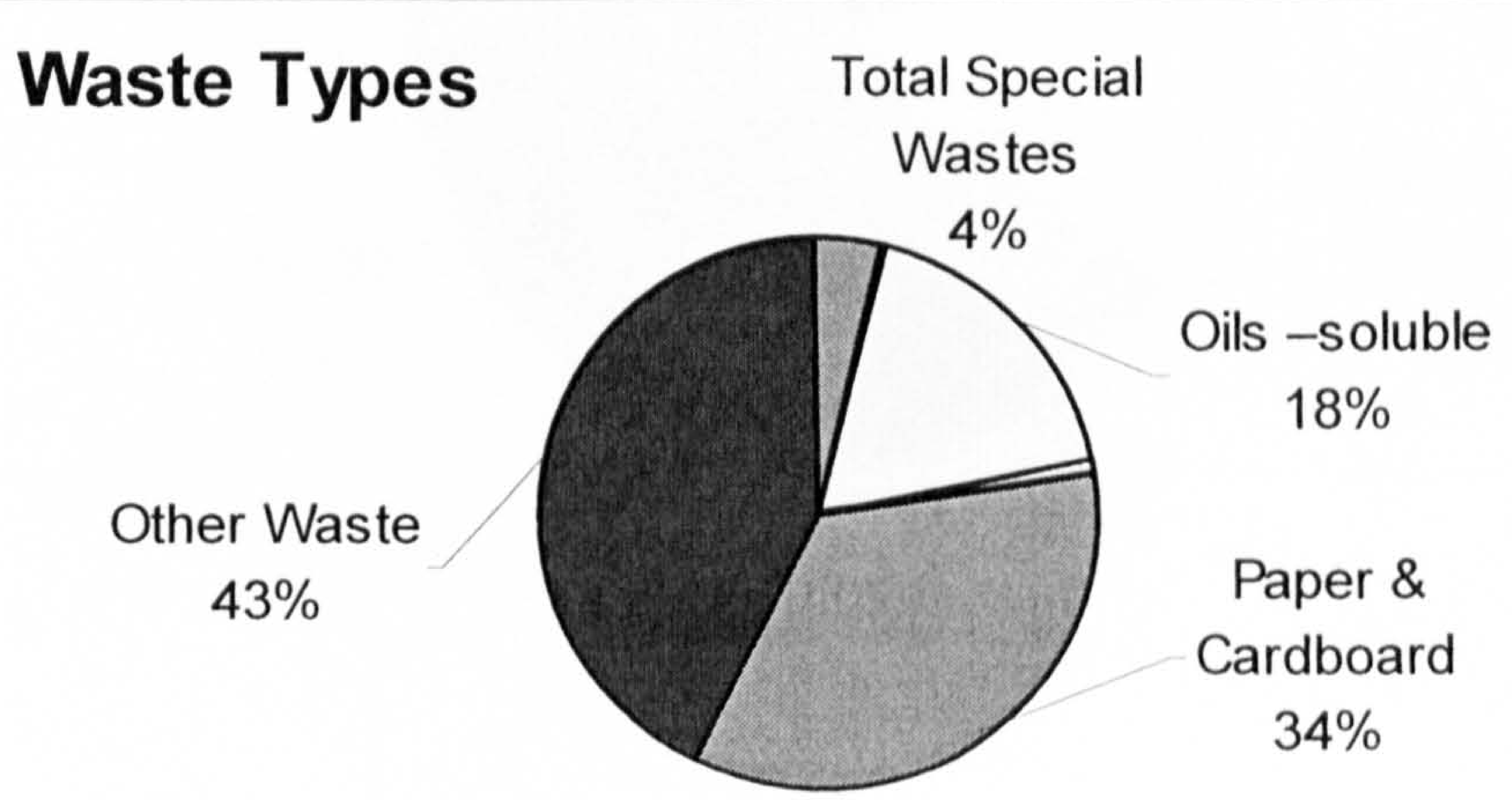
- Waste per Employee was highest at B with over 1,200kg per person
- Second highest Waste per Employee was S at 1,100kg per person
- Third highest Waste per Employee were S L and W with over 900kg per person
- The average was 343kg per person

Waste Types

- 40% is "Other Waste" – i.e. mixed general waste
- 37% is paper and cardboard
- 19% soluble oils (including the water!)
- 4% is special waste





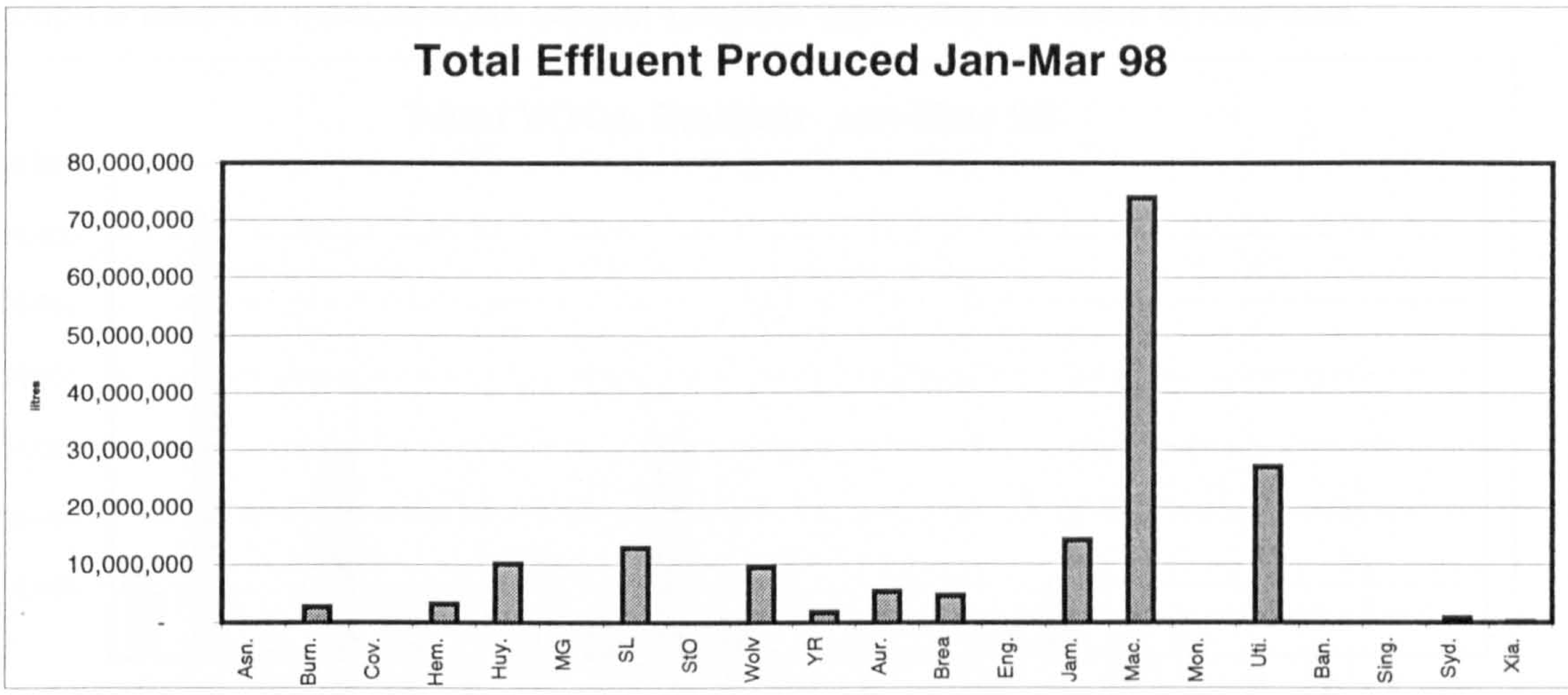


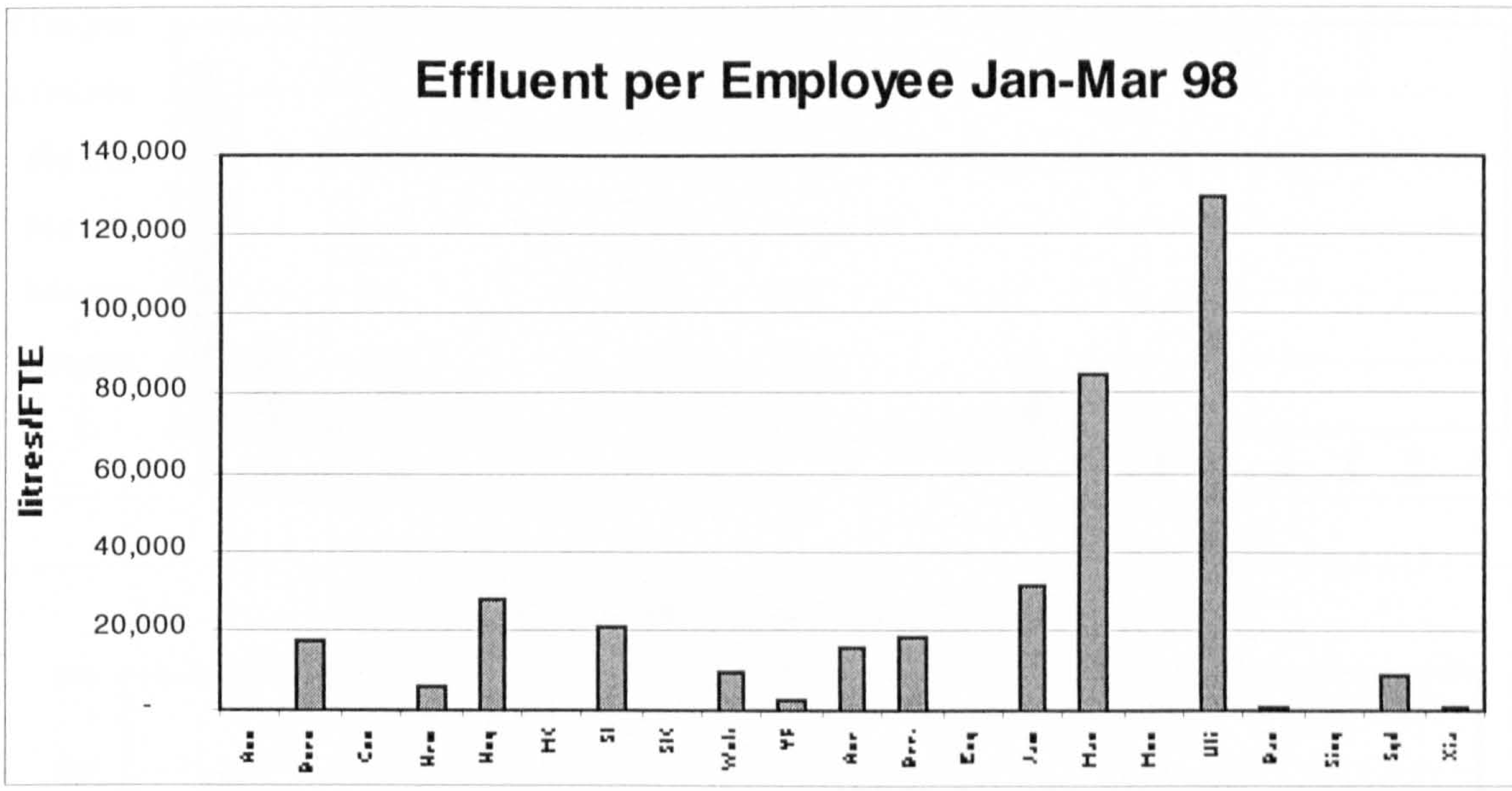
Data compiled by Nicolette Lawson

Waste (3) - *Effluent*

Comments on Effluent Produced

- Total Effluent (waste water sent to the foul sewer) produced was over 166 million litres
- The highest producer was M at 75 million litres
- Effluent per employee was highest at U with 130,000 litres per person
- M uses over 80,000 litres per person

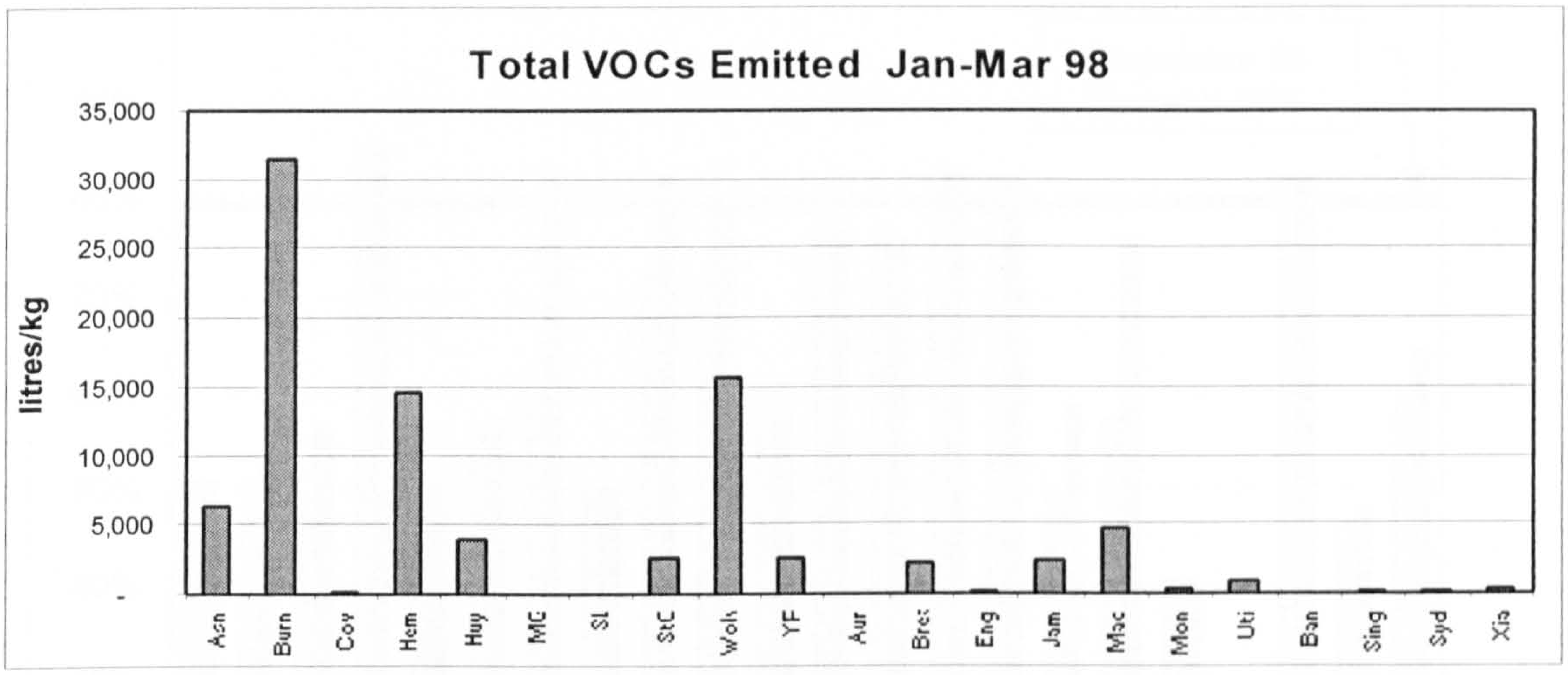


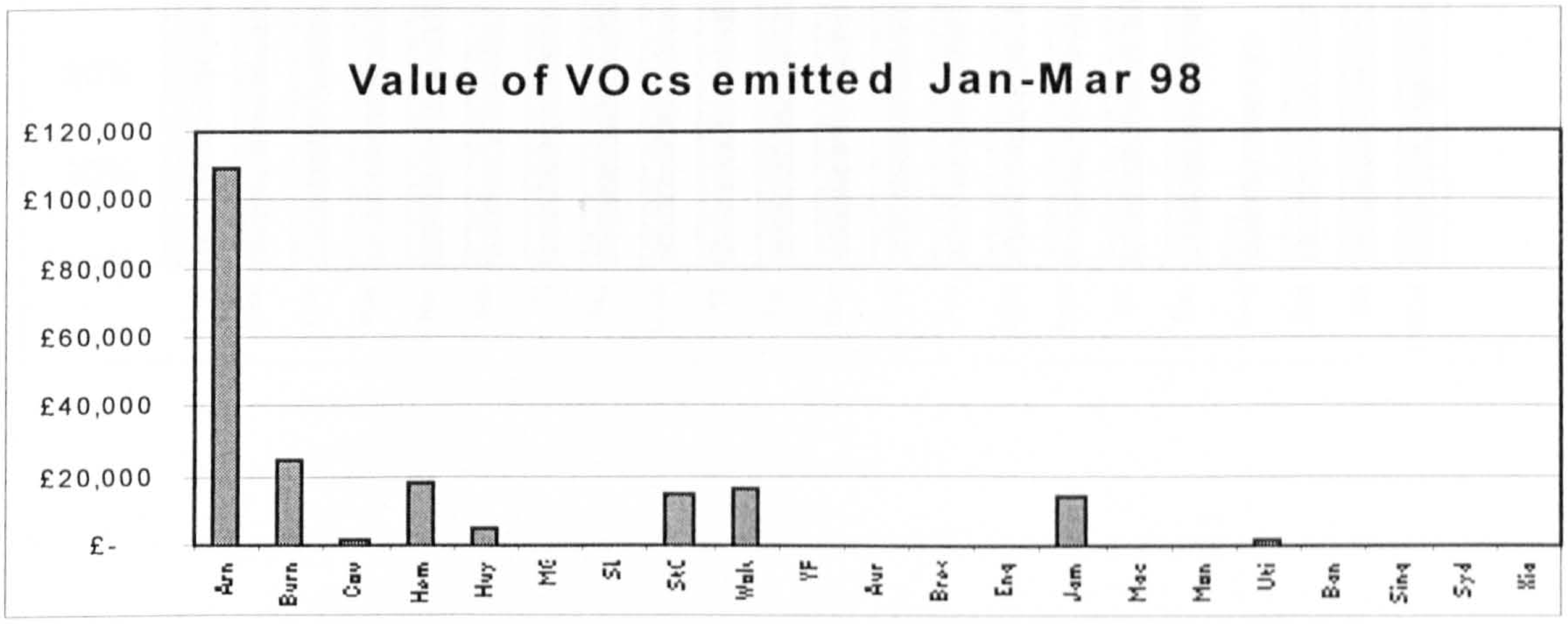


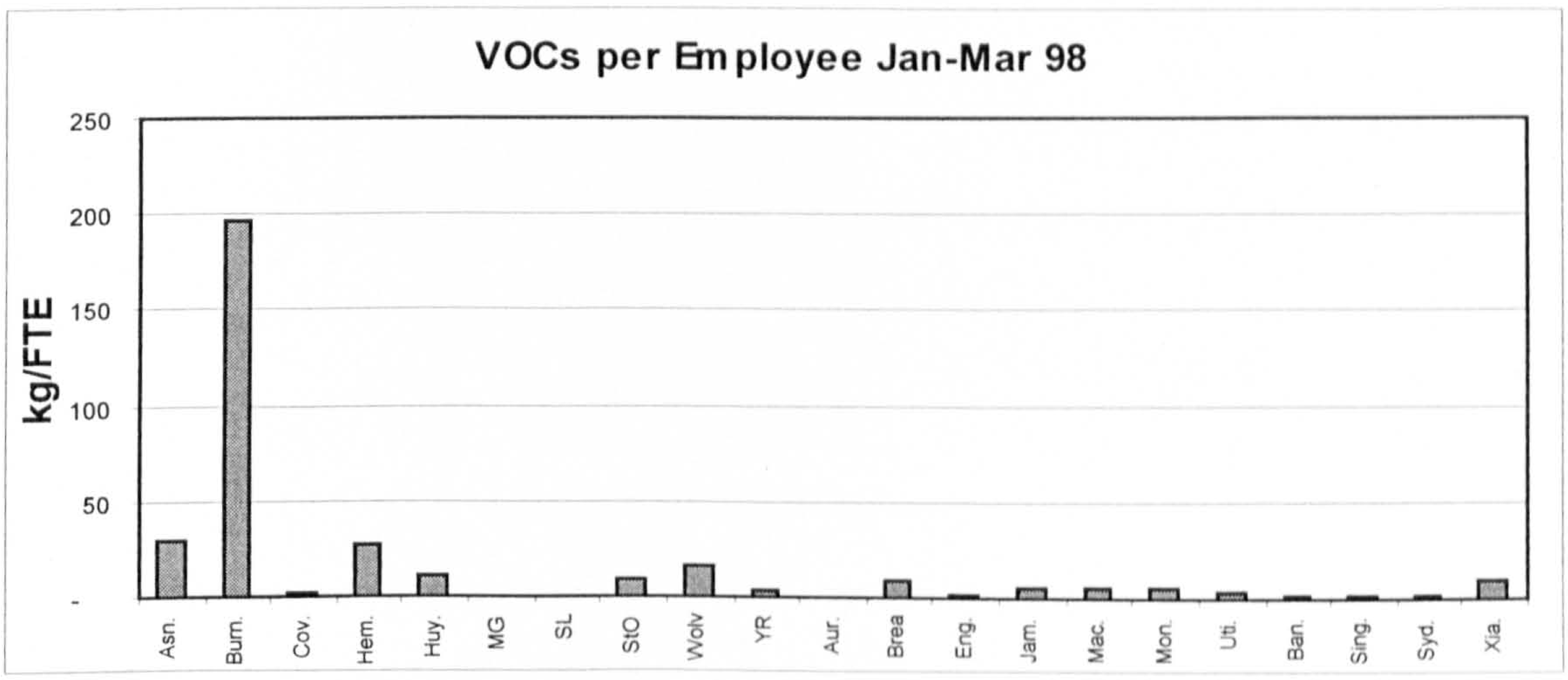
Waste (4) – *Volatile Organic Compounds (VOCs)*

Comments on VOCs emitted

- Total VOCs emitted (lost to atmosphere) = 89,638 litres
- B emitted over 30,000 litres per person (this is due to the vast amounts of methanol burnt in the furnace – other sites may not have reported VOCs used to control furnace atmospheres).
- Next highest is W at over 15,000 litres per person, closely followed by He.
- B also has the highest VOCs per Employee at nearly 200 litres per person
- The average is 13 litres per person
- The total value of VOCs lost through evaporation amounts to £205,281.
- Here A is losing over £100,000 of VOCs to atmosphere. Although they do not emit vast quantities, what they do emit is vary expensive.
- Although B uses the most its costs are just £25,000, due to the low value of methanol.





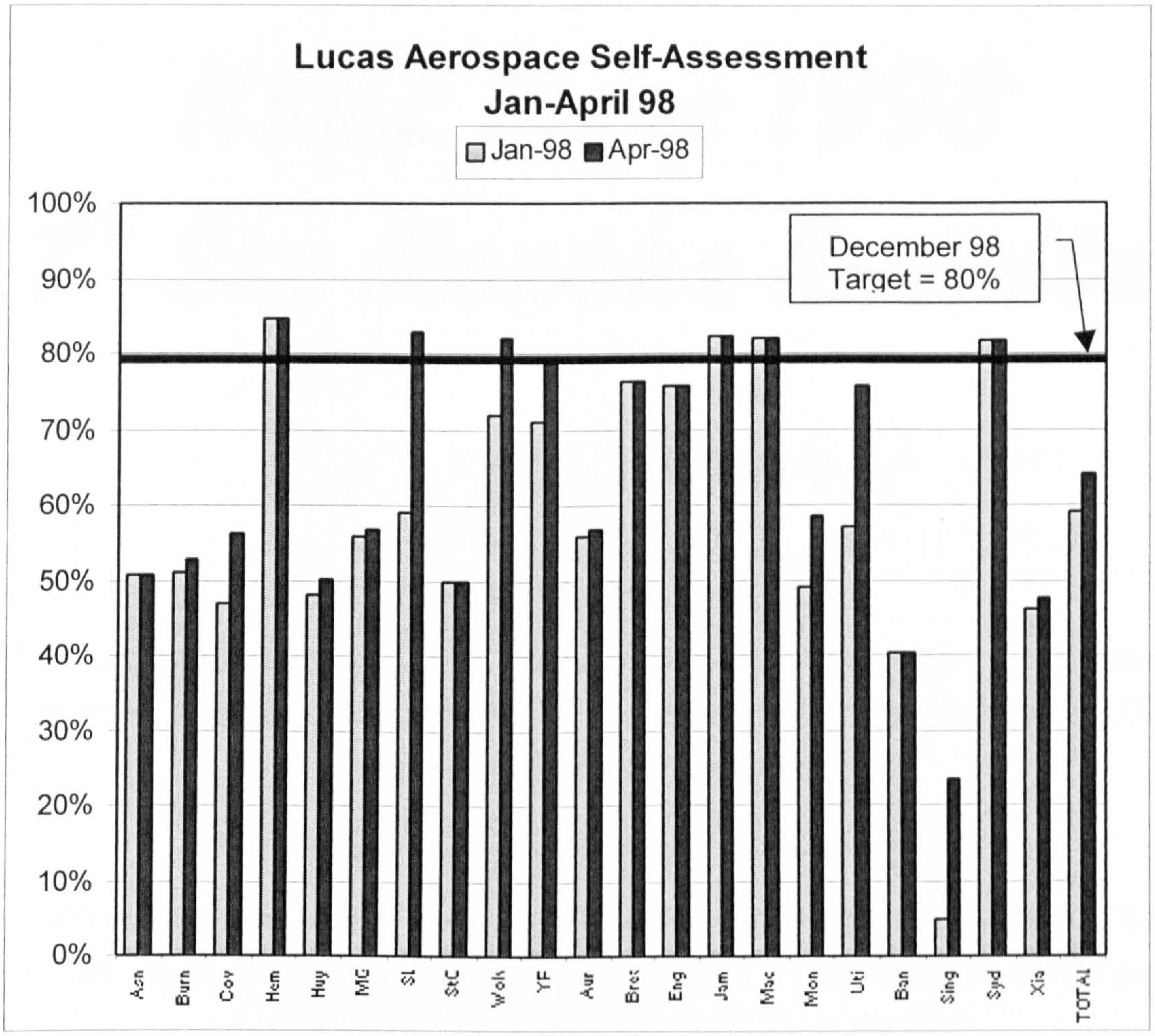


Data compiled by Nicolette Lawson

Self-Assessment (1) – implementation of LucasVarity standards

Comments on Self Assessment

- Self Assessment scores have been plotted alongside those submitted in January
- There has been an average improvement of about 4%.
- SL, U and S show the biggest improvements



Lucas Aerospace

HS&E Mops 1998
1st Six Months Results

Did you Know?

In the first six months of 1998:

- Lucas Aerospace used over 115,000,000 KWh of energy. That caused over 91 thousand tonnes of CO_2 to be released, as much as 30,000 cars would produce in a year!
- Energy cost the company over £2.9 million.
- Lucas Aerospace used over 540,000,000 litres of water, enough to fill 300 Olympic sized swimming pools. That's over 80,000 litres per employee (or 8,000 toilet flushes each!).
- Lucas Aerospace disposed of over 12 thousand tonnes of waste, that's 1.8 tonnes for each employee. Or, as much as 37,500 average UK households would produce in the same time period.
- 20% of waste produced was recycled.
- The cost of waste and effluent disposal was over £219,000.
- At least £280,000 was lost as more than 174,000 litres of solvents evaporated into thin air.

Terry Bridgewater
HS&E Manager
August 1998

Data compiled by Nicolette Lawson

Contents

Introduction and Notes

We have now collected a significant quantity of data for the first six months of 1998.

We have included a graph of the Self-Assessment progress and the detail of the second quarter's data, but have only focussed on the waste measures for analysis and action setting.

The highlights are presented in the "Did You Know?" box on the front sheet.

Why focus on waste?
- Waste data is patchy
- It looks like a poorly managed area which is not under control at all sites
- Costs (for disposal and recycling) vary greatly
- It looks neglected
- Waste is highly visible to the workforce and site visitors
- Lucas Aerospace compares poorly to other parts of LucasVarity

Benefits of Improvement
- Cost Savings
- Reduction of environmental liabilities
- Visible signal of positive action to the workforce and others.

Time Frame
Data covers the six months of January through to June 1998. It was collected and analysed quarterly in April and July and the cumulative results will be presented to LucasVarity HS&E committee in October 1998.

Notes
- The quality of data is improving and some has been adjusted retrospectively.

Please send your comments back to Terry Bridgewater, c/o Shaftmoor Lane.

Action Summary

MG: Obtain more accurate electricity consumption figures for second quarter (kWh given is less than 1% of last quarter!)

Action: WH

MG: Provide waste data (estimate if accurate figures not available – volumes can be converted to approximate weights)

Action: WH

M: Investigate and report on reason for high waste disposal costs (due to high level of special waste?)

Action: NW

SL and W: Check volumes of general waste and requirement for 2 skips per day.

Action: MB
Action: KD

W: Check why costs are twice (?) that of SL, for the same volume.

Action: KD

SL: Understand waste volumes.

Action: MB

U: Advise why effluent is so high.

Action: DW

All Sites: Ensure special waste is properly segregated, to avoid contamination of other waste. Ensure all waste is clearly labelled – unknown waste could be treated as special waste.

Action: HS&E Co-ordinators

All Sites: Reduce stock holding to a minimum. A lot of waste is unused chemicals that are out of date. It has been known for disposal costs to exceed the original cost of the chemicals!

Action: HS&E Co-ordinators

All Sites: Investigate prices obtained for metal recovery. Could value be increased by better segregation, draining of coolant etc.?

Action: HS&E Co-ordinators

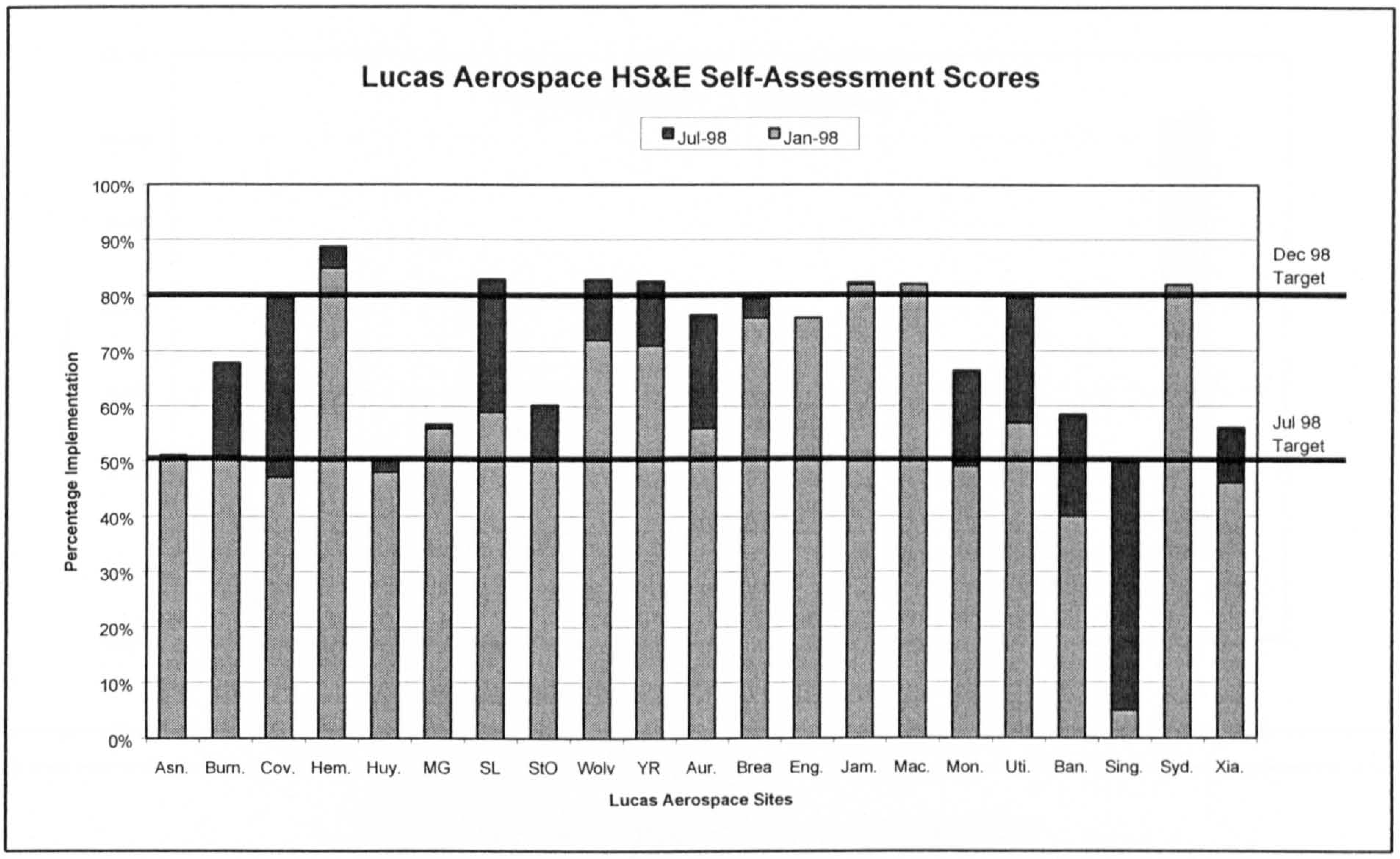
All Sites: Investigate composition of other (general) waste. Could materials be segregated and recycled?

Action: HS&E Co-ordinators

Self-Assessment Progress

Comments on Self-Assessment

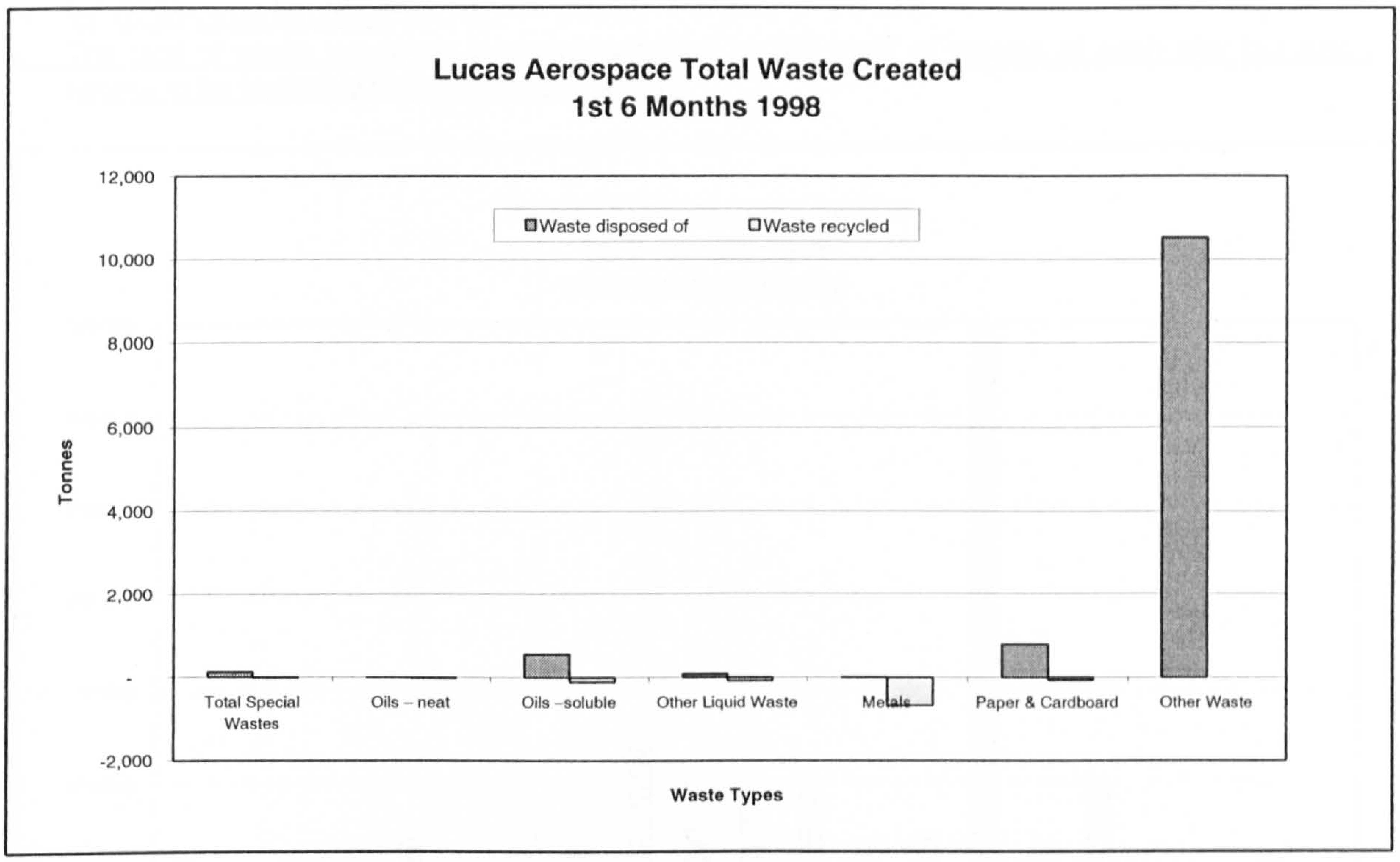
- All sites have passed the July 98 target of 50%
- 10 sites have already reached the December 98 target of 80%
- 5 sites have not improved their self-assessment score since January 98 (although 3 of these were already over 80%).
- Improvements over 80% are much harder to achieve than those starting from a lower position.
- H reports the highest Self-Assessment score (89%)

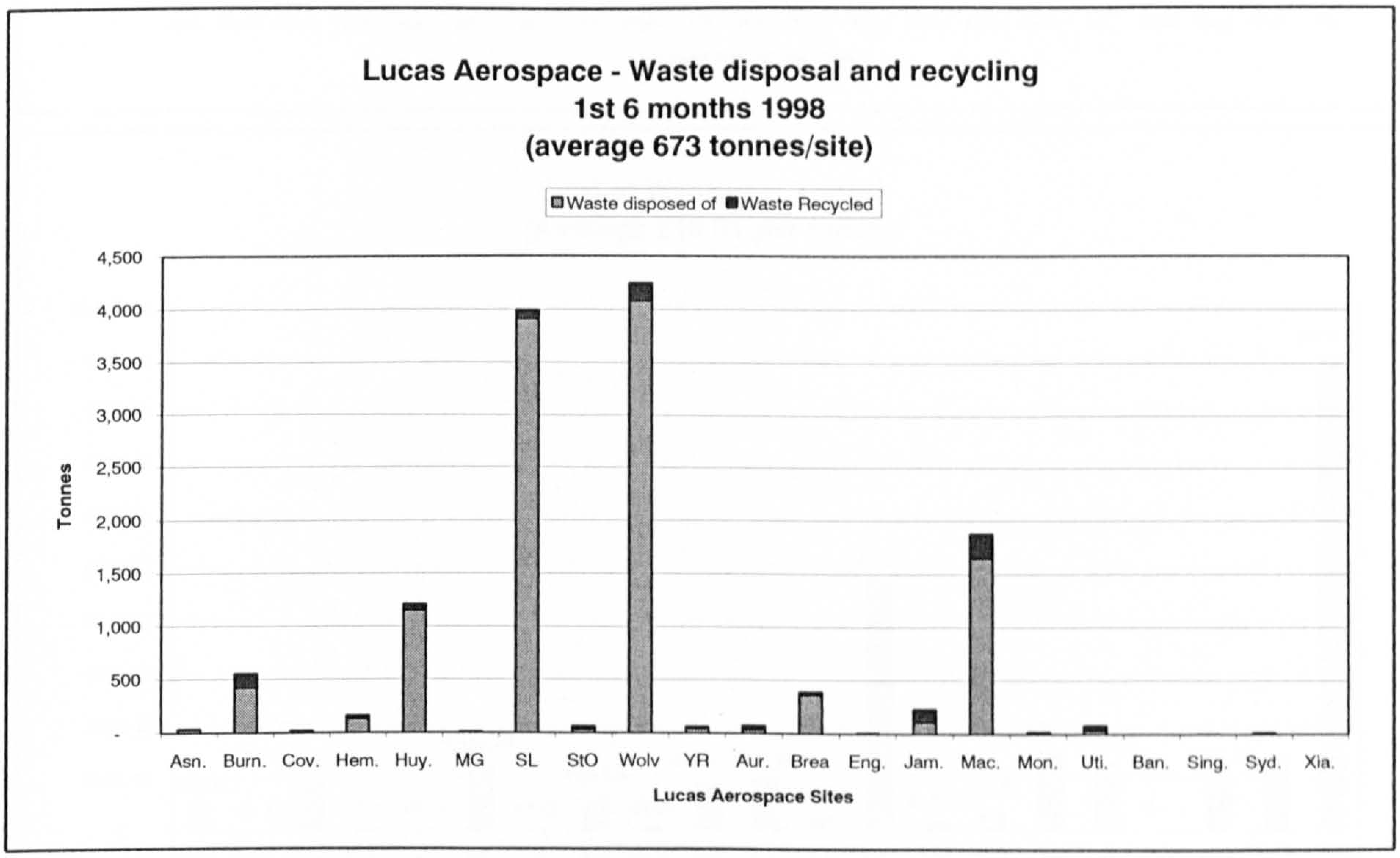


Total Waste Created (includes waste disposed of and waste recycled)

Comments on waste created

- The total waste created in the first 6 months weighed 13,062 tonnes, as much as 40,800 average UK households.
- SL and W produce significantly more waste than other sites (6 times the average!). This is mainly due to Other (General) Waste.
- The amount recycled is small.

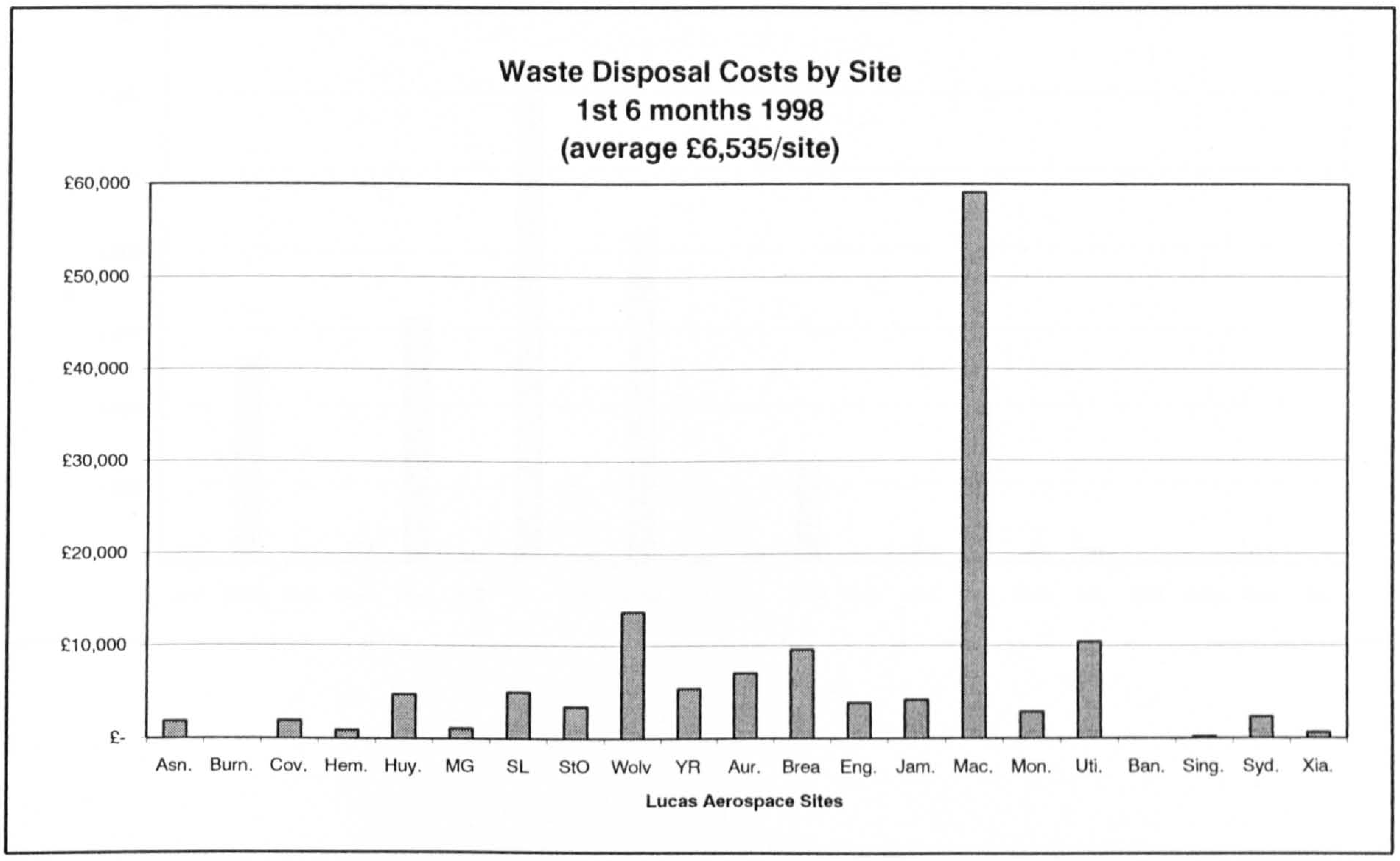


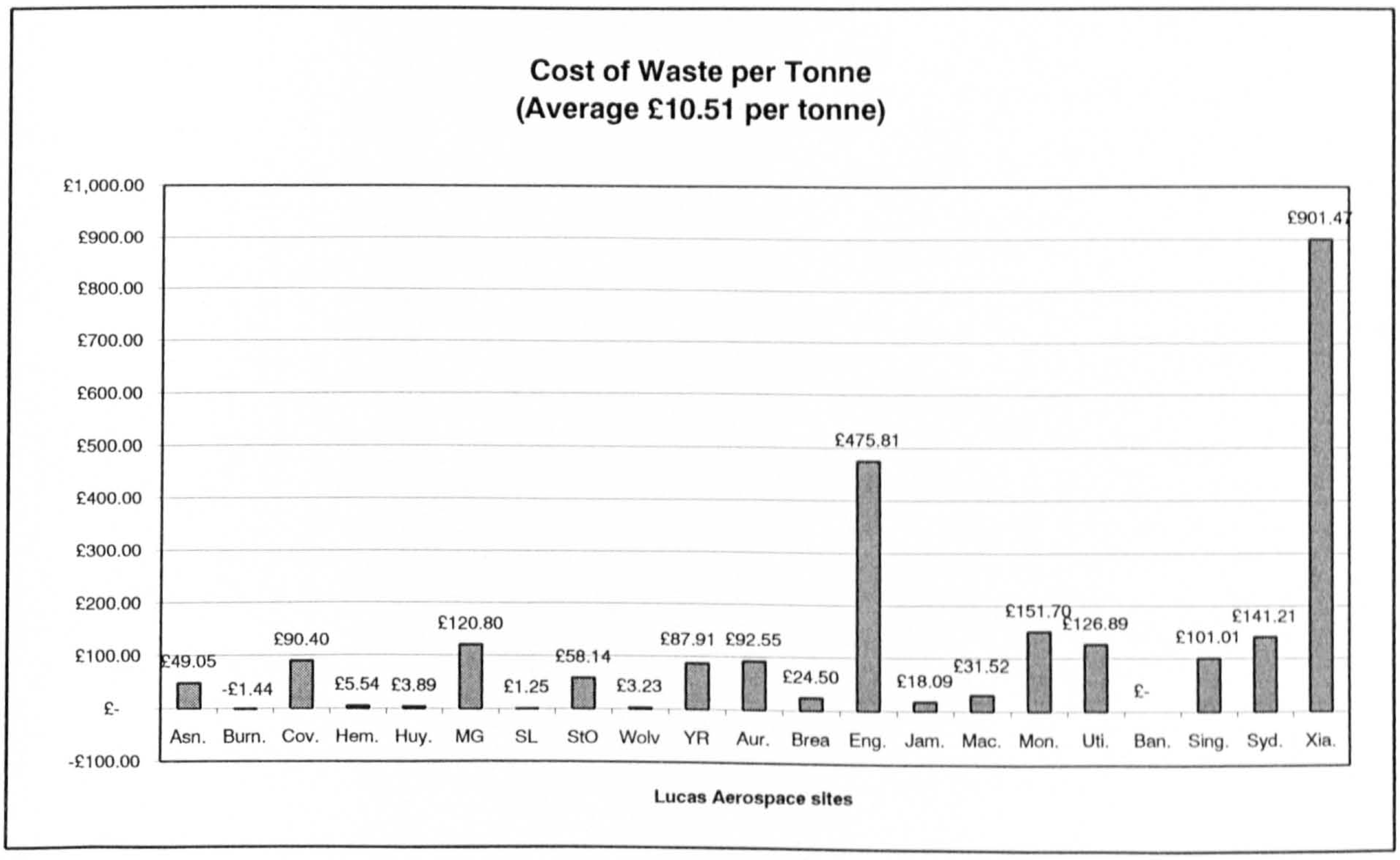


Total Waste Costs (includes disposal and receipts from recycling)

Comments on waste costs

- The total waste disposal costs (minus money received from recycling) in the first 6 months was £137,245, an average of £6,535 per site.
- The highest costs by far are reported by M (9 times the average). Although it's average costs per tonne are not the highest.
- SL and W have very low costs compared to the amount of waste created, since it is predominantly general waste which is taken away daily and the charge per skip is very low (£27 for 16 yd³, £25 for 12 yd³).
- The cost of waste per tonne is greatly affected by the "mix" of wastes at each site, but also it seems to be inversely proportional to quantity.

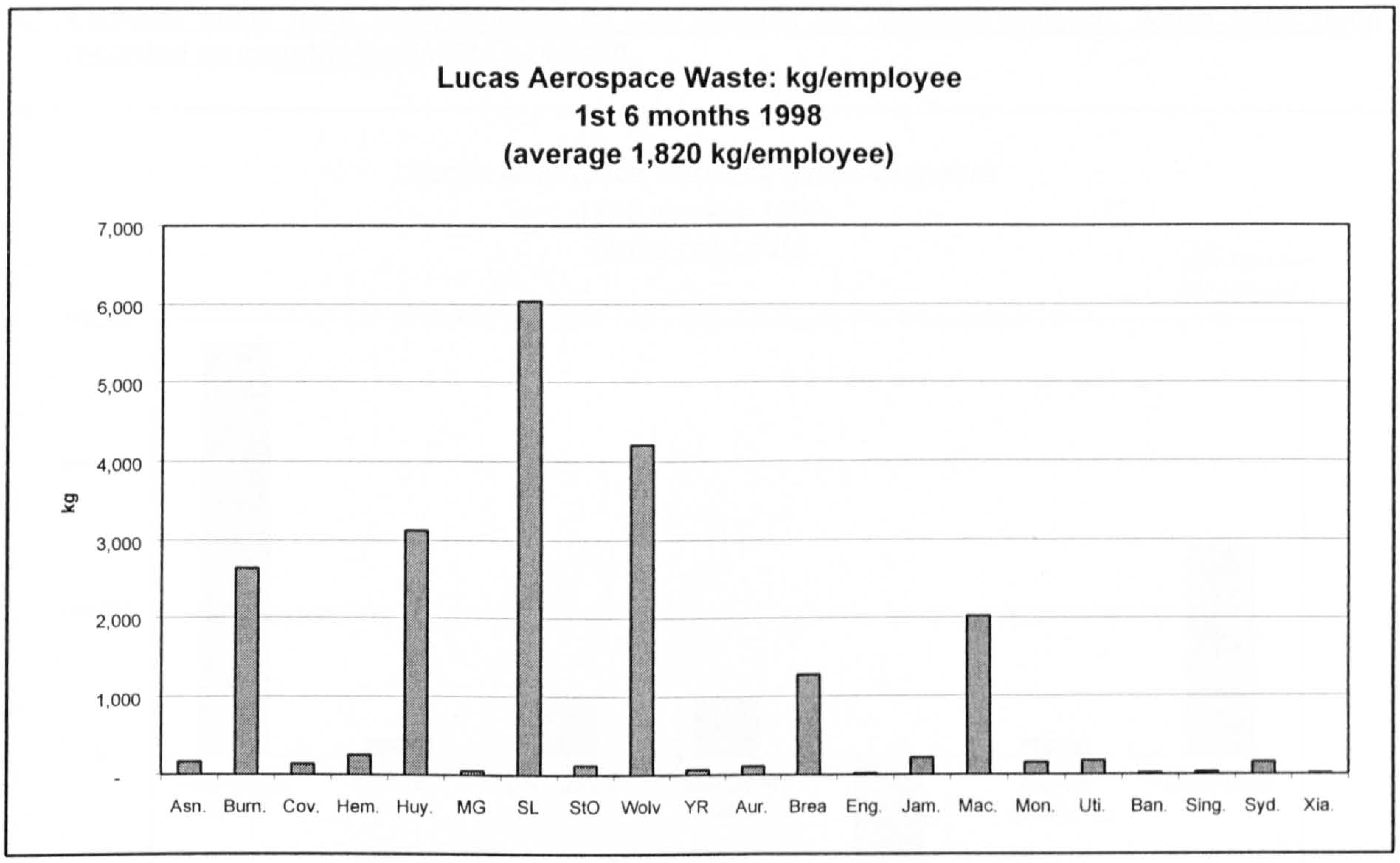




Waste per Employee

Comments on waste per employee

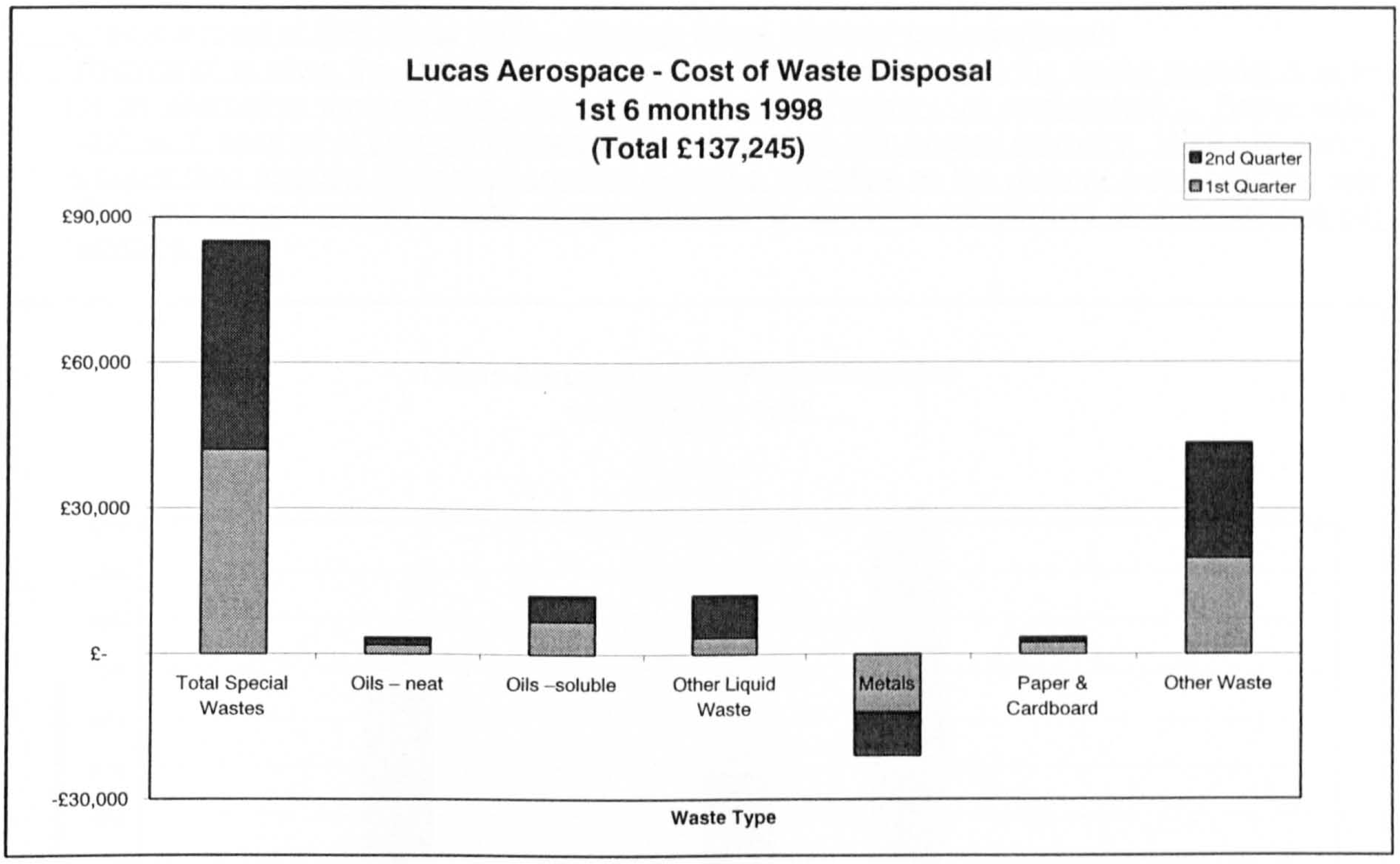
- The average amount of waste (excluding recycled) per employee is 1,820 kg in six months.
- SL has the highest amount per employee at 6,000 kg (6 tonnes or 1 tonne per month per employee)

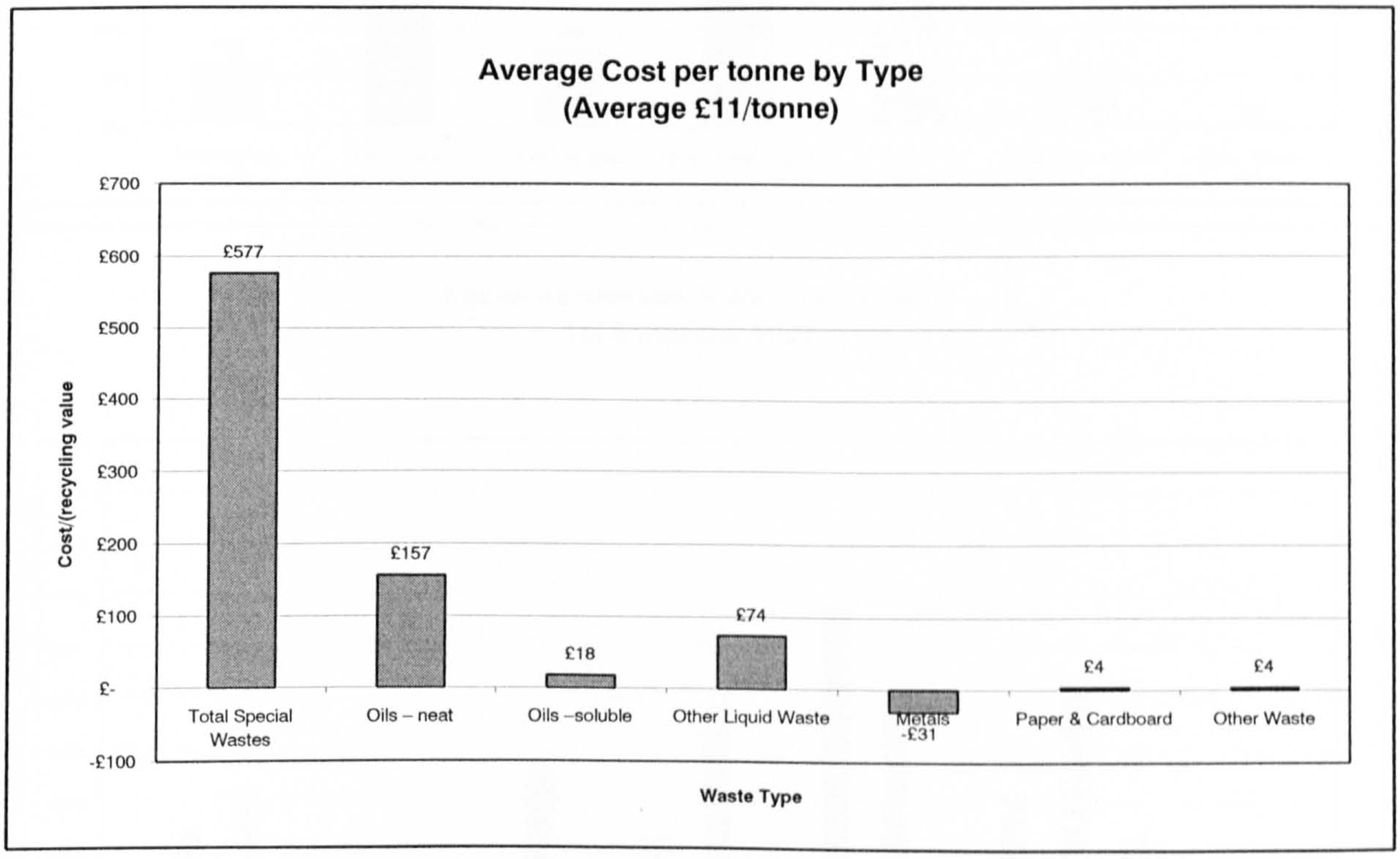


Overall Waste Picture by Type

Comments on overall waste picture

- These charts demonstrate that small quantities (see Total Waste Created) of special (hazardous) waste are very costly to dispose of. It is therefore important to segregate waste and not allow general waste to become contaminated, as this would necessitate disposal as special waste (at high prices).
- Disposal costs have been reduced by any receipts for recycled material, which have been recorded as negative costs (i.e. a benefit).

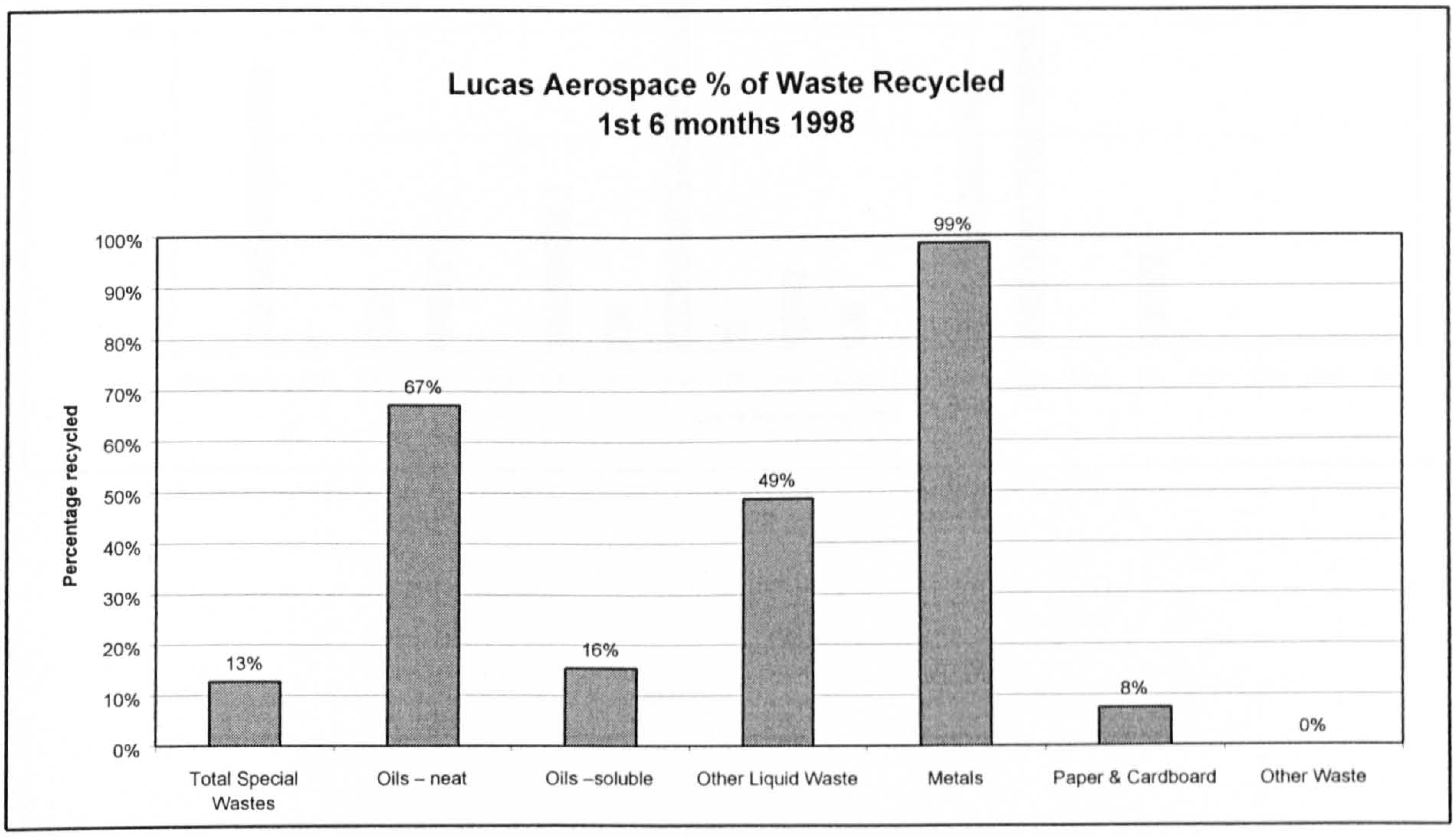


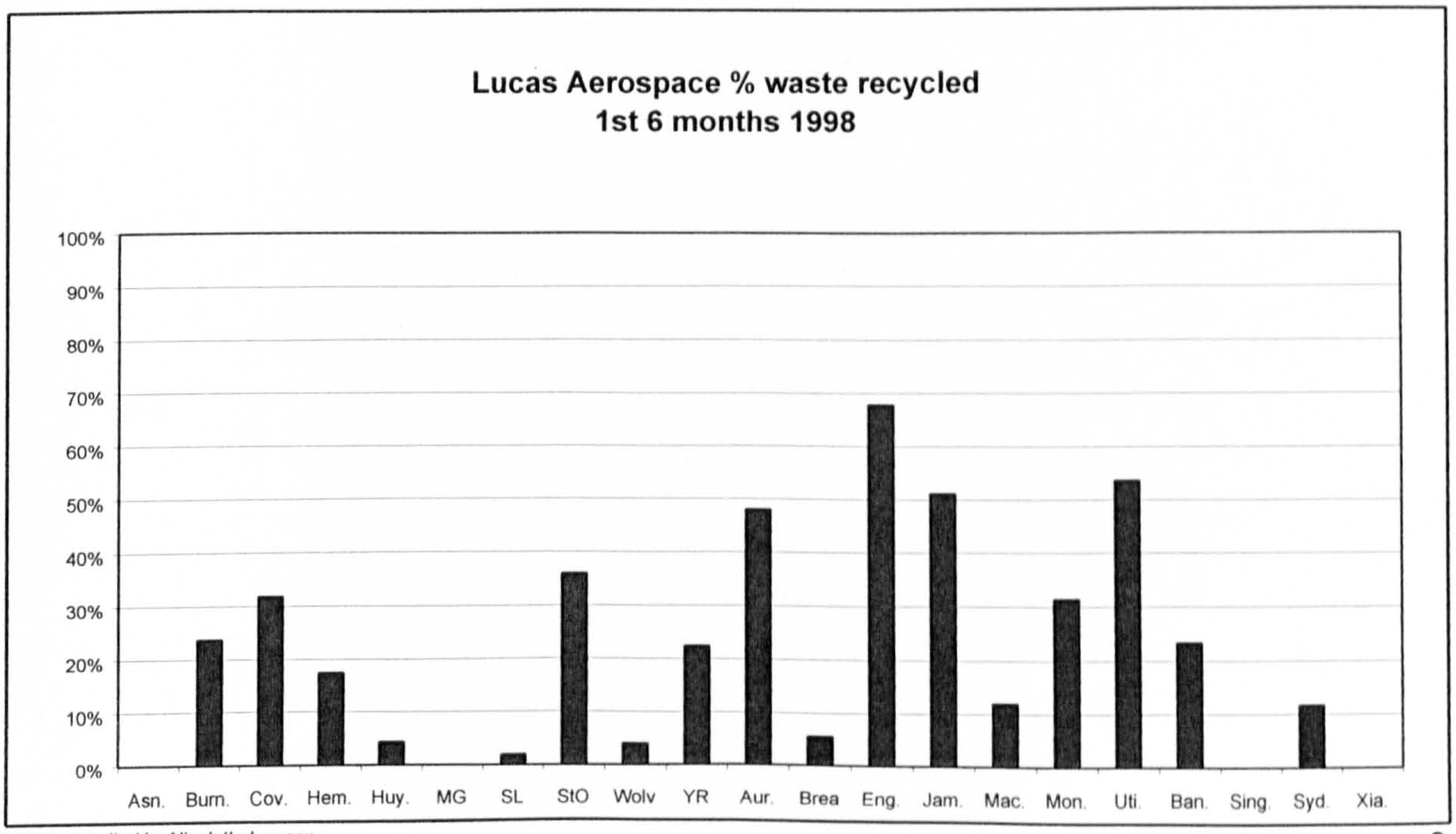


Recycling Performance (1)

Comments on recycling performance

- 99% of metal waste created is recycled. However, examination of cost data suggests that we do not segregate well and therefore get a poor price.
- Other Liquid Waste is 49% recycled. This includes kerosene and solvents.
- Paper and cardboard at 8% is very poor.
- Other Waste is not recycled at all because it is all mixed. Although studies at other companies have shown that over 50% of General Waste is usually paper and cardboard which could be segregated for recycling.
- E recycle most of their waste (68% - although this is all paper and cardboard)
- "Recycling" is when the material is used again. "Recovery" is when the waste material is used for an alternative purpose (e.g. incinerated to produce energy, or composted). Some sites, such as Y, send all of their general waste for incineration with energy recovery. Whilst Recovery is better than disposal it is not as good as recycling, therefore as the present data collection only allows for two categories of data, recovered waste is currently categorised as disposal and not recycling.



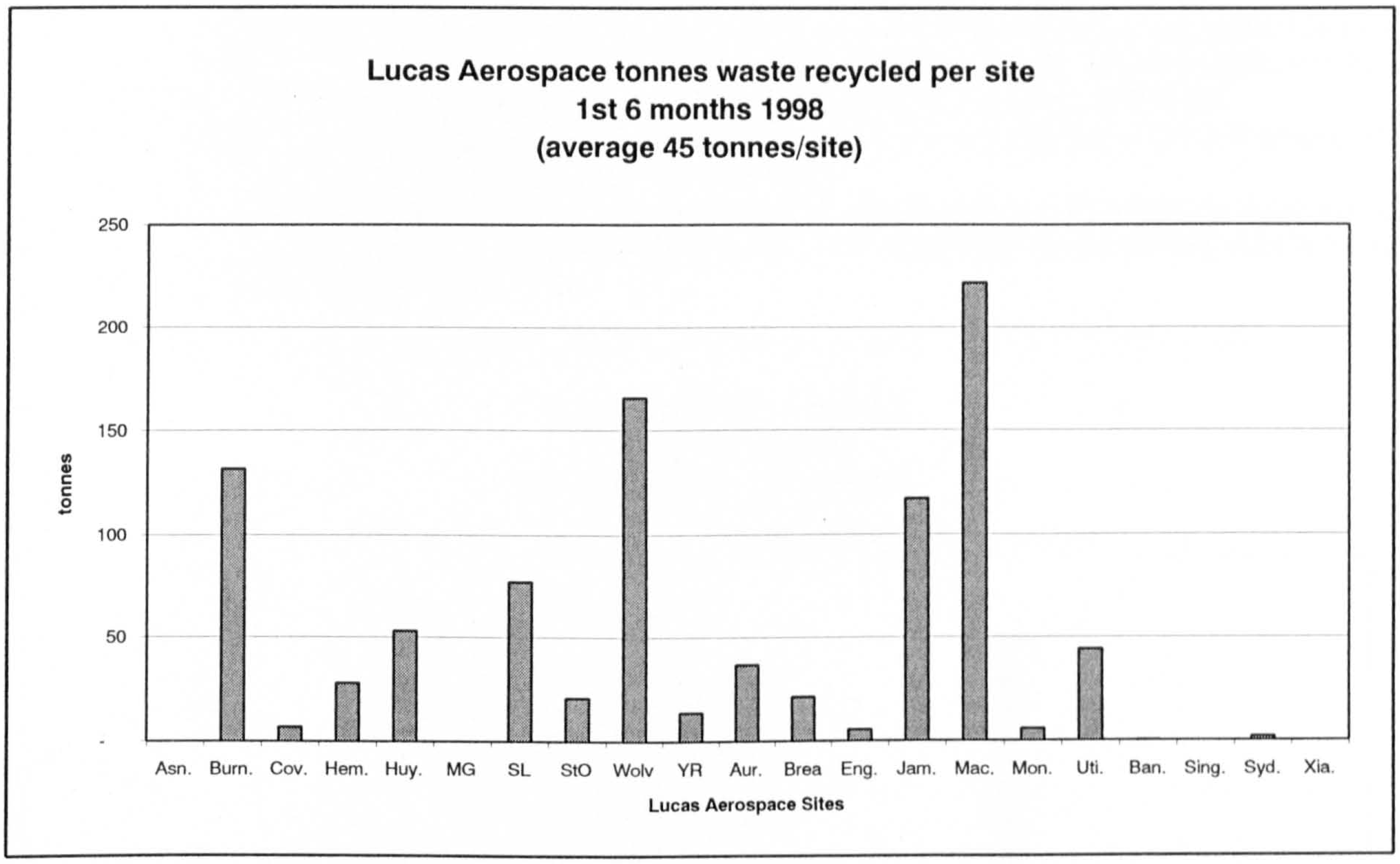


Data compiled by Nicolette Lawson

Recycling Performance (2)

Comments on recycling performance

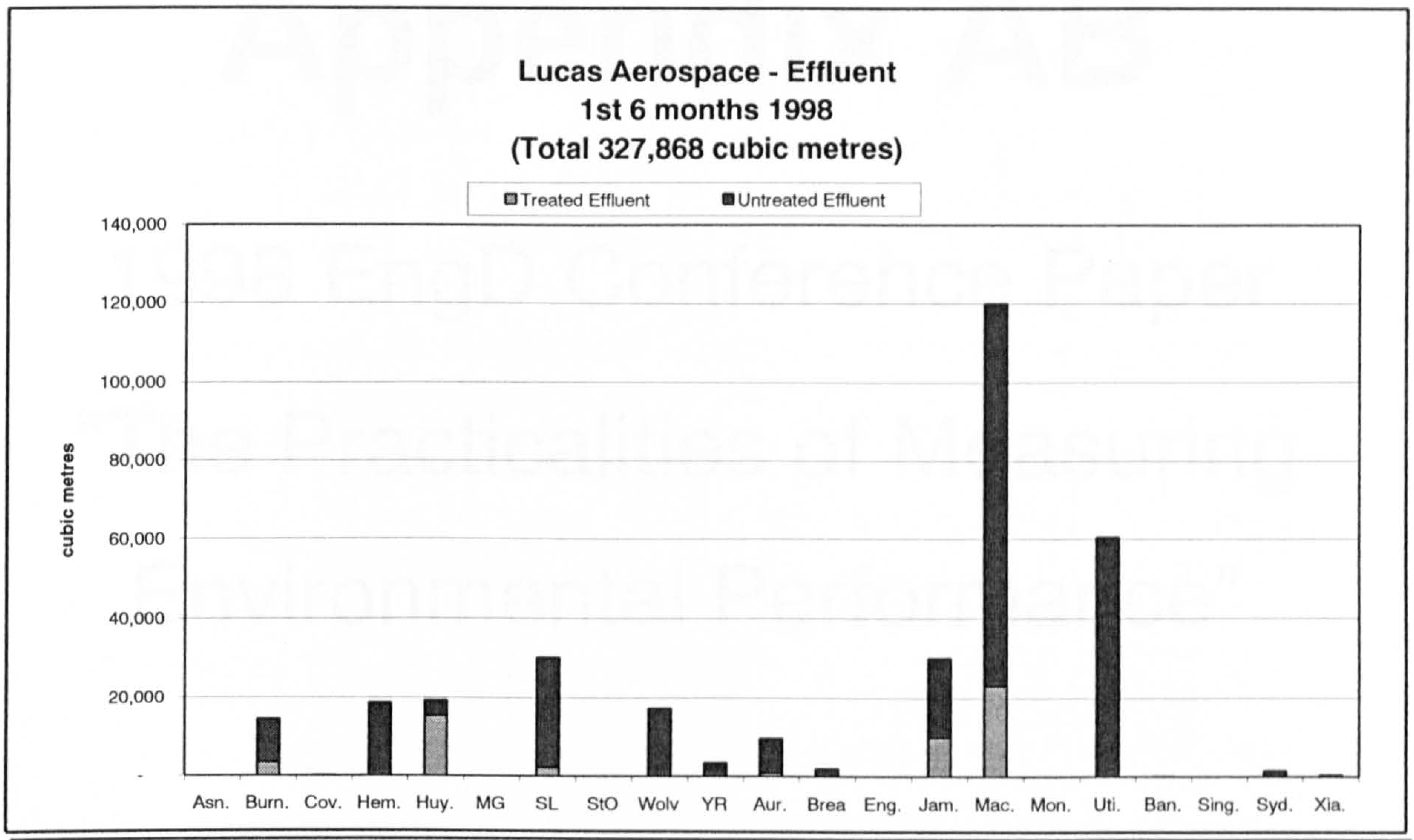
- M recycled over 220 tonnes of waste, but this was only 10% of their total waste.
- Likewise, W recycled 160 tonnes of waste (mainly metal), but this is less than 5% of their total waste.

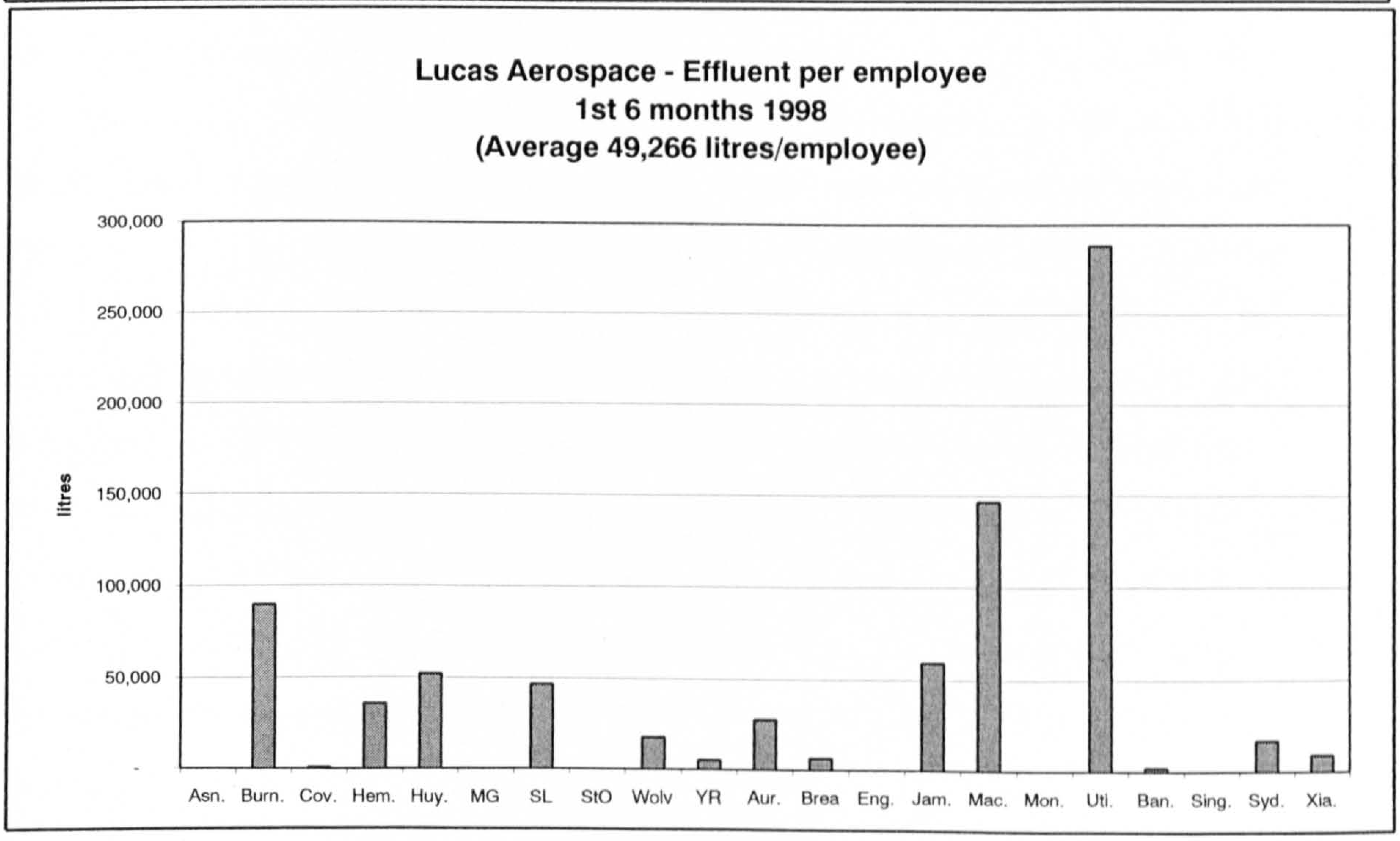


Effluent

Comments on effluent

- "Effluent" is waste water from manufacturing, and support, processes. Domestic waste water (from toilets, kitchens etc) should not be included in the "Effluent" figure.
- "Treated Effluent" has had some treatment on site prior to discharge to drain (e.g. pH adjustment, ion exchange, neutralisation etc.)
- "Untreated Effluent" is trade effluent that goes directly from the process to the foul sewer drain. It is acceptable by the sewerage undertakers/water company because any contamination is within prescribed consent limits and therefore does not require treatment prior to discharge.
- The difference between incoming water consumption and effluent (treated and untreated) will represent domestic waste water and evaporative losses.
- Some sites have included domestic waste water in their effluent figures, (this seems to be due to confusion over the definitions, above) therefore the data presented is not strictly comparable. All effluent figures require checking.





Appendix AB

1998 EngD Conference Paper

"The Practicalities of Measuring Environmental Performance"

THE PRACTICALITIES OF MEASURING ENVIRONMENTAL PERFORMANCE

Nicolette Lawson [(1)] Dr.C.France [(2)] Dr.M.J. McKiernan [(1)]

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1 Abstract

Industry needs to measure its environmental performance in order to understand the scale of its environmental impacts. Environmental Indicators are necessary to monitor improvement, to make the business case for HS&E policies and action, to demonstrate that resources are being applied to the best possible effect, to help set priorities for action and because managers expect performance to be measured.

This paper describes the development and recent implementation of a company-wide system to report Environmental Measures of Performance in LucasVarity.

The importance of the measurement system, the numerical results and the cultural, physical and business constraints that affected the development of the system are discussed.

Key Words: Environmental Performance Indicators, Measures of Performance, Environmental Management Systems

2 Introduction

"Almost every company will need to pay greater attention to environment-related performance measurement, both to have better data for internal decision making and to meet the demands of ever more sophisticated stakeholders. They will also have less flexibility as initiatives such as ISO14031 (guidelines on environmental performance measurement) and government regulations build a consensus about what should be measured and how it should be communicated." (Bennett & James 1998)[1]. Other critics, such as Welford and Jones (1994)[2] cite a long list of areas that businesses could measure to indicate Sustainability, but for a company just starting out on the environmental measurement road this looks like an impossible wish list.

Since the beginning of environmental action in Lucas Industries (now LucasVarity), which was signified by the setting up of the corporate Health, Safety and Environment (HS&E) Department in November 1991, the challenge has been to understand the environmental performance of the company and track its progress.

The first approach was to launch an Audit system in July 1992, to assess the businesses against the new HS&E policy. A questionnaire was developed, with nearly 650 questions, which could be answered by the audit team after the site review and would give a percentage score for the 5-steps[3] identified as necessary for the implementation of HS&E management: Policy, Organisation and Arrangements, Planning and Implementation, Measuring Performance, Reviewing Performance.[4] The same questions, analysed in a different way, were also used to provide a score for the four areas of Management Systems, Health & Safety, Environment and People (training, awareness, competence, communications etc.). Results were displayed on a Max-Min graph, which showed the range of scores from worst to best (Figure 1). The position of the current site being audited could also be plotted for comparison.

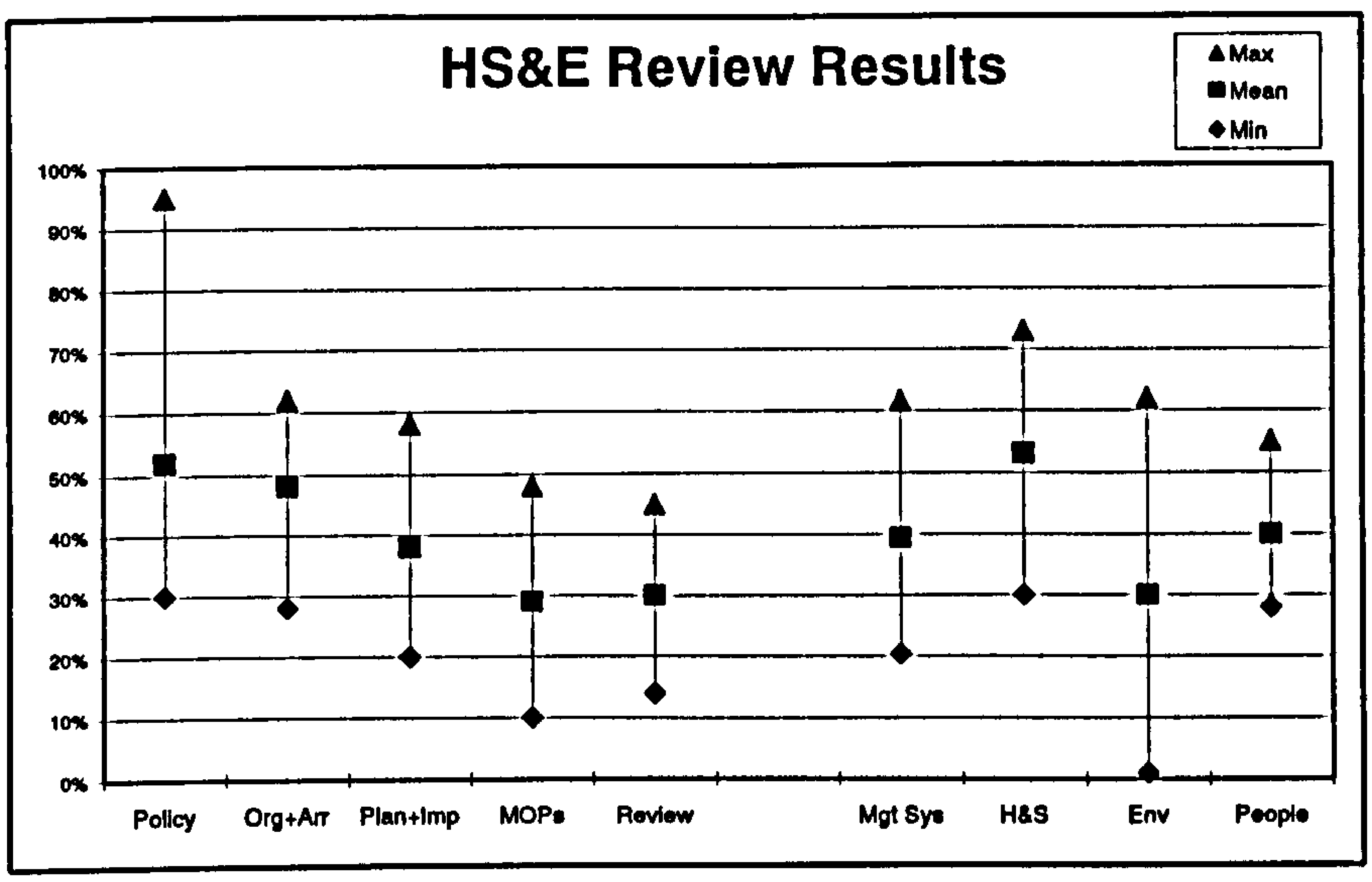

Figure 1: example of Phase 1 audit result.

However, the results tended to follow a typical profile, with Measures of Performance and Review consistently the weakest elements. Hence the need to improve this area was identified early in the process.

Businesses were also asking about measures of performance and the need for standards against which to compare themselves. Thus, the Lucas Industries HS&E Handbook (1995)[5], containing standards on Management Systems, Environment, Safety and Heath issues was developed in 1995 and issued to all Lucas businesses as a best practice benchmark. The second phase of audits then measured businesses against the Standards and gave them a percentage score in relation to achieving best practice. This system was subsequently adopted as a Self-Assessment System (SAS)[5] so that sites could benchmark themselves between audits.

However, it was recognised that additional, quantifiable, performance indicators were required to back-up this qualitative management systems approach to measuring performance and to provide a more complete picture. The search for a suitable set of quantifiable performance indicators started in 1993 when enthusiastic ideas generated a list of over 40 items – a mixture of programmes and procedures to implement and parameters to measure. The first output from this exercise was a short set of targets ("commitments to progress") issued in 1994, intended to raise the minimum level of performance across all the businesses. These targets included elimination of Ozone Depleting Substances, compilation of an inventory of environmental impacts, preparation of a waste map and reduction of energy and water consumption by 10%. The targets had the desired effect of causing businesses to focus on HS&E issues. However, timescales were not realistic for all businesses, targets were not separated into "must do" and "should do" and progress towards the target was reported rather than actual figures.

The positive response to the concept of targets would be the foundation for future measurement, but with objectives set at group level, allowing businesses to set their own timescale targets. It was recognised that a lack of follow-up could de-motivate and lose credibility.[6]

The aim of this research was to develop a robust set of performance indicators which could be used consistently across all 124 LucasVarity businesses in its 25 operating countries, enabling performance of the Group, as well as individual sites and divisions, to be understood.

This report briefly summarises the findings of a pilot study undertaken with six Lucas businesses in 1995/96 to test the feasibility of collecting HS&E performance data. It then goes on to explain the developments that took place subsequent to the pilot study, the implementation of a company-wide scheme in 1998 and the lessons learnt from the first round of world-wide data collection and analysis.

3 Methodology

A proposed set of HS&E measures of performance (MOPs) were presented for review at the Group HS&E Committee. The need and concept of measuring HS&E performance was accepted, but total confidence was not obtained for the chosen set of measures and doubts about the capabilities of the businesses to collect such information were expressed. It was therefore decided to carry out a pilot exercise [4,8] on six sites, one from each division, to see if these misgivings were founded, before implementing the system company-wide.

Following the pilot study the MOPs were revised and presented to the new LucasVarity HS&E Committee (since a company merger had occurred in the interim). The committee requested that the proposed list be simplified again, resulting in a set of seven HS&E indicators. This paper shall concentrate on the Environmental Performance measures, consisting of aggregate measures such as energy consumed, waste disposed and emissions discharged.[7] This set of MOPs was agreed and implemented at the end of 1997 for reporting to begin quarterly in 1998.

3.1 Pilot Study Results and Lessons Learnt[8]

The six nominated businesses returned results for 1995/96 in the following areas: management systems, environmental performance, health and safety, commitment to competence (training) and contextual business information. This paper focuses on the environmental measures.

3.1.1 Management Systems

All six businesses submitted their HS&E programmes, objectives and targets for the previous and future years. However, the level of detail varied so greatly between businesses that it became an almost impossible area to analyse. It was decided that in order to compare businesses and compile information at Group level in the future, sites should submit their current self-assessed score, showing progress towards implementation of the Company Standards.

3.1.2 Environmental Performance

This section was the most detailed part of the required data, which Senior Managers initially thought would be too difficult for businesses to answer. However, it was completed by all businesses with few problems. The main data weaknesses seem to be in the reporting of quantities (e.g. for energy, waste etc.), but all businesses were able to report on costs (probably because the financial accounting systems are the only integrated data systems that all the businesses share). The consensus from the pilot sites was that it was a useful exercise and that the data was generally available but not necessarily in the right formats.

3.2 World-wide Implementation and Lessons Learnt[9]

Every LucasVarity business now has to submit its HS&E Measures of Performance (MOPs) once a quarter, in time for reporting at the Group HS&E Committee. The first quarter's results were collected in April 1998, the second in July. Data was collected, compiled and analysed for one of the six divisions (this division will be referred to as "A"), the fourth largest in terms of people. Division "A" consists of 21 sites in the UK, France, North America, China, Singapore and Australia. Aggregate results across the six divisions (A, B, C, D, E, and F) were also compared. This hands-on approach enabled the researcher to find out what difficulties the businesses were experiencing and the practicalities of collecting, compiling and analysing this type of data.

3.2.1 Data Collection Problems

3.2.1.1 Level of Detail

The first thing to be realised is that reporting of aggregate figures at Group level is hardly a realistic simplification once you get down to site level. The requirement for "Total Energy consumed" still requires knowledge of how much gas, electricity, oil or other fuel has been used. In fact, the more detailed data that is available the better, and in truth it is more realistic, since these things are originally separate items. If sufficient detail is collected the data will not only satisfy the aggregate requirements of the Group executive, but will also enable important analysis to be carried out at site level. However, the balance has to be right, since too much detail submitted at Divisional level will slow down the process and may result in time being spent on low priority issues. For example, in Division A, two sites in the first quarter and one in the second quarter, provided detailed lists of substances containing VOCs. Whilst it was possible to compile the data into VOC types (as requested on the MOP proforma), it was a time-consuming exercise for the data compiler.

In some cases there was a complete lack of data available. In the first quarter, 12 out of 21 sites, and 8 in the second quarter, were unable to supply data that was requested.

For each item being measured, it is useful to have two pieces of data, for example cost and quantity. This makes it easier to spot abnormalities in the data, since there are then two points of reference, to be used in absolute or relative terms. One such comparison of cost and quantity revealed that different units had been used each time.

3.2.1.2 Units

When collecting data from many countries the problem of measurement units is encountered. Despite the Standard International (SI) unit system, some countries (particularly the USA) use different units and companies are likely to submit data in whatever unit local custom and practice dictates.

The MOP proforma sent to all the sites specified the units required. However, in the first quarter 8 out of 21 sites provided data in different units to those requested. Consistency improved however because this had fallen to 2 by the second quarter.

Where costs were collected, they were all converted to a single currency (£ sterling) for comparison and aggregation. However, because exchange rate fluctuations could have distorted overseas figures, it was decided to use the same exchange for the second and subsequent quarters, in order to maintain some consistency with cost versus consumption comparisons over time.

Some (5/21) sites were unable to supply general waste figures as a weight, only by volume. Here an assumption that a cubic metre of waste was equal to 1000kg was used. This is likely to be an over-estimation because general waste is a mixture of materials, usually not compacted, and is unlikely to weigh this much. Often waste contractors visit sites to empty skips on a set frequency basis and skips are emptied regularly whether they are full or not. Clearly this is an area where sites may not be getting value for money: i.e. they are paying for fresh air to be disposed of. The benefits of such a crude volume-to-weight conversion however is that it will at least draw attention to those sites which operate inefficient waste removal systems. The figures will also be consistent for those sites over time – until they change the way they manage waste disposal!

Other wastes were submitted in kg or litres (as requested), lbs., tons, tonnes, gallons (imperial and US), cubic metres and cubic yards. Quantities of substances, such as solvents, were in some cases quoted in “drums”, “units”, “packs” and “containers” – not a lot of use when you are trying to compare them to litres!

Energy figures were submitted in nearly as many units, particularly gas: which was reported in seven different units including kWh (as requested) therms and cubic feet.

3.2.1.3 Frequency

In the pilot study a whole year's data was requested. In the newly implemented system, data is collected quarterly, so that results can be presented at the quarterly Group HS&E Committee. Some sites collect their data monthly and submit it quarterly as required. Collecting data frequently is a good discipline, however analysing it too often can cause problems. For instance, certain figures such as energy consumption are seasonal and so improvements over time can only be seen clearly when compared year by year. On the other hand if electricity for production can be separated out from that used for heating or lighting, improvements may be shown over much shorter time periods.

Waste disposal also varies greatly, particularly special wastes and tankered liquids that are often saved-up until an economical disposal quantity is reached. Waste levels also vary greatly during times of refurbishment and "spring cleaning".

The usual time period for reporting data, particularly externally, is on an annual basis, as this tends to iron out most of the seasonal fluctuation. More frequent data collection and reporting however does have the advantage of highlighting anomalies earlier and enabling problems to be investigated. For Division A for example, the second quarter's data raised 12 questions about data presented in the first quarter: these included costs and quantities that were proportionally inconsistent with the first set of data, miscalculations, false conversions, typing errors and mismatched units. Three sites even submitted data identical to the first time.

3.2.1.4 Definitions

Clear definitions of what is to be reported are crucial. However problems with definitions may not arise until part way through implementation. When designing a system to be implemented by many different businesses in many different countries, the aim was to keep it as simple as possible and focus on the issues that all businesses would have. Definitions and explanations were provided as well as a proforma, defining the units in which quantities should be submitted. Still questions over definition have been raised and will need to be addressed. These include:

- Whether standing charges should be included in energy costs?
- Whether waste incinerated with energy recovery should be counted as waste disposed of or recycled, or a separate recovery figure?
- Whether water consumption costs include effluent disposal costs?
- Whether simple calculations, such as that for VOCs emitted (purchased quantity minus disposed of quantity -including any recycled- multiplied by the percentage volatility) are accurate enough, given that assumptions such as 1 litre of solvent evaporates to give 1 kg of gas, do not make reference to specific gravity.

4 Discussion

Despite a long and protracted development period (extended by organisational changes in the company), an environmental performance measurement system has finally been implemented across all of the LucasVarity businesses (124 sites in 25 countries). Although a number of teething problems have arisen, the process has started and can be improved and refined over time. Bennett and James (1994)[10] state that "the scale of the challenge is such that even the simplest measures are better than nothing at all. Immediate action of almost any kind can signal a serious intention to the world, make some reduction of environmental impacts, reduce risks of negative reactions by regulators, customers and stakeholders and provide a platform for further action. The overriding necessity is to begin the process of continuous improvement of environmental performance".

Bennett and James' views seem to have been borne out since the collection and reporting of this data has focussed businesses and managers on previously ignored areas of business operations. Reporting of the data and comparisons of divisions, and sites within divisions, has already started to stimulate competition to do better and a curiosity has been awakened causing more questions to be asked and more investigation to be carried out.

Analysis of the data is a time-consuming task, but one that is best handled manually, rather than automatically, at the outset to enable anomalies to be filtered out and fed back to the businesses for rectification. Once all the problems of data collection (units, definitions, assumptions etc.) have been addressed then systems for automatic data analysis could be considered.

For the first year, or two, it is accepted that inaccuracies will occur in the data. Sites may start by submitting estimated quantities where they have no current systems of recording data, but it is expected that the information will become more accurate over time as people become used to the process and investigations into "suspect" areas are carried out. The data collected is still valuable for internal reporting. Slight errors will not affect the big picture, which will be better than no picture at all! Large errors are likely to get investigated, as they will show up as abnormalities, which will draw scrutiny and eventually help in refinement of the process.

In their latest, and most comprehensive, report for ACCA, Bennett & James (1998)[1] explain that the process of measuring environment-related performance can be as, or more, important than the data, since it raises awareness, starts people thinking, and builds support for more proactive environmental initiatives. They agree that it is an ongoing, iterative process, because much data is incomplete to begin with, and will be improved over time. They also concur with our approach of starting simple and making maximum use of existing data to address mainstream business concerns.

The process is by no means complete and will need to be refined and developed over time. Issues of definition need to be addressed and additional data may also be needed to complete the sketchy picture that we are now able to draw. It is intended that the data and the system will be reviewed at the end of the first data collection year and improvements put forward for next year.

When designing a system it is important not to underestimate the power of political motives to influence the design of systems. A good system design is one that can be implemented. Therefore it is necessary to understand the invisible forces that will determine whether a system succeeds or fails; the drivers, the barriers, the key players and their motives. In order to have a proposal implemented, it needs to fit the culture and ability of the business (or the perceived culture - do senior management really understand the cultural differences in the organisation layers below the one in which they operate?). Once in place the systems will naturally be revised and improved and some of the original ideas may eventually be incorporated.

5 Conclusions

This paper has concentrated on the practicalities of measuring environmental performance, rather than the actual data collected.

Future work in the company now has to focus on improving the quality of data collection, simplification or automation of the analysis process and an assessment of the validity and usefulness of the information reported.

The difficulty is in implementation and maintenance of a system that can be readily used by a wide variety of businesses and in the selection of data that is reportable by the majority of businesses and of significant meaning to the company as a whole.

This research has resulted in a robust, implementable system, utilising both quantitative and qualitative performance indicators, which is already starting to raise awareness and open up areas for further work. It may lack the sophistication sought by external critics[1,2] and exhibited by more progressive companies, such as BT[11] or ICI[12], but at least it is a step in the right direction, which can only lead to better environmental performance.

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1 **Bennett, M. and James, P.** (1998), "Environment Under The Spotlight – Current Practice and Future Trends in Environment-Related Performance Measurement for Business", The Association of Certified Chartered Accountants (ACCA) Research Report 55, Certified Accountants Educational Trust, London. 1998

2 **Welford, R, & Jones, D** (1994) "Measures of Sustainability in Business", CCEM, University of Huddersfield

3 **Health and Safety Executive** (1993), "Successful Health & Safety Management", Health & Safety series booklet HS(G)65", 1991 (revised 1993)

4 **Lawson, N,** (1997) "Group HS&E Measures of Performance - Results of Pilot Study", LucasVarity HS&E Department (Internal Report).

5 **Lucas Industries** (1995) "Health, Safety & the Environment Handbook" 1995 & revised 1997

6 **Lawson, N,** (1995), "The Need For Environmental Performance Indicators In Management Systems", Proceedings of the Engineering Doctorate in Environmental Technology Annual Conference 1995.

7 **McKiernan, M.J.** (LucasVarity Director for HS&E) (1997) "LucasVarity HS&E Performance Indicators" Document 2-9-97 (internal document).

8 **Lawson, N,** (1997), "A Measure of Success", Proceedings of the Engineering Doctorate in Environmental Technology Annual Conference 1997.

9 **Bridgewater, T & Lawson, N,** (1998), "Lucas Aerospace HS&E MOPs – 1998 1st Quarter's Results", Internal Lucas Aerospace Report, April 1998

10 **Bennett, M. and James, P.** (1994), "Environment-Related Performance Measurement in Business: From Emissions to Profit and Sustainability?", Ashridge Management Research Group

11 **BT** (1997), "A Question of Balance – A report on sustainable development and telecommunications", British Telecommunications plc 1997, London.

12 **ICI** (1997), "Environmental Burden: The ICI Approach", ICI Public Affairs, London.

Appendix AC

Measures of Performance Definitions

Lucas Aerospace HS&E
Measures of Performance
Results Proforma

To be completed for the previous Lucas quarter
Return to: **Terry Bridgewater.** Fax: 0121-707 8826
by 1st week of the new quarter, as below

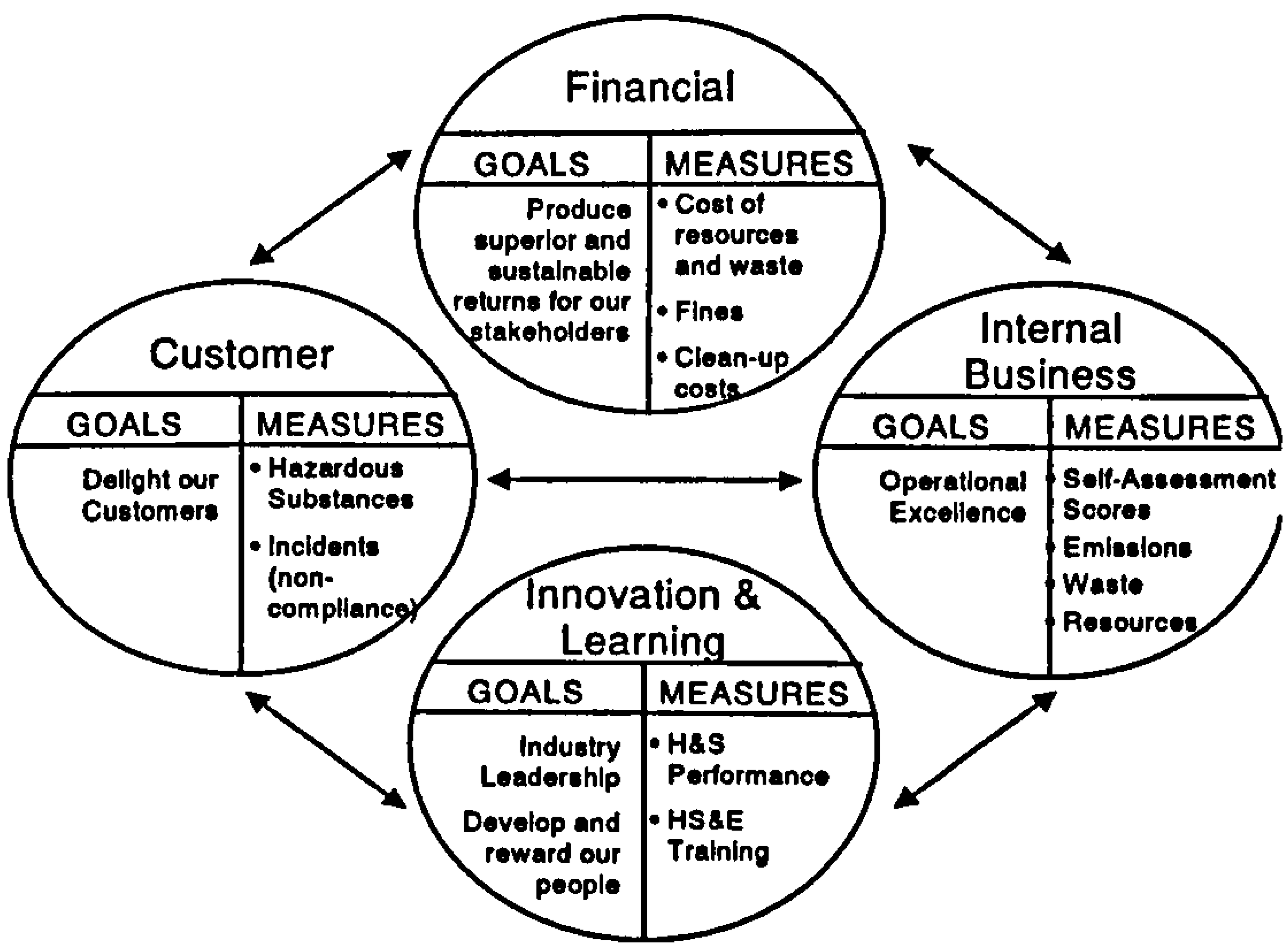
For Quarter:	Report MoPs by
January to March	1st Week of April
April to June	1st Week of July
July to September	1st Week of October
October to December	1st Week of January

Submitted by Site:		Date:
Contact Name	Title	Phone

1. HS&E Balanced Scorecard

Vision: In all activities we are committed to safety and environmental responsibility.

Business Plan: To achieve 80% compliance with LucasVarity HS&E criteria.



2. To put this information in to context:

Site Specific Information	No. / £
Number of Employees (Full Time Equivalents including long-term contractors/temporary staff)	
Annual Site Sales £ (current annual budget)	*Note 1.1*

3. Safety Performance

* do not include day of accident

Work related injuries	Number of occurrences (where absence >1 day)	Total Days Lost* (if absent > 1 day)	Total Employee Days Worked
	Note 2.1		*Note 2.2*

4. Health Performance

* do not include day of accident

Work related illness	Number of occurrences (where absence >1 day)	Total Days Lost* (if absent > 1 day)	Total Employee Days Worked
	Note 2.1		*Note 2.2*

5. HS&E Training

Learning Programme	Senior Managers		Managers & Supervisors		Other Employees	
	Total	No. trained	Total	No. trained	Total	No. trained
	Note 4.1	*Note 4.2*	*Note 4.1*	*Note 4.2*	*Note 4.1*	*Note 4.2*
	Note 4.1	*Note 4.2*	*Note 4.1*	*Note 4.2*	*Note 4.1*	*Note 4.2*
	Note 4.1	*Note 4.2*	*Note 4.1*	*Note 4.2*	*Note 4.1*	*Note 4.2*
	Note 4.1	*Note 4.2*	*Note 4.1*	*Note 4.2*	*Note 4.1*	*Note 4.2*
	Note 4.1	*Note 4.2*	*Note 4.1*	*Note 4.2*	*Note 4.1*	*Note 4.2*
	Note 4.1	*Note 4.2*	*Note 4.1*	*Note 4.2*	*Note 4.1*	*Note 4.2*

6. Environmental Performance

6.1 Consumption of Resources

TOTAL SITE RESOURCES	£	KWh
Consumption of Gas *Note 5.1.1*		*Note 5.1.2*
Consumption of Heating Oil		*Note 5.1.2*
Consumption of Electricity		*Note 5.1.2*
Consumption of other Fossil Fuels *Note 5.1.3*		*Note 5.1.2*
TOTAL ENERGY		*Note 5.1.2*

	£	Litres
Consumption of Water	*Note 5.1.4*	*Note 5.1.5*

If you have any problems please phone **Terry Bridgewater** on **0121-707 7111 x 5354**

6.2 *Emissions To Land (all Waste taken from site)*

Waste Disposal *Note 5.2.1*	**Total Disposal Costs £**	**Kg Disposed of (minus recycled)**	**Litres Disposed of (minus recycled)**	**Main Constituents**	**Amount Recycled (kg/litres)**
Total Special Wastes*	*Note 5.2.2*				*Note 5.2.5*
Oils – neat*	*Note 5.2.2*		*Note 5.2.3*		
Oils –soluble*	*Note 5.2.2*		*Note 5.2.3*		
Other Liquid Waste*	*Note 5.2.2*				
Metals*	*Note 5.2.2*				
Paper & Cardboard*	*Note 5.2.2*				
Other Waste*	*Note 5.2.2*				
TOTAL WASTE	*Note 5.2.2*	*Note 5.2.4*	*Note 5.2.4*		

* Provide details separately, if available

6.2.1 Emissions To Drain

Effluent *Note 5.2.6*	**Cu m Disposed of**	**Cost of disposal**	**Main Contaminants**
Effluent - Treated	*Note 5.2.7*		
Effluent - Untreated	*Note 5.2.8*		
TOTAL EFFLUENT	*Note 5.2.9*	*Note 5.2.10*	

6.3 *Emissions To Air*

Volatile Organic Compound (VOC)* Emissions *Note 5.3.* Please group by type:	**Litres Purchased (A)** *Note 5.3.1*	**Cost per Litre £**	**% Volatile (B)**	**Litres Disposed of (C)**	**Disposal Route** (e.g. landfill, incinerator recycled etc)	**VOCs emitted** (A-C)xB% **(kg)**
Adhesives		*Note 5.3.2*	*Note 5.3.2*	*Note 5.3.3*		*Note 5.3.4*
Cleaning Solvents		*Note 5.3.2*	*Note 5.3.2*	*Note 5.3.3*		*Note 5.3.4*
Coatings		*Note 5.3.2*	*Note 5.3.2*	*Note 5.3.3*		*Note 5.3.4*
Sealants		*Note 5.3.2*	*Note 5.3.2*	*Note 5.3.3*		*Note 5.3.4*
Thinners		*Note 5.3.2*	*Note 5.3.2*	*Note 5.3.3*		*Note 5.3.4*
Others:		*Note 5.3.2*	*Note 5.3.2*	*Note 5.3.3*		*Note 5.3.4*
TOTAL						

*Provide details separately if available

7. Management Systems

Current Self-Assessment Scores:

Standard	% Score
M1: Policy, Objectives and Targets	
M2: Organisational Arrangements	
M3: Operational Management Systems	
M4: Self-Assessment & Audit Systems	
E1: Environmental Protection Programme	
S1: Risk Elimination & Control Programme	
H1: Occupational Health Programme	
OVERALL (average of all scores)	*Note 6.1*

8. Health, Safety and Environmental Incidents

CATEGORY A: INCIDENTS THAT HAVE LED TO PROSECUTION

Description	No. of Occurrences	Resulting fines & penalties (£)
Note 7.1		

CATEGORY B: INCIDENTS THAT HAVE INVOLVED INTERVENTION OF REGULATORY AUTHORITIES, BUT NO PROSECUTION

Description	No. of Occurrences	Action Carried Out & Cost (£)
Note 7.1		

CATEGORY C: ACCIDENTAL SPILLAGES AND OTHER UNPLANNED RELEASES OF SUBSTANCES (NOT A COMPLIANCE ISSUE)

Description	No. of Occurrences	Action Carried Out & Cost (£)
Note 7.1		

9. Use of Hazardous Substances in Product Manufacture

Hazardous Substances	Kg Purchased	Kg Disposed	Disposal Route
Asbestos *Note 8.1*		*Note 8.3*	*Note 8.4*
Cadmium		*Note 8.3*	*Note 8.4*
Chromium 6		*Note 8.3*	*Note 8.4*
Cyanide		*Note 8.3*	*Note 8.4*
Phosphates		*Note 8.3*	*Note 8.4*
Lead *Note 8.2* (if Solder state % lead)		*Note 8.3*	*Note 8.4*
Nickel		*Note 8.3*	*Note 8.4*

HS&E MoPs – Definitions and Points of Clarification

1. Contextual Information

1.1 Site Sales is an annual figure (from your current annual budget). See conversion table in Appendix 1 for currency conversions used.

2. Safety Performance and 3.Health Performance

2.1 Number of occurrences – only report injuries and illnesses that have resulted in absence of one day or more (excluding the day of the accident)

2.2 Total Employee Days Worked – this is the total number of employee days worked for the whole site (i.e. number of employees x number of working days in quarter). This will be used to obtain a "rating", which can be compared over time.

4. HS&E Training

We recognise that this section is very difficult to answer and we will be providing extra guidance in time. In the meantime please provide the following data:

4.1 Total (first column) = total number of Senior Managers; Managers & Supervisors and Others which you <u>plan</u> to train in the current year, against various HS&E training courses. These three totals <u>do not have to</u> add up to the total number of Full Time Employees reported in section 1.

4.2 No. trained (second column) = Number of these people that have been trained, not the hours spent on training.

5 Environmental Performance –
5.1 Consumption of Resources

5.1.1 Gas – includes heating, cooking and process gas.

5.1.2 KWh – please convert gas, oil, electricity and other fuels to KWh (most bills provide this information) if possible. See conversion table in Appendix 1.

5.1.3 Other fossil fuels – you do not need to report fuel for transportation (although this is useful data to know – it may be included in future years MOPs)

8.1.1 Water costs - please provide incoming water costs only. If your figure includes effluent costs please state.

5.1.5 Water – 1 m^3 (1 Cu.m) = 1000 litres. For other units see conversion table in Appendix 1.

5.2 Emissions to Land

5.2.1 The waste referred to here, is all waste that is taken away from the site, for disposal to landfill or recycling etc. It includes liquid waste that is taken away for treatment or disposal and not liquids that are disposed of to drain. "Other Waste" is general waste (i.e. office and non-hazardous waste). Do not include wastes due to an incident e.g. contaminated soil, this is not a normal waste and should be recorded as a cost in section 7.

5.2.2 Disposal Costs are just those costs that you pay to the waste Disposal Company, it does not include internal handling costs etc. It does include any money received for recycled materials – show as a negative figure. State if costs for one category are included in another category.

5.2.3 Oils (neat and soluble) – include any waste hydraulic or lubricating oils as well as cutting oils

5.2.4 The units must all be in kg or litres (1 litre will be assumed to weigh 1 kg). If the weight of waste is not known an estimate should be made based on the volume of waste removed. Ask your disposal company if they can estimate the weight of waste per skip. Any volume to weight estimates not provided will be assumed to be 1 cubic metre = 1000 kg (worst case).

5.2.5 The amount of waste disposed of does not include any waste that goes for recycling, please record this separately in the end column (weight please, not percentage). Waste that is "recovered", i.e. composted or incinerated with energy production is currently categorised as disposed of, not recycled. This may become a separately reported item in future years.

5.2.6 "Effluent" is waste water from manufacturing, and support, processes. Domestic waste water (from toilets, kitchens etc) should not be included in the "Effluent" figure.

5.2.7 "Treated Effluent" has had some treatment on site prior to discharge to drain (e.g. pH adjustment, ion exchange, neutralisation etc.)

5.2.8 "Untreated Effluent" is trade effluent that goes directly from the process to the foul sewer drain. It is acceptable by the sewerage undertakers/water company because any contamination is within prescribed consent limits and therefore does not require treatment prior to discharge.

8.1.1 Total Effluent should be less than the Total Water Consumption (5.1). The difference between incoming water and effluent (treated and untreated) will represent domestic waste water and evaporative losses.

8.1.2 Please state if effluent costs are additional to or already included in Water Consumption costs.

5.3 Emissions to Air

8.1.1 Please report Volatile Organic Compounds (VOCs), grouped by type. Quantities must be in litres, not packs or bottles. Provide estimated "used" quantities if purchasing happens infrequently.

8.1.2 Since VOCs are grouped by type, this will necessitate providing average cost per litre and average % volatile. If no cost per litre is given a nominal £1 per litre will be used. If volatility is not known the following assumptions will be used: cleaning solvents and thinners 100%; adhesives, coatings and sealants 50%; Avtur/test fuel 80%.

5.3.3 Litres disposed of, in this case, includes any that are sent for recycling.

5.3.4 It is assumed that the difference between the amount purchased (or used) and the amount disposed of (plus recycled) has either gone onto/into the product (the non-volatile part) or has evaporated (the volatile part). In order to simplify the calculation the specific gravity of the substances are not included. Therefore a 1 litre of liquid is assumed to create 1 kg of volatile gas. This could result in a 5-10% error in the data, but considering the accuracy of the data, this is acceptable. The amount of VOCs emitted can be negative if you disposed of more solvent this quarter than you bought. This will put you in "credit" for another quarter.

6. Management Systems

6.1 Overall percentage is an average of all 7 self-assessment scores.

7. Health, Safety and Environmental Incidents

7.1 This section includes Health and Safety as well as Environmental incidents that have resulted in legal action or intervention by regulatory authorities. We are particularly interested in the cost of any fines or penalties incurred. Report the incident in the quarter in which the cost occurs.

8. Use of Hazardous Substances in Product Manufacture

8.1 Do not include hazardous substances from buildings (e.g. asbestos)

8.2 If Lead is in Solder, and the quantity is the weight of the solder, please state the % Lead content.

8.3 Where disposal quantity is greater than the amount purchased, it must be due to the addition of another substance (water, sludge etc). Therefore for this section only the purchased amount will be used, although the full amount must be included in 5.2 under Special Waste.

APPENDIX 1

Conversion Factors used

GAS

KWh	Therms	decatherms
29.270	**1.000**	0.10
1.000	0.03416	0.003416
292.700	10	**1**

KWh	Cu.m	1 Cu.Ft	C Cu.Ft
1,710.00	152.80		
10.54	**1.00**	35.30	0.35
0.299	0.0283	**1.00**	0.0100
1.00	0.0949	3.35	0.0335
29.86	2.8329	100.00	**1.00**

Fuel Oil

litres	kWh
1	10.1

Currency

£	$ Aus	$ US	FF
1	2.2	1.65	9.89
	$Sing	**$Can**	
	2.657	2.342	

Quantity

kg	lbs
1	2.2
0.4545	1

tonne	kg
1	1000
ton	**lbs**
1	2240
ton	**kgs**
1	1018.2

gallons	us gall	litres
1	1.2	4.54
0.2203	0.264	1
0.8333	1	3.7833

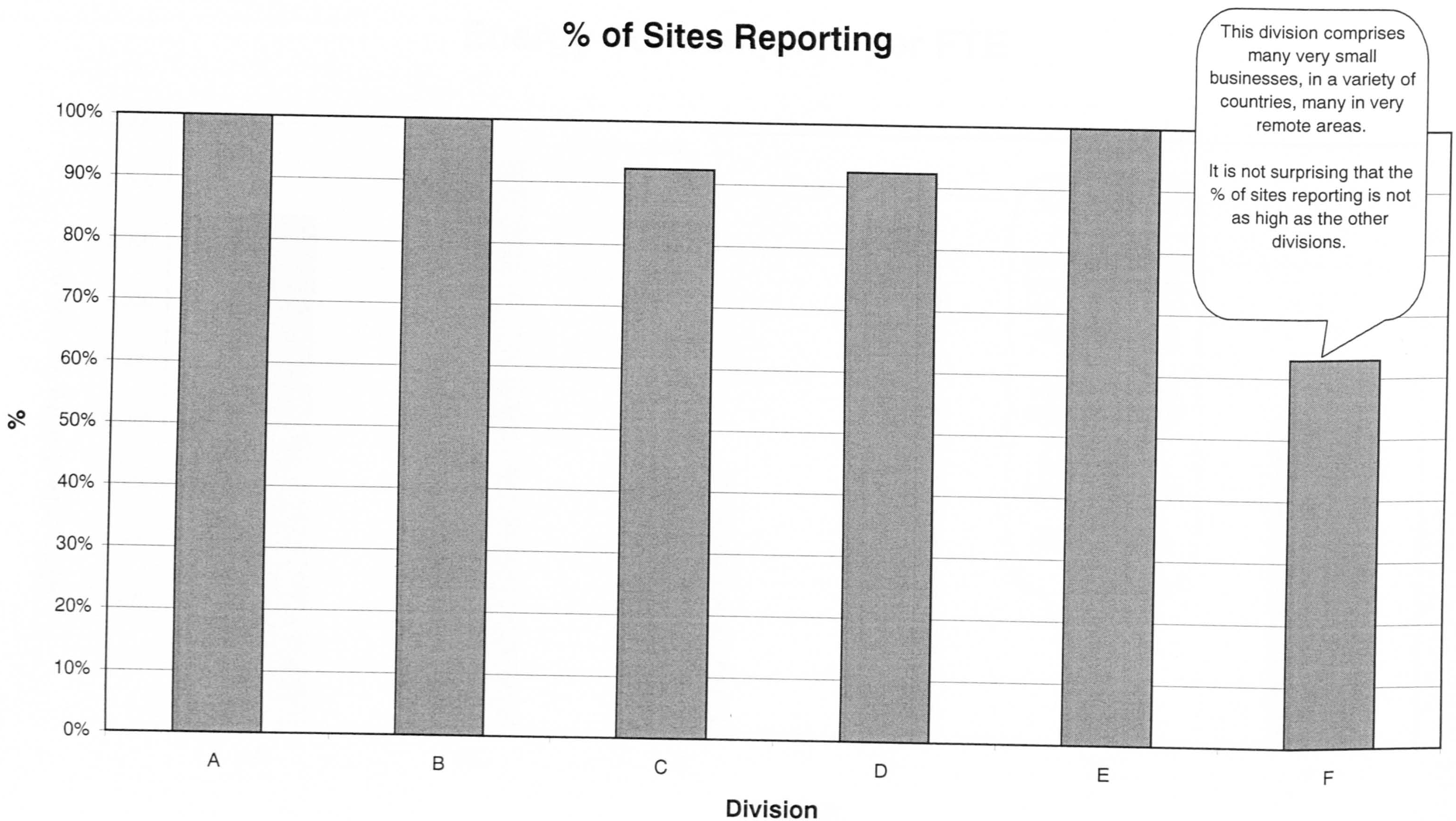
Volume

cu.yd	cu.m	kg
1	1.2714	1271.4

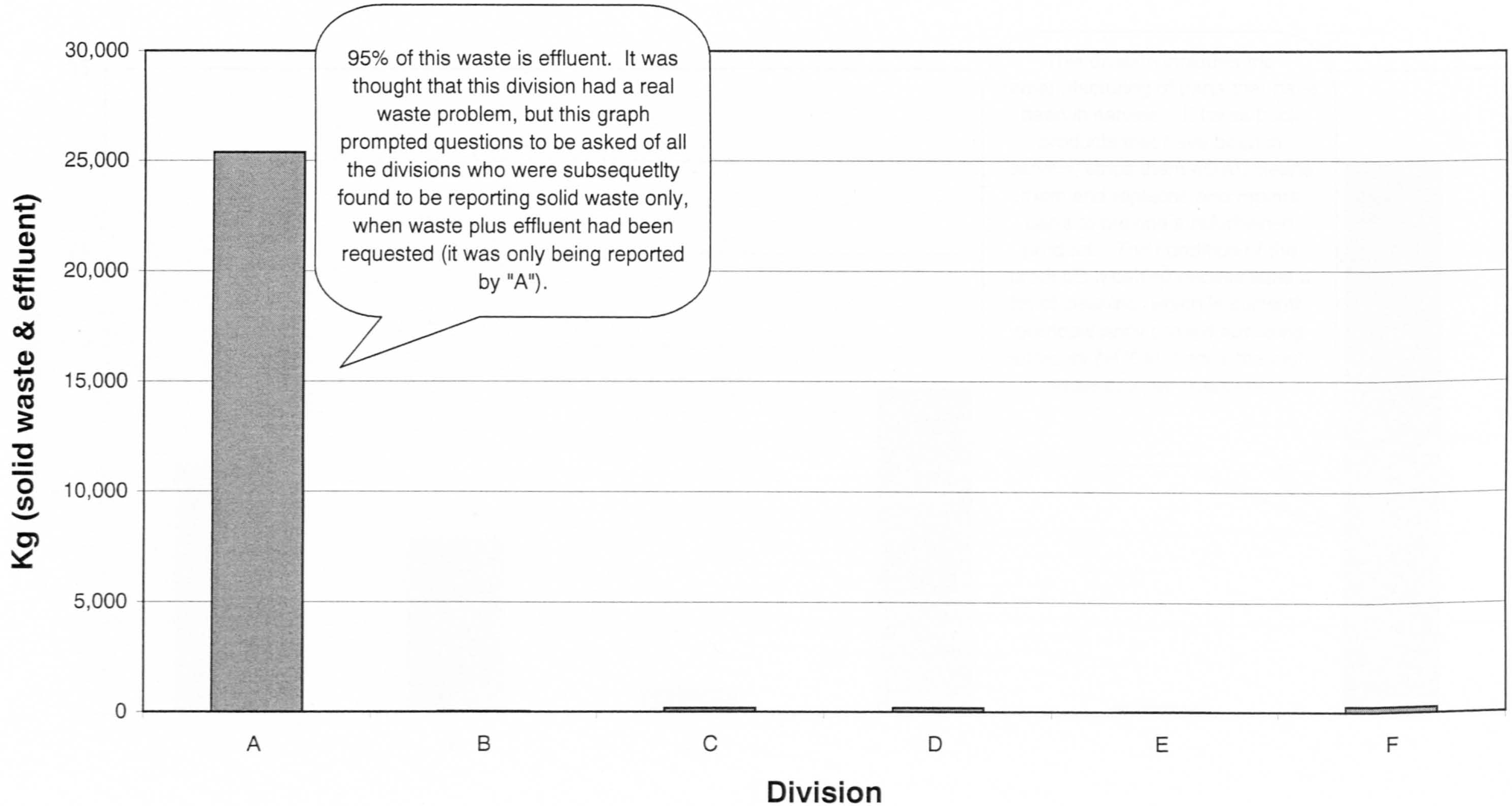
If any further clarification is required, please contact Terry Bridgewater or Nicolette Lawson at Shaftmoor Lane (5354).

Appendix AD

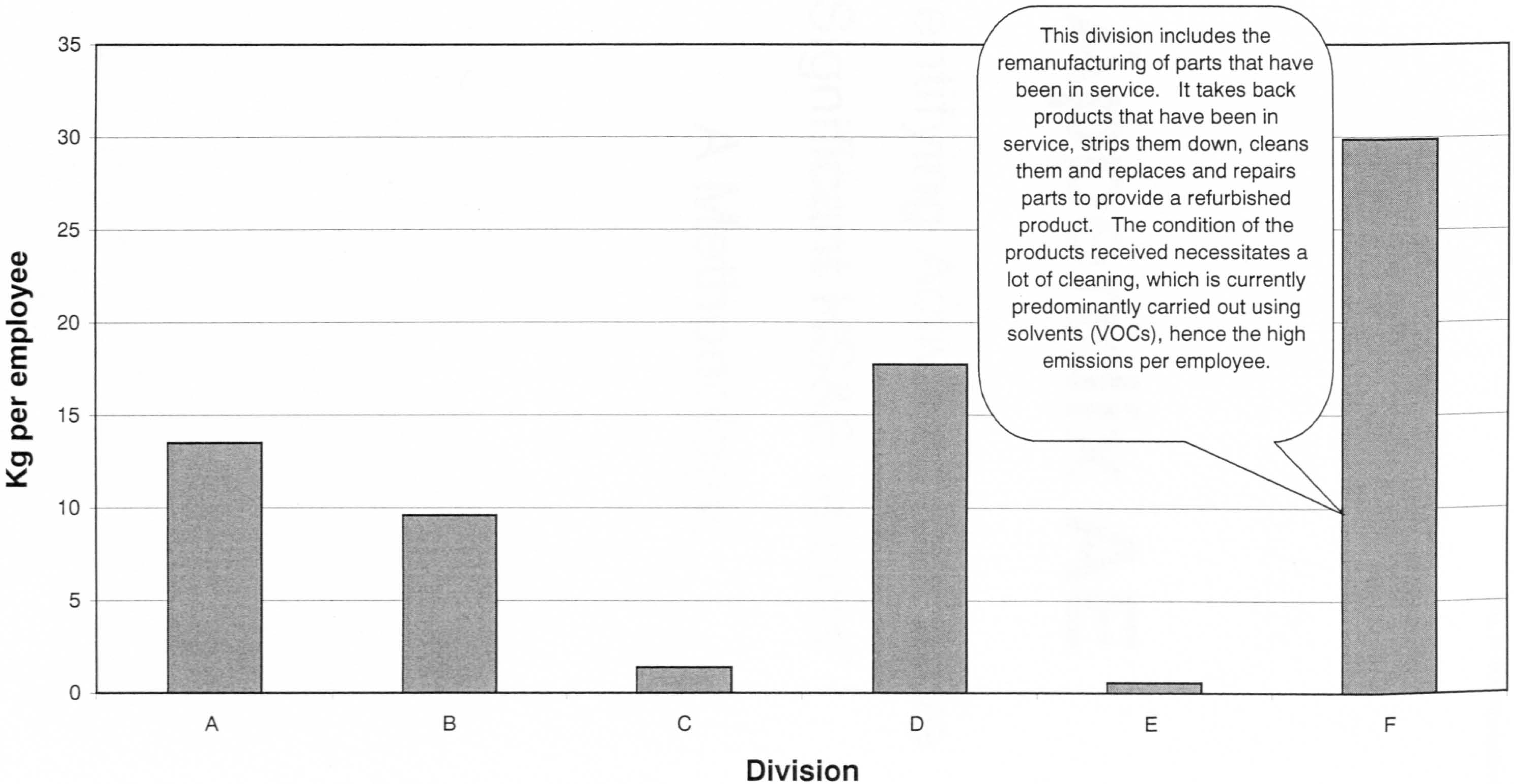
LucasVarity Divisional Analysis of Measures of Performance data for Quarter 1 1998.


% of Sites Reporting
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
%
A
B
C
D
E
F
Division
This division comprises many very small businesses, in a variety of countries, many in very remote areas.
It is not surprising that the % of sites reporting is not as high as the other divisions.

Waste Disposal per FTE



VOC emissions per FTE



Appendix AE

"Identifying Activities that have Significant HS&E effects"

A Methodology.

Identifying Activities that have Significant HS&E effects

A Methodology by:

Nicolette Lawson,

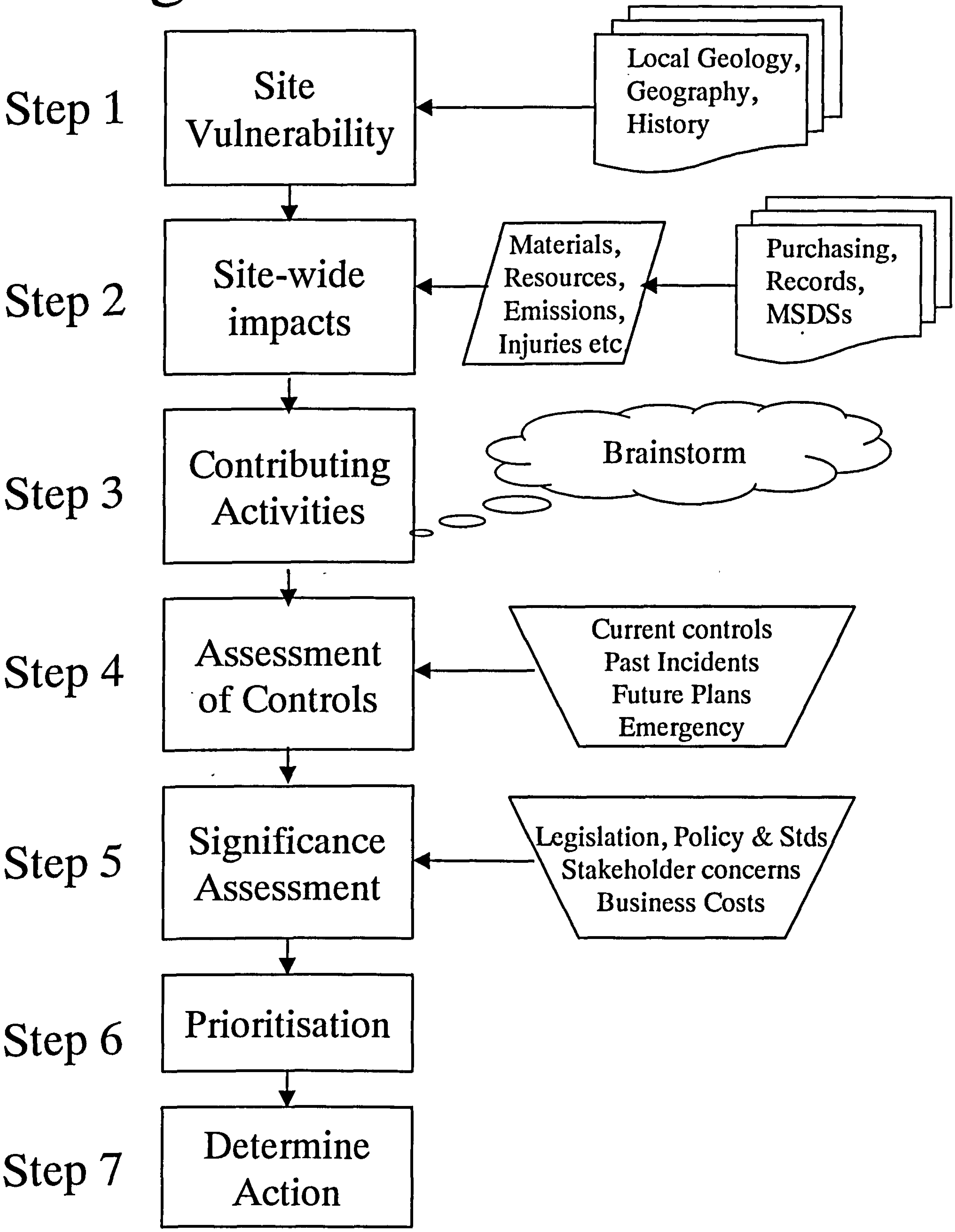
Independent Environmental Management Consultant,

21 Richmond Road, Olton, Solihull, B92 7RP.

0121-706 0144

Based on work first developed by Nicolette Lawson, Environment Programme Manager, Lucas Industries, and work by Annelli Gilbert and Linda Warrick, Teaching Company Associates working at Lucas Industries (now LucasVarity) HS&E department 1994 to 1997.

Identifying Activities that have Significant HS&E effects



Step 1.
Site Vulnerability Assessment

Purpose

To ascertain the vulnerability of the local environment, which will be dependent on the site's location, the local geology, proximity of water courses and surrounding land use.

Information Required

Distance from nearest Site of Special Scientific Interest (SSSI)
Surrounding Land Use (Residential, Agricultural, Industrial etc.)
Local Air Quality Standards
Nearest Surface Waters (streams, lakes etc) and Classification
Size and number of Bulk storage facilities (above and below ground)
Aquifer type and Groundwater uses
Nearest abstraction wells
Soil Type
Site History (Industrial, Greenfield, etc.)

Assessment Methodology

Protocol to assess vulnerability to Air, Land, Water
(See Appendix 1).

Step 2a.
Site Wide Impacts

Purpose

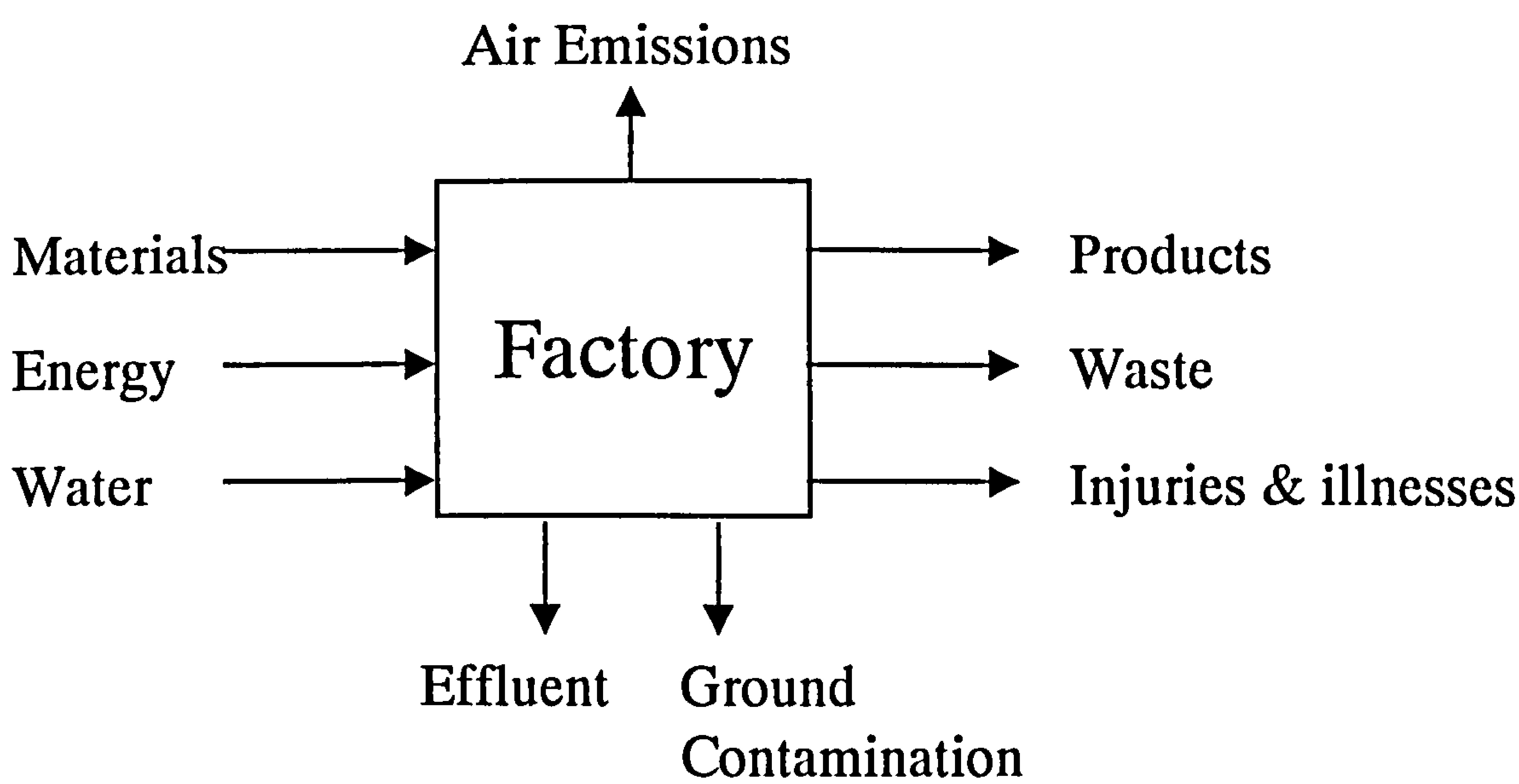
To identify all the HS&E impacts arising from the site and its operations.

Information Required

Inputs: Material types, Energy & Water consumption.
Outputs: Products, Waste types, Air emissions, Effluent, Work-related injuries and illnesses.
Try to gather or estimate quantities (purchasing, waste records, meters) and gather hazard information about substances (MSDSs, COSHH assessments).

Assessment Methodology (a)

Draw a site "input-output" diagram.



Step 2b.
Site Wide Impacts

Assessment Methodology (b)

Group the materials and wastes into generic types, to reduce the list and simplify the assessment process. Allocate a 1-3 ranking for both quantity and hazard. (See Appendix 2 on how to allocate these rankings).

Add the site vulnerability scores to the "Emissions Impacts" for air, land and water emissions.

Example:

	VUL.	QTY.	HAZ.	IMPACT TOTAL
INPUTS:				
MATERIALS				
metals		3	1	**4**
oils		3	2	**5**
chemicals		2	3	**5**
solvents		2	3	**5**
paper		3	1	**4**
RESOURCES				
electricity		3	1	**4**
gas		3	2	**5**
water		2	1	**3**
OUTPUTS:				
AIR EMISSIONS		1	2	**13**
EFFLUENT	**10**	3	3	**16**
WASTES	**10**	2	3	**8**
	3			
ILLNESSES & INJURIES		3	20	**23**

List different types and quantify each if data available

Site Vulnerability scores by media

Step 3a.
Identify Contributing Activities

Purpose

To identify the main activities causing the site HS&E impacts.

Information Required

Processes, manual activities, operations, key equipment, operating procedures.

Assessment Methodology (a)

Gather together a multi-disciplinary team to brainstorm the activities which contribute to each of the identified HS&E impacts. "Activities" should be described in a generic sense, such as "use of lighting", "machining" etc. Too much detail at this stage would make the process very complicated.

INPUTS:	IMPACT TOTAL	ACTIVITIES
MATERIALS		
metals	4	Machining
oils	5	Machining, Test
chemicals	5	Plating
solvents	5	Cleaning
paper	4	Admin/Design
RESOURCES		
electricity	4	Lights, machines
gas	5	Heating
water	3	Plating, domestic water
OUTPUTS:		
AIR EMISSIONS	13	Plating, boilers
EFFLUENT	16	Plating, domestic water
WASTES	8	Machining, packaging
ILLNESSES & INJURIES	23	Plating, machining, test

Step 3b.
Identify Contributing Activities

Assessment Methodology (b)

Rationalise the list of activities, so that each is only mentioned once, but add up all of the impacts. This will weight the activities which have more impacts on HS&E more heavily. Improvements to these activities will therefore have the greatest impact on HS&E performance.

KEY ACTIVITIES	TOTAL IMPACT
Plating (5+3+13+16+23)	60
Machining (4+5+4+8+23)	44
Test (5+23)	28
Domestic water (3+16)	19
Boilers/heating (5+13)	18
Packaging	8
Admin	6
Cleaning	5
Design	4
Lights	4

Note, that the numbers have no absolute meaning, they are merely a method for prioritisation.

Step 4.
Assessment of Controls

Purpose

The previous impact assessment, only indicates what impact the activities could have on the environment. If all the necessary hardware and software controls are in place and operating correctly the actual likelihood of an environmental release or safety problem would be small. However, if controls and management are inadequate then the likelihood of an incident is greatly increased. This "assessment of controls" is therefore a proxy for "likelihood".

Information Required

You will need to know whether controls are required, either by law or as an outcome of a risk assessment.
Controls could be physical (abatement equipment, interlocks, etc): procedural (safe operating procedures, work permits, etc.) or managerial (training, information, supervision, etc.). You will need to assess whether these controls are adequate for the purpose.
Past history will give an indication of the adequacy of the controls, so records of accidents or signs of spillage or damage should be investigated.
The future requirements should be questioned: will production increase or decrease, will legislative requirements tighten?
Emergency situations should also be assessed at this stage: would the controls and procedures be adequate in an emergency (spillage, explosion, employee accident etc.).

Assessment Methodology

Select a worst case example, or carry out an overall assessment, for each activity. Review the controls and use the assessment table in Appendix C to allocate a score.

Step 5.
Significance Assessment

Purpose

Having obtained an "impact" score and a "likelihood" score from the assessment of controls, it is now necessary to assess the significance based on drivers for action such as legislation, stakeholder concern and business costs.

Information Required

Legislation:
You will need to know whether legislation applies, or is likely to apply in the future, to these activities. Are the correct measures are in place to comply?
Stakeholder concern:
Have there been any complaints from neighbours; concerns from employees; questions from investors; demands from customers or any other third parties?
Business Cost:
Could savings be made by improving these activities? Will it cost a lot to maintain compliance? Is clean-up or remediation likely to be expensive? Is there potential for business disruption (if an incident occurs or in the event of non-compliance)?

Assessment Methodology

A group of informed people should assess the status of each activity against these three drivers: legislation, stakeholder concern, business cost.
The matrices in Appendix D can be used to allocate scores.

Step 6.
Prioritisation

Purpose

To combine all the scores and prioritise the activities that have a significant HS&E effect. Objectives and targets for improvement can then be set.

Information Required

List of Activities and Impact Score, Control score and Significance scores (legislation, stakeholder concern and business cost)

Assessment Methodology

Add up the scores to give a total "significance" rating, then prioritise.

	Steps 1,2,3	Step 4	Step 5	Step 5	Step 5	Step 6	Step 6
ACTIVITIES	Impact	Control	Leg.	S/holder	Cost	TOT	**Priority**
Plating	60	15	15	6	12	108	**1**
Machining	44	5	5	6	9	69	**3**
Test	28	13	10	9	10	70	**2**
Domestic water	19	9	5	0	6	39	**6**
Boilers/heating	18	5	5	3	12	43	**5**
Packaging	8	8	10	9	9	44	**4**
Admin	6	5	0	3	4	18	**9**
Cleaning	5	5	0	3	4	17	**10**
Design	4	5	0	9	2	20	**8**
Lights	4	5	0	3	10	22	**7**

Objectives and Targets

What's next?

Having prioritised the most significant activities, everything else must be linked to these priorities.

Management must set some objectives and targets for improvement.

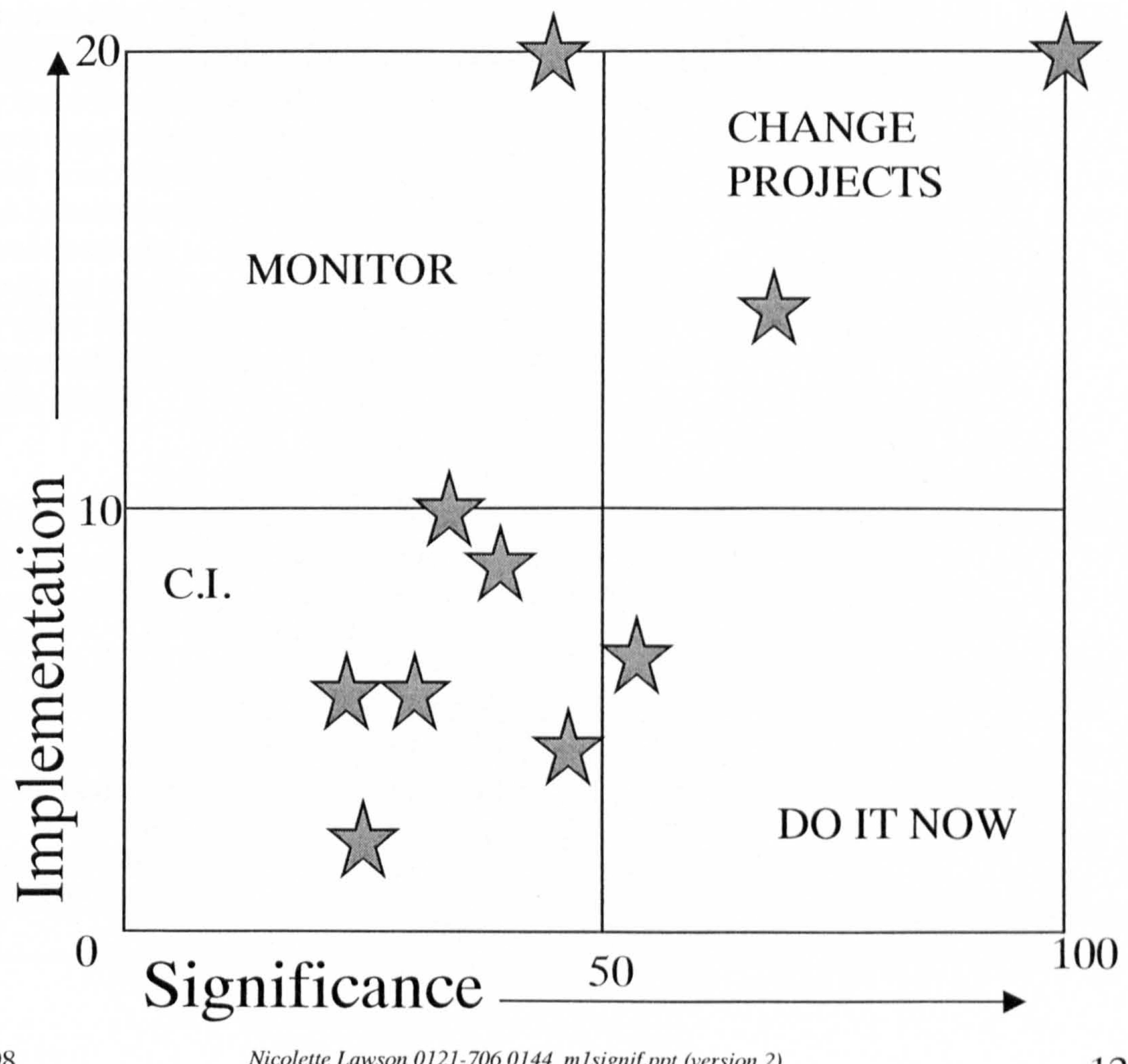
Project plans should be drawn up and resources allocated.

In order to decide how each issue should be handled, an assessment of implementation ease/difficulties and cost should be carried out (see Step 7 overleaf) and the results plotted on a Boston Matrix. Projects will then fall in to 4 main categories:

1. High significance and difficult to implement = change projects
2. High significance and easy to implement = do it now.
3. Low significance and easy to implement = continuous improvement
4. Low significance and difficult to implement = monitor to see if influencing factors change.

Step 7. Determine action

KEY ACTIVITIES	IMPLEMENTATION Ease	Cost	TOTAL	SIG
Plating	10	10	20	108
Test	10	10	20	70
Machining	8	8	16	69
Packaging	2	2	4	44
Boilers/heating	5	5	10	43
Domestic water	5	3	8	39
Lights	3	3	6	22
Design	4	2	6	20
Cleaning	3	4	7	18
Admin	1	1	2	17



Appendix A

Step 1- Site Vulnerability Assessment

Vulnerability of Air

Vulnerability Criteria	Classification Scores	Score
How close are the nearest **nature reserves**, sites of special scientific interest, areas of outstanding natural beauty or agricultural land?	<200m = 10 200m - 500m = 8 500m - 1km = 6 1km - 5km = 4 > 5km = 2	
What is the main **surrounding land use**?	Residential = 10 Agricultural / Forestry = 8 Greenfield = 6 Commercial = 4 Industrial = 2	
Should your Air Emissions meet with Local Air Quality Standards	Yes but not met = 10 Yes and met = 5 No = 2	
	Average Air Score	

Vulnerability of Water

Vulnerability Criteria	Classification Scores	Score
How close are the nearest **nature reserves**, sites of special scientific interest, areas of outstanding natural beauty or agricultural land?	<200m = 10 200m - 500m = 8 500m - 1km = 6 1km - 5km = 4 > 5km = 2	
How close are the nearest **surface waters** (river, stream, lake)?	<200m = 10 200m - 500m = 8 500m - 1km = 6 1km - 5km = 4 > 5km = 2	
What is the **classification** of the nearest surface waters? *(based on UK Surface Water classifications)*	RE1:V.good quality suitable for all fish=10 RE2:Good quality suitable for all fish=8 RE3:Fair, OK for high class coarse fish=6 RE4:Fair, OK for coarse fish=4 RE5: Poor, likely to limit coarse fish=2	
What bulk storage do you have for substances with environmental impact? (UGST=Under Ground Storage Tank, AGST=Above Ground Storage Tank)	UGST >200 gallons = 10 UGST < 200 gallons = 8 AGST >200 gallons = 6 AGST <200 gallons = 4 < 201 l in any area = 2	
	Average Water Score	

Vulnerability of Land

Vulnerability Criteria	Classification Scores	Score
How close are the nearest **nature reserves**, sites of special scientific interest, areas of outstanding natural beauty or agricultural land?	<200m = 10 200m - 500m = 8 500m - 1km = 6 1km - 5km = 4 > 5km = 2	
What type of **aquifer** exists in this area?	Major-no capping geology = 10 Major-with capping geology = 8 Minor- no capping geology = 6 Minor-with capping geology = 4 None = 2	
How close is the nearest **abstraction well**?	<200m = 10 200m - 500m = 8 500m - 1km = 6 1km - 5km = 4 > 5km = 2	
What is the local **groundwater used for**?	Drinking water = 10 Process water = 5 None = 2	
What is the predominant **geological construction** of the local area?	Permeable e.g.Chalk/Limestone=10 8 6 4 Impermeable e.g.Granite = 2	
What is the predominant **soil type** in the local area?	Permeable e.g. Gravel = 10 8 6 4 Impermeable e.g.Clay = 2	
Are previous Site uses likely to have caused ground contamination?	Previous use with potential to cause pollution = 10 Previous use unlikely to cause pollution = 5 Greenfield = 2	
	Average Land Score	

N.B.

Vulnerability of Air	this will affect the impact of air emissions
Vulnerability of Water	this will affect the impact of effluent and surface water
Vulnerability of Land	this will affect the impact of waste and ground contamination

Appendix B

Step 2b. Site Wide Impact Assessment

Quantity Classification (per year)

Resource Usage (Inputs)			Pollution (Outputs)			Material Inputs	
Electricity *kWh*	Gas *kWh*	Water *Cu.m*	Waste *tonnes*	Effluent *Cu.m*	Air emissions *kg*	Materials & consumables *Any unit*	RANKING SCORE
over 10m kWh	over 10m kWh	over 100,000 Cu.m	over 5,000 tonnes	over 100,000 Cu.m	over 20,000 kg	High	**3**
5-10m kWh	5-10m kWh	50,000-100,000 Cu.m	1,000 to 5,000 tonnes	10,000-100,000 Cu.m	3,000-20,000 kg	Medium	**2**
under 5m kWh	under 5m kWh	under 50,000 Cu.m	under 1,000 tonnes	under 10,000 Cu.m	under 3,000 kg	Low	**1**

Different scales have been provided for different types of impact, i.e. Resource Usage and Pollution. These scales have been calculated based on HS&E Measures of Performance data. For your particular site, you may wish to assign actual numerical ranges to Materials and consumables, to aid judgement e.g. High may be over 100 tonnes, Medium may be 1-2 tonnes etc.

Hazard Classification

Substance Criteria	Rank
Prescribed Substances Very Toxic Toxic On Lucas Aerospace "substances to avoid" list	3
Very Flammable Flammable Corrosive Sensitiser Irritant Harmful	2
Inert	1

Health & Safety	Rank
Death Non-curable disease Lost limb	30
Broken Limb Hospitalisation	20
Minor injury Near miss	10

Hazard information will be available from Material Safety Data Sheets, suppliers' information and other reference documents. You may wish to add your site's own "outlawed" substances to the list.

Appendix C

Step 4. Assessment of Controls

	High Risk 3	Medium 2	Low Risk 1	Score
Are controls required by law or as a result of risk assessment?	Yes - legislation	Yes – Best Practice	No	
Are the controls adequate?	No	OK	Yes – Best Practice Or Not Required	
Is there any evidence of inadequate control (past)?	Frequent past occurrences	Rare past occurrences	None	
Will controls be adequate for the future?	No - Legislation tightening Or Volume increasing	Volume and/or legislation to stay the same	Volume will decrease or Equipment will be replaced.	
Would controls be adequate in an emergency?	Not adequate	Patchy	Good equipment, plans & procedures	
TOTAL SCORE (Max 15 – Min 5)				

This may be adapted to incorporate issues/questions pertinent to the site.

Appendix D

Step 5. Significance Assessment

LEGISLATION	High 15	Medium 10	Low 5	None 0	Score
Legislation – current and future	Non compliant	Applies – some measures in place	Applies – measures in place	None applies	

STAKEHOLDER CONCERN	High 9	Medium 6	Low 3	None 0	Score
Questions, concerns, requirements, audits	Customers Investors	Neighbours	Employees	None	

BUSINESS COSTS	High 3	Medium 2	Low 1	None 0	Score
Can savings be made?	High	Medium	Low	None	
Is compliance maintenance expensive?	High	Medium	Low	None	
Is clean-up / remediation expensive?	High	Medium	Low	None	
Is there potential for business disruption?	High	Medium	Low	None	
TOTAL (max 12 – min 0)					

Appendix AF

Diagram showing how management of HS&E improves EVA (Economic Value Added)

Conclusions...

Management of HS&E improves EVA

Increase Profit

- eliminate wasted materials and resources
- control HS&E costs
- improve throughput with ergonomics
- continuously improve
- reduce absenteeism
- avoid fines & clean-ups

Use Less Capital

- eliminate polluting processes & abatement equipment
- reduce inventories of hazardous substances
- preventative maintenance to prolong asset life & improve energy efficiency
- reuse and recycle
- eliminate/replace inefficient processes

Appendix AG

Membership of the Institute of Environmental Management:

- Application
- Certificate of Membership

Application for Full Membership to Institute of Environmental Management

Short Paper

"How I believe I meet the Standards of Competence of the Institute of Environmental Management"

by Nicolette Lawson, 21 Richmond Road, Solihull B92 7RP

HISTORY

I worked for Lucas (now LucasVarity) from 1985 to 1997. Firstly, as a manufacturing systems engineer and latterly as Environmental Programme Manager. I now work as a freelance environmental management consultant.

My first foray into the environmental world began in 1990 when I had to seriously consider the direction in which my career was going. I decided that the most constructive and fulfilling work I could do would be in an area where I had a passion. After much reflection I realised that I was passionate about waste – wasted products, wasted materials, wasted energy, wasted water, it all drove me mad. I was a compulsive bin-watcher and a squirrel of "useful" items that "might-come-in-handy–one-day"!

I applied my reawakened mind to industry with all its waste and squandered materials and decided it was time something was done. So my crusade to make a difference began.

In early 1991 I got an opportunity to research environmental trends and their effects on business, and I wrote numerous papers and presentations to persuade our company executives of the need to act.

In late 1991 the Corporate Health, Safety and Environment Department was set up. I became one of the founding members, firstly as Technical Manager, then Programme Manager responsible for the Environmental and Management Systems programmes.

Early work in the department was strategic. What issues were facing the company and how could we address them? What could the corporate department do to change the approach and the attitude of 45,000 employees' worldwide?

We started by developing a company HS&E policy and associated audit programme, which was launched at a grand management event in 1992. A programme of auditing the businesses began, giving us a deeper understanding of the issues facing the businesses, the scale of the problems and the areas of weakness.

The problem areas were

- knowledge-based (lack of awareness of the issues and responsibilities),
- systems-based (poor documentation and procedures) and
- management-based (lack of understanding and hence commitment).

Specific environmental risks included

- Land contamination (poor storage facilities and handling procedures, limited secondary containment, leaking machines, inadequate spillage procedures, lack of awareness of consequences);
- Drains (lack of drainage plans, poor control of liquid disposals, lack of awareness of the consequences);
- Volatile Organic Compounds (excessive usage and wastage of solvents, poor handling procedures, inadequately maintained or wrongly adjusted equipment, lack of awareness)

- Waste (poor waste management and documentation, lack of segregation, inadequate storage facilities, inadequately maintained or wrongly adjusted equipment, lack of awareness)
- Energy (old and inefficient equipment, lack of awareness of consumption and costs, lack of motivation)
- Product engineering (proliferation of hazardous materials and processes, lack of awareness of down-stream consequences)

Training, guidelines, workshops and projects were set up to help address the deficiencies and conferences were organised to spread the gospel according to good environmental management.

Businesses began to ask for more and more guidance on what was required, and so the HS&E Standards were born. In 1995, after much research into other corporate approaches we launched a set of best practice Management, Environmental (and Health & Safety) Standards. These simple, one-page (per subject) standards formed a common HS&E Handbook, for every Lucas business worldwide. The audit process was revised in order to measure progress against implementation of the standards and a Self-Assessment system was also developed.

As well as auditing, and developing standards and guidelines, I managed a team of environmental specialists and research engineers *(see plan of management structure)* in order to deliver services under the banner of the Environmental Programme. Projects included:

- **Environmental Protection** – a pollution prevention initiative, to ensure that all businesses were aware of the issues surrounding ground and ground-water contamination, effluent, surface water and air emissions, and were taking the necessary precautions (facilities, training, procedures) to ensure that the risk of pollution was minimised.
- **Waste Minimisation** – a development project (Teaching Company supported) to devise methodologies and collect data and case studies to promote waste minimisation in the Company. Potential savings amounting to over £100,000 were identified.
- **Energy Conservation** – An awareness raising exercise, providing information via newsletters and workshops to encourage businesses to save energy. Businesses achieved at least 10% savings during this period (approximately £1 million).
- **Environmental Management Systems** – a development project covering methodologies, guidelines, case study material, training and co-ordination of businesses implementing environmental management systems. An ISO14001 implementation network was set up to ensure that good practice was shared across businesses and peer pressure maintained.
- **Measures of Performance** – a development project (also the subject of my Engineering Doctorate thesis) to design and implement systems for collecting and analysing data, in order to facilitate internal (and eventually external) environmental reporting and thus support management decisions and improvement programmes. I ran a pilot project with six businesses in 1996, and the system has now been implemented worldwide. The first data from all LucasVarity sites is being collected in April 1998.
- **Strategic Sourcing** – a project developing the idea that sourcing (purchasing) is a key activity related to environmental risk, both in terms of the risks that may be brought into the company from suppliers (and contractors) and the risks that they themselves pose to the environment. I developed a simple environmental risk assessment protocol for use by supplier quality auditors and a draft supplier policy, which was implemented in some Lucas companies.
- **Design for Environment** – a project to introduce environmental thinking and decision making tools into the product design process. This has now been implemented into the Product Introduction Management process in at least one of the divisions and workshops have been held for engineers.

SUMMARY OF ENVIRONMENTAL MANAGEMENT ACTIVITIES THAT I HAVE UNDERTAKEN:

1. Strategic Vision (knowledge and attitude)

- I produced the first drafts of the company policy and the management standards and contributed to the overall HS&E strategy
- I developed the auditing system and reporting format.
- I developed the Environmental Measures of Performance, conducted the pilot study and compiled the data into the first internal environmental report. The system has now been implemented worldwide and I am involved (on a freelance basis) in the collation and analysis of this data.
- I have made numerous presentations to Company executives.
- I have persuaded management why they should address environmental issues when they have so many other business issues to attend to.

2. Management skills (ability) – business awareness and professionalism

- I have considerable business awareness based on my previous experience as a Manufacturing Systems Engineer where I was involved in 14 different projects ranging from complete business redesigns to financial feasibility studies.
- I have the ability to assess and analyse different solutions from technical, political, economic and environmental viewpoints.
- I am experienced in change management and persuading people to challenge their beliefs and do things differently.
- I have a good understanding of business processes, their functions and interactions.
- I take a practical approach to systems and implementation (i.e. it is better to implement a simple (less-than-perfect) systems that will work, than design a perfect or complex solution that cannot be implemented.

3. Management skills (ability) – communications: internal and external

- I have led audit teams at sites around the world.
- I have written papers and presented at conferences.
- I have devised training material and conducted workshops and training sessions.
- I was the secretariat of the Corporate HS&E Committee (1991 to 1996), with executive representatives from each of the divisions.
- I was a member of various external committees and bodies (SMMT waste working group, DoE Duty of Care Working Group) and am currently on the Solihull Council's Local Agenda 21 Working Group.
- I guided site management in the setting up of steering groups and project teams, defining terms of reference, priorities, objectives and targets.
- I have given environmental talks and after-dinner speeches to various organisations such as schools, the Luton Industrial Society and I.Mech.E young engineers.

MY VALUES AND BELIEFS

I believe in a broad, proactive, risk assessment approach, which goes far beyond environmental compliance. Compliance is a necessity and proves to authorities that a minimum level of performance is being achieved. However, focusing on compliance (as often happens in countries where legislation is very prescriptive) can cause myopia, businesses can concentrate so much on filling in the forms and putting up the notices that they fail to see the broader risks or future opportunities. Focus on compliance often produces end-of-pipe solutions rather than cleaner technology (the catalytic converter versus lean-burn engine for example) and end-of pipe solutions always have a limited useful life. Reacting to legislation as it arrives is always more expensive and stressful than being proactive. Businesses need to look forward, understand the long-term implications of environmental trends and then plan their strategies accordingly.

Although sustainability is the goal, this cannot be achieved overnight. Sustainability will need to be developed in conjunction with government policies, economic reform and public re-education. Business needs to keep its eye on sustainability but try not to put itself out of business in the process! Like all good management approaches the issues and actions must be prioritised, in this case according to their environmental significance, and solutions should meet both environmental and business needs.

My doctoral research into environmental measures of performance supports my belief that performance measurement is one of the most important, and demanding, components of environmental management. Measuring environmental performance helps managers to understand environmental issues in a language that they are familiar with. It enables arguments to be put forward and challenges to be made on behalf of environmental protection. It helps to raise awareness and effect responsibility, as well as providing a foundation for open and constructive communication with stakeholders. Measurement of performance is essential in the drive for action to achieve ongoing environmental improvement.

As far as responsibility is concerned I am convinced that every person in an organisation has an important role to play. From designers to directors, personnel to purchasing, finance to facilities, operators to office workers, all have an adverse effect on the environment and all should do their part to reduce it. I believe that environmental issues should be integrated into all business processes, so that all employees can play their part. If environmental issues continue to be dealt with by a limited number of specialists, the real changes, sustainable changes, cannot happen.

However, the power of environmental leadership must not be overlooked, or underestimated. Senior executives cannot ignore the environment and survive; they must demonstrate their true commitment to environmental improvement. Appointing "someone to deal with it" is not enough. Employees want to know what the top man (or preferably woman) believes is important. Simple actions from the top could have a dramatic effect. The decision to use only recycled paper would soon touch every employee in the company. The banishment of company cars (especially the gas-guzzling executive variety) would send a similar widespread message. Employees will only make a real effort if they think those efforts will be appreciated.

The environment is such a large and complex subject that no one person can understand all the issues and interactions. I know the limits of my own personal knowledge, but I try to maintain high standards by attending courses and conferences, continuing my research and, of course, consuming all the material published by the IEM!

Nicolette Patricia Lawson

Experienced manager skilled in the implementation of change, programme management and performance improvement.

Key experiences:

- Development, planning and implementation of a company wide change programme (Environmental Management).
- Development, planning and implementation of Corporate Environmental policy and procedures.
- Auditing of businesses, planning and prioritising improvement projects.
- Building effective relationships and communication links with customers, senior managers, supervisors, engineers, union representatives, specialists and colleagues.
- Systems engineering with practical experience of manufacturing systems, structures, procedures, people issues and equipment capabilities.

Career in brief:

XL Associates	***Self Employed***	Environmental Management Consultant	May 1997 - present
Lucas Industries	***HS&E (Corporate)***	Environmental Programme Manager	1995 – April 1997
		Technical Manager	1991 - 1995.
	MT&E	Technical Manager	1991 - 1991.
	LE&S	Senior Engineer	1988 - 1991.
		Systems Engineer	1985 - 1988.
ICI	***Technical Drawing***	Student Engineer	Aug-Sept 1984
Stuttgart University	***Computer Programming***	Student Engineer	Apr -July 1984
British Gas	***Experimental Engineering***	Student Engineer	Apr -Sept 1983
Vauxhall Motors	***Workshop Practice***	Student Engineer	Apr -Sept 1982

Academic Qualifications:

Engineering Doctorate *(in progress)*	Environmental Technology *("Environmental Performance Indicators in Industry")*	Brunel University and University of Surrey	1994-1999
BSc (Hons.)	Mechanical Engineering	Brunel University	1985
International Baccalaureate	Maths, Physics, English, French, German, Geography	Ingatestone Anglo-European School	1981

Personal Details:

Date of birth:	02-11-62
Status:	Married with 1 child.
Home Address:	21 Richmond Road, Olton, Solihull, West Midlands, B92 7RP.
Phone / Fax:	0121-706 0144 E-mail: nicolette@lawson-curtis.demon.co.uk

Career History

Environmental Management Consultant May 1997 – Present.

Self-Employed Consultant:- specialising in development of Corporate Environment and Management Systems, Environmental Measures of Performance and Environmental Awareness Training.

- Supporting new Corporate HS&E Manager. Analysing current management systems and recommending changes, introducing environmental issues to business procedures (e.g. Product Introduction, Due Diligence, Supplier Development, Measures of Performance).
- Developing and delivering training courses.
- Environmental Auditing.

Programme Manager. 1995 – April 1997.

Environment and Management Systems.

Reporting to the Lucas HS&E Director:- responsible for developing, implementing and on-going business support for various Environment and Management Systems projects. Leading multi-disciplinary teams as part of a company wide Review Programme and managing a number of experienced Environmental Scientists and Engineers.

- Key role within a successful Management Team in the implementation of a Lucas HS&E Programme Worldwide.
- Responsible for developing and implementing effective group and business specific projects based on the requirements of Company Management Standards / review findings / CAP commitments / legal enforcements.
- Responsible for managing technical staff to ensure department and personnel objectives are met, performance appraised, skills and customer image maintained.
- Providing presentations and training to all levels within the organisation (including Directors, General Managers, Senior Managers and Union Representatives).
- Team Leader for business HS&E Reviews in the UK, Europe and the USA.
- Providing a liaison role between Lucas businesses.

Technical Manager. 1991 - 1995.

Environment and Management Systems.

Reporting to the HS&E Programme Manager:- responsible for the development and implementation of the Lucas HS&E Policy, Review Programme, Standards and Guidelines. Project support to individual businesses and sites as and when required.

- Member of the Management Team responsible for developing and implementing the Lucas HS&E Programme.
- Responsible for developing and implementing effective group and site projects.
- Developed, organised and participated in various training courses, seminars, workshops and presentations to all levels within the organisation (including Directors, General Managers, Senior Managers and Union Representatives).
- Supported and advised various Lucas businesses in the planning, implementation and review of projects for performance improvement as a result of review findings / commitments to progress / legal enforcements.
- Responsible for the quality and technical standards of work prepared by staff.
- Team Leader of multi-disciplinary teams for over 20 HS&E Reviews in the UK, Europe and the USA.

Nicolette Patricia Lawson
Tel/Fax: 0121-706 0144

Technical Manager. March - Nov 1991.

Manufacturing Technology and Engineering.

Reporting to the MT&E Manager:- research into the environmental pressures on business and analysis of auditing systems.

- Responsible for preparing business plan for the delivery of HS&E Consultancy
- Successfully lobbied for environmental issues to be included on Corporate agenda and Corporate HS&E department to be set-up.
- Developed a group strategy for the management of HS&E issues.
- Developed HS&E audit system

Senior Manufacturing Systems Engineer. 1988 - 1991.

Lucas Engineering and Systems.

Responsible to the Technical Manager (LE&S) and General Manager (within the businesses) for manufacturing re-engineering projects. Project involvement (in UK and France) included the following:

- Delivered practical and effective solutions on time, to specification and within budget.
- Supported or led projects from evaluation to implementation and hand-over.
- Introduced cellular manufacturing, just in time production controls, quality systems, employee skill reviews and continuous improvement activities.
- Designed layout and manufacturing systems for new production facilities.
- Provided advice and support to increase customer / staff competence.
- Ability to identify and develop new systems, procedures and operational methodologies.
- Researched market opportunities and analysed business strengths and weaknesses to develop future business plan.
- Carried out financial and practical feasibility study for manufacturing facilities overseas.

Manufacturing Systems Engineer. 1985 - 1988.

Lucas Engineering and Systems.

Responsible to a Senior Engineer (LE&S) and General Manager (within the business) for site based multi-disciplinary project re-design teams. Project involvement (in UK and New Zealand) included the following:

- Complete business redesign, including market analysis, product cost analysis, product viability assessment, make or buy decisions, design of product-based production modules, capacity analysis, job design and implementation plans.
- Industrial Engineering: evaluation of stock costs, shortage and excesses; evaluation of product futures; factory layouts; implementation of quality procedures; implementation of MRP system and training of users.
- Assessment and appraisal of production proposals for existing and new products, including capacity analysis, resource requirements, plant layout, risk analysis and financial implications.
- Total Quality Management; systems engineering techniques and Japanese methodology to allow flexible JIT manufacture. Shop-floor information and control systems i.e. in-cell capacity planning, databases, Kanban, etc;

Nicolette Patricia Lawson
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Student Engineer. **1981 - 1985.**

ICI, Thornton Cleveleys, Lancashire **Aug-Sept. 1994.**

Manual technical drawing and CAD in design office.

Stuttgart University, W.Germany **Apr -July 1994.**

Writing of Database programme in FORTRAN, for Machine Tool department.

British Gas Corporation, Fulham **Apr-Sept. 1993.**

Research and development of test rigs. Building of electronic control cabinets, development of automated test equipment.

Vauxhall Motors, Luton, Beds. **Apr-Sept. 1992.**

Basic Workshop Practice (EP1) and Design and Make Project (EP2)

Management Training Undertaken:

Business Systems Awareness
COSHH & Risk Assessment
Creative Problem Solving
Design for Assembly
Environmental Auditing
Environmental Management Foundation Course
Finance for Managers
Leadership Skills
Presentation Skills
Product Life Cycle Analysis
Project Management
Risk Communication
Risk Management
Risk Perception
Sociology of the Environment
Strategic Marketing
Taguchi
Talking to the Media
Time Management

Other Information:

- Open University Tutor for module T830 "Enterprise and the Environment" (since May 1998).
- Registered Environmental Auditor under Environmental Auditors Registration Scheme (EARA)
- Full Member of Institute of Environmental Managers (IEMgt)
- Member of I.Mech.E, Chartered Engineer and European Engineer (Eur. Ing.)
- Experienced PC user (Word, Excel, Powerpoint, Access)
- Intermediate / working knowledge of French and German
- Holder of full, clean driving licence (and lapsed private pilot's licence!)
- Member of Mensa

Nicolette Patricia Lawson
Tel/Fax: 0121-706 0144

Job Description

Nicolette Lawson, 21 Richmond Road, Solihull B92 7RP

Attached is a copy of my previous job description, when I was Environment Programme Manager for Lucas Industries up to April 30th 1997.

I now work as a freelance Environmental Management Consultant (under the name of XL Associates). In general, the work that I carry out includes:

- Development of company strategy and appropriate management systems
- Development of guidelines and training material
- Development of procedures and checklists (e.g. auditing, due diligence)
- Development and implementation of Environmental Management systems
- Development and implementation of Environmental Performance Measuring systems, collection and analysis of data, formulation of internal reports.
- Environmental awareness training
- Running, or presenting at, specialist workshops (e.g. packaging, design for environment)

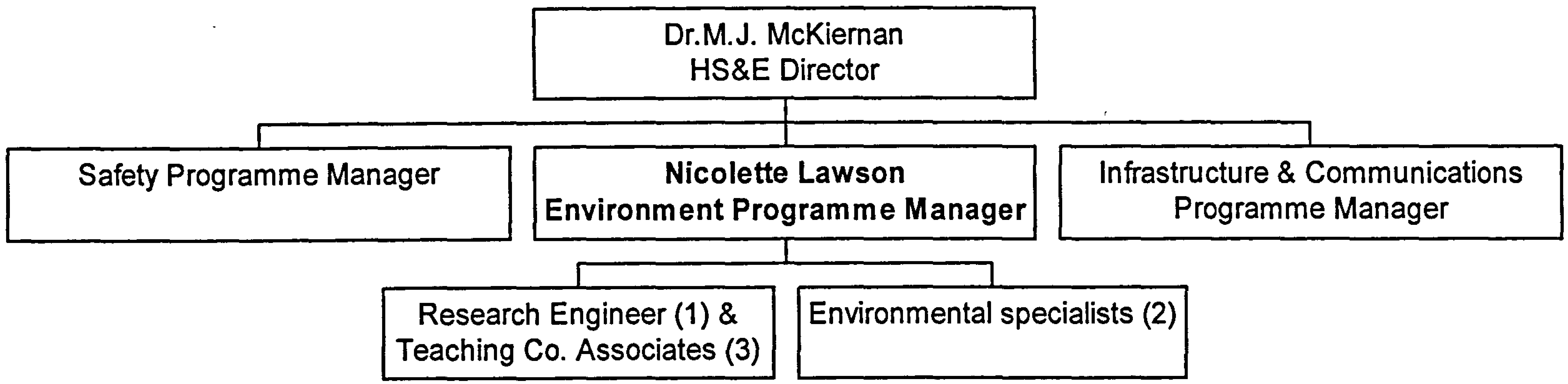
I am currently supporting the Lucas Aerospace Divisional Health, Safety and Environment (HS&E) Manager. Specific tasks have included:

- Development of company strategy to achieve World-class HS&E performance
- Procedural gap analysis
- Organisation and participation in HS&E management workshop
- Writing of Due Diligence procedure
- Development and integration of Health, Safety and Environmental considerations in to the Product Introduction Management process.
- Organisation and participation in Design for Environment workshop
- Compilation of Health, Safety and Environment Design Guidelines
- Development of HS&E induction training material
- Development and implementation of HS&E Measures of Performance, collection and analysis of data, and production of internal report.

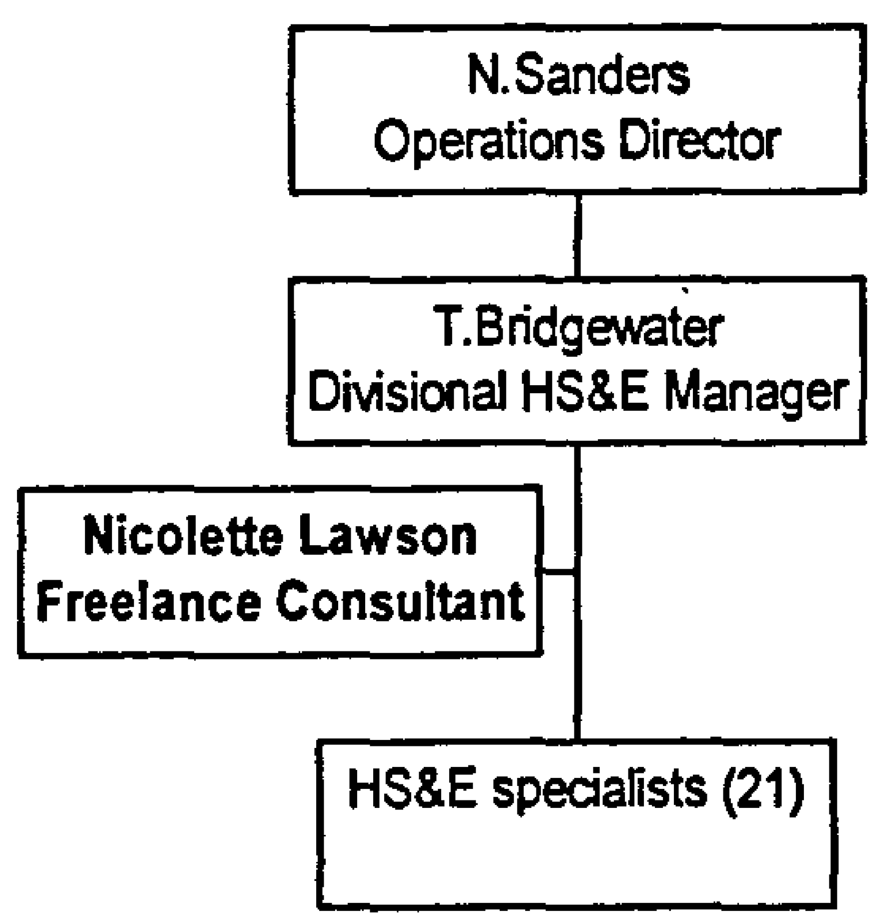
I am also about to begin (May 1998) as a tutor for the Open University IGDS Module 15 "Enterprise and the Environment". This entails being familiar with the course work, supporting students by answering their questions, marking assignments, setting assignments and recommending updates to the course material.

An outline of my organisation's management structure & my roles within it

LucasVarity Group HS&E Department (up to 30th April 1997)



Lucas Aerospace Division HS&E Structure (from October 1998)



An outline of my organisation's activities and its principal environmental effects.

Nicolette Lawson, 21 Richmond Road, Solihull B92 7RP

Company Background

LucasVarity plc is an international engineering company, listed on both the London and New York stock exchanges. It employs some 50,000 people worldwide.

LucasVarity designs, manufactures and supplies advanced technology systems, products and services in the world's automotive and aerospace industries. In 1997 it had annual revenues of £4.7 billion.

Within the automotive sector, LucasVarity is one of the world's largest suppliers of braking, diesel fuel injection and electrical and electronic systems and is a leading provider of aftermarket products and services.

Within the aerospace sector, LucasVarity holds leading positions in the provision of high integrity systems in engine controls, power generation, flight controls, cargo handling and customer support.

Products, Manufacturing Processes and Principal Environmental Impacts

Braking systems: *Drum Brakes, Disk Brakes, Callipers, Cylinders.*

Materials

- Mainly aluminium and steel, with some surface finishing (e.g. chrome and zinc plating).
- Some rubber seals.
- Asbestos brake linings have been phased out.

Manufacture

- Press work and turning – consuming energy, using coolants and producing metallic swarf.
- Cleaning of metal parts using solvents or water-based washing.
- Chrome & Zinc Plating, using energy & water, producing effluent and special wastes.
- Bonding of brake lining to shoes using solvent based adhesives.

Use

- Weight of braking systems affects fuel efficiency of vehicle during use.
- Hydraulic fluids used in braking system.

Disposal

- Brake units tend to be remanufactured (linings and seals replaced) and used several times during the life of a vehicle.
- Hydraulic Fluids to be disposed of.
- Metals can be recycled.

Diesel systems: *Diesel Pumps, Injectors, Filters.*

Materials

- Mainly aluminium and steel, with some surface finishing (e.g. zinc plating & phosphating) and heat treatments.
- Some rubber seals.
- Paper and plastics in filters

Manufacture

- Mainly turning from castings and solid bar – consuming energy, using coolants and producing metallic swarf.
- Cleaning of metal parts using solvents or water-based washing.
- Zinc Plating and Phosphating using energy & water, producing effluent and special wastes.
- Testing of pumps and injectors using fuel.

Use

- Operation of diesel system directly affects fuel efficiency of vehicle during use.
- Weight of components indirectly affects fuel efficiency of vehicle during use.

Disposal

- Diesel pumps and injectors tend to be remanufactured and used several times during the life of a vehicle.
- Filters are replaced and disposed of during vehicle servicing.
- Metals can be recycled.

Electrical and electronic systems: *Wiring harnesses, engine management systems, switches, controls and actuators.*

Materials
- Copper for windings and cables
- Plastic housings and PVC for cable
- Printed circuit boards, thin-film circuitry and electronic components.
- Lead solder

Manufacture
- Drawing and bunching of copper to produce cable (energy intensive)
- Plastic injection moulding producing plastic waste and emissions, using electricity.
- Assembling of printed circuit boards including soldering producing colophony and lead fume.
- Cleaning of printed circuit boards using solvents or water-based washing.

Use
- Operation of engine management systems directly affects fuel efficiency of vehicle during use.
- Power consumption of electrical and electronic components affects vehicle power supply and ultimately fuel economy.
- Weight of components indirectly affects fuel efficiency of vehicle during use.

Disposal
- Electronic "black box" type components generally cannot be repaired and will be disposed of if replaced due to faults during vehicle life.
- Complexity, small size and mixture of materials means that these components cannot be easily recycled.

Aerospace products: *Fuel pumps, electronic controllers, actuators, power equipment, cargo systems.*

Materials
- Mainly aluminium and steel, with some surface finishing (e.g. zinc plating & phosphating) and heat treatments.
- Some "exotic" metals/alloys used for high performance specifications
- Printed circuit boards and electronic components

Manufacture
- Mainly turning from castings and solid bar – consuming energy, using coolants and producing metallic swarf.
- Cleaning of metal parts and printed circuit boards using solvents or water-based washing.
- Plating includes zinc, chrome and cadmium using energy & water, producing effluent and special wastes.
- Testing of pumps uses kerosene.

Use
- Operation of fuel pumps directly affects fuel efficiency of aircraft during use.
- Weight of components indirectly affects fuel efficiency of aircraft during use.

Disposal
- Aerospace products tend to be in service for 30-40 years. They are repaired and overhauled at regular service intervals.
- Metals can be recycled.

General Comments

As a manufacturer of vehicle components LucasVarity is contributing to global environmental impacts:

- The manufacturing processes use energy and materials, produce waste, air emissions and effluent. Administration uses predominantly energy and paper.
- In use its products use fossil fuels and produce air emissions that contribute to global warming, acid rain and local air pollution.
- At the end of their life most products are disposed of to landfill, although remanufacturing does prolong the life of the mechanical and electro-mechanical products and metals are generally recovered for recycling.

INSTITUTE OF
ENVIRONMENTAL
MANAGEMENT

This is to certify

Nicolette Lawson

has satisfied the criteria for
Membership established by the
Institute of Environmental Management
and has been admitted as a

MEMBER

of the

INSTITUTE OF ENVIRONMENTAL
MANAGEMENT

Date: 11 June 1998

Signed: SHarpe

for and on behalf of the Executive Committee

Appendix AH

"Our Environmental Challenge"
Lucas Aerospace Environmental Measures of Performance Impact Report

COMMERCIALLY CONFIDENTIAL

Lucas Aerospace

Our Environmental Challenge

Issue 2A

Covering 12 months
to December 1998

Terry Bridgewater,
HS&E Manager

Nicolette Lawson,
Independent Consultant

Contents

Introduction

The current world focus on climate change is expected to lead to emissions controls and targets for industry. We are already seeing government consultation papers suggesting the use of economic instruments to meet the Kyoto obligations. In addition, the Sustainability debate will make us focus more on resource consumption.

This document is an attempt to gauge the impact of Lucas Aerospace activities on the Global Environment. Where possible we have used the HS&E measures of performance data, collected during 1998 for each of the 21 Lucas Aerospace factories, as a basis for determining our impact.

Within manufacturing industry this appears to be a novel approach and it has been difficult to find any proven methodology. Thus we are pleased to be amongst the first in our industry to recognise and attempt to quantify our environmental impact.

Global Issues

The recognised major issues are:

1. Air Pollution
2. Ozone Depletion
3. Global Warming
4. Aquatic Toxicity
5. Deforestation
6. Land Degradation
7. Resource Depletion

The following data sheets define the issue, describe the impact of Lucas Aerospace operations and then attempt to quantify the key contributions from each Lucas Aerospace factory.

Notes

- Direct comparison between each factory's total impact is not valid because of the extreme variation in size, activity and product.
- Graphs comparing total impact versus impact per employee can be found in Appendix B
- Graphs comparing total impact versus impact per £,000 Sales can be found in Appendix C.
- The 1998 Measures of Performance data will be used as a baseline from which to set objectives and targets and gauge future improvement.
- This exercise has highlighted gaps in our MOPs data collection, which will be addressed in future MOPs design and improvement activities, for example: effluent toxicity and ground contamination.

External Data Sources

- NIFES Consulting Group, "The Energy Saver" Gee Publishing Ltd.
- ICI, "Environmental Burden: - The ICI Approach"
- Electricity Association, "The UK Electricity Industry and the Environment" 1998.
- Institute of Environmental Management "Focus on Life Cycle Assessment" Special Report, Vol. 5, Issue 3, June 1998
- Open University Module T830 "Enterprise and the Environment"
- Porteous, A, 1997, "Dictionary of Environmental Science and Technology", Wiley.
- National Society for Clean Air and Environmental Protection 1997 "Pollution Handbook" NSCA.

Results in context

1998 Performance Measures

Measure	Includes:	units	1998 Total	Per employee	Cost	Totals in Context
Energy	Gas, electricity, oil etc.	MWh	259,839	38	£ 5,823,923	As much as 64,960 average UK homes use in a year
Water	Process & domestic use	tonnes	939,964	142	£ 563,278	Equivalent to 522 Olympic Sized swimming pools
Waste Disposal	Hazardous, oils, general, etc.	tonnes	8,543	1.6	£ 330,540	As much as 13,350 average UK homes produce in a year
VOCs Lost	Solvents, paint, adhesives etc.	tonnes	303	0.045	£ 1,527,804	Enough to fill over 6,000 balloons
Days lost	Work related injury & illness	days	718	0.1067	£ 269,250	(Assuming £375[1] per lost day)
					£ 8,514,795	

Resulting Impacts

Input Measures	Issue	Item	1998 Total	units
Energy	**Air Pollution – Acid Rain**	SO_2	815	tonnes
Energy	**Air Pollution - Smog**	NOx	164	tonnes
Energy VOCs	**Global Warming**	CO_2 and equivalents	136,976	tonnes
Water	**Aquatic Toxicity**	Process Effluent	611,727	tonnes
Energy Waste VOCs	**Resource Depletion**	Waste, Fuel & lost VOCs	54,621	tonnes

Please send your comments back to Terry Bridgewater, c/o Shaftmoor Lane.

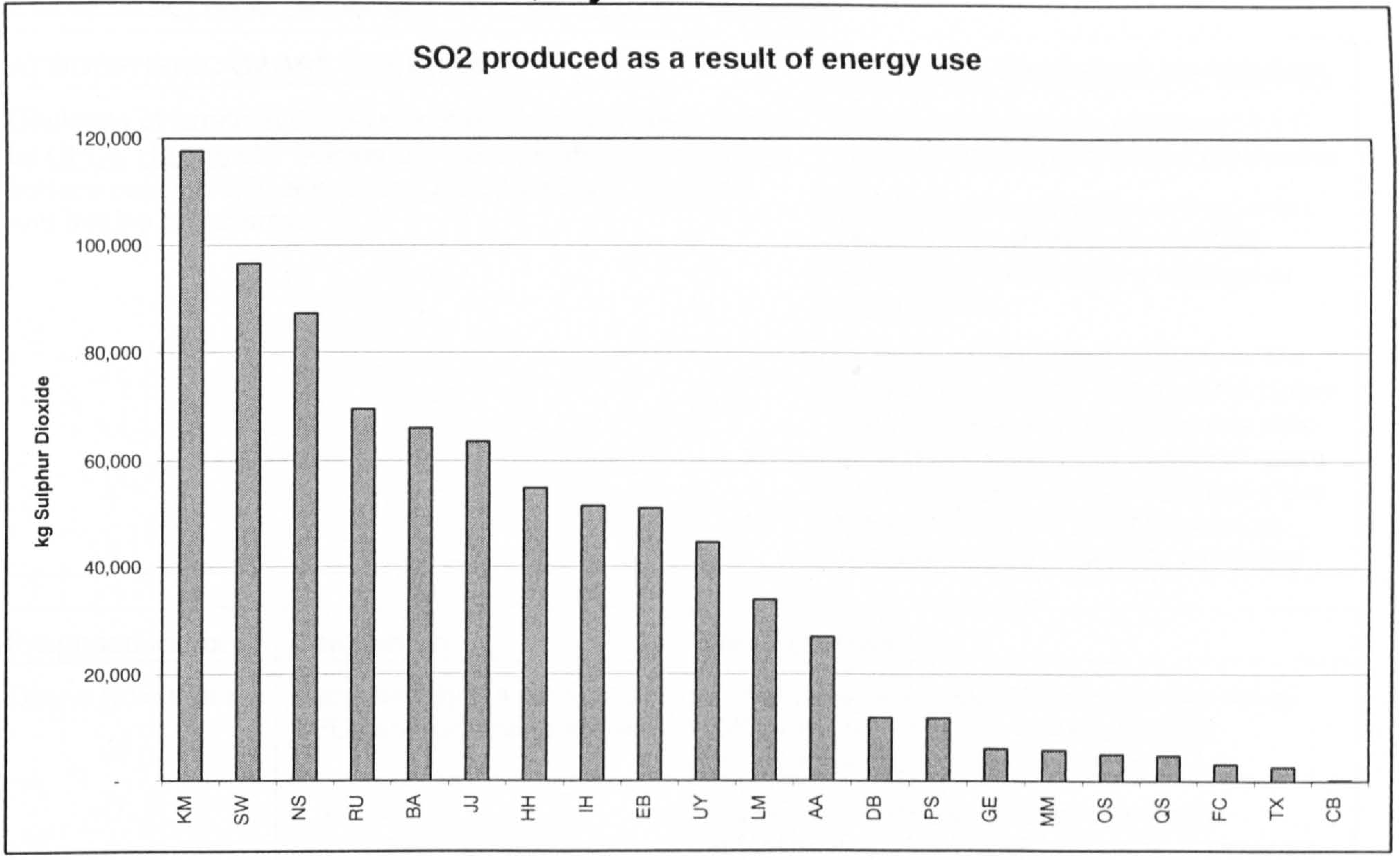
[1] Assuming employment costs are £25,000 per year per employee and 200 days are worked per year then costs are £125 per day per person. The cost due to lost time accidents is assumed to be 3 x £125 per day (£375). This allows for the person injured to be absent, a replacement employee and a person's time to investigate the accident and administrate it.

Issue 1: Air Pollution

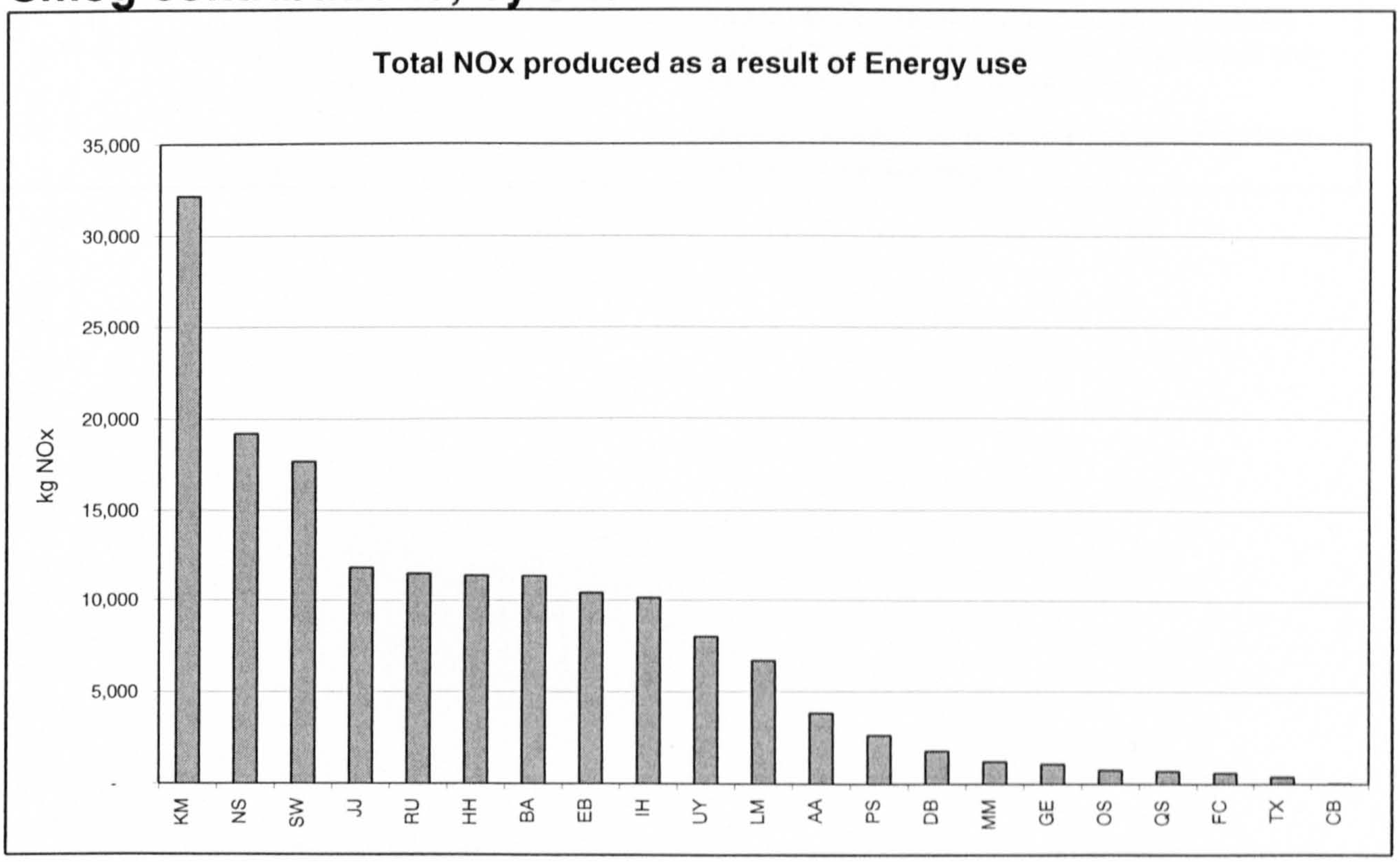
AIR POLLUTION PROBLEMS	Main Lucas Aerospace contribution
Air Pollution includes global issues such as acid rain, as well as local issues such as low level smog and the presence of contaminants such as dust, fumes, mist, odour, smoke or vapour, in quantities or characteristics, and of duration likely to be injurious to human, plant or animal life or property.	See below:
Acid Rain is mainly due to SO_2 in the air dissolving in water.	SO_2 is created when fossil fuels are burnt in power stations, boilers and vehicles.
Photochemical Smog is due to NOx reacting with other elements in the air.	NOx are created when fossil fuels are burnt in power stations, boilers and vehicles.
In the Troposphere increasing levels of ozone react with other pollutants (NOx, VOCs etc) and sunlight to form **smog** (see above).	Vehicles used by employees and transportation of the product and parts. Discharges from photocopiers and laser printers. VOCs used in Lucas Aerospace are found in cleaning solvents, adhesives, coatings, test fuels etc.
Other air pollution:	Various air emissions from production processes, and boilers.

Proposed Index	Calculation	Possible Now?
Acid Rain Index	calculated by the amount of SO_2 produced as a result of energy use	Yes, based on 1996/97 statistics from the UK Electricity Industry and average % content in fuels (see graph overleaf)
Smog Index	calculated by the amount of NO_x produced as a result of energy use	Yes, based on 1996/97 statistics from the UK Electricity Industry and NOx produced from fuels during combustion (see graph overleaf)

Acid Rain contributions, by site:



Smog contributions, by site:



Issue 2: Ozone Depletion

ATMOSPHERIC OZONE CHEMISTRY	Main Lucas Aerospace contribution
Depletion of ozone in the Stratosphere **(ozone hole)** caused by CFCs, Halons etc. Allows UV radiation through to earth's surface causing skin cancer and harmful effects to plants and marine organisms.	All sites should have eliminated CFC solvents used in production processes. CFCs are still present in refrigeration plant, which needs to be carefully maintained to ensure no leakage of these gases. Halon is still to be found in some fire protection systems. Halon is no longer manufactured and therefore supplies will not be available to replenish spent systems. Halon is also 40 times more potent than CFCs and therefore its disposal must be carefully controlled

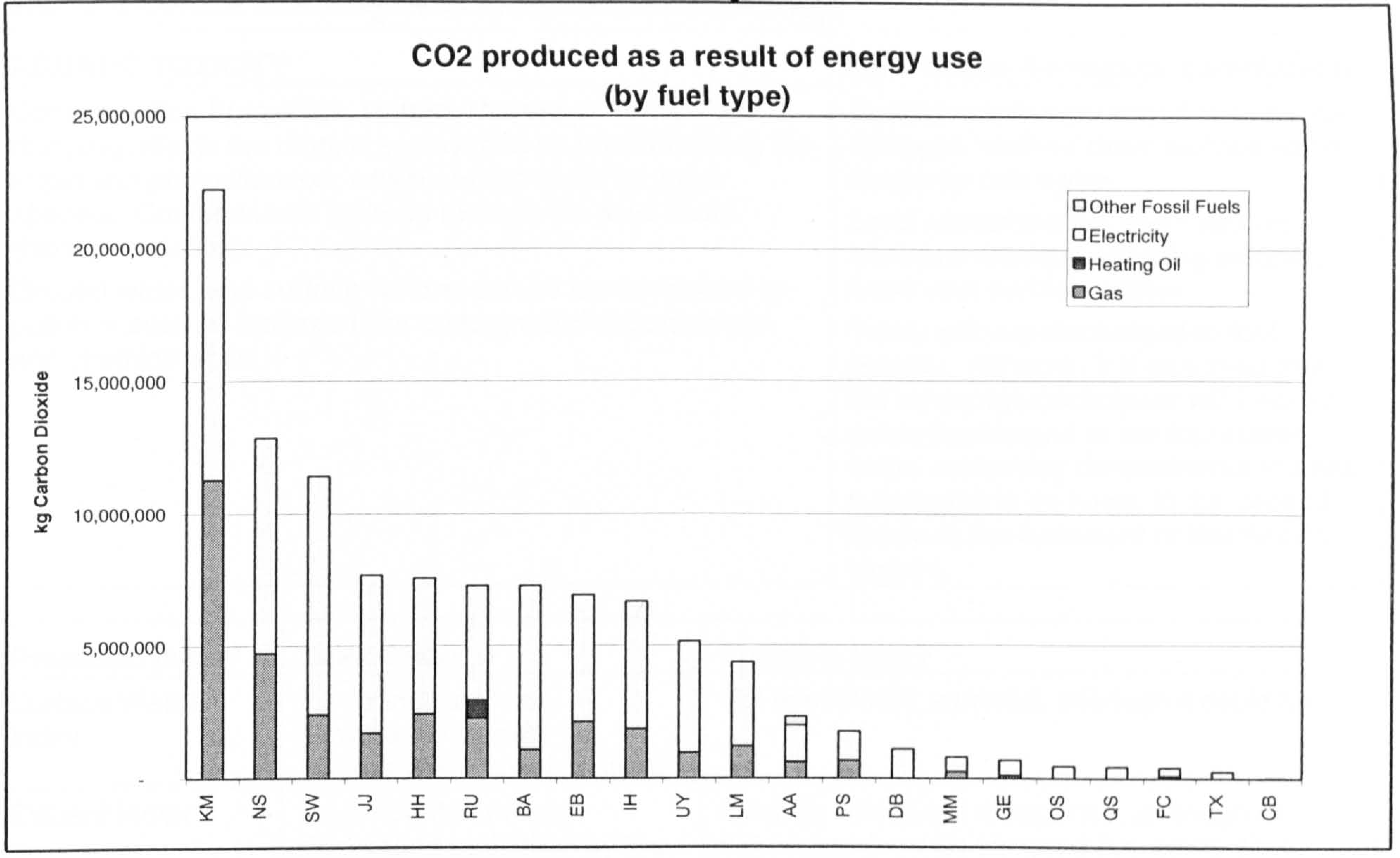
Proposed Index	Calculation	Possible Now?
Ozone Hole Index	calculated by the amount of CFCs and Halons released	In theory, all sites should have stopped using CFC solvents. Therefore leakage from refrigeration units is the next source. We do not currently measure this as it is assumed to be negligible. Although it would be possible to record "topping-up" of systems, during maintenance/servicing. Halon, where still in place, should be in totally sealed fire-protection systems, which must only be released in the event of a fire. A Halon survey would reveal the potential harm within Lucas Aerospace.

Issue 3: Global Warming (The "Greenhouse" effect)

GLOBAL WARMING or The "Greenhouse" Effect			Main Lucas Aerospace contribution
Caused by excess levels of "Greenhouse gases" predominantly CO_2 released when fossil fuels are burnt. Heat is trapped around the Earth causing disruption to weather patterns and raising of sea levels due to melting of polar ice-caps. Global Warming (greenhouse) gases include:			Use of gas and oil for space heating, use of electricity for production and lighting. Transport for goods and employees.
Gas (global contribution)	**Sources**	**Relative effect per tonne**	
CO_2 (50%)	fossil fuel burning, deforestation & land use, cement manufacture	1	Energy use, use of virgin paper, development of green-field sites, use of cement in building work.
Methane (18%)	rice cultivation, ruminants (sheep, cows, etc), biomass burning & decay (landfills), releases from fossil fuel production	88	Waste sent to landfill may contribute to methane production. Recycling waste would reduce the production of methane and also reduce CO_2since less energy is used to convert waste into new products.
CFCs (14%)	manufactured for solvents refrigerants aerosol spray propellants, foam packaging etc. Also Halon for fire protection.	Up to 9,000	All sites should have eliminated CFC solvents used in production processes. CFCs are still present in refrigeration plant and Halon in fire systems. Both need to be carefully maintained to ensure no leakage of these gases.
Nitrous oxides [NOx] (6%)	Fertilisers Fossil fuel burning Land conversion for agriculture	160	Energy use.
Ozone (12%)	Formed by reactions between nitrogen oxides, oxygen and vehicle exhaust emissions, assisted by solar radiation, plus a small amount from electrical discharges.	1800	Vehicles used by employees and transportation of the product and parts. Discharges from photocopiers and laser printers.
Volatile Organic Compounds (VOCs)	*Adhesives, Coatings, Thinners, Cleaning solvents etc.*	*Various: Assume 10*	*VOCs used in Lucas Aerospace are found in cleaning solvents, adhesives, coatings, test fuels etc.*
Pre-cursor gases involved in ozone and methane chemistry	Nitrogen oxides Non-methane hydrocarbons Carbon monoxide Fossil fuel burning Evaporation of liquid fuels Fossil fuel and biomass burning		Combustion gases from power stations, boilers and vehicles. Fugitive emissions from use of kerosene and solvents.

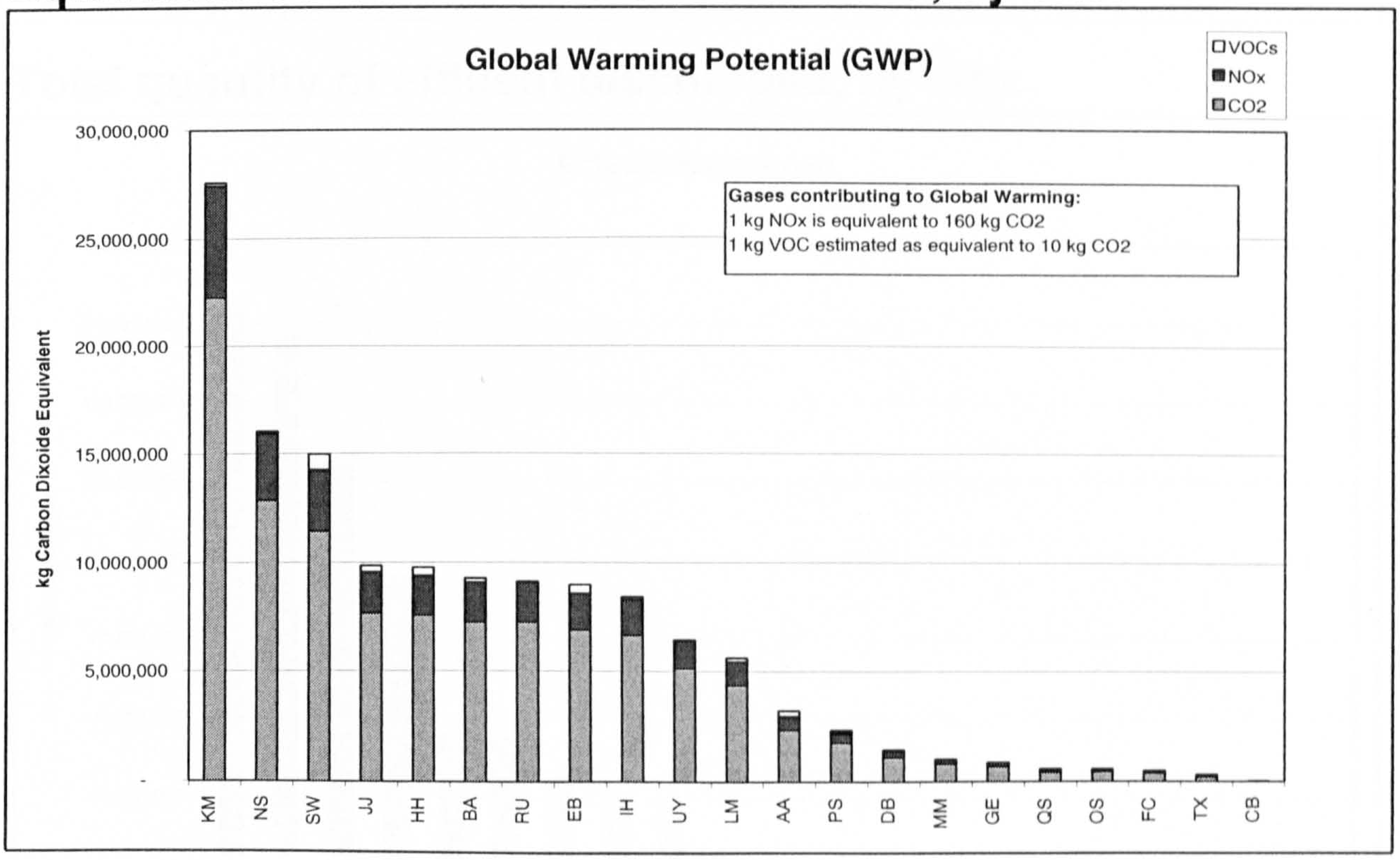
Proposed Index	Calculation	Possible Now?
Greenhouse Index	calculated by the amount of CO_2 produced as a result of energy use <u>Or</u>, CO_2 produced plus NOx and VOCs expressed in CO_2 equivalents	Yes, quantities of CO_2 produced during combustion of each type of fuel are known (see following graphs).

Carbon Dioxide contributions, by site:



However, although Carbon Dioxide is the most important gas, because it contributes 50% to the Greenhouse Effect, other gases are more potent and therefore relatively small quantities can still have an important impact. This is demonstrated by the following graph, where Nitrous Oxides (1 kg NOx – equivalent to 160 kg CO_2) and Solvents (1 kg VOCs assumed to be equivalent to 1000 kg CO_2) have been included:

Equivalent Carbon Dioxide contributions, by site:

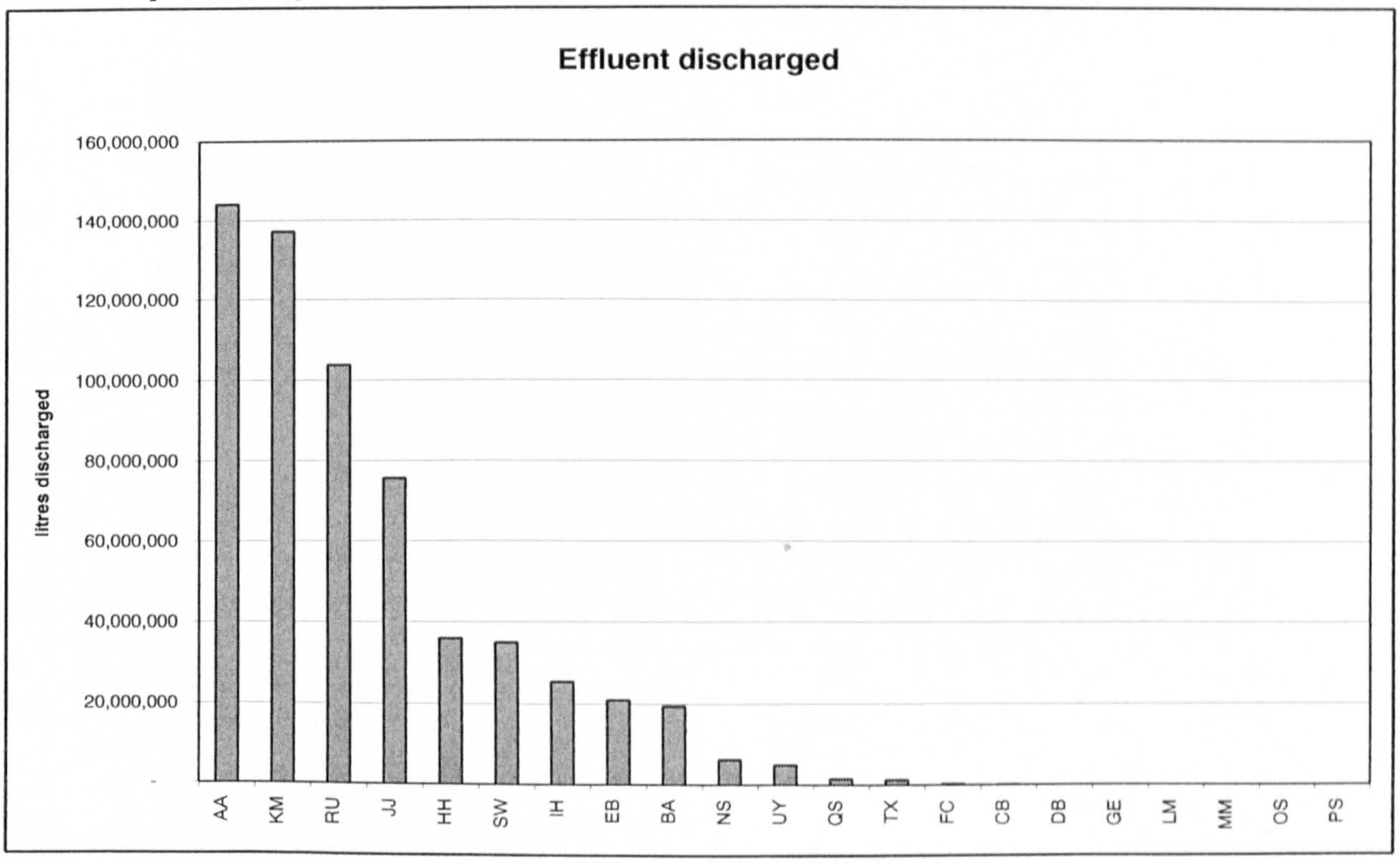


Issue 4: Aquatic Toxicity

AQUATIC TOXICITY	Main Lucas Aerospace contribution
Contamination from ships, coastal sources or rivers and dumping affects the marine eco-system by contaminating the algae and phytoplankton, which are the foods for other species. Contaminants build-up through the food chain (bioaccumulation). Ground water, and surface waters, can be contaminated by pollution such as leakage from underground storage tanks and chemical spills.	Contaminants discharged to rivers via spillages washed down surface water drains by rain water. Land contamination (from leaking chemical storage) affecting ground-water and surface waters. Trade effluent discharged to foul sewers. Although it is assumed that the sewerage undertaker will treat all water discharged to the foul sewer, water containing contaminants still has a potential to do harm, in the case of failure in the treatment or distribution system.

Proposed Index	Calculation	Possible Now?
Surface Water Index	the incidents of non-compliance against the surface water consent limits	Not specifically reported, although it could be.
Effluent Index	the amount of effluent discharged multiplied by the average annual concentrations of COD (chemical oxygen demand), toxic metals, oil, suspended solids etc.	Quantity of effluent is reported, although its nature needs to be checked (i.e. some sites report domestic waste water as effluent) (see graph below). Average annual concentrations could be obtained from sites (although not currently requested). Alternatively, their allowable concentrations of substances as defined by consents to discharge. This would give the maximum allowable pollution levels, rather than actual.

Total quantity of effluent discharged, by site:



Data compiled by Nicolette Lawson

Issue 5: Deforestation

DEFORESTATION	Main Lucas Aerospace contribution
Deforestation causes **soil erosion, floods** in wet seasons and **drought** in dry seasons. Also loss of forests exacerbates the effects of **Global Warming** since forests play an important part in the removal of CO_2. Finally, deforestation is a major cause of habitat loss resulting in **loss of biodiversity.**	Main contribution to deforestation is use of virgin paper and cardboard / wooden packaging from non-sustainable sources.

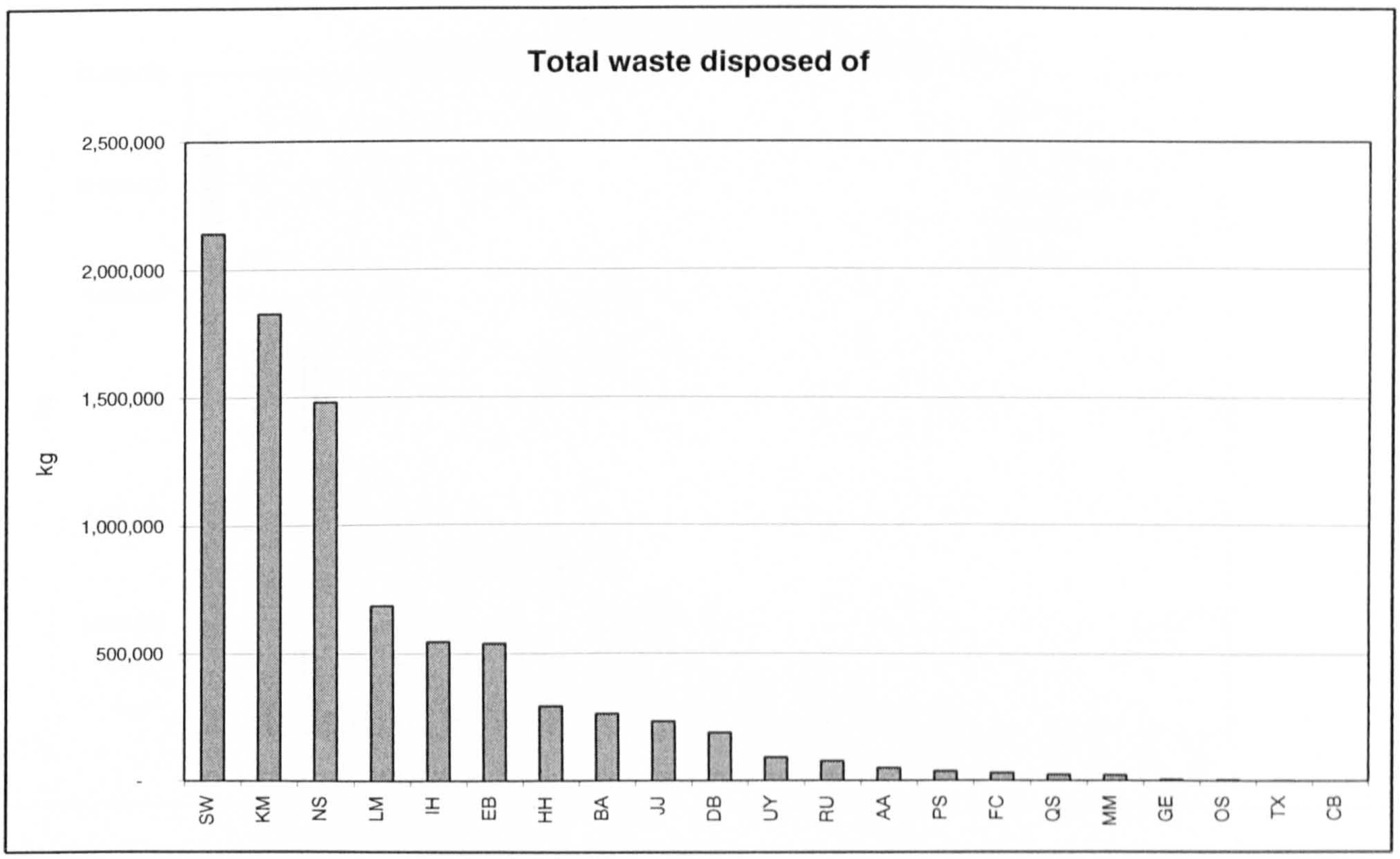
Proposed Index	Calculation	Possible Now?
Paper Index	calculated by the amount of virgin paper used and cardboard packaging	Paper and packaging use is not currently measured, although we could use the paper & cardboard waste figure. However, most paper & card ends up in general (other) waste and so this is not a good indicator. Recording of purchased quantities (weight of paper and cardboard) could give this figure.

Issue 6: Land Degradation

LAND DEGRADATION	Main Lucas Aerospace contribution
Land degradation can occur through nutrient depletion, structural decline and compaction, biological decline, chemical deterioration (acidification and salinity) and soil erosion. Causes are cultivation, mining, building, industrial land use and waste disposal.	Land contamination from spillages, leaking storage tanks (particularly underground), building work and disposing of waste to landfill.

Proposed Index	Calculation	Possible Now?
Land Contamination Potential	the total capacity of underground storage tanks plus a factor for known historical land contamination	Not currently measured. But this would be good information to collect, given that land contamination is LAe's most costly environmental issue.
Waste Index	the total weight of waste sent to landfill	This can be provided now (see following graph). However, due to the mixed nature of the wastes the true environmental burden, due to toxicity of wastes could not be given.

Total weight of waste disposed of, by site:

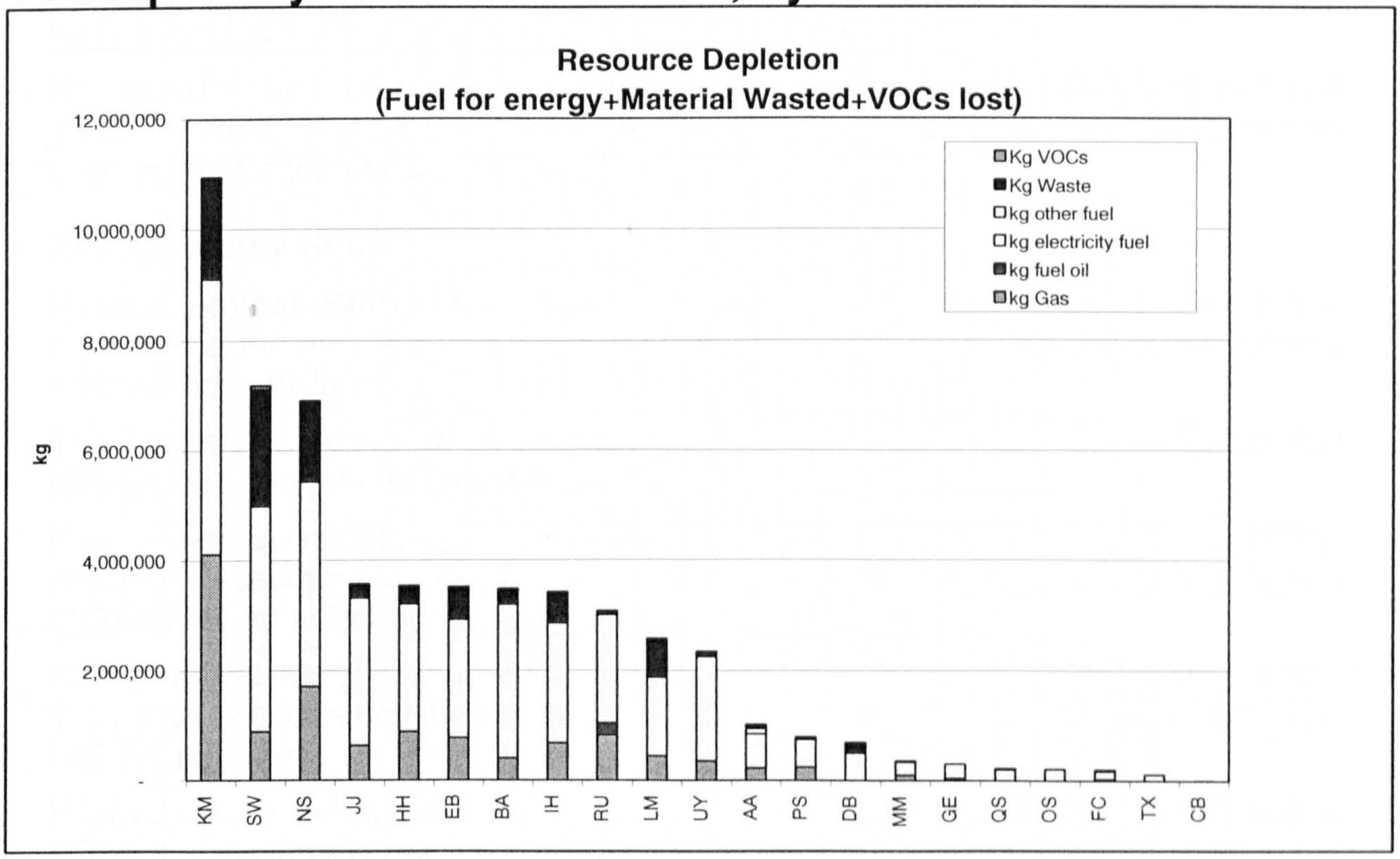


Issue 7: Resource Depletion

RESOURCE DEPLETION	Main Lucas Aerospace contribution
Non-renewable, virgin materials used to produce goods and energy.	Use of virgin materials for product and services. Use of fossil fuels for energy. Little use of recycled materials and limited recycling of waste.

Proposed Index	Calculation	Possible Now?
Resource Index	The amount of virgin materials used, which cannot be / are not used again.	Fuels for energy could be calculated (see graph below). Waste disposed of, including VOCs lost, could be used as an indicator of depleted resources (see graph below). Effluent is generally recycled, via the Water treatment companies, and therefore not lost.

Total quantity of resources used, by site:



Appendix A

Calculations and Assumptions

Impact 1. Air Pollution

- **Acid Rain Contributions**

  Acid Rain is mainly due to Sulphur Dioxide (SO_2) in the air dissolving in water. SO_2 is created when fossil fuels are burnt in power stations, boilers and vehicles. The Lucas Aerospace acid rain contributions are based on assumptions about the sulphur content of fuels used to produce the energy that we use.

  Gas is assumed to have zero sulphur content (this is the main reason why power stations have switched from Coal to Gas.). Therefore any use of gas by sites is assumed not to contribute to Acid Rain.

  Assuming coal has a 1.4% sulphur content and oil has 3%, and comparing the UK Electricity Industry's Fuel Mix in 1997 (Electricity Association report), then electricity is calculated to produce 0.005896 kg SO_2 per kWh and fuel oil 0.012634 kg SO_2 per kWh.

  Site contributions are therefore dependent on their mix of gas, electricity and fuel oil use. No account has been made for national variations. No estimation has been made for the impact of company transport or employee travel.

- **Smog Contributions**

  Photochemical Smog is due to Nitrous Oxides (NOx) reacting with other elements in the air. NOx are created when fossil fuels are burnt in power stations, boilers and vehicles.

  The Lucas Aerospace smog contributions are based on assumptions about the NOx given off by of fuels used to produce the energy that we use.

  Gas, when burnt, produces 0.00024kg NOx for each kWh energy, at 100% efficient. Assuming our gas boilers are on average 68% efficient gives us a figure of 0.000347 kg NOx per kWh.

  NOx from Electricity production is based on the UK Electricity Industry 1997 data. Total NOx produced by the industry divided by total kWh produced gives 0.000891 kg NOx per kWh.

  Fuel oil, when burnt, produces 0.00059kg NOx for each kWh energy, at 100% efficient. Assuming our oil fired boilers are on average 68% efficient gives us a figure of 0.000871 kg NOx per kWh.

  Site contributions are therefore dependent on their mix of gas, electricity and fuel oil use. No account has been made for national variations. No estimation has been made for the impact of company transport or employee travel.

  VOCs are expected to contribute to smog, but this cannot be quantified.

Impact 3. Global Warming

Two "Greenhouse" calculations were made. The first based purely on CO_2 (the main Greenhouse gas), produced as a result of energy use and the second calculation also includes NOx and VOCs, since they also have a "Greenhouse" effect, each kg released being far more potent than a kg of CO_2, therefore these have been converted to CO_2 equivalents, as described below.

- **CO_2 Contributions**

  Gas, when burnt, produces 0.185kg CO_2 for each kWh energy, at 100% efficient. Assuming our gas boilers are on average 68% efficient gives us a figure of 0.273 kg CO_2 per kWh.

  CO_2 from Electricity production is based on the UK Electricity Industry 1997 data. CO_2 per kWh produced was given as 0.55 kg.

  Fuel oil, when burnt, produces 0.25kg CO_2 for each kWh energy, at 100% efficient. Assuming our oil fired boilers are on average 68% efficient gives us a figure of 0.368 kg CO_2 per kWh.

  Site contributions are therefore dependent on their mix of gas, electricity and fuel oil use. No account has been made for national variations. No estimation has been made for the impact of company transport or employee travel.

- **Equivalent CO_2Contributions**

  Although Carbon Dioxide is the most important gas, because it contributes 50% to the Greenhouse Effect, other gases are more potent and therefore relatively small quantities can still have an important impact.

  For this calculation

  1 kg NOx is assumed to be equivalent to 160 kg CO_2 and

  1 kg VOCs is assumed to be equivalent to 10 kg CO_2.

Impact 7. Resource Depletion

Of the parameters measured for the HS&E Measures of Performance, fuels for energy, waste disposed of and VOCs lost were considered to be indicators of depleted resources.

Waste and VOCs are already measured in kg, but the fuel used to create the energy we consume has been calculated based on known CO_2 figures, for example:

For Gas, 1kg of fuel produces 2.75kg CO_2 (at 68% efficiency) and 1 kWh produces 0.273kg CO2 (at 68%), therefore 0.099 kg of fuel is required to produce 1kWh.

For Heating oil 0.116 kg of fuel produces 1kWh (at 68%)

And Coal requires 0.404 kg of fuel per kWh (at 33%)

However, currently (1997) in the UK, coal now only represents a third of electricity generation. Allowing for the fact that gas and nuclear power now both contribute over a quarter of electricity in the UK and the use of CHP (combines heat and power) and renewables are increasing, 0.25kg of mixed fuel is a better approximation for electricity.

The resulting graph shows that fuel used for electricity generation and waste disposed of dominates these figures.

No account has been made for national variations. No estimation has been made for the impact of company transport or employee travel.

Appendix B

Total Impact vs. per employee

As mentioned earlier in this report, direct comparison between each factory's total impact is not valid because of the extreme variation in size, activity and product. In order to be able to make comparisons between businesses it would be necessary to report these impacts in relation to a common variable. In a simple industry, making one type of product, a denominator, such as number of units produced, could be used to take account of the fluctuations attributable to normal production level variations.

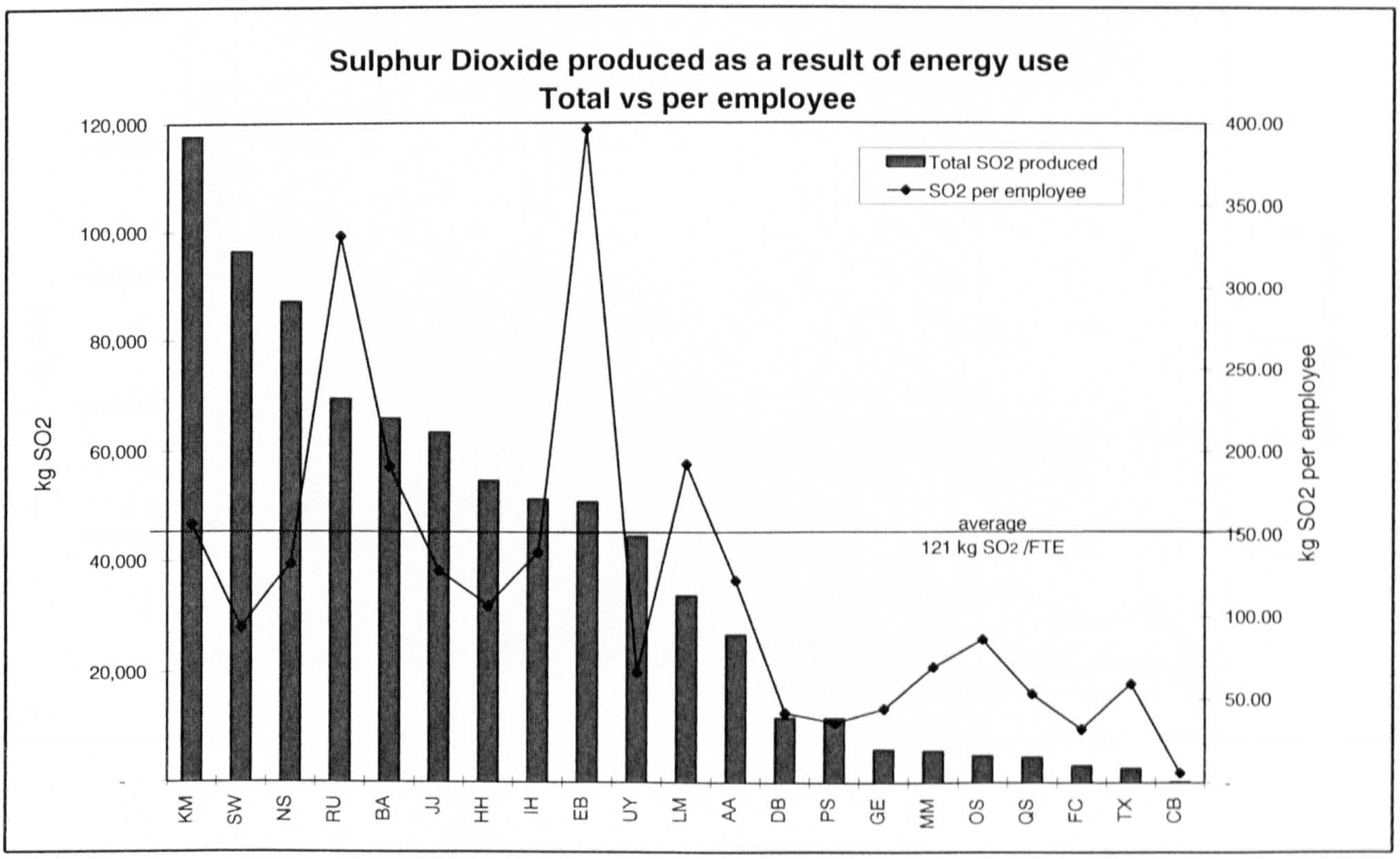
In an industry such as Lucas Aerospace where each factory makes a different mix of products and utilises different processes, it is not possible to find a suitable "production" type denominator.

However, in order to express some relationship to the size and activity of the business, the number of Full Time Employees and the Value of Sales has been recorded.

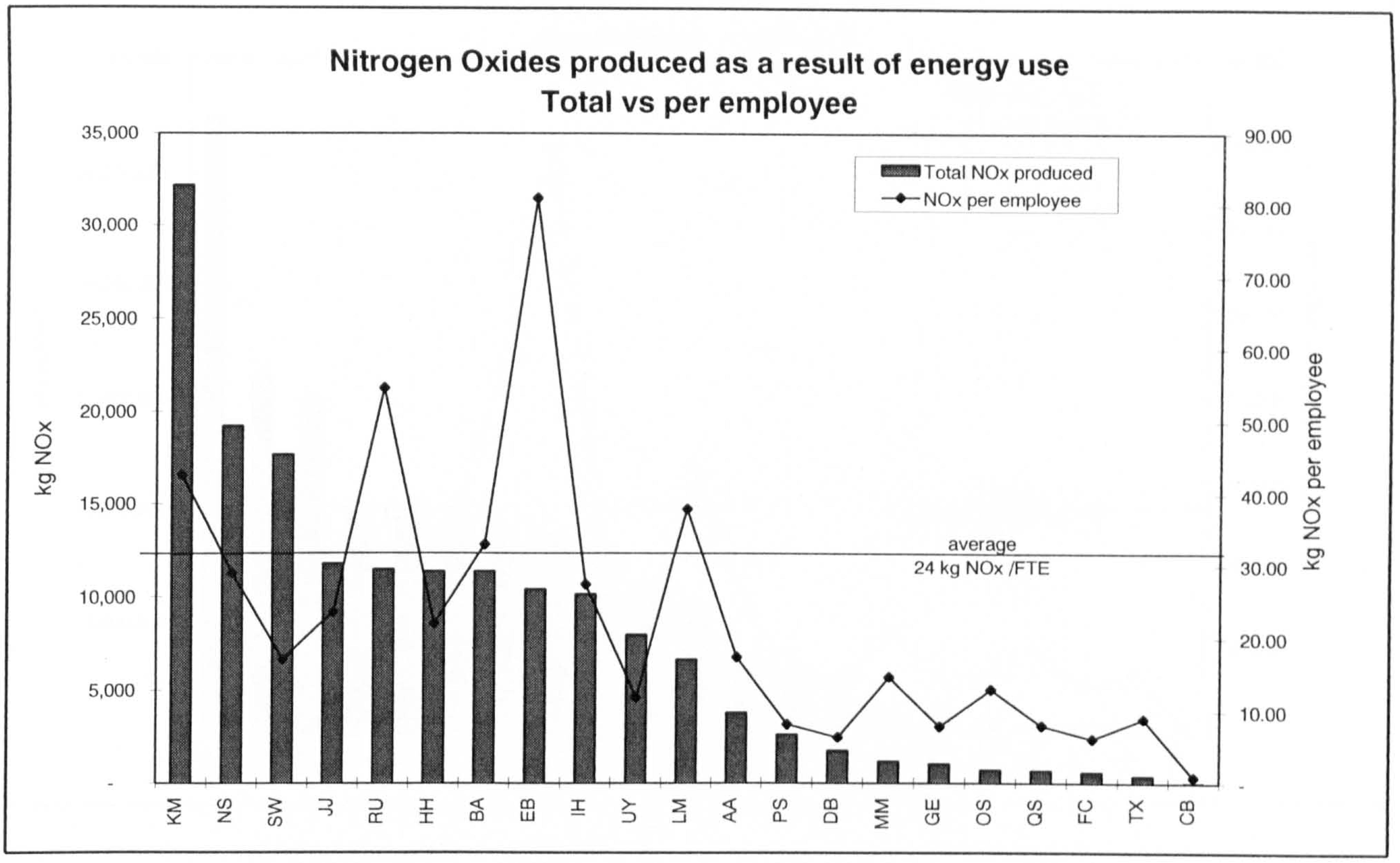
In this Appendix, the graphs show total burden versus burden per employee. An average line has been added to each graph. Points above this line can be regarded as less efficient (or more polluting per employee) than the average site and points below this line can be regarded as more efficient (or less polluting per employee) than the average site.

Issue 1: Air Pollution

Acid Rain contributions, by site:

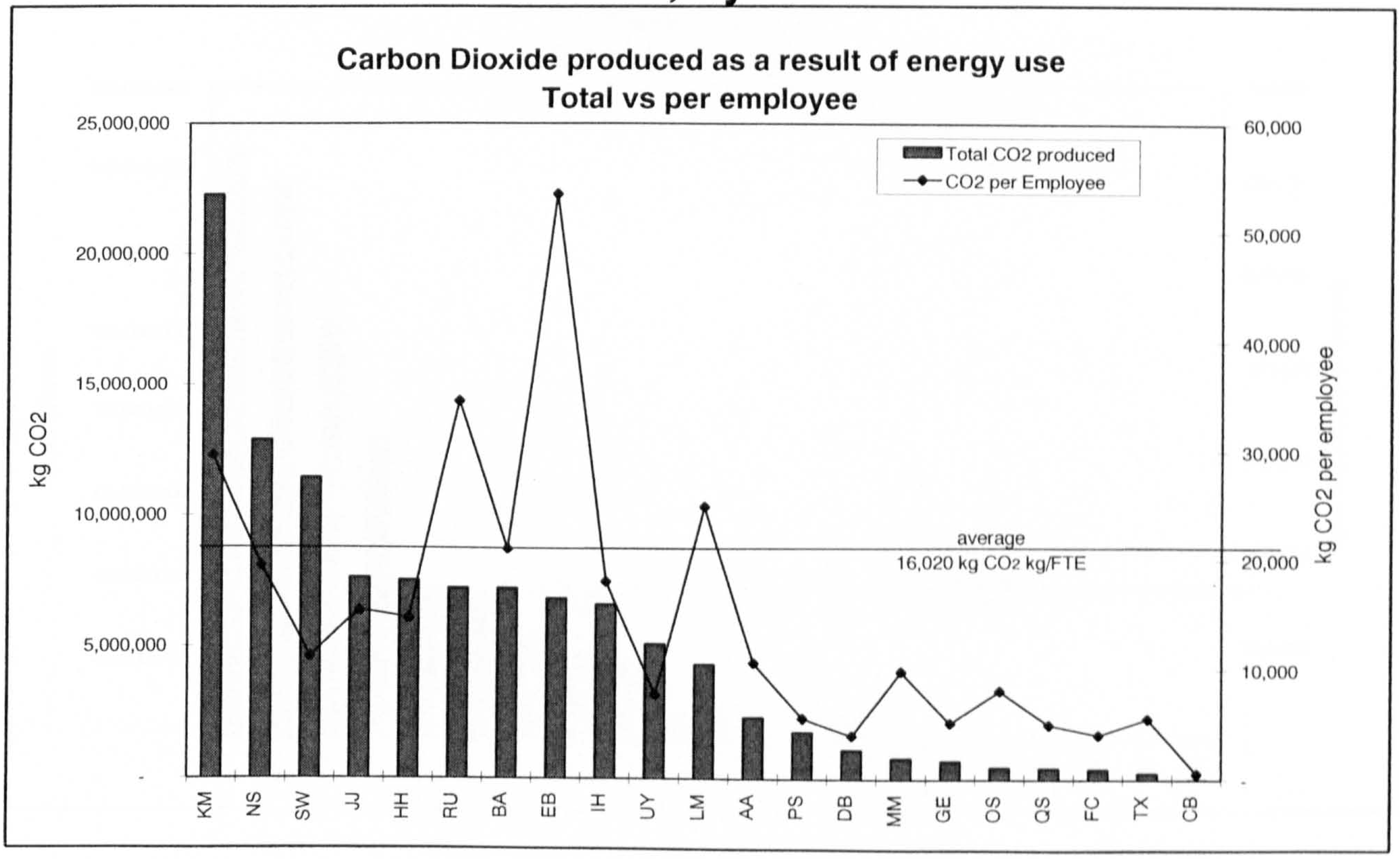


Smog contributions, by site:

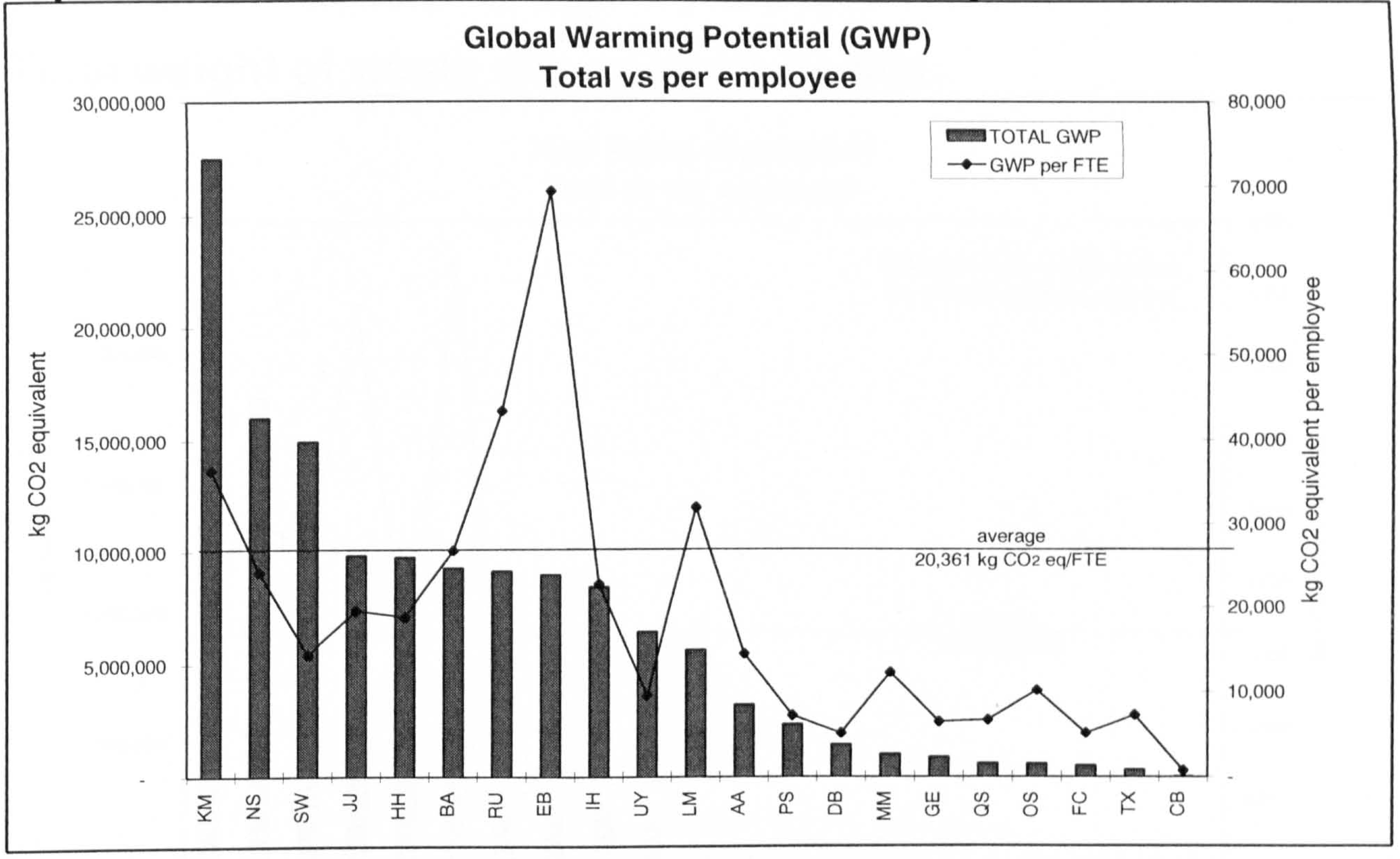


Issue 3: Global Warming (The "Greenhouse" effect)

Carbon Dioxide contributions, by site:

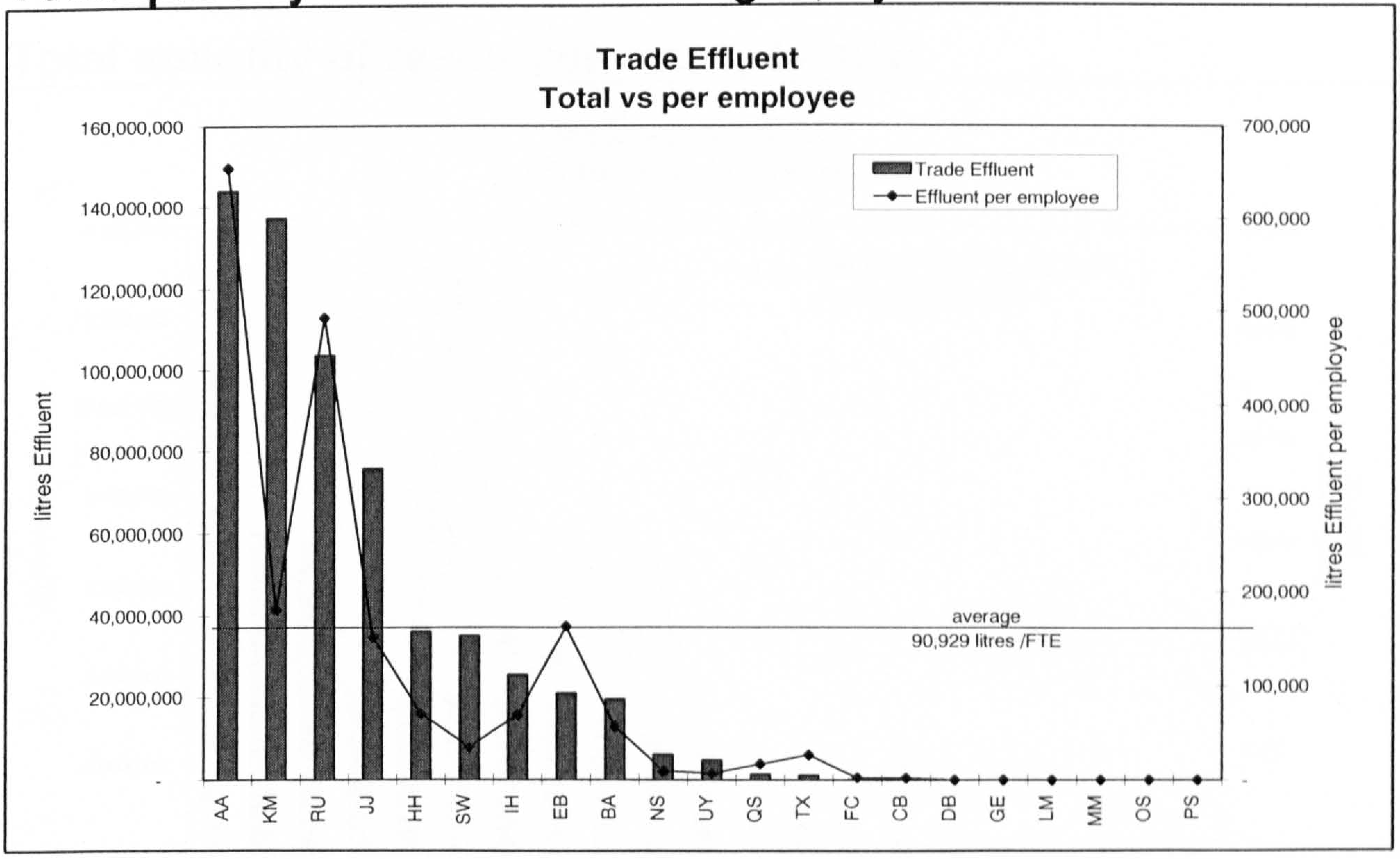


Equivalent Carbon Dioxide contributions, by site:



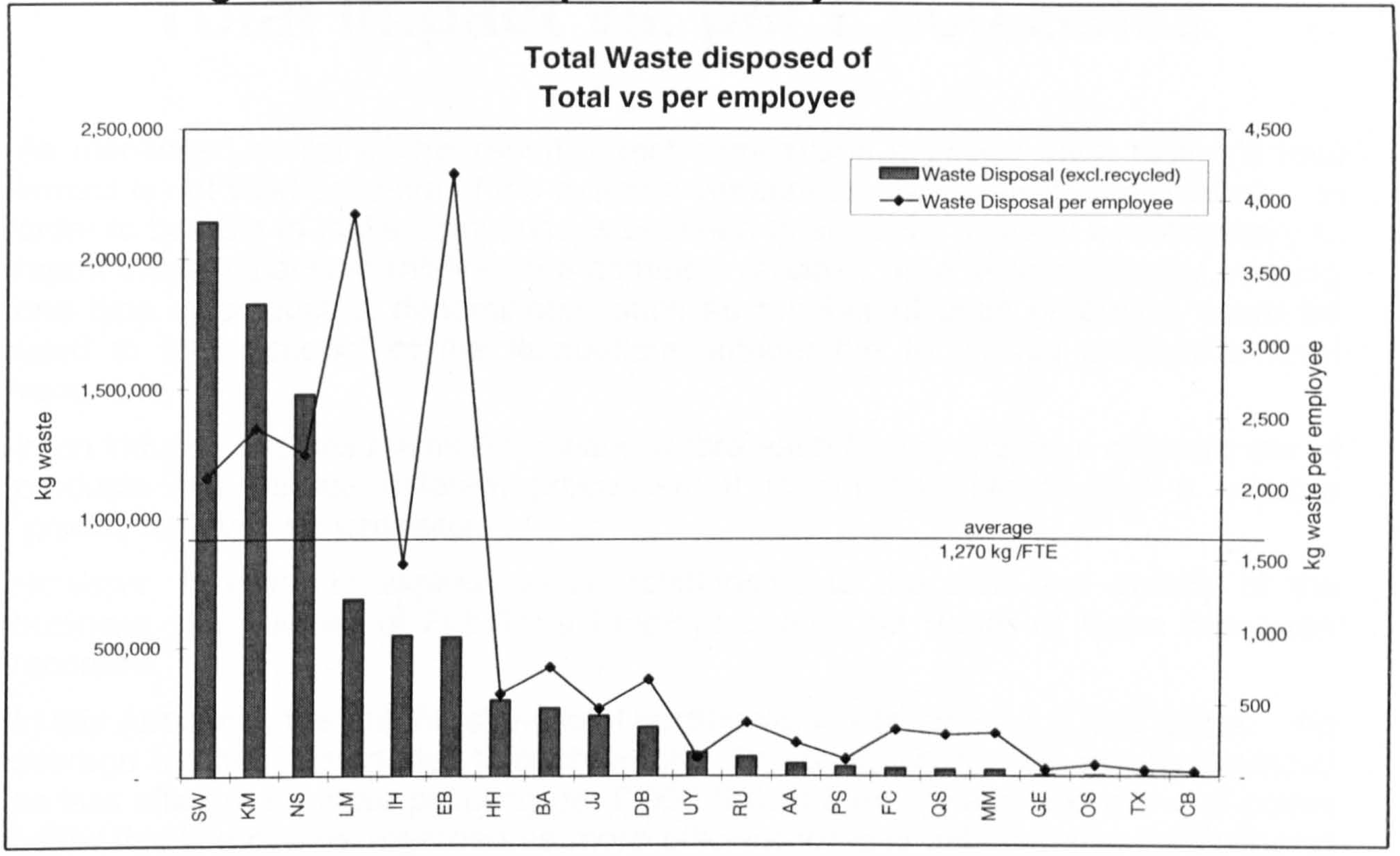
Issue 4: Aquatic Toxicity

Total quantity of effluent discharged, by site:



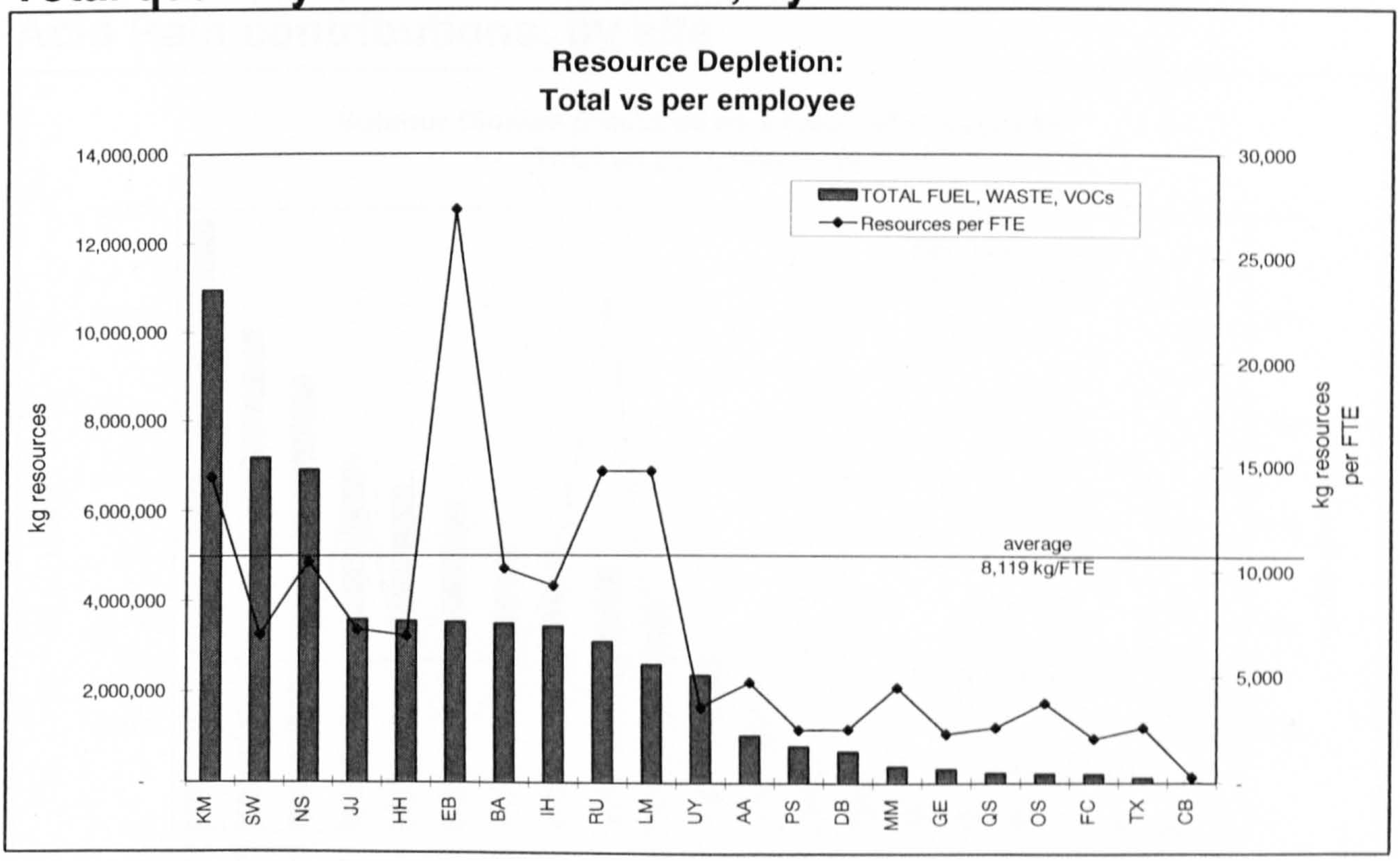
Issue 6: Land Degradation

Total weight of waste disposed of, by site:



Issue 7: Resource Depletion

Total quantity of resources used, by site:



Appendix C

Total Impact vs. per £,000 Sales

As mentioned earlier in this report, direct comparison between each factory's total impact is not valid because of the extreme variation in size, activity and product. In order to be able to make comparisons between businesses it would be necessary to report these impacts in relation to a common variable. In a simple industry, making one type of product, a denominator, such as number of units produced, could be used to take account of the fluctuations attributable to normal production level variations.

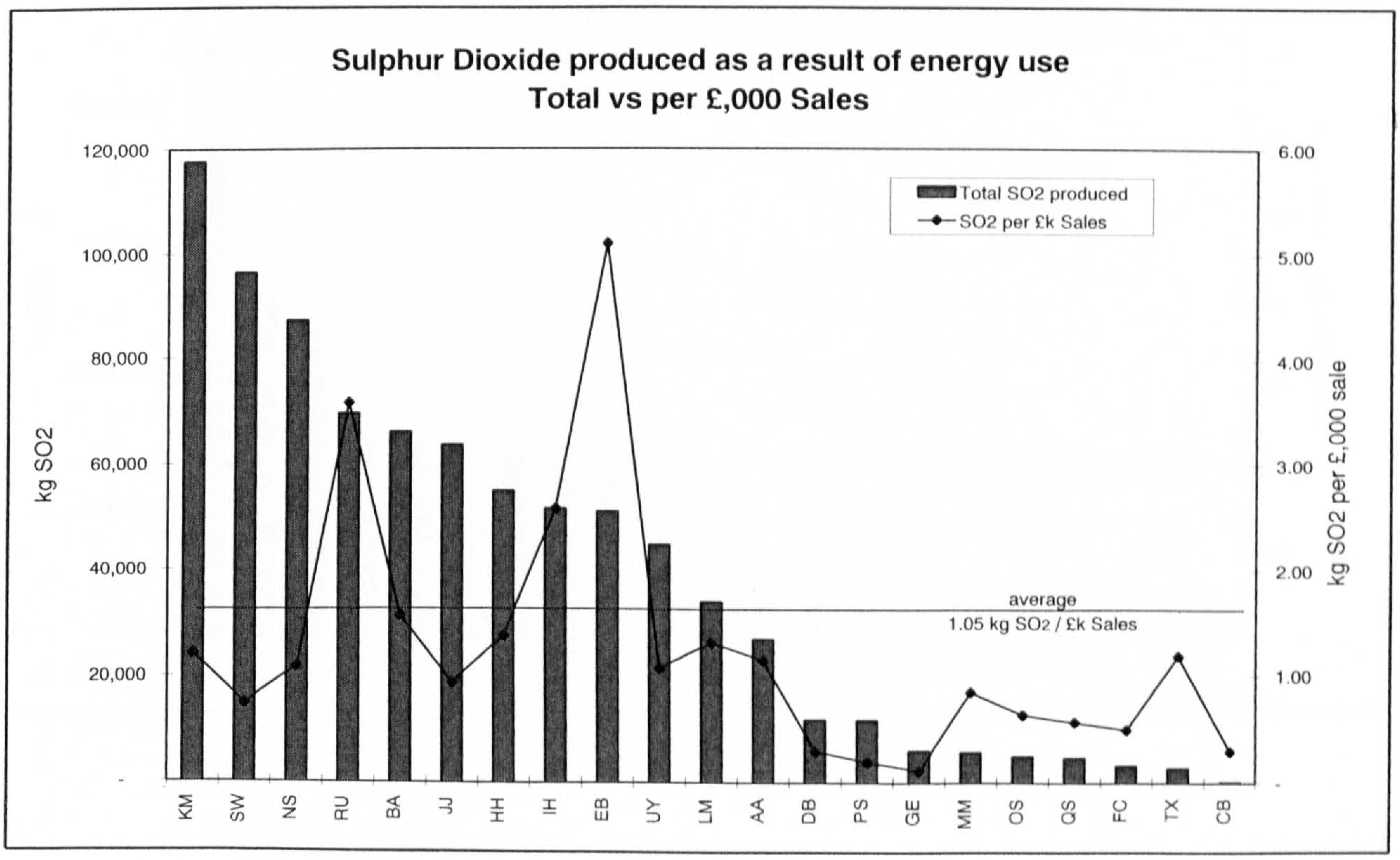
In an industry such as Lucas Aerospace where each factory makes a different mix of products and utilises different processes, it is not possible to find a suitable "production" type denominator.

However, in order to express some relationship to the size and activity of the business, the number of Full Time Employees and the Value of Sales has been recorded.

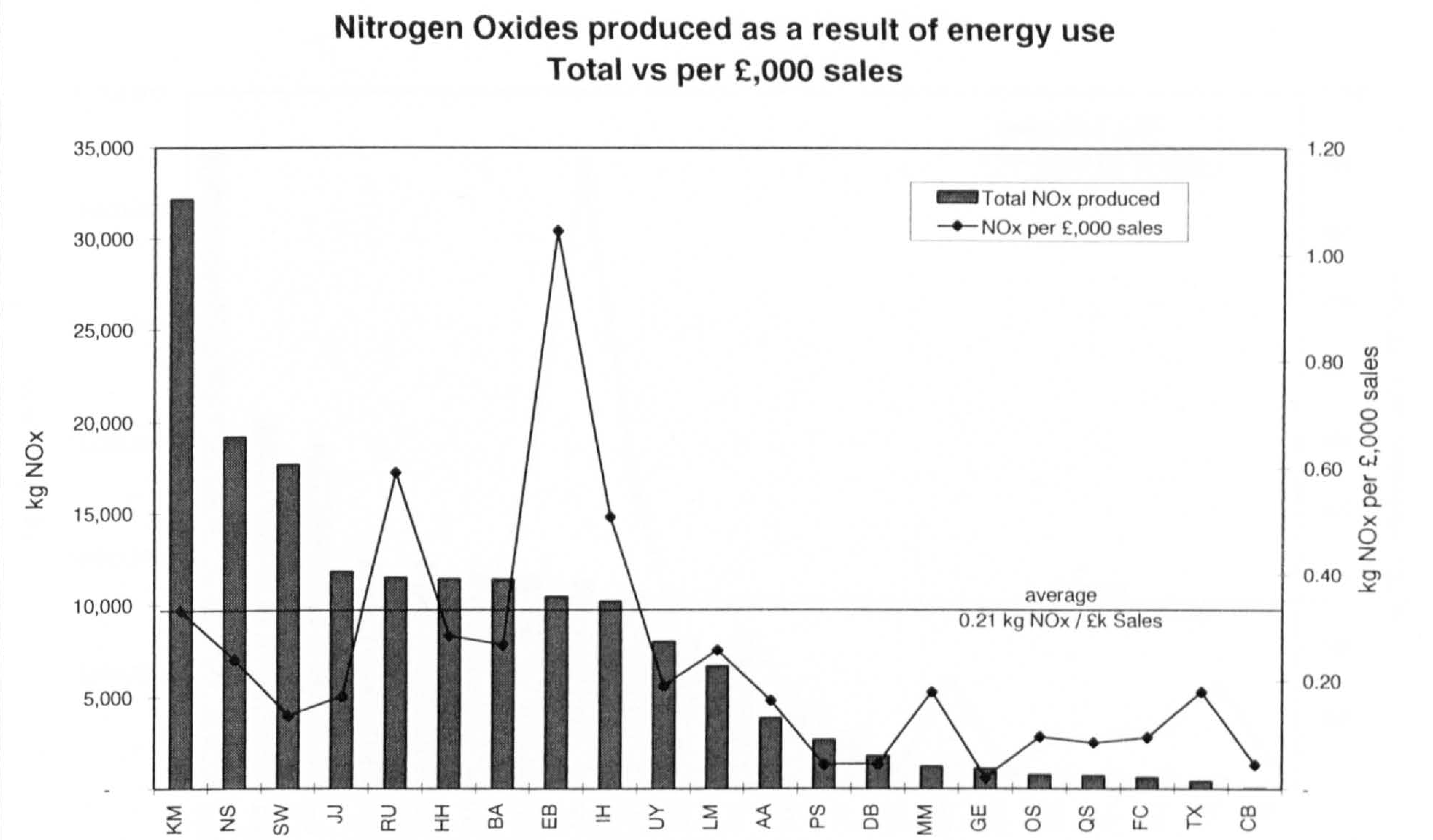
In this Appendix, the graphs show total burden versus burden per £,000 Sales. An average line has been added to each graph. Points above this line can be regarded as less efficient (or more polluting per £,000 Sales) than the average site and points below this line can be regarded as more efficient (or less polluting per £,000 Sales) than the average site.

Issue 1: Air Pollution

Acid Rain contributions, by site:

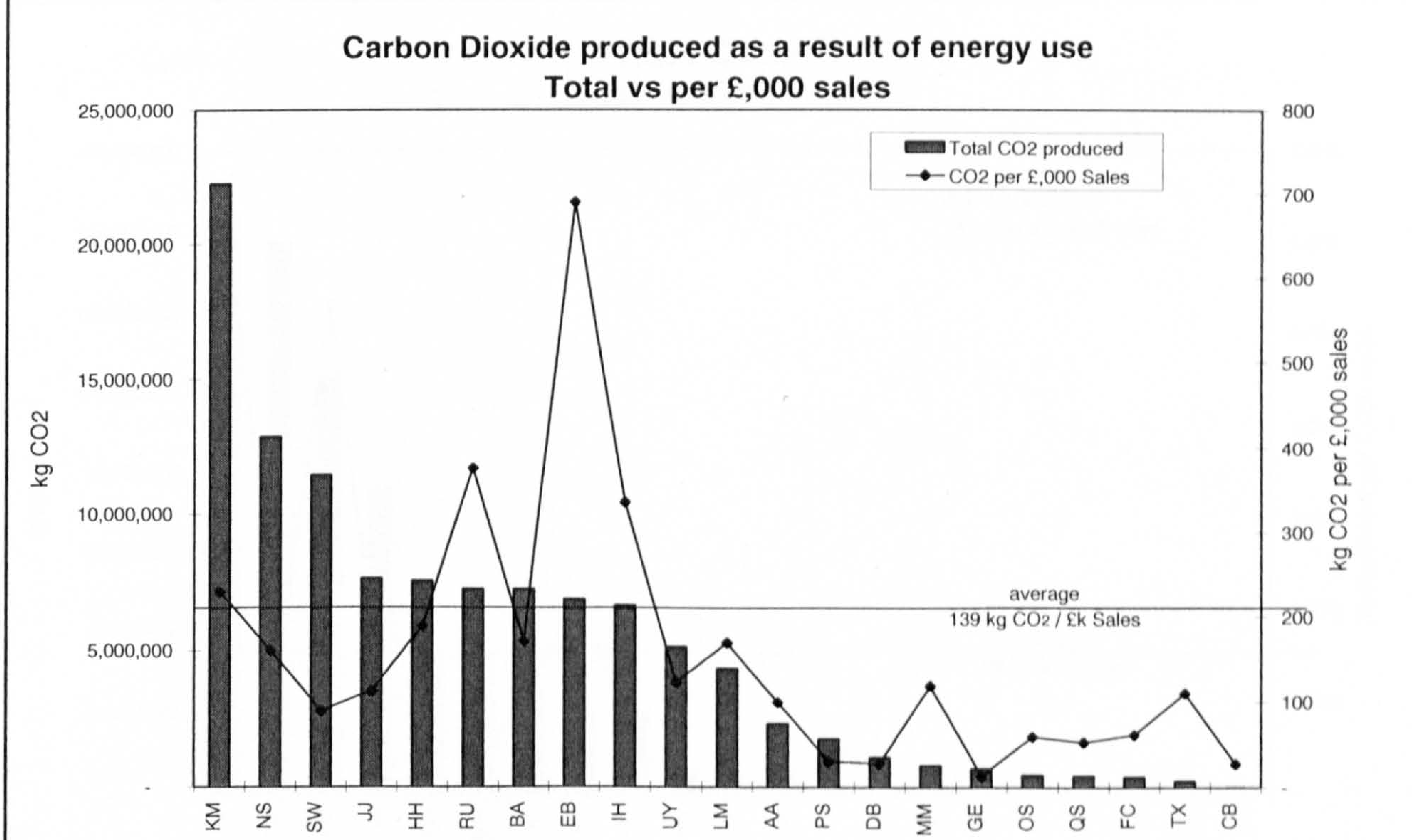


Smog contributions, by site:

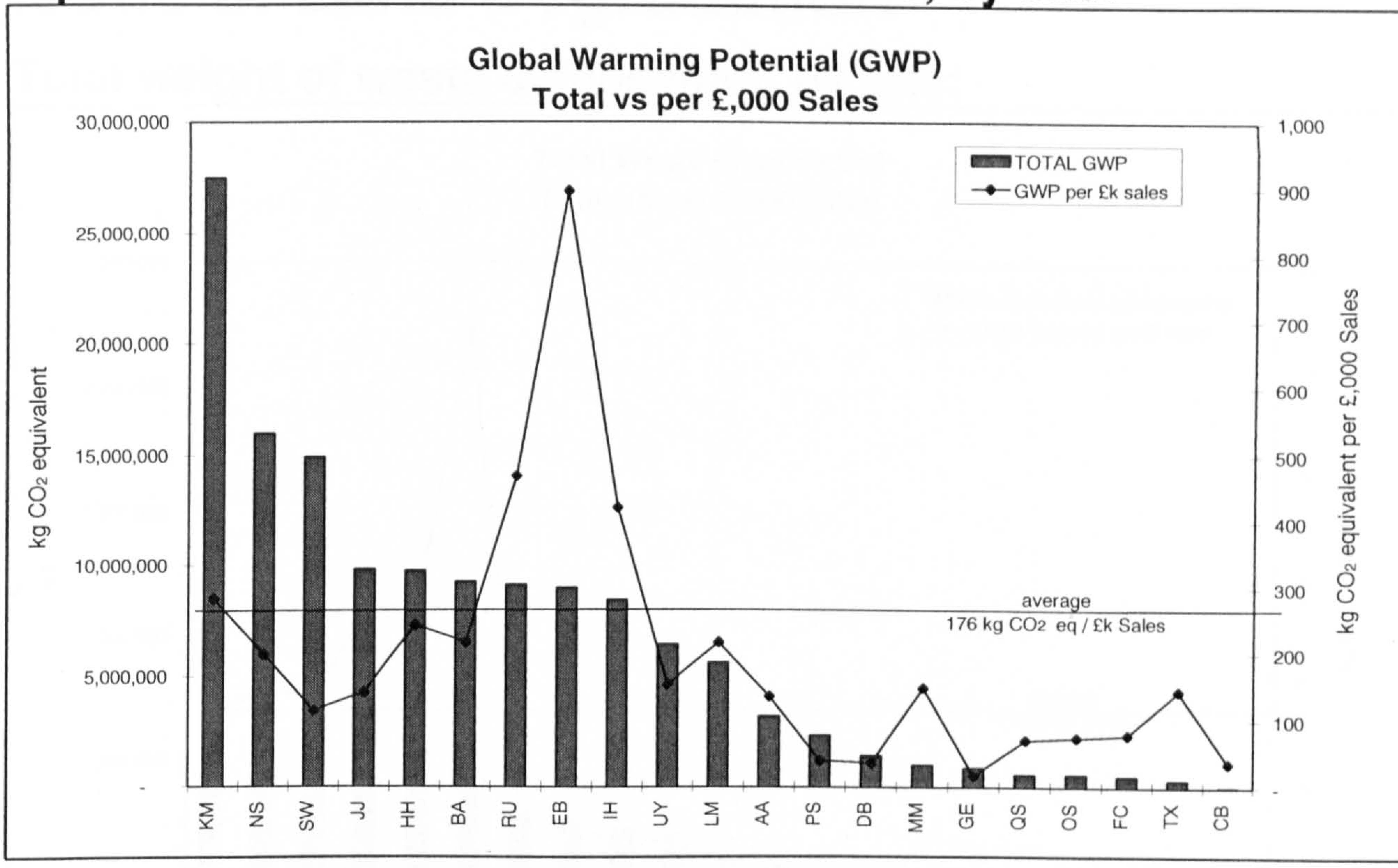


Issue 3: Global Warming (The "Greenhouse" effect)

Carbon Dioxide contributions, by site:

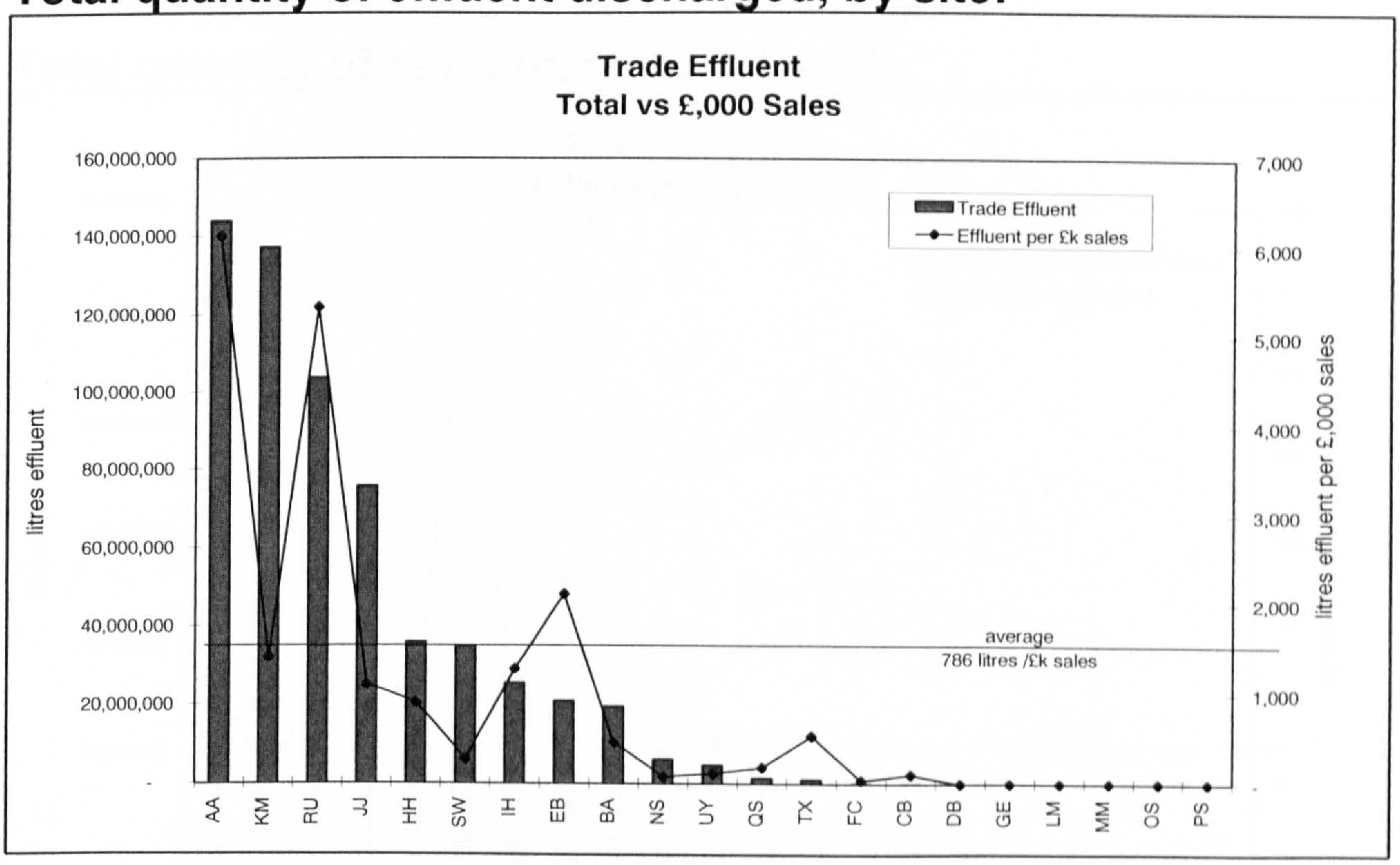


Equivalent Carbon Dioxide contributions, by site:



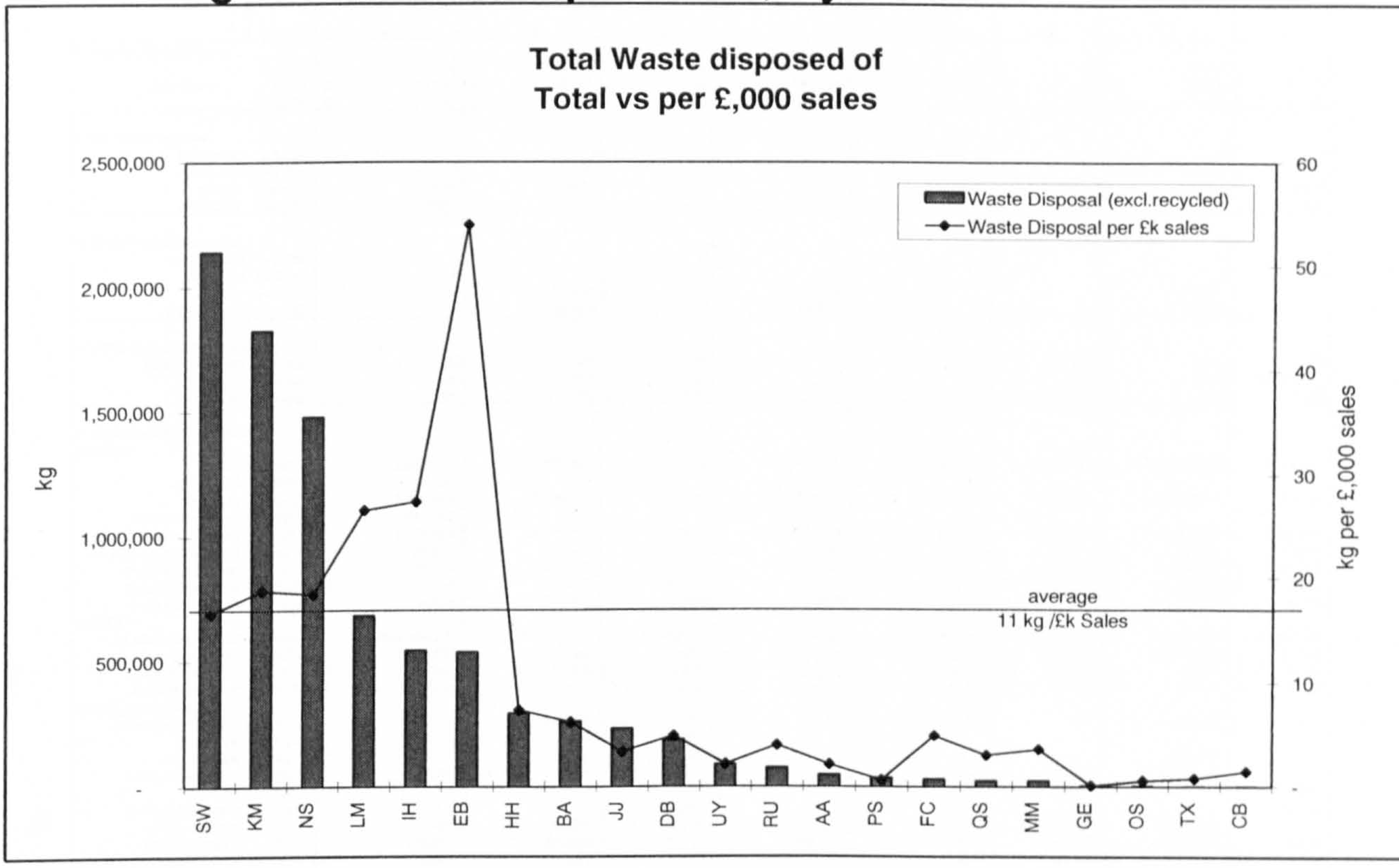
Issue 4: Aquatic Toxicity

Total quantity of effluent discharged, by site:



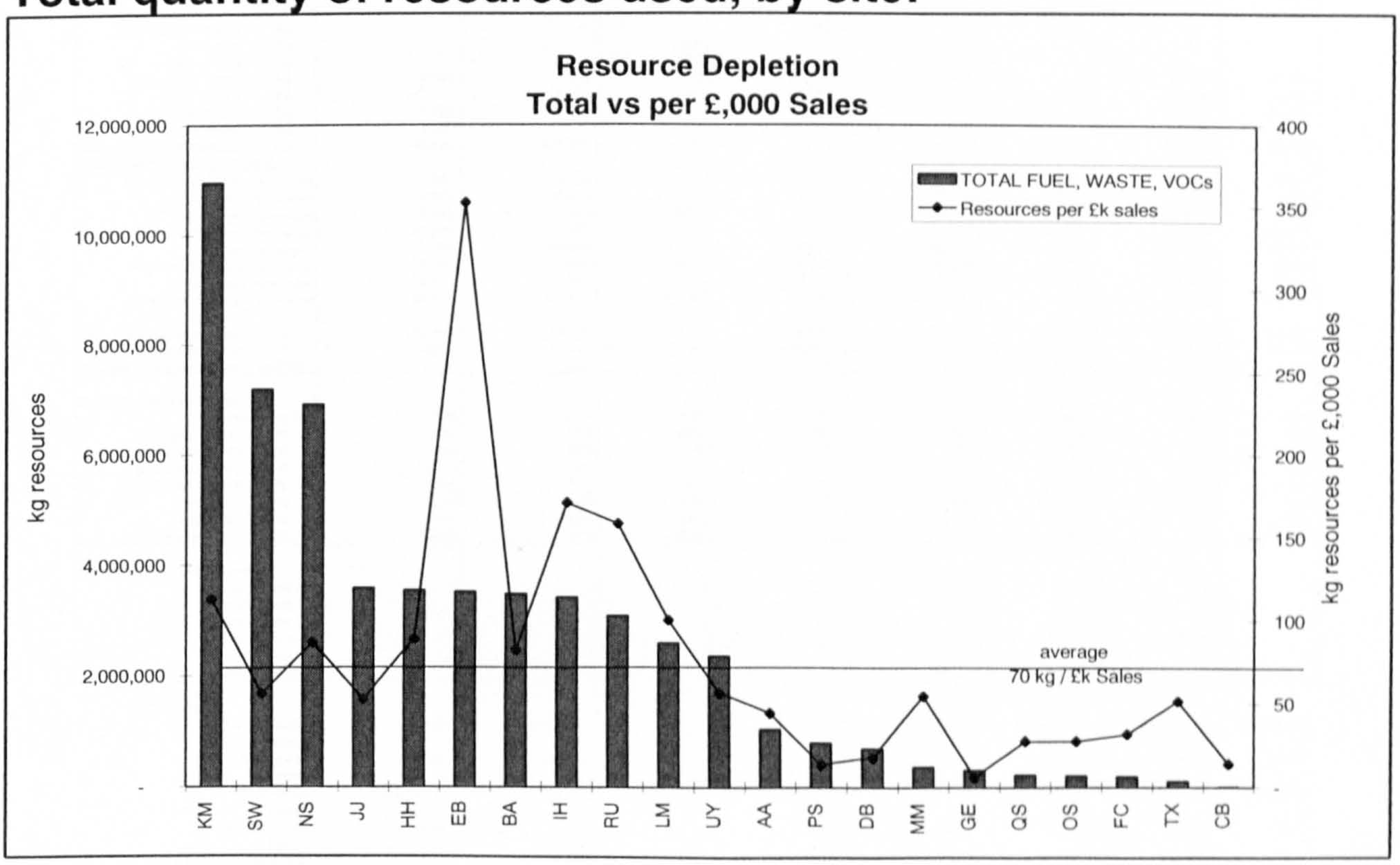
Issue 6: Land Degradation

Total weight of waste disposed of, by site:



Issue 7: Resource Depletion

Total quantity of resources used, by site:



Lucas Aerospace HS&E Performance Analysis

Lucas Aerospace

Example Data

	SITES	AA	BB	CC	DH	EH	FM	GS	HO
1. Number of employees									
	FTE's	220	129	99	514.75	370	176	661.5	322.5
Total Sales	£,000	£ 23,500	£ 10,000	£ 6,500	£ 40,000	£ 20,000	£ 25,894	£ 80,000	£ 58,220
	£k/FTE	£ 107	£ 78	£ 66	£ 78	£ 54	£ 147	£ 121	£ 181
2. Lost Time Injuries									
No. Injuries	> 1 day	1	3	1	7	5	18	7	6
Days Lost	excl day1	13	25	5	44	51	39	106	37
Injuries	*per FTE*	*0.0045*	*0.0233*	*0.0101*	*0.0136*	*0.0135*	*0.1023*	*0.0106*	*0.0186*
Days Lost	*per FTE*	*0.0591*	*0.1938*	*0.0505*	*0.0855*	*0.1378*	*0.2216*	*0.1602*	*0.1147*
3. Work Related Illness									
No. Illnesses	> 1 day	0	3	0	1	0	0	1	0
Days Lost	excl day1	0	32	0	13	0	0	6	0
Injuries	*per FTE*	-	*0.0233*	-	*0.0019*	-	-	*0.0015*	-
Days Lost	*per FTE*	-	*0.2481*	-	*0.0253*	-	-	*0.0091*	-
4. HS&E Training Programmes									
Senior Managers	% to target	0%	100%	0%	0%	0%	0%	100%	0%
Managers	% to target	0%	35%	6%	0%	10%	100%	100%	#DIV/0!
Employees	% to target	84%	57%	66%	4%	10%	100%	100%	119%
5. Environmental Performance									
ENERGY									
Gas	kWh	2,260,583	7,837,681	372,213	8,962,488	6,850,582	4,456,974	17,385,236	2,505,451
Heating Oil	kWh	52,924	-	-	-	-	-	-	-
Electricity	kWh	2,483,426	8,659,440	542,803	9,308,742	8,740,258	5,746,591	14,802,912	1,999,848
Other Fossil Fuels	kWh	914,050	-	-	-	-	-	-	-
Total Energy consumed	kWh	5,710,983	16,497,121	915,016	18,271,230	15,590,840	10,203,566	32,188,148	4,505,299
Total Energy consumed	*kWh/FTE*	*25,959*	*127,885*	*9,243*	*35,495*	*42,137*	*57,975*	*48,659*	*13,970*
Total Energy Cost	£	£ 161,622	£ 363,102	£ 36,494	£ 391,843	£ 392,649	£ 276,823	£ 641,762	£ 121,244
Total Energy Cost	*£/FTE*	£ *734.65*	£ *2,814.74*	£ *368.62*	£ *761.23*	£ *1,061.21*	£ *1,572.86*	£ *970.16*	£ *375.95*
Total Energy Cost	*% of Sales*	*0.69%*	*3.63%*	*0.56%*	*0.98%*	*1.96%*	*1.07%*	*0.80%*	*0.21%*
WATER									
Total Water consumed	litres	316,428,000	18,316,000	2,200,398	36,444,238	47,208,728	14,315,840	66,391,000	13,423,470
Total Water consumed	*litres/FTE*	*1,438,309*	*141,984*	*22,226*	*70,800*	*127,591*	*81,340*	*100,364*	*41,623*
Total Water Cost	£	£ 75,281	£ 11,264	£ 3,008	£ 21,061	£ 32,103	£ 12,430	£ 50,393	£ 8,026
Total Water Cost	*£/FTE*	£ *342.19*	£ *87.32*	£ *30.38*	£ *40.92*	£ *86.76*	£ *70.63*	£ *76.18*	£ *24.89*
WASTE DISPOSAL									
Total Special Wastes	Kg	-	120,850	1,287	9,158	16,951	872	92,295	-
Oils – neat	Kg	1,111	3,690	100	-	-	-	-	-
Oils –soluble	Kg	-	33,325	4,100	-	45,297	-	225,000	-
Other Liquid Waste	Kg	7,380	3,130	384	-	143,918	20,166	39,146	-
Metals	Kg	-	3,220	-	-	-	5,000	-	6,000
Paper & Cardboard	Kg	14,000	-	25,227	-	-	-	-	31,560
Other Waste	Kg	27,350	375,349	216	283,220	339,780	660,681	1,123,161	-
TOTAL WASTE	***Kg***	***49,841***	***539,564***	***31,314***	***292,378***	***545,946***	***686,720***	***1,479,602***	***37,560***
WASTE DISPOSAL COST	**£**	£ 8,502	£ 4,284	£ 3,300	£ 9,482	£ 13,930	£ 10,040	£ 24,451	£ 8,615
Waste disposed of /FTE	*kg/FTE*	*227*	*4,183*	*316*	*568*	*1,476*	*3,902*	*2,237*	*116*
Effluent - Treated	litres	-	3,631,000	-	-	21,647,000	-	6,147,000	-
Effluent - Untreated	litres	144,000,000	17,394,000	242,100	36,051,886	3,816,000	-	-	-
TOTAL EFFLUENT	***litres***	***144,000,000***	***21,025,000***	***242,100***	***36,051,886***	***25,463,000***	-	***6,147,000***	-
EFFLUENT COST	**£**	£ -	£ 8,951	£ 37	£ 10,531	£ 7,822	£ -	£ 22,478	£ -
Effluent disposed of /FTE	*litres/FTE*	*654,545*	*162,984*	*2,445*	*70,038*	*68,819*	-	*9,293*	-
Total Waste & Effluent	**Kg**	**144,049,841**	**21,564,564**	**273,414**	**36,344,264**	**26,008,946**	**686,720**	**7,626,602**	**37,560**
Waste & Effluent Disposal	*% of Sales*	*0.04%*	*0.13%*	*0.05%*	*0.05%*	*0.11%*	*0.04%*	*0.06%*	*0.01%*
WASTE RECYCLED									
Total Special Wastes	Kg	-	-	-	1,647	-	-	-	-
Oils – neat	Kg	-	-	60	-	-	-	-	-
Oils –soluble	Kg	-	-	1,260	-	10,934	-	-	-
Other Liquid Waste	Kg	2,680	150	40	2,726	2,125	-	93,759	21,000
Metals	Kg	-	209,760	7,200	45,801	78,511	4,200	36,926	4,080
Paper & Cardboard	Kg	7,000	-	-	6,373	110	-	2,050	39,600
Other Waste	Kg	8,400	-	10	-	-	-	-	-
OTAL WASTE RECYCLED	***Kg***	***18,080***	***209,910***	***8,570***	***56,547***	***91,680***	***4,200***	***132,735***	***64,680***
WASTE RECYCLING:DISPOSAL									
Total Special Wastes	% recycled	*0.00%*	*0.00%*	*0.00%*	*15.24%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
Oils – neat	% recycled	*0.00%*	*0.00%*	*37.50%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
Oils –soluble	% recycled	*0.00%*	*0.00%*	*23.51%*	*0.00%*	*19.44%*	*0.00%*	*0.00%*	*0.00%*
Other Liquid Waste	% recycled	*26.64%*	*4.57%*	*9.43%*	*100.00%*	*1.46%*	*0.00%*	*70.55%*	*100.00%*
Metals	% recycled	*0.00%*	*98.49%*	*100.00%*	*100.00%*	*100.00%*	*45.65%*	*100.00%*	*40.48%*
Paper & Cardboard	% recycled	*33.33%*	*0.00%*	*0.00%*	*100.00%*	*100.00%*	*0.00%*	*100.00%*	*55.65%*
Other Waste	% recycled	*23.50%*	*0.00%*	*4.42%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
TOTAL WASTE	**% recycled**	***26.62%***	***28.01%***	***21.49%***	***16.21%***	***14.38%***	***0.00%***	***8.23%***	***63.26%***
VOC Emissions discharged	Kg	24,667	41,193	936	38,319	13,184	18,567	7,147	12,287
Value of VOCs discharged	£	£ 70,658	£ 76,615	£ 8,904	£ 152,811	£ 14,203	£ 424,745	£ 7,229	£ 60,315
Average VOCs per person	*kg/FTE*	112	319	9	74	36	105	11	38
6. Self-Assessment Score									
Overall	Avg %	80%	81%	81%	88%	82%	80%	80%	80%
Management (M1)	%	80%	86%	82%	92%	85%	80%	80%	80%
Management (M2)	%	80%	88%	78%	90%	82%	80%	80%	80%
Management (M3)	%	80%	83%	81%	97%	81%	80%	80%	80%
Management (M4)	%	80%	86%	77%	95%	82%	80%	80%	80%
Health (H1)	%	80%	73%	82%	75%	82%	80%	80%	80%
Safety (S1)	%	80%	74%	82%	89%	80%	80%	80%	80%
Environment (E1)	%	80%	76%	82%	83%	82%	80%	80%	80%
7. Prosecutions/Infringements									
Number	Type A	0	0	0	0	0	0	0	0
Cost	Fines £	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Number	Type B	0	0	1	1	0	0	2	0
Cost	Actions £	£ -	£ -	£ -	£ 100.00	£ -	£ -	£ 29,793.00	£ -
Number	Type C	0	0	0	0	0	0	1	0
Cost	Actions £	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -

1998 Ranking

		AA	BB	CC	DH	EH	FM	GS	HO
TOTAL Energy		5,710,983	16,497,121	915,016	18,271,230	15,590,840	10,203,566	32,188,148	4,505,299
Rank		12	7	17	4	8	11	2	13
TOTAL Energy/FTE		25,959	127,885	9,243	35,495	42,137	57,975	48,659	13,970
Rank		10	1	18	8	7	4	5	15
TOTAL Water		316,428,000	18,316,000	2,200,398	36,444,238	47,208,728	14,315,840	66,391,000	13,423,470
Rank		1	10	19	8	7	12	6	13
TOTAL Water Cost	£	75,281	£ 11,264	£ 3,008	£ 21,061	£ 32,103	£ 12,430	£ 50,393	£ 8,026
Rank		1	12	18	6	4	10	3	15
TOTAL Effluent Cost	£	-	£ 8,951	£ 37	£ 10,531	£ 7,822	£ -	£ 22,478	£ -
Rank		15	7	14	5	9	15	3	15

Lucas Aerospace HS&E Perf

Lucas Aerospace

	SITES	IW	JY	KA	LB	ME	NJ	OM	PM
1. Number of employees									
	FTE's	1029.75	666.75	345.75	279.5	137	498.5	755.25	83
Total Sales	£,000	£ 128,435	£ 41,700	£ 42,424	£ 38,788	£ 51,500	£ 68,485	£ 97,000	£ 6,833
	£k/FTE	£ 125	£ 63	£ 123	£ 139	£ 376	£ 137	£ 128	£ 82
2. Lost Time Injuries									
No. Injuries	> 1 day	5	4	3	0	1	0	1	5
Days Lost	excl day1	28	119	7	0	6	0	2	49
Injuries	*per FTE*	*0.0049*	*0.0060*	*0.0087*	-	*0.0073*	-	*0.0013*	*0.0602*
Days Lost	*per FTE*	*0.0272*	*0.1785*	*0.0202*	-	*0.0438*	-	*0.0026*	*0.5904*
3. Work Related Illness									
No. Illnesses	> 1 day	0	1	2	0	0	0	0	0
Days Lost	excl day1	0	3	43	0	0	0	0	0
Injuries	*per FTE*	-	*0.0015*	*0.0058*	-	-	-	-	-
Days Lost	*per FTE*	-	*0.0045*	*0.1244*	-	-	-	-	-
4. HS&E Training Programmes									
Senior Managers	% to target	0%	100%	33%	26%	0%	0%	0%	100%
Managers	% to target	0%	100%	41%	38%	0%	0%	0%	73%
Employees	% to target	0%	100%	36%	44%	0%	0%	0%	100%
5. Environmental Performance									
ENERGY									
Gas	kWh	8,921,050	3,586,128	4,028,263	-	480,167	6,328,598	41,450,756	1,004,716
Heating Oil	kWh	-	-	-		-	-	-	-
Electricity	kWh	16,372,872	7,587,454	11,214,805	2,012,010	1,035,996	10,792,760	19,963,848	982,000
Other Fossil Fuels	kWh	-	-	-		-	-	-	-
Total Energy consumed	kWh	25,293,922	11,173,582	15,243,068	2,012,010	1,516,163	17,121,358	61,414,604	1,986,716
Total Energy consumed	*kWh/FTE*	*24,563*	*16,758*	*44,087*	*7,199*	*11,067*	*34,346*	*81,317*	*23,936*
Total Energy Cost	£	£ 675,848	£ 290,507	£ 533,820	£ 117,013	£ 82,765	£ 352,322	£ 753,980	£ 48,132
Total Energy Cost	*£/FTE*	£ *656.32*	£ *435.71*	£ *1,543.95*	£ *418.65*	£ *604.12*	£ *706.77*	£ *998.32*	£ *579.90*
Total Energy Cost	*% of Sales*	*0.53%*	*0.70%*	*1.26%*	*0.30%*	*0.16%*	*0.51%*	*0.78%*	*0.70%*
WATER									
Total Water consumed	litres	75,541,000	16,586,000	20,898,392	10,729,188	2,942,548	75,779,592	80,732,295	11,979,528
Total Water consumed	*litres/FTE*	*73,359*	*24,876*	*60,444*	*38,387*	*21,478*	*152,015*	*106,895*	*144,332*
Total Water Cost	£	£ 70,782	£ 12,109	£ 12,905	£ 4,281	£ 2,612	£ 14,119	£ 15,167	£ 8,997
Total Water Cost	*£/FTE*	£ *68.74*	£ *18.16*	£ *37.32*	£ *15.32*	£ *19.07*	£ *28.32*	£ *20.08*	£ *108.40*
WASTE DISPOSAL									
Total Special Wastes	Kg	15,340	3,397	19,214	5,618	208	-	23,133	-
Oils – neat	Kg	-	-	32,195	1,518	2,083	1,135	-	-
Oils –soluble	Kg	346,516	-	140,142	440	832	-	-	-
Other Liquid Waste	Kg	11,389	-	-	2,195	2,727	-	74	21,320
Metals	Kg	-	-	2,265	-	-	-	6,090	2,500
Paper & Cardboard	Kg	736,000	-	-	-	-	1	-	-
Other Waste	Kg	1,030,744	88,400	68,346	178,263	131	230,909	1,798,931	200
TOTAL WASTE	***Kg***	***2,139,989***	***91,797***	***262,163***	***188,034***	***5,981***	***232,045***	***1,828,228***	***24,020***
WASTE DISPOSAL COST	***£***	£ 25,714	£ 10,640	£ 41,328	£ 19,727	£ 5,125	£ 7,185	£ 106,048	£ 6,721
Waste disposed of /FTE	*kg/FTE*	*2,078*	*138*	*758*	*673*	*44*	*465*	*2,421*	*289*
Effluent - Treated	litres	-	-	1,910,990	26,885	-	27,017,944	40,384,800	-
Effluent - Untreated	litres	34,978,000	4,809,000	17,608,734	-	-	48,691,653	96,852,000	-
TOTAL EFFLUENT	***litres***	***34,978,000***	***4,809,000***	***19,519,724***	***26,885***	-	***75,709,597***	***137,236,800***	-
EFFLUENT COST	***£***	£ 20,017	£ 6,240	£ 7,916	£ 1,217	£ -	£ 9,903	£ 23,269	£ -
Effluent disposed of /FTE	*litres/FTE*	*33,967*	*7,213*	*56,456*	*96*	-	*151,875*	*181,710*	-
Total Waste & Effluent	**Kg**	**37,117,989**	**4,900,797**	**19,781,887**	**214,919**	**5,981**	**75,941,642**	**139,065,028**	**24,020**
Waste & Effluent Disposal	*% of Sales*	*0.04%*	*0.04%*	*0.12%*	*0.05%*	*0.01%*	*0.02%*	*0.13%*	*0.10%*
WASTE RECYCLED									
Total Special Wastes	Kg	4,729	10,105	-	3,757	-	-	-	-
Oils – neat	Kg	-	-	-	1,227	-	4,162	2,569	-
Oils –soluble	Kg	332,984	-	-	-	-	-	9,310	-
Other Liquid Waste	Kg	29,262	-	-	-	-	-	3,029	-
Metals	Kg	128,410	-	39,640	37,401	-	332,500	354,299	-
Paper & Cardboard	Kg	6,280	17,189	26,968	11,098	19,021	5,936	17,374	8,910
Other Waste	Kg	-	-	-	-		-	-	-
OTAL WASTE RECYCLED	***Kg***	***501,665***	***27,294***	***66,609***	***53,483***	***19,021***	***342,598***	***386,581***	***8,910***
WASTE RECYCLING:DISPOSAL									
Total Special Wastes	% recycled	*23.56%*	*74.84%*	*0.00%*	*40.07%*		*0.00%*	*0.00%*	*0.00%*
Oils – neat	% recycled	*0.00%*	*0.00%*	*0.00%*	*44.70%*		*78.57%*	*100.00%*	*0.00%*
Oils –soluble	% recycled	*49.00%*	*0.00%*	*0.00%*	*0.00%*		*0.00%*	*100.00%*	*0.00%*
Other Liquid Waste	% recycled	*71.98%*	*0.00%*	*0.00%*	*0.00%*		*0.00%*	*97.62%*	*0.00%*
Metals	% recycled	*100.00%*	*0.00%*	*94.59%*	*100.00%*		*100.00%*	*98.31%*	*0.00%*
Paper & Cardboard	% recycled	*0.85%*	*100.00%*	*100.00%*	*100.00%*		*99.98%*	*100.00%*	*100.00%*
Other Waste	% recycled	*0.00%*	*0.00%*	*0.00%*	*0.00%*		*0.00%*	*0.00%*	*0.00%*
TOTAL WASTE	**% recycled**	***18.99%***	***22.92%***	***20.26%***	***22.14%***	***0.00%***	***59.62%***	***17.45%***	***27.06%***
VOC Emissions discharged	Kg	69,669	1,386	18,408	4,751	934	29,087	13,322	1,020
Value of VOCs discharged	£	£ 73,545	£ 1,386	£ 18,408	£ 11,588	£ 522	£ 500,079	£ 13,322	£ 457
Average VOCs per person	*kg/FTE*	68	2	53	17	7	58	18	12
6. Self-Assessment Score									
Overall	Avg %	82%	81%	80%	80%	83%	80%	82%	80%
Management (M1)	%	80%	75%	80%	80%	85%	80%	77%	80%
Management (M2)	%	85%	84%	81%	81%	80%	80%	83%	80%
Management (M3)	%	81%	73%	79%	80%	84%	80%	74%	80%
Management (M4)	%	80%	84%	80%	80%	85%	80%	80%	80%
Health (H1)	%	81%	88%	81%	79%	82%	80%	86%	80%
Safety (S1)	%	89%	83%	81%	79%	81%	80%	86%	80%
Environment (E1)	%	77%	81%	81%	81%	81%	80%	88%	80%
7. Prosecutions/Infringements									
Number	Type A	0	0	0	1	0	0	0	0
Cost	Fines £	£ -	£ -	£ -	£ 4,545.45	£ -	£ -	£ -	£ -
Number	Type B	2	0	0	0	4	1	0	0
Cost	Actions £	£ 4,300.00	£ -	£ -	£ -	£ -	£ 339.39	£ -	£ -
Number	Type C	0	0	0	1	4	0	0	0
Cost	Actions £	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -

1998 Ranking

	IW	JY	KA	LB	ME	NJ	OM	PM
TOTAL Energy	25,293,922	11,173,582	15,243,068	2,012,010	1,516,163	17,121,358	61,414,604	1,986,716
Rank	3	10	9	14	16	6	1	15
TOTAL Energy/FTE	24,563	16,758	44,087	7,199	11,067	34,346	81,317	23,936
Rank	11	13	6	20	16	9	3	12
TOTAL Water	75,541,000	16,586,000	20,898,392	10,729,188	2,942,548	75,779,592	80,732,295	11,979,528
Rank	5	11	9	15	18	4	3	14
TOTAL Water Cost	£ 70,782	£ 12,109	£ 12,905	£ 4,281	£ 2,612	£ 14,119	£ 15,167	£ 8,997
Rank	2	11	9	17	19	8	7	14
TOTAL Effluent Cost	£ 20,017	£ 6,240	£ 7,916	£ 1,217	£ -	£ 9,903	£ 23,269	£ -
Rank	4	10	8	12	15	6	2	15

Lucas Aerospace HS&E Perf

Lucas Aerospace

	SITES	QU	RB	SS	TS	UX	TOTAL / AVG
1. Number of employees							
	FTE's	210	36.5	58	89	46	**6,728**
Total Sales	£,000	£ 19,455	£ 748	£ 7,903	£ 8,400	£ 2,289	**£ 778,073**
	£k/FTE	£ 93	£ 20	£ 136	£ 94	£ 50	**£ 116**
2. Lost Time Injuries							
No. Injuries	> 1 day	7	2	0	2	0	**78**
Days Lost	excl day1	77	3	0	8	0	**619**
Injuries	*per FTE*	*0.0333*	*0.0548*	-	*0.0225*	-	*0.0116*
Days Lost	*per FTE*	*0.3667*	*0.0822*	-	*0.0899*	-	*0.0920*
3. Work Related Illness							
No. Illnesses	> 1 day	0	1	0	0	0	**9**
Days Lost	excl day1	0	2	0	0	0	**99**
Injuries	*per FTE*	-	*0.0274*	-	-	-	*0.0013*
Days Lost	*per FTE*	-	*0.0548*	-	-	-	*0.0147*
4. HS&E Training Programmes							
Senior Managers	% to target	100%	0%	100%	68%	40%	**37%**
Managers	% to target	100%	200%	100%	70%	29%	**#DIV/0!**
Employees	% to target	100%	6%	100%	72%	34%	**54%**
5. Environmental Performance							
ENERGY							
Gas	kWh	8,352,747	-	-	-	-	**124,783,633**
Heating Oil	kWh	1,855,839	-	-	-	-	**1,908,763**
Electricity	kWh	7,838,067	37,052	848,570	803,487	459,625	**132,232,567**
Other Fossil Fuels	kWh	-	-	-	-	-	**914,050**
Total Energy consumed	kWh	18,046,653	37,052	848,570	803,487	459,625	**259,839,013**
Total Energy consumed	*kWh/FTE*	*85,936*	*1,015*	*14,631*	*9,028*	*10,046*	*38,623*
Total Energy Cost	£	£ 466,822	£ 4,028	£ 46,442	£ 35,538	£ 31,167	**£ 5,823,923**
Total Energy Cost	*£/FTE*	£ *2,222.96*	£ *110.37*	£ *800.72*	£ *399.31*	£ *681.24*	£ *865.69*
Total Energy Cost	*% of Sales*	*2.40%*	*0.54%*	*0.59%*	*0.42%*	*1.36%*	*0.75%*
WATER							
Total Water consumed	litres	132,515,203	171,300	5,526,460	3,105,970	708,964	**951,944,113**
Total Water consumed	*litres/FTE*	*631,025*	*4,693*	*95,284*	*34,899*	*15,496*	*141,500*
Total Water Cost	£	£ 25,322	£ 170	£ 9,169	£ 4,964	£ 196	**£ 394,360**
Total Water Cost	*£/FTE*	£ *120.58*	£ *4.67*	£ *158.09*	£ *55.77*	£ *4.28*	£ *58.62*
WASTE DISPOSAL							
Total Special Wastes	Kg	-	-	800	-	442	**309,565**
Oils – neat	Kg	-	-	-	1,400	220	**43,452**
Oils –soluble	Kg	208	-	-	200	-	**796,061**
Other Liquid Waste	Kg	11,033	-	2,750	3,347	-	**268,960**
Metals	Kg	-	950	-	-	1,040	**27,065**
Paper & Cardboard	Kg	-	122	800	375	44	**808,129**
Other Waste	Kg	65,478	10	-	19,560	-	**6,290,729**
TOTAL WASTE	***Kg***	***76,719***	***1,082***	***4,350***	***24,882***	***1,746***	***8,543,961***
WASTE DISPOSAL COST	***£***	£ 19,752	£ 133	£ 344	£ 4,260	£ 959	**£ 330,540**
Waste disposed of /FTE	*kg/FTE*	*365*	*30*	*75*	*280*	*38*	*1,270*
Effluent - Treated	litres	-	-	-	5,950	431,000	**101,202,569**
Effluent - Untreated	litres	103,730,000	76,000	-	1,495,350	780,000	**510,524,723**
TOTAL EFFLUENT	***litres***	***103,730,000***	***76,000***	-	***1,501,300***	***1,211,000***	***611,727,292***
EFFLUENT COST	***£***	£ 47,269	£ -	£ -	£ 2,864	£ 406	**£ 168,919**
Effluent disposed of /FTE	*litres/FTE*	*493,952*	*2,082*	-	*16,869*	*26,470*	*90,929*
Total Waste & Effluent	**Kg**	**103,806,719**	**77,082**	**4,350**	**1,526,182**	**1,212,746**	**620,271,253**
Waste & Effluent Disposal	*% of Sales*	*0.34%*	*0.02%*	*0.00%*	*0.08%*	*0.06%*	*0.06%*
WASTE RECYCLED							
Total Special Wastes	Kg	17,092	-	-	-	-	**37,329**
Oils – neat	Kg	15,669	-	-	-	-	**23,687**
Oils –soluble	Kg	12,048	216	-	-	-	**366,752**
Other Liquid Waste	Kg	-	-	-	-	-	**154,771**
Metals	Kg	58,391	383	-	1,500	-	**1,339,002**
Paper & Cardboard	Kg	11,619	-	-	775	-	**180,303**
Other Waste	Kg	-	36	-	-	-	**8,446**
OTAL WASTE RECYCLED	***Kg***	***114,819***	***635***	-	***2,275***	-	***2,110,291***
WASTE RECYCLING:DISPOSAL							
Total Special Wastes	% recycled	*100.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	**10.76%**
Oils – neat	% recycled	*100.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	**35.28%**
Oils –soluble	% recycled	*98.30%*	*100.00%*	*0.00%*	*0.00%*	*0.00%*	**31.54%**
Other Liquid Waste	% recycled	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	**36.53%**
Metals	% recycled	*100.00%*	*28.73%*	*0.00%*	*100.00%*	*0.00%*	**98.02%**
Paper & Cardboard	% recycled	*100.00%*	*0.00%*	*0.00%*	*67.39%*	*0.00%*	**18.24%**
Other Waste	% recycled	*0.00%*	*78.26%*	*0.00%*	*0.00%*	*0.00%*	**0.13%**
TOTAL WASTE	**% recycled**	***59.95%***	***36.99%***	***0.00%***	***8.38%***	***0.00%***	**19.81%**
VOC Emissions discharged	Kg	2,502	123	65	3,812	1,208	**302,588**
Value of VOCs discharged	£	£ 9,007	£ 193	£ 314	£ 3,754	£ 79,747	**£ 1,527,804**
Average VOCs per person	*kg/FTE*	12	3	1	43	26	45
6. Self-Assessment Score							
Overall	Avg %	81%	82%	80%	81%	81%	**81%**
Management (M1)	%	83%	81%	80%	80%	83%	**81%**
Management (M2)	%	83%	83%	80%	80%	80%	**82%**
Management (M3)	%	84%	90%	81%	80%	81%	**81%**
Management (M4)	%	82%	75%	79%	79%	80%	**81%**
Health (H1)	%	81%	81%	79%	85%	82%	**81%**
Safety (S1)	%	79%	86%	79%	80%	82%	**81%**
Environment (E1)	%	76%	79%	82%	80%	82%	**81%**
7. Prosecutions/Infringements							
Number	Type A	0	0	0	1	0	**2**
Cost	Fines £	£ -	£ -	£ -	£ 6,818.18	£ -	**11363.63636**
Number	Type B	0	0	0	0	0	**11**
Cost	Actions £	£ 107,879	£ -	£ -	£ -	£ -	**£ 142,411**
Number	Type C	1	0	0	0	0	**7**
Cost	Actions £	£ -	£ -	£ -	£ -	£ -	**0**

1998 Ranking

	QU	RB	SS	TS	UX
TOTAL Energy	18,046,653	37,052	848,570	803,487	459,625
Rank	5	21	18	19	20
TOTAL Energy/FTE	85,936	1,015	14,631	9,028	10,046
Rank	2	21	14	19	17
TOTAL Water	132,515,203	171,300	5,526,460	3,105,970	708,964
Rank	2	21	16	17	20
TOTAL Water Cost £	£ 25,322	£ 170	£ 9,169	£ 4,964	£ 196
Rank	5	21	13	16	20
TOTAL Effluent Cost £	£ 47,269	£ -	£ -	£ 2,864	£ 406
Rank	1	15	15	11	13

EXAMPLE SITE DATA

	Notes/units	98 Qtr 1	98 Qtr 2	98 Qtr 3	98 Qtr 4	1998 Total
1. Site Information						
Total Employees	Full Time	210	210	210	210	**210**
Total Sales	thousands	£ 19,455	£ 19,455	£ 19,455	£ 19,455	**£ 19,455**
2. Safety Performance						
Work related injuries	Type				11	
Number of occurrences	No.	2	0	3	2	**7**
Total Days Lost	Days	4		9	64	**77**
Total Employee Days Worked	Days	13,527	14081	12743	11443	**51794**
3. Health Performance						
Work related illness	Type					
Number of occurrences	No.	0	0	0	0	**0**
Total Days Lost*	Days	0				**0**
Total Employee Days Worked	Days	13,527	14081	12743	11443	**51794**
4. HS&E Training						
Senior Managers	Target No.	10	20	0	0	**30**
	Number trained	10	20	0	0	**30**
	% Target achieved	100%	100%	0%	0%	**100%**
Managers & Supervisors	Target No.	69	142	5	2	**218**
	Number trained	69	142	5	2	**218**
	% Target achieved	100%	100%	100%	100%	**100%**
Other Employees	Target No.	143	274	7	10	**434**
	Number trained	143	274	7	10	**434**
	% Target achieved	100%	100%	100%	100%	**100%**
5. Environmental Performance						
5.1 Consumption of Resources						
Consumption of Gas	£	£ 24,759	£ 19,493	£ 4,831	£ 14,661	**£ 63,745**
	KWh	3,853,820	2,095,407	556,320	1,847,200	**8,352,747**
Consumption of Heating Oil	£	£ 5,436	£ 5,191	£ 3,181	£ -	**£ 13,807**
	KWh	631,887	631,989	591,963	-	**1,855,839**
Consumption of Electricity	£	£ 99,858	£ 97,616	£ 109,481	£ 82,315	**£ 389,270**
	KWh	1,948,619	1,925,135	2,083,326	1,880,987	**7,838,067**
Cons. of other Fossil Fuels	£					**£ -**
	KWh					**-**
TOTAL ENERGY	£	**£ 130,053**	**£ 122,300**	**£ 117,493**	**£ 96,976**	**£ 466,822**
	KWh	**6,434,326**	**4,652,531**	**3,231,609**	**3,728,187**	**18,046,653**
Consumption of Water	£	£ 5,065	£ 5,899	£ 8,817	£ 5,541	**£ 25,322**
	Litres	27,208,446	33,351,301	41,199,936	30,755,520	**132,515,203**
5.2 Emissions To Land (all Waste taken from site)						
Total Special Wastes*	Disposal Costs £	£2,091	£3,867	£0	£2,150	**£ 8,107**
Oils – neat*	Disposal Costs £					**£ -**
Oils –soluble*	Disposal Costs £				£117	**£ 117**
Other Liquid Waste*	Disposal Costs £		£2,692	£0	£2,985	**£ 5,676**
Metals*	Disposal Costs £	-£113	-£454	-£227	-£230	**-£ 1,024**
Paper & Cardboard*	Disposal Costs £	£55	-£45	£45	£55	**£ 109**
Other Waste*	Disposal Costs £	£1,712	£649	£1,714	£2,692	**£ 6,766**
TOTAL WASTE	Disposal Costs £	**£3,744**	**£6,708**	**£1,532**	**£7,767**	£ 19,752
Total Special Wastes*	Kg/l Disposed of					**-**
Oils – neat*	Kg/l Disposed of					**-**
Oils –soluble*	Kg/l Disposed of				208	**208**
Other Liquid Waste*	Kg/l Disposed of		6,453		4,580	**11,033**
Metals*	Kg/l Disposed of					**-**
Paper & Cardboard*	Kg/l Disposed of					**-**
Other Waste*	Kg/l Disposed of	24,131	7,620	20,122	13,605	**65,478**
TOTAL WASTE	Kg/l Disposed of	**24,131**	**14,073**	**20,122**	**18,393**	**76,719**
Total Special Wastes*	Recycled (kg/l)	9,072	762	-	7,258	**17,092**
Oils – neat*	Recycled (kg/l)	2,706	9,178	3,785		**15,669**
Oils –soluble*	Recycled (kg/l)	5,380	2,807	3,861		**12,048**
Other Liquid Waste*	Recycled (kg/l)					**-**
Metals*	Recycled (kg/l)	8,921	2,166	1,083	46,221	**58,391**
Paper & Cardboard*	Recycled (kg/l)		3,175	4,634	3,810	**11,619**
Other Waste*	Recycled (kg/l)					**-**
TOTAL WASTE	Recycled (kg/l)	**26,079**	**18,088**	**13,363**	**57,289**	**114,819**
5.2.1 Emissions To Drain						
Effluent - Treated	m3 Disposed of					**-**
Effluent - Untreated	m3 Disposed of	27,190	33,361	24,720	18,459	**103,730**
TOTAL EFFLUENT	m3 Disposed of	**27,190**	**33,361**	**24,720**	**18,459**	**103,730**
	kg/litres	27,190,000	33,361,000	24,720,000	18,459,000	**103,730,000**
Effluent - Treated	Cost of disposal					£ -

Effluent - Untreated	Cost of disposal	£ 10,400	£ 12,608	£ 12,608	£ 11,653	£ 47,269.09
TOTAL EFFLUENT	Cost of disposal	**£ 10,400**	**£ 12,608**	**£ 12,608**	**£ 11,653**	**£ 47,269.09**

5.3 Emissions To Air - VOCs

						total
Adhesives	Litres Purchased		1		-	**1**
Cleaning Solvents	Litres Purchased				832	**832**
Coatings	Litres Purchased		50	84	63	**197**
Sealants	Litres Purchased	27			-	**27**
Thinners	Litres Purchased	466	38	11	8	**523**
Others:	Litres Purchased	416		833	625	**1,874**
TOTAL	Litres Purchased	**909**	**89**	**928**	**1,528**	**3,454**
						average
Adhesives	Cost per Litre £		£ 24.85	£ -	£ -	**£ 8.28**
Cleaning Solvents	Cost per Litre £				£ 0.16	**£ 0.16**
Coatings	Cost per Litre £		£ 15.76	£ 16.36	£ 6.42	**£ 12.85**
Sealants	Cost per Litre £	£ 24.02				**£ 24.02**
Thinners	Cost per Litre £	£ 1.33	£ 3.03	£ 3.85	£ 1.52	**£ 2.43**
Others:	Cost per Litre £	£ 0.52		£ 0.43	£ 0.16	**£ 0.37**
AVERAGE (Weighted by volume)	Cost per Litre £	**£ 1.63**	**£ 10.43**	**£ 1.91**	**£ 0.43**	**£ 3.60**
Adhesives	% Volatile		45%	45%		**45%**
Cleaning Solvents	% Volatile				100%	**100%**
Coatings	% Volatile		45%	45%	60%	**50%**
Sealants	% Volatile	45%				**45%**
Thinners	% Volatile	100%	100%	100%	100%	**100%**
Others:	% Volatile	100%		100%	100%	**100%**
AVERAGE (Weighted by volume)	% Volatile	**98%**	**68%**	**95%**	**98%**	**90%**
Adhesives	Litres Disposed of					**0**
Cleaning Solvents	Litres Disposed of				458	**458**
Coatings	Litres Disposed of		27	780	16	**823**
Sealants	Litres Disposed of	15				**14.8**
Thinners	Litres Disposed of				0	**0**
Others:	Litres Disposed of				0	**0**
TOTAL	Litres Disposed of	**15**	**27**	**780**	**474**	**1295.8**
Adhesives	VOCs emitted (kg)	0	0	0	0	**0**
Cleaning Solvents	VOCs emitted (kg)	0	0	0	374	**374**
Coatings	VOCs emitted (kg)	0	10	-313	28	**- 275**
Sealants	VOCs emitted (kg)	5	0	0	0	**5**
Thinners	VOCs emitted (kg)	466	38	11	8	**523**
Others:	VOCs emitted (kg)	416	0	833	625	**1,874**
TOTAL	VOCs emitted (kg)	**887**	**49**	**531**	**1,035**	**2,502**

6. Management Systems

						Final
M1: Policy, Objectives and Targets	%	81%	82%	83%	83%	**83%**
M2: Organisational Arrangements	%	81%	82%	83%	83%	**83%**
M3: Operational Management Systems	%	83%	83%	84%	84%	**84%**
M4: Self-Assessment & Audit Systems	%	82%	82%	82%	82%	**82%**
E1: Environmental Protection Programme	%	57%	75%	76%	76%	**76%**
S1: Risk Elimination & Control Programme	%	73%	78%	79%	79%	**79%**
H1: Occupational Health Programme	%	73%	81%	81%	81%	**81%**
OVERALL (average of all scores)	%	**76%**	**80%**	**81%**	**81%**	**81%**

7. Health, Safety and Environmental Incidents

CATEGORY A: PROSECUTION	Description					
	Occurrences					**0**
	fines etc (£)					**£ -**
CATEGORY B: INTERVENTION	Description					
	Occurrences					**0**
	Action & cost (£)	£ 107,879				**£ 107,879**
CATEGORY C: ACCIDENTAL	Description		punctured drum			
	Occurrences		1	0	0	**1**
	Action & cost (£)		?	?	0	**£ -**

8. Use of Hazardous Substances in Product Manufacture

Asbestos	Kg Purchased					**0**
Cadmium	Kg Purchased		5.4	0	0	**5.4**
Chromium 6	Kg Purchased					**0**
Cyanide	Kg Purchased					**0**
Phosphates	Kg Purchased					**0**
Lead (if Solder state % lead)	Kg Purchased					**0**
Nickel	Kg Purchased					**0**
Asbestos	Kg Disposed					**0**
Cadmium	Kg Disposed		0.8	45.45		**46.25**
Chromium 6	Kg Disposed					**0**
Cyanide	Kg Disposed			968		**968**
Phosphates	Kg Disposed					**0**
Lead (if Solder state % lead)	Kg Disposed					**0**
Nickel	Kg Disposed					**0**

Appendix AI

Database of Environmental Measures

Quantitative Measures & improvements - Absolutes

General Category	Measure	Units	company	Reference
Accidental Releases	Chemical Spills	number & litres	Vauxhall Motors	Vauxhall 98
Accidental Releases	Chemical spills and leakage	number	Novo Nordisk	Novo Nordisk 1997
Accidental Releases	Non-routine air emissions	number & volume	Vauxhall Motors	Vauxhall 98
Accidental Releases	Oil Spills	number & litres	Vauxhall Motors	Vauxhall 98
Accidental Releases	Spills by fate (drum, bund, special area, sump, uncontained)	number	Glaxo Wellcome	Glaxo Wellcome 1997
Accidental Releases	Spills by size (10-100, 100-500, 500-1k, 1k-5k, >5k litres)	number	Glaxo Wellcome	Glaxo Wellcome 1997
Air Emissions	Absolute emissions	Quantity	Petrofina	UNEP/Sustainability 97
Air Emissions	Acid Gases	tonnes hydrogen ions	ICI	ICI 1997
Air Emissions	Aggregate emissions from GM cars and light trucks on road	Quantity	General Motors	UNEP/Sustainability 98
Air Emissions	Atmospheric emissions	Quantity	Bass	PIRC 98
Air Emissions	CFCs	kg	Novo Nordisk	Novo Nordisk 1997
Air Emissions	CFCs (CFC11 equivalents)	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Air Emissions	CFCs in use or stock	kg	BAA	BAA 1998
Air Emissions	Chlorinated organic solvents	tons	Novo Nordisk	Novo Nordisk 1997
Air Emissions	Chlorinated VOCs	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Air Emissions	CO emitted	Quantity		Azzone et al (1996)
Air Emissions	CO from energy use	Quantity	Vauxhall Motors	Vauxhall 98
Air Emissions	CO2 due to Energy use	thousand tonnes	BT	BT 1997
Air Emissions	CO2 due to Energy use	thousand tons	Novo Nordisk	Novo Nordisk 1997
Air Emissions	CO2 emissions	thousand tonnes	BAA	BAA 1998
Air Emissions	CO2 emissions from commercial Fleet	thousand tonnes	BT	BT 1997
Air Emissions	CO2 emitted	Quantity		Azzone et al (1996)
Air Emissions	CO2 from energy generation	Quantity	Electricity Industry	EA 98
Air Emissions	CO2 from energy use	Quantity	Vauxhall Motors	Vauxhall 98
Air Emissions	CO2 from Fleet Transport	Quantity	Vauxhall Motors	Vauxhall 98
Air Emissions	Consumption of CFCs	Quantity		Azzone et al (1996)
Air Emissions	Consumption of Halons	Quantity		Azzone et al (1996)
Air Emissions	Emissions	Quantity	BA	PIRC 98
Air Emissions	Global Warming potential	tonnes CO2 equivalent	ICI	ICI 1997
Air Emissions	Greenhouse gas emissions	Quantity	DOW Canada	UNEP/Sustainability 97
Air Emissions	Hazardous emissions to air	tonnes benzene equivalent	ICI	ICI 1997
Air Emissions	HCFCs	kg	Novo Nordisk	Novo Nordisk 1997
Air Emissions	Key emissions	Quantity	Volvo	UNEP/Sustainability 97
Air Emissions	NH3 emitted	Quantity		Azzone et al (1996)
Air Emissions	Noise		BA	PIRC 98
Air Emissions	Non-chlorinated VOCs	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Air Emissions	NOx due to Energy use	thousand tonnes	BT	BT 1997
Air Emissions	NOx due to Energy use	tons	Novo Nordisk	Novo Nordisk 1997
Air Emissions	NOx emitted	Quantity		Azzone et al (1996)
Air Emissions	NOx from energy use	Quantity	Vauxhall Motors	Vauxhall 98
Air Emissions	Organic solvents	tons	Novo Nordisk	Novo Nordisk 1997
Air Emissions	Oxides of nitrogen	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Air Emissions	Ozone Depletion	tonnes CFC-11 equivalent	ICI	ICI 1997
Air Emissions	Particulates to air	thousand tonnes	ICI	ICI 1997
Air Emissions	Photochemical ozone (smog) creation	tonnes carbon ethylene eqv	ICI	ICI 1997
Air Emissions	POCP (ethylene equivalents)	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Air Emissions	SO2 content in air around major refinery	Quantity	Neste	UNEP/Sustainability 97
Air Emissions	SO2 due to Energy use	thousand tonnes	BT	BT 1997
Air Emissions	SO2 due to Energy use	tons	Novo Nordisk	Novo Nordisk 1997
Air Emissions	SO2 emissions from commercial Fleet	thousand tonnes	BT	BT 1997
Air Emissions	Solvent emissions from car painting	Quantity	Vauxhall Motors	Vauxhall 98
Air Emissions	SOx emitted	Quantity		Azzone et al (1996)
Air Emissions	SOx from energy use	Quantity	Vauxhall Motors	Vauxhall 98
Air Emissions	Sulphur Dioxide	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Air Emissions	VOC emissions from business travel by car	tonnes	BT	BT 1997
Air Emissions	VOC emissions from commercial Fleet	tonnes	BT	BT 1997
Air Emissions	VOC emissions from motor transport workshops	tonnes	BT	BT 1997
Air Emissions	VOCs - CFC (purchases)	Quantity	GKN	GKN 1998
Air Emissions	VOCs - Chlorinated (purchases)	Quantity	GKN	GKN 1998
Air Emissions	VOCs - non-chlorinated (purchases)	Quantity	GKN	GKN 1998
Air Emissions	VOCs emitted	Quantity		Azzone et al (1996)
Air Emissions/Resource Use	Distance travelled by commercial fleet	million kilometres	BT	BT 1997
Air Emissions/Resource Use	Number of aircraft and/or distances	number / mileage		Azzone et al (1996)
Air Emissions/Resource Use	Number of cars and/or distances	number / mileage		Azzone et al (1996)
Air Emissions/Resource Use	Number of goods vehicles and/or distances	number / mileage		Azzone et al (1996)
Air Emissions/Resource Use	Number of passenger transport vehicles and/or distances	number / mileage		Azzone et al (1996)
Air Emissions/Resource Use	Number of petrol/diesel vehicles in commercial fleet	number	BT	BT 1997
Air Emissions/Resource Use	Number of petrol/diesel vehicles in company car fleet	number	BT	BT 1997
Compliance	Breaches of regulatory limits	number	Novo Nordisk	Novo Nordisk 1997
Compliance	compliance orders	number	Tate & Lyle	PIRC 98
Compliance	Compliance with emissions consents	%	ICI	ICI 1997
Compliance	Incidents leading to regulatory authority action	number	Coats Viyella	PIRC 98
Cost	Biomass management	DKK million	Novo Nordisk	Novo Nordisk 1997
Cost	Cost of Wastewater treatment at municipal plants	DKK million	Novo Nordisk	Novo Nordisk 1997
Cost	Disposal and handling of solid waste	DKK million	Novo Nordisk	Novo Nordisk 1997
Cost	Remediation of polluted sites	DKK million	Novo Nordisk	Novo Nordisk 1997
Cost	Running costs of environmental department	DKK million	Novo Nordisk	Novo Nordisk 1997
Cost	Sales of materials for recycling	DKK million	Novo Nordisk	Novo Nordisk 1997
Cost	Tax on Energy, CO2, SO2 and other environmental taxes	DKK million	Novo Nordisk	Novo Nordisk 1997
Impact	Environmental Impact Potential for Acidification	tons SO2 eqv	Novo Nordisk	Novo Nordisk 1997
Impact	Environmental Impact Potential for Eutrophication	Index	Novo Nordisk	UNEP/Sustainability 97
Impact	Environmental Impact Potential for Global Warming	thousand tons CO2 eqv	Novo Nordisk	Novo Nordisk 1997
Impact	Environmental Impact Potential for Ozone depletion	kg CFC11 eqv	Novo Nordisk	Novo Nordisk 1997
Impact	Environmental Impacts	Index	Tomkins	PIRC 98

Impact	Global Warming Potential: emissions	tonnes (millions) CO2 eqv	Glaxo Wellcome	Glaxo Wellcome 1997
Impact	Global Warming Potential: energy on-site	tonnes (millions) CO2 eqv	Glaxo Wellcome	Glaxo Wellcome 1997
Impact	Global Warming Potential: off-site electricity	tonnes (millions) CO2 eqv	Glaxo Wellcome	Glaxo Wellcome 1997
Pollution	Toxic Releases (TRI)	millions of lbs.	Boeing	Boeing 1997
Resource use	chemicals	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Resource use	Coal Consumption	Quantity	GKN	GKN 1998
Resource use	congestion (aircraft use extra fuel)		BA	PIRC 98
Resource use	Electricity consumption	Quantity	GKN	GKN 1998
Resource use	Electricity consumption	Quantity	Vauxhall Motors	Vauxhall 98
Resource use	Energy consumption	million kWh	BAA	BAA 1998
Resource use	Energy consumption - total	million GJ	Novo Nordisk	Novo Nordisk 1997
Resource use	Energy consumption - total	Quantity		Azzone et al (1996)
Resource use	Energy consumption by type	Quantity		Azzone et al (1996)
Resource use	Energy efficiency	%	MFI	PIRC 98
Resource use	Energy saving	Quantity	Tesco	PIRC 98
Resource use	energy usage	Quantity	Boots	PIRC 98
Resource use	energy usage	Quantity	Ladbrooke Group	PIRC 98
Resource use	Energy usage	Quantity	Scottish & Newcastle	PIRC 98
Resource use	energy usage	Quantity	Sedgewick	PIRC 98
Resource use	Energy usage (Index value based on 1993 baseline)	Index	Boeing	Boeing 1997
Resource use	Energy use - electricity	GWh	BT	BT 1997
Resource use	Energy use - electricity	Terajoules	Glaxo Wellcome	Glaxo Wellcome 1997
Resource use	Energy use - gas	GWh	BT	BT 1997
Resource use	Energy use - gas	Terajoules	Glaxo Wellcome	Glaxo Wellcome 1997
Resource use	Energy use - heating oil	GWh	BT	BT 1997
Resource use	Energy use - heavy fuel oil	Terajoules	Glaxo Wellcome	Glaxo Wellcome 1997
Resource use	Energy use - light fuel oil	Terajoules	Glaxo Wellcome	Glaxo Wellcome 1997
Resource use	Energy used at Emden Plant	Quantity	Volkswagen	UNEP/Sustainability 97
Resource use	excipients	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Resource use	Fleet Transport Fuel consumption	Quantity	Vauxhall Motors	Vauxhall 98
Resource use	Fuel consumption for site-to-site transportation	thousand litres	Novo Nordisk	Novo Nordisk 1997
Resource use	Fuel economy	Quantity	Bass	PIRC 98
Resource use	Fuel used by commercial fleet (leaded / unleaded petrol, diesel)	million litres	BT	BT 1997
Resource use	Gas consumption	Quantity	Vauxhall Motors	Vauxhall 98
Resource use	Gas Consumption - LPG, butane, propane	Quantity	GKN	GKN 1998
Resource use	Gas Consumption - Natural gas	Quantity	GKN	GKN 1998
Resource use	Material balance		Neste	UNEP/Sustainability 97
Resource use	Materials used at Emden Plant	Quantity	Volkswagen	UNEP/Sustainability 97
Resource use	new building energy	Quantity	Rank	PIRC 98
Resource use	new building water conservation		Rank	PIRC 98
Resource use	Oil Consumption - Gas oil	Quantity	GKN	GKN 1998
Resource use	Oil Consumption - Heavy	Quantity	GKN	GKN 1998
Resource use	Oil Consumption - Light	Quantity	GKN	GKN 1998
Resource use	Oil Consumption - Medium	Quantity	GKN	GKN 1998
Resource use	Packaging purchased (by type)	thousand tons	Novo Nordisk	Novo Nordisk 1997
Resource use	paper packaging	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Resource use	Paper used in production of BT directories	thousand tonnes	BT	BT 1997
Resource use	plastic packaging	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Resource use	Progress against responsible care		Eli Lilly	UNEP/Sustainability 97
Resource use	Raw Materials purchased	thousand tons	Novo Nordisk	Novo Nordisk 1997
Resource use	Recycled material use	Quantity	Scottish & Newcastle	PIRC 98
Resource use	Renewable energy consumption	kWh	BAA	BAA 1998
Resource use	Resource use	Quantity	Scottish & Newcastle	PIRC 98
Resource use	solvents	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Resource use	Transport - public transport used by passengers	%	BAA	BAA 1998
Resource use	Transport - rail use & car share		Boots	PIRC 98
Resource use	Transport Fuels - Diesel	Quantity	GKN	GKN 1998
Resource use	Transport Fuels - Gasoline/petrol	Quantity	GKN	GKN 1998
Resource use	Water conservation	Quantity	Tesco	PIRC 98
Resource use	Water consumption	million m3	Novo Nordisk	Novo Nordisk 1997
Resource use	Water consumption	Quantity	Vauxhall Motors	Vauxhall 98
Resource use	water supplied	thousand m3	BAA	BAA 1998
Resource use	water usage	Quantity	Ladbrooke Group	PIRC 98
Resource use	water use	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Stakeholders	Complaints	number	DSM	UNEP/Sustainability 97
Stakeholders	Complaints	number	Novo Nordisk	Novo Nordisk 1997
Stakeholders	Complaints (Noise, traffic, lighting, dust, odour, visual, other)	number	Glaxo Wellcome	Glaxo Wellcome 1997
Various	Environmental Performance		Various	PIRC 98
Various	Input / Output data		Volkswagen	UNEP/Sustainability 97
Various	Inputs		Volvo	UNEP/Sustainability 97
Various	Store construction		Tesco	PIRC 98
Various	tourism		BA	PIRC 98
Various	Transport		Tesco	PIRC 98
Various	Weight and distance of hazardous cargoes	thousand tons / 000 km	Novo Nordisk	Novo Nordisk 1997
Various	Weight and distance of product transported site to site by truck	thousand tons / 000 km	Novo Nordisk	Novo Nordisk 1997
Various	Weight of product exported by aircraft	thousand tons	Novo Nordisk	Novo Nordisk 1997
Various	Weight of product exported by ship	thousand tons	Novo Nordisk	Novo Nordisk 1997
Various	Weight of product exported by truck	thousand tons	Novo Nordisk	Novo Nordisk 1997
Waste	Batteries recycled - lead acid exchange batteries	tonnes	BT	BT 1997
Waste	Batteries recycled - lead acid vehicle batteries	number	BT	BT 1997
Waste	Batteries recycled - nickel cadmium	tonnes	BT	BT 1997
Waste	General Waste to Landfill	Quantity	Vauxhall Motors	Vauxhall 98
Waste	Hazardous waste disposed by destination	Quantity		Azzone et al (1996)
Waste	Hazardous waste generated - total	Quantity		Azzone et al (1996)
Waste	Hazardous waste generated by category	Quantity		Azzone et al (1996)
Waste	Hazardous waste transported	Quantity		Azzone et al (1996)
Waste	Hazardous waste treated	Quantity		Azzone et al (1996)
Waste	Hazardous Wastes to land	thousand tonnes	ICI	ICI 1997
Waste	Liquid Waste - NovoGro	thousand m3	Novo Nordisk	Novo Nordisk 1997

Waste	Liquid Waste - NovoGro	thousand m3	Novo Nordisk	Novo Nordisk 1997
Waste	Liquid Waste - Yeast slurry	thousand m3	Novo Nordisk	Novo Nordisk 1997
Waste	Metal Recovered	Quantity	Vauxhall Motors	Vauxhall 98
Waste	Metals recovered from exchanges (steel/iron, copper, aluminium)	thousand tonnes	BT	BT 1997
Waste	new building recycling		Rank	PIRC 98
Waste	new building waste disposal		Rank	PIRC 98
Waste	Non-hazardous waste disposed by destination	Quantity		Azzone et al (1996)
Waste	Non-hazardous waste generated - total	Quantity		Azzone et al (1996)
Waste	Non-hazardous waste generated by category	Quantity		Azzone et al (1996)
Waste	Non-hazardous Wastes to land	thousand tonnes	ICI	ICI 1997
Waste	Non-Metallic materials recycled		Vauxhall Motors	Vauxhall 98
Waste	Non-process Wastes to land	thousand tonnes	ICI	ICI 1997
Waste	Recycling		Boots	PIRC 98
Waste	Recycling Index		Fiat	UNEP/Sustainability 97
Waste	Recycling recovery rates			Azzone et al (1996)
Waste	Scrap cable recovered for recycling (6 types)	tonnes	BT	BT 1997
Waste	Solid Waste - controlled destruction	thousand tons	Novo Nordisk	Novo Nordisk 1997
Waste	Solid Waste - incinerated	thousand tons	Novo Nordisk	Novo Nordisk 1997
Waste	Solid Waste - landfilled	thousand tons	Novo Nordisk	Novo Nordisk 1997
Waste	Solid Waste - recycled	thousand tons	Novo Nordisk	Novo Nordisk 1997
Waste	Special Waste to Landfill	Quantity	Vauxhall Motors	Vauxhall 98
Waste	Telephones recovered (resold or recycled)	thousands	BT	BT 1997
Waste	Total wastes to air, land and water	millions of tonnes	ICI	ICI 1997
Waste	Waste	Quantity	BA	PIRC 98
Waste	Waste minimisation	Quantity	Scottish & Newcastle	PIRC 98
Waste	waste reduction	Quantity	English China Clays	PIRC 98
Waste	waste reduction	Quantity	Ladbrooke Group	PIRC 98
Waste	waste reduction	Quantity	Zeneca	PIRC 98
Waste	Wastes	Quantity	Volvo	UNEP/Sustainability 97
Waste	Hazardous solid waste	tonnes	GKN	GKN 1998
Waste	Hazardous waste	millions of lbs.	Boeing	Boeing 1997
Waste	Hazardous waste	thousand tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Waste	Non-hazardous solid waste	tonnes	GKN	GKN 1998
Waste	Non-hazardous waste - total	thousand tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Waste	Other liquid waste (specify)	litres	GKN	GKN 1998
Waste	Recycled/recovered	%	Glaxo Wellcome	Glaxo Wellcome 1997
Waste	Solid waste to incineration - total	%	GKN	GKN 1998
Waste	Solid waste to landfill - total	%	GKN	GKN 1998
Waste	Total solid waste recycled or recovered	%	GKN	GKN 1998
Waste	Waste - total	thousand tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Waste	Waste oil	litres	GKN	GKN 1998
Waste	Waste recycled or recovered - total	Tonnes	BAA	BAA 1998
Waste	Waste to landfill - total	tonnes	BAA	BAA 1998
Water Emissions	Acids to water	tonnes hydrogen ions	ICI	ICI 1997
Water Emissions	Aquatic Ecotoxicity	tonnes copper/formaldehyd	ICI	ICI 1997
Water Emissions	Aquatic Oxygen Demand	tonnes oxygen equivalent	ICI	ICI 1997
Water Emissions	BOD load from de-icers	tonnes	BAA	BAA 1998
Water Emissions	Cadmium & Mercury	kg	GKN	GKN 1998
Water Emissions	Certain chemicals in surface waters of rivers	concentration	Henkel	UNEP/Sustainability 97
Water Emissions	Chemical Oxygen Demand of Effluent	mg/l	Vauxhall Motors	Vauxhall 98
Water Emissions	Chlorinated VOCs	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Water Emissions	COD	kg	GKN	GKN 1998
Water Emissions	COD (total chemical oxygen demand)	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Water Emissions	COD in waste water	tons	Novo Nordisk	Novo Nordisk 1997
Water Emissions	Discharged waste water - total volume	thousand m3	Novo Nordisk	Novo Nordisk 1997
Water Emissions	Nitrogen in waste water	tons	Novo Nordisk	Novo Nordisk 1997
Water Emissions	Non-chlorinated VOCs	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Water Emissions	Oil	kg	GKN	GKN 1998
Water Emissions	Other Toxic Metals	kg	GKN	GKN 1998
Water Emissions	Phosphorus in waste water	tons	Novo Nordisk	Novo Nordisk 1997
Water Emissions	Process wastewater discharge	m3	GKN	GKN 1998
Water Emissions	Suspended solids	kg	GKN	GKN 1998
Water Emissions	Suspended solids	tonnes	Glaxo Wellcome	Glaxo Wellcome 1997
Water Emissions	Total Suspended Solids in Effluent	mg/l	Vauxhall Motors	Vauxhall 98
Water Emissions	Toxic Metals in Effluent	mg/l	Vauxhall Motors	Vauxhall 98
Water Emissions	Water consumption	m3	GKN	GKN 1998
Water Emissions	Water Index		Elf Atochem	UNEP/Sustainability 97

Quantitative Measures & improvements - Relative

Category	Measure	denominator	Indicator units	Co.	Ref.
Air emissions	Average emissions	oil well		Enterprise Oil	PIRC 98
Air emissions	CO	1000 tons of product by road	kg	Novo Nordisk	Novo Nordisk 1997
Air emissions	CO	energy	g/kWh	Sainsbury	PIRC 98
Air emissions	CO2	1000 tons of product by road	kg	Novo Nordisk	Novo Nordisk 1997
Air emissions	CO2	floor area	kg/sq.m	Sainsbury	PIRC 98 & UNEP/Sus 97
Air emissions	CO2	kWh	g/kWh	Power companies	PIRC 98
Air emissions	CO2	kWh	t/GWh	Power companies	PIRC 98
Air emissions	CO2	kWh	kg/kWh	Power companies	PIRC 98
Air emissions	CO2	unit Turnover	tonnes/£million	EMI	PIRC 98
Air emissions	CO2	unit Turnover	tonnes/£million	Thorn	PIRC 98
Air emissions	CO2 emissions	available tonne kilometres		BA	PIRC 98
Air emissions	CO2 emissions	employees		Body Shop	UNEP/Sus 97
Air emissions	CO2 emissions	passenger	kg/pax	BAA	BAA 1998
Air emissions	CO2 emissions	turnover	tonnes/£million	Zeneca	PIRC 98
Air emissions	CO2 emissions	unit of value added		Body Shop	UNEP/Sus 97
Air emissions	CO2 emissions	unit sales		Smithkline Beecham	PIRC 98
Air emissions	Dust	kWh	g/kWh	Power companies	PIRC 98
Air emissions	Dust	kWh	t/GWh	Power companies	PIRC 98
Air emissions	emissions	passenger		BAA	PIRC 98
Air emissions	emissions	production	%	BP	PIRC 98 & UNEP/Sus 97
Air emissions	Emissions	tonne of product	kg	Statoil	UNEP/Sus 97
Air emissions	emissions to air	tonne of glass made		Pilkington	PIRC 98
Air emissions	emissions to air	tonne of product		Inspec	PIRC 98
Air emissions	Global Warming gases	1995 EB value	index	ICI	ICI 1997
Air emissions	Hazardous air emissions	1995 EB value	index	ICI	ICI 1997
Air emissions	HCl	kWh	g/kWh	Power companies	PIRC 98
Air emissions	HCl	kWh	t/GWh	Power companies	PIRC 98
Air emissions	Hydrocarbons	1000 tons of product by road	kg	Novo Nordisk	Novo Nordisk 1997

Air emissions	NOx	1000 tons of product by road	kg	Novo Nordisk	Novo Nordisk 1997
Air emissions	NOx	kWh	g/kWh	Power companies	PIRC 98
Air emissions	NOx	kWh	t/GWh	Power companies	PIRC 98
Air emissions	NOx	tonnes output		Shell	PIRC 98
Air emissions	Ozone Depletion Potential	1995 EB value	index	ICI	ICI 1997
Air emissions	particulates	energy	g/kWh	Sainsbury	PIRC 98
Air emissions	Photochemical Ozone Creation	1995 EB value	index	ICI	ICI 1997
Air emissions	Ratio of emissions	production	%	BP	UNEP/Sus 97
Air emissions	refining emissions	throughput	%	BP	PIRC 98
Air emissions	SO2	kWh	g/kWh	Power companies	PIRC 98
Air emissions	SO2	kWh	t/GWh	Power companies	PIRC 98
Air emissions	SO2	tonnes output		Shell	PIRC 98
Air emissions	solvent emissions	unit sales		Smithkline Beecham	PIRC 98
Air emissions	solvent use	million units of output		EMI	PIRC 98
Air emissions	Solvents from painting	per car	kg emitted	Vauxhall Motors	Vauxhall 98
Air emissions	Soot	1000 tons of product by road	kg	Novo Nordisk	Novo Nordisk 1997
Cost	environmental expenditure	sales	ratio	Roche	UNEP/Sus 97
Cost	environmental expenditure	sales	ratio	Roche	UNEP/Sustainability 97
Cost	Environmental investments	Total investments	%	Novo Nordisk	Novo Nordisk 1997
Cost	Environmental related investment	total investment	%	Volvo	UNEP/Sus 97
Cost	Total environmental costs	Operating income	%	Novo Nordisk	Novo Nordisk 1997
Cost	Total environmental costs	total production costs	%	Novo Nordisk	Novo Nordisk 1997
Cost	Total environmental costs	Turnover	%	Novo Nordisk	Novo Nordisk 1997
Financial	utility costs	employee/sq.m occupied		Body Shop	PIRC 98
Noise	Chapter 3&5 aircraft	jet aircraft movements	%	BAA	BAA 2000
Noise	Infringements	departure - day	no.	BAA	BAA 1998
Noise	Infringements	departure - night	no.	BAA	BAA 1999
Pollution	Acidity to Air and Water	1995 EB value	index	ICI	ICI 1997
Pollution	environmental damage	sales	ratio	Roche	UNEP/Sustainability 97
Pollution	environmental damage	sales	ratio	Roche	UNEP/Sus 97
Resource use	diesel used	1000 tons of product by road	kg	Novo Nordisk	Novo Nordisk 1997
Resource use	energy	productivity	index	Novo Nordisk	UNEP/Sustainability 97
Resource use	energy consumption	by type	%	Wessex Water	PIRC 98

Resource use	energy consumption	energy produced	%	National Power	PIRC 98
Resource use	energy consumption	floor area	kWh/sq.m.	Sainsbury	PIRC 98
Resource use	Energy consumption	per passenger	kWh/pax	BAA	BAA 1998
Resource use	energy consumption	tonne of product		Allied Colloids	PIRC 98
Resource use	Energy consumption	vehicles produced		General Motors	UNEP/Sus 97
Resource use	energy efficiency	1995 EB value	index	ICI	ICI 1997
Resource use	energy use	hectolitre packaged		Guiness	PIRC 98
Resource use	energy use	litre of alcohol		Guiness	PIRC 98
Resource use	energy use	tonne of glass made		Pilkington	PIRC 98
Resource use	energy use	tonne of malt		Guiness	PIRC 98
Resource use	energy use	tonne product manufactured		Unilever	PIRC 98
Resource use	energy use	unit sales		Smithkline Beecham	PIRC 98
Resource use	fuel consumption	available tonne kilometres		BA	PIRC 98
Resource use	fuel efficiency	available tonne kilometres		BA	PIRC 98
Resource use	packaging	productivity	index	Novo Nordisk	UNEP/Sustainability 97
Resource use	raw materials	productivity	index	Novo Nordisk	UNEP/Sustainability 97
Resource use	recycled paper	employees	kg	Statoil	UNEP/Sus 97
Resource use	Recycled Paper used indirectories	Total Paper used in directories	%	BT	BT 1997
Resource use	water	productivity	index	Novo Nordisk	UNEP/Sustainability 97
Resource use	Water abstracted	effective rainfall	%	Wessex Water	PIRC 98
Resource use	Water production	Resource available	%	Wessex Water	PIRC 98
Resource use	water use	per passenger	litres/pax	BAA	BAA 1998
Resource use	water use	tonne product manufactured		Unilever	PIRC 98
Resource use	water use	unit sales		Smithkline Beecham	PIRC 98
Resource use	Water used	beer produced	ratio	Guiness	PIRC 98
Various	freight by air	total freight	%	Body Shop	PIRC 98
Waste	Hazardous waste	million units of output		EMI	PIRC 98
Waste	Hazardous waste	tonne product manufactured		Unilever	PIRC 98
Waste	Hazardous waste	turnover	tonnes/£million	Zeneca	PIRC 98
Waste	non-hazardous waste	tonne product manufactured		Unilever	PIRC 98
Waste	Off site waste	tonne of product		Inspec	PIRC 98
Waste	Sludge waste	tonnes production		Shell	PIRC 98
Waste	Total waste	production (millions of tonnes)	ratio	ICI	ICI 1997

Waste	Waste	tonne of product		Allied Colloids	PIRC 98
Waste	waste generated	unit sales		Smithkline Beecham	PIRC 98
Waste	Waste recycled	passenger	kg/pax	BAA	BAA 1998
Waste	Waste recycled	waste created	%	SW Water	PIRC 98
Waste	Waste to landfill	passenger	kg/pax	BAA	BAA 1998
Water Emissions	Aquatic Ecotoxicity	1995 EB value	index	ICI	ICI 1997
Water Emissions	Aquatic Oxygen demand	1995 EB value	index	ICI	ICI 1997
Water Emissions	COD	tonne product manufactured		Unilever	PIRC 98
Water Emissions	compliance	emissions consents	%	ICI	PIRC 98
Water Emissions	Discharges to water	tonnes production		Shell	PIRC 98
Water Emissions	Drinking Water quality	compliance	%	Wessex Water	PIRC 98
Water Emissions	Fluoride emissions	aluminium produced	kg/tonne	Rio Tinto	PIRC 98
Water Emissions	liquid effluent	tonne of product		Inspec	PIRC 98
Water Emissions	nitrogen in waste water recycled	total nitrogen in waste water	%	Novo Nordisk	Novo Nordisk 1997
Water Emissions	phosphorus in waste water recycled	total phosphorus in waste water	%	Novo Nordisk	Novo Nordisk 1997
Water Emissions	Waste water	tonne of product		Allied Colloids	PIRC 98
Water Emissions	waste water COD load	unit sales		Smithkline Beecham	PIRC 98
Water Emissions	waste water recycled	total waste water	%	Novo Nordisk	Novo Nordisk 1997

Appendix AJ

Summary of EngD Assignments

and Marks

After Examiners
Score **8.7** Meeting Oct 98

Nicolette Lawson: Eng D Assignment marks

Average

B	6	60%

Year	Assignment Title	Title	Report submitted	Report returned	Marker	Mark		Avg%	Notes
1	Communication skills and team work	Presentation skills and team work	Jan-95	Mar-95	C.France	B	6	62%	
1	Project Management	Project Management & LCA	Dec-95	Mar-95	A.Roberts	A+	10	90%	
1	Environmental LCA	Project Management & LCA	Dec-95	Mar-95	R.Clift	A-/A	8.5	75%	
1	Environmental Measurement	Environmental Measurement	Feb-95	Mar-95	C.France	B	6	62%	
1	Natural v Technological Risk	Risk Perception	31-May-95	Jul-95	R.Lofstedt	B+	7	67%	
1	Sociology	Sociology	19-May-95	Jun-95	K.Burningham	C	3	47%	
1	Audit Report	Hands-on Audit	Jul-95	No	J.Donaldson	*C+*	*4*	*52%*	1*
2	Clean Technology	Clean Technology	Nov-95	No	R.Clift	*B*	*6*	*62%*	2
2	Risk Communication	Risk Communication	Jan-96	Mar-96	R.Lofstedt	B/B+	6.5	65%	
2	The Environmental Act	Environmental Law	Jan-97	No	R.Malcolm	*C+*	*4*	*52%*	3*
3	Sociology	Sociology 2	Jun-97	Aug-97	K.Burningham	B	6	62%	
2	Finance (Case Study)	Finance & Marketing	Jun-97	Oct-98	P.Schmidt-Hanson	B-	5	**55%**	
2	Marketing (Body Shop)	Finance & Marketing	Jun-97	Oct-98	P.Schmidt-Hanson	B-	5	**55%**	
3	Environmental Economics (my project)	Environmental Economics	May-97	Aug-97	Suzi Hodgson	B-	5	57%	
3	Risk Management:UK v USA approach	Risk Management	1-Jun-98	Jul-98	R.Lofstedt	A	9	77%	
3	Group Report - a potential new activity	Advanced Leadership	1-Sep-97	May-98	R.Schultz	*C+*	*4*	*52%*	4*
4	Video explaining the EngD to sponsors	Talking to the Media	Nov-97	Mar-98	A.Roberts	A-	8	52%	5

Year	Elective Title	Title	submitted	returned	Marker	Mark		Avg%	Notes
1	Associate Membership of IEMgt	Open book exam	1-Jun-95	Sep-95	IEMgt	*Pass*	4	*52%*	
2	MSc in Env. Mgt (Paper+Exam)	Mod.2: Systems for Env.Mgt	Jan-96	No	Brunel Mgt Prog.	C+	4	52%	6*
4	Full Membership of IEMgt	Application, short paper & interview	2-Jun-98	Jun-98	IEMgt	*Pass*	*4*	*52%*	

Notes:

1 Group report - official mark never given and report not returned, I will assume a pass (C+).
2 Report lost by marker - I believe a B was given.
3 Submitted late due to maternity leave - report and mark not yet returned.
4 Group report - still waiting for official mark
5 Video assignment
6 MSc Module - Paper and Exam, never returned. Assume a pass
* *Where mark is not known a pass mark of 52% (C+) is assumed.*

Marking comparisons:

A+	10	80-100%
A	9	75-79%
A-	8	70-74%
B+	7	65-69%
B	6	60-64%
B-	5	55-59%
C+	4	50-54%

EngD in

ENVIRONMENTAL TECHNOLOGY
2nd floor, Howell Bldg.,
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Course co-ordinator: Carole Carr, ext. 2631
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Memorandum

TO: Nicolette Lawson

FROM: Dr Chris France, EngD Programme Director

DATE: 23 November 1998

RE: **EngD Examination Board 1997 - 98**
Course Marks for EngD Modules

We are pleased to inform you that the Board of Examiners at a recent meeting have considered the average marks for you which were:-

8.7

and we are pleased to advise you that you have satisfied the course work requirements and that you may submit your portfolio for viva examination.

pp Nicolette Lawson
Dr Chris France

(signed in the absence of Dr France)