

# **Developing Living Information Systems Through Systems Tailorability: Deferred Systems Design**

A thesis submitted for the Degree of Doctor of Philosophy

By

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## ABSTRACT

An interpretivist investigation of computer-based business information systems was conducted in two commercial companies and two higher education institutes, by using both quantitative questionnaire survey and qualitative interview research methods. The investigation focused on the social and organisational context of information systems development and usage in these organisations. The utility of structured methodologies is now being questioned by some researchers who are calling for alternative approaches, and this investigation draws on that alternative strand of thinking. The collected data primarily reveals that the development and usage of information systems happens in changing organisations, which suggests that the design and usage of information systems must cater for such a changing or dynamic environment. Therefore the data is interpreted using a philosophical outlook encompassing the notion of “living” information systems and Critical Theory, and this philosophical stance regards information technology as liberating human endeavour in organisations. Five sub-concepts and the concept of deferred system’s design are derived from the data, which have been formulated to account and cater for change in information systems environments. The concept of deferred system’s design encourages the design of information systems which allow for organisational human behaviour, consisting of organisational change, uncertainty, and learning, to be mediated by information technology. A systems design principle called ‘deferred system’s design decisions’ is derived to enable designs of tailorable information systems, which may be regarded as one form of living information systems to facilitate such organisational behaviour. An intersubjective theoretical model called the spiral of change model of tailorable information systems is proposed to explain and understand better the changing organisational environment in which information systems must be developed and in which they must function. To inform practice a computer tool is proposed which enables conceptions of tailorable information systems that employ the principle of deferred system’s design decisions and enables modelling changing or dynamic information systems.



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# Declaration

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Gardner L.A., Paul R. J. and Patel N. V. (1995), Moving Beyond the Fixed Point Theorem with Tailorable Information Systems. In *Proceedings of The Third European Conference on Information Systems, Athens, Greece*. (Doukidis G., Galliers R., Jelassi T., Kremar H. and Land F. Eds.), 183-192.

Patel N. V. (1997) Tailorable Information Systems: Deferred Systems Design for Changing Organisations. In the Proceedings of the 7<sup>th</sup> Annual BIT Conference, BIT '97, Business Information Management - Alternative Futures, November 5/6, the Manchester Metropolitan University, UK. (The Proceedings are only available in CD-ROM format).

Stamoulis D. S., Patel N. V. and Martakos D. I. (1996) A Systems Architecture Model and Implementation Platforms for Tailorable Information Systems. In *Proceedings of the Fourth European Conference on Information Systems*, ( Coelho J. D., Jelassi T., König W., Kremar H., O'Callaghan R, and Sääksjärvi M, Eds.), Lisbon, Portugal, July 2-4. 313-322.



# **1. From Information Systems to Living Information Systems**

## **1.1 Introduction**

This dissertation is a report of research which investigated aspects of the development and usage of computer-based information systems in business organisations. To facilitate the development and usage of information systems in such an environment a general design principle called deferred system's design decisions is proposed and developed. This design principle is compatible with the philosophical outlook of the thesis, which is to regard information systems as living entities. To operationalise the proposed design principle the mechanism of making information systems tailorable by users is introduced. The thesis of this dissertation is the view that tailorable information systems are suitable for dynamic organisational environments.

The proposition of the principle of deferred system's design decisions entails questioning the existing power of systems professionals to make design decisions. In an early insightful paper, Dearden (1972) challenged as "absurd" the idea that a group of experts like systems professionals could design information systems for all the needs of a company. This idea of experts controlling the development and usage of information systems has nevertheless persisted and has even been elaborated into methodologies for development. Today, information systems are developed by systems professionals who use the life cycle model as the basis of methodologies, which themselves are bound in business projects that have predetermined time and monetary constraints (see for example, Iivari, 1991, Grindley 1993, Avgerou and Cornford, 1993, and Morris and Hugh 1993). In contrast to the findings of this research that information systems environments are dynamic, the life cycle model approach to information systems development fundamentally assumes a static information systems environment.

Grindley's (1986) influential work highlights some fundamental philosophical and pragmatic problems with using the life cycle model, business projects, and experts. He argues that the use of projects and methodologies leads to users being dissatisfied with delivered

information systems. The use of methodologies bound in business projects means that systems professionals need to know a complete set of systems requirements from potential users before systems can be built. Grindley (1986) asserts that this type of systems specification has proved to be extremely problematic to achieve because of the difficulty of getting potential users to agree requirements.

## 1.2 Philosophical Outlook

In the circumstances outlined above, the question of how information systems development should proceed is addressed by Paul's (1993) mock fixed point theorem of information systems. The theorem is both a succinct formulation of the current problems of using the life cycle model and acts as a catalyst for thinking of alternative ways of proceeding. The fixed point theorem will be fully elaborated in Chapter 2, but in brief it is a statement of the difficulties associated with using the life cycle model and systems experts from two pragmatic vistas. First, the life cycle model's assumption that potential users are able to know what they want at a specified time in the systems development project is questioned. Thus the efficacy of establishing a complete set of systems requirements is doubted. Second, the life cycle model's assumption that potential users can agree among themselves and with systems professionals on systems requirements is also questioned. Both these concerns of the theorem underpin the present research.

Paul's (1993) paper is thus instrumental in informing the research underpinning this dissertation and in providing the necessary philosophical orientation. This philosophical orientation may be summed up as "ontological design", a philosophy of computer systems design found in the work of Winograd and Flores (1993). Ontological design is concerned with giving a full consideration to the ways in which people perceive the situations they encounter. In the context of the present research, these situations consist of peoples work environment or organisational situations. Ontological design also considers the effects of the design on peoples' "being" in the future, thus allowing for human growth. So ontological design recognises the reflective and political aspects of computer systems design. Winograd and Flores (1993) argue that ontological design is the most important kind of computer systems design.

Since this study examines the social and organisational context in which information systems are developed and used, it has ethical implications. In essence, an ethical



consideration of proposed designs is the true meaning of doing ontological design. Consideration of ethical aspects has a tradition in information systems research (for example see the works of Mumford, 1983 and Hirschheim and Klein, 1994). Researchers like Lyytinen and Klein (1985) and Hirschheim and Klein (1989) have used Habermas' (1972) Critical Theory to consider the ethical implications of information systems design. The data interpretation from the present investigation also draws on Habermas' (1972) Critical Theory. For the purposes of the present research, Paul's (1993) normative arguments which underpin this study suggest that information systems design should not force mechanised human behaviour, rather such designs should be "living". The principle outcome of this study proposes deferring systems design decisions to potential users, thus enabling richer information systems and avoiding system designs which force mechanistic behaviour in humans.

### **1.3 Researching the Development and Usage of Information Systems**

The broad purpose of this research is to understand the organisational and social context in which information systems are developed and used. By understanding this social context the aim is to develop appropriate concepts to inform ontological designs of living information systems. Walsham (1995) recognises the development of concepts as a valid research goal because they provide relevance by increasing our understanding of the phenomena studied. In that sense this research fulfils a valid need because the notion of living information systems is new and lacks a conceptual basis, and this research seeks to contribute to its formation.

The specific purposes of the research undertaken are twofold. One, to understand empirically what is meant by Paul's (1993) concept of "living systems" in business organisations. He argues that information systems should be designed to be living because businesses themselves are living systems. To inform the design of living information systems it is necessary to understand in what senses a business organisation may be described as a living system. This understanding may then be used to inform appropriate living information systems designs. The second purpose is to use the empirical data thus collected to develop relevant systems design concepts and theory to explain the observed phenomenon. This

facilitates the design of living information systems by providing an empirically based conceptual context to inform designing.

There is much currently not known about living information systems development. The purposes detailed above seek to add to our understanding. In particular, we do not have detailed knowledge of the “living” aspects of the processes of information systems development and usage. It is critical to understand those processes to form a clearer picture of the kinds of system designs needed, and to learn how to approach their development.

## 1.4 The Research Questions

Two research questions arise from the stated purposes and were identified to contribute to our understanding of the living aspects of information systems. The two questions are: one, how are information systems used in organisations by people who are charged with completing work tasks and fulfilling their organisational responsibilities? Two, how are information systems developed in the context of continuous performance of organisational tasks and responsibilities?

To answer the first question, it is necessary to know how information systems are used. A major part of the living aspects of information systems is their actual usage. In some cases, actual usage is reported to be inhibited because of prior systems design decisions by systems professionals. The focus of the second question is to uncover and understand the living aspects of the development process.

The phrase “information systems development” is used in a broad sense in this dissertation. The four case organisations are each involved in developing computer-based information systems to support their business operations. To do this they are active in applying information technology. The development of information systems in the four case organisations ranges from in-house systems development to the customisation of industry standard application packages. The Datatel Corporation case organisation develops its systems in-house, as well as using industry standard packages. The University of Luton and Nene College of Higher Education case organisations lack the required systems development expertise, so they commission bespoke systems to support their administration. The Ace Business Computers case organisation, a relatively small company, uses industry standard applications.



The phrase “information systems usage” is used to mean the use of computer-based information systems to support organisational work practices. Information systems support all aspects of work in the four case organisations, ranging from routine operational details such as inventory control at the Datatel Corporation, administrative support for degree programme management at the University of Luton and Nene College of Higher Education, and management accounting systems at the Ace Business Computers. Each of the case organisations uses information systems to support operational, administrative and management functions. The usage of systems in these case organisations is undertaken by employees who are charged with the responsibility of fulfilling certain organisational tasks. The phrase “information systems usage” encompasses the ability of the provided information systems to support those organisational tasks that employees have to complete.

The two research questions complement each other. By understanding how information systems are used it is possible to use the knowledge to improve the development process. Equally, by understanding the information systems development process it is possible to identify its utility to actual information systems usage. The answers to these questions should contribute to the overall purpose of the research, which is to inform living information systems development. An understanding of the current theory and practice in development and usage of information systems will provide opportunities to seek improvements in those areas in terms of the philosophical underpinnings of this research.

The question of how information systems are used is a justifiable research issue because usage is the ultimate purpose of developing information systems. Company users of information systems have specific information needs which arise from the organisational responsibilities and tasks they have to complete. Thus usage is dependent on organisational circumstances and requirements of users. A better understanding of this dependency will provide knowledge for informing the development process relevant to user needs. Perhaps more importantly the study of how information systems are developed is justifiable too because actual usage is dependent on how information systems are designed. If the design does not match requirements then usage could be minimal or not at all.

The critically different orientation of these research questions is the philosophical thinking underpinning them in that the research was conducted from the standpoint of thinking of information systems as living entities. An even more radically different orientation of the research is that it seeks to understand information systems usage and

development independently of the paradigm of the life cycle model and the largely unquestioned expertise and dominance of systems professionals. By doing so the aim is to diffuse control over information systems to those members of organisations traditionally considered to be non-experts in information technology and information systems development.

## 1.5 Contributions to Living Information Systems Thinking

Field data analysis has led to the formulation of concepts considered relevant for designing living information systems, and an intersubjective theoretical explanation of the data has led to the formulation of the *spiral of change model of tailorable information systems*. A more general contribution is the design principle called *deferred system's design decisions*. The essence of information systems design based on this principle is to create skeletal systems which subsequently enable users to add their own designs according to the organisational situations they encounter. For the purpose of this dissertation, the use of this design principle is proposed to realise living information systems in the form of tailorable information systems.

A further contribution is the design of a CASE tool called *Hyper-Tmodeller*. This tool is a practical embodiment of the deferred system's design decisions principle and the spiral of change model of tailorable information systems, and thus demonstrates the design principle's potential applicability for systems development purposes. The purpose of the tool is to identify and match tailorable aspects of information with the changing work environment. It is proposed that it be used by both developers and users.

In addition, this research has resulted in an empirical contribution to the ongoing debate on living information systems. Both quantitative and qualitative evidence is produced to support Paul's (1993) contention that businesses are indeed "living systems".

The overall result is an increased understanding of practical and theoretical issues concerned with designing living information systems. In particular, the concept of tailorable information systems or *systems tailorability* provides a potential mechanism for operationalising the notion of living information systems.



## 1.6 Dissertation Overview

This dissertation is organised as follows. Chapter 2 sets out the information systems development conceptual context which informs the research. A discussion is conducted of the dominant life cycle model for developing information systems. The chapter assesses the life cycle model's suitability for information systems development by considering the results of previous research. Certain shortcomings concerning user satisfaction provide the catalyst for thinking of alternatives. The amethodological argument as an alternative is then considered. Tailorable computer systems are introduced as systems which cater better for users' uncertain and variable needs, and as systems which do not rely on detailed elicitation of user requirements for development purposes. The fixed point theorem of information systems development is invoked, and it provides the catalyst to propose the suitability of systems tailorability to business information systems. Finally, issues concerning research epistemology and research methods are considered.

An interpretive research design is detailed in Chapter 3. In this chapter the interpretivist approach used to investigate the research questions is discussed, and justification for the use of interpretivism as the research epistemology is provided. Consideration is also given to designing triangulation into the research and to the data sources. Case studies are introduced as an appropriate vehicle for applying interpretivist research design to living information systems research. A consideration of data analysis issues and discussion on how to evaluate interpretivist research is given.

The interactive qualitative research process is discussed in Chapter 4. Outline descriptions of the changing case organisations are provided by detailing the kind of change affecting the organisations and how such changing organisations perceive information technology. Brief descriptions of the role of the information technology departments in each case organisation is also provided. Examples of information systems which are developed and used in the changing organisations are provided as references for the research data. Issues concerning the implementation of the research design are also discussed in this chapter. Aspects of data collection and recording are detailed, and how access to the data was gained is described. The issue of the validity of the collected data and that of the consequent interpretations made is considered. The data analysis strategy or data interpretation is discussed in the context of the

issue of the empirical validity of the data itself. Finally, limitations of the research methods used are considered.

The actual interpretation of the data is discussed in Chapter 5. Interpretive data analysis and difficulties encountered with its use are discussed. Critical Social Theory is presented in the context of information systems research. Data analysis leads to the formulation of relevant concepts for informing living information systems designs, and so the formulation of the second order concept of deferred systems design is described. The principle of deferred system's design decisions for living information systems development is also developed from the data. Questions concerning the validity of the developed concepts and the design principle are addressed in terms of triangulation. The chapter ends by considering the empirical validity of the data interpretation done.

The penultimate chapter postulates an intersubjective theoretical explanation of the data. The interpretive concepts and the principle of deferred system's design decisions developed in the previous chapter are organised into a plausible model of organisational and information systems change to explain theoretically the dynamic information systems environment of development and usage which the data reveals. The model is formed on the basis of the interpretivist notion of intersubjective theory as a theoretical explanation, and is named the spiral of change model of tailorable information systems. The model is then compared to Boehm's spiral model. The spiral of change model of tailorable information systems is then juxtapositioned with the mock fixed point theorem of information systems development to demonstrate how it diverges from the theorem. Implications of the developed spiral of change model for information systems practice generally, and for tailorable information systems in particular, are then discussed.

The final chapter is a conclusion to the dissertation. A summary of the dissertation is provided, and limitations of the research are discussed. Issues concerning further research are discussed.



## **2. Countering the Fixed Point Theorem with Systems Tailorability**

### **2.1 Introduction**

This chapter discusses the life cycle model for information systems development. The chapter considers the ongoing debate in information systems research and development, since as Cresswell (1994) states, a consideration of the “conceptual context” helps to frame the research and address issues concerning research methodology. The conceptual context consists of the assumptions, theories, expectations, beliefs and system of concepts in the existing field. Maxwell (1996) recommends setting the conceptual context to clarify what supports and informs the research. More pertinently he states that the conceptual context is constructed by the researcher and not “found”, and that it leads to the formulation of valid research questions. So the conceptual context is developed in this chapter.

Section 2.2 critically considers the dominant life cycle model used to develop information systems. The life cycle model’s shortcomings lead to the introduction in Section 2.3 of the alternative amethodological approach to systems development. This provides the background in which to consider in Section 2.4 whether the idea of tailorable computer systems is applicable to business information systems. The fixed point theorem of information systems development is then introduced in Section 2.5 as epitomising the life cycle model’s time and place constraints, and its assumption of users knowing information requirements. That provides the springboard in Section 2.6 for thinking of applying the notion of systems tailorability to information systems to avoid the fixed point theorem. Thus the idea of tailorable information systems is developed as being more suitable for changing or dynamic information systems environments. Some conclusions are drawn in the final section.

### **2.2 Systems Development Using the Life Cycle Model**

Fitzgerald (1990) states there are over 300 methodologies for developing information systems. All these methodologies share the life cycle model as their base, thus making the life cycle model the dominant approach for information systems development. As Friedman and

Cornford (1989) show in their history of computing, the generalised life cycle model has arisen from the reports and reflections of practitioners and researchers involved in individual and separate development projects. This generalisation is a systematic and sequential prescription which details the steps thought necessary to define, design and develop information systems. In this section the life cycle model is briefly reviewed and its shortcomings as identified by other researchers is discussed. Solutions proposed by other researchers for improving the life cycle model are also identified and briefly considered.

Sommerville (1992) presents the life cycle model in five stages. These stages are listed and then briefly explained. The stages are: requirements analysis and definition, system and software design, implementation and unit testing, integration and system testing, and operation and maintenance.

Requirements analysis and definition consists of establishing the system's services, constraints and goals, which is done in consultation with potential systems users. The requirements are then defined such that both users and systems professionals can understand them. Though in practice this is not possible because users do not understand the technical jargon used (see Mouakket et al., 1994 for a report on the problems of communication between users and developers). The second stage of the systems design process divides the defined requirements into hardware and software systems and thus establishes a potential systems architecture. Software design consists of representing the defined requirements in computer programs.

The third stage of implementation and unit testing first transforms the software design into actual computer programs and then tests each suite of programs to check that they meet the specifications. The fourth stage of integration and systems testing integrates the separate suites of programs together into a whole and tests them to check they meet the predetermined requirements. At this stage the system is delivered to users.

The final stage of operation and maintenance entails installing and using the system. Maintenance consists of correcting errors previously missed and improving the implementation of the system, and enhancing the system's services as new requirements are discovered.

In practice methodologies based on such a life cycle model are bound in logical time-frames termed projects, in which information systems development has to be initiated, completed, and evaluated against some predetermined measures. Methodologies and projects



together comprise information systems conception, design, implementation and use. This practice of using methodologies and projects is coined methodologico-project frameworks.

The acknowledgement in the life cycle that new requirements arise after the first stage of requirements analysis and definition is significant in terms of the philosophical outlook of this dissertation. The emergence of new requirements supports Paul's (1993) argument that information systems should be regarded as "living" systems and so designed to be living entities.

Other research casts doubt on the usefulness of the life cycle model or methodologies based on it. The role of methodologies has been examined by many researchers (see Gause and Weinberg, 1989; Parnas and Clements 1986; Brooks 1987; and Turner 1987). On the whole their data reveals that methodologies are not used in practice, though curiously many researchers continue to advocate their use and others continue to research newer methodologies. Baskerville et al's., (1992) data further weaken the argument for the life cycle model by revealing that the pace of business change leads to difficulties when using methodologies, and they assert that some change in organisations is too fast for methodologies to keep pace. The data from the present research confirms this view (see Chapter 5).

Given the problem definition and requirements specification phases of the life cycle model, it is not unreasonable to argue that the life cycle model assumes a static information systems environment, which gives little or no consideration to the social and organisational issues involved in systems development and usage. This is difficult to justify given the dynamic social and organisational aspects of information systems environments. The weak premises of the life cycle model approach may be summarised as follows. A presumption in the life cycle model is that users do know what systems functionality is required from a proposed development and systems analysts seek to establish exactly those requirements. The validity of this premise is shaky given the numerous reports of difficulties with establishing user requirements (see for example, Hitchman, 1995 and Mouakket et al., 1994). An equally fallacious premise is that user requirements can be agreed by users themselves and with systems professionals. This is evidently mistaken as the work on stakeholders' interests in information systems by Rouhonen (1991) and others shows. Also the present research data reveals lack of agreement among information systems users about information requirements (see Section 5.4.2 for details).

Apart from such mistaken premises, the life cycle model in the form of methodologies is cumbersome to deploy. The volume of documentation that has to be read and numerous processes and sub-processes that have to be followed make the application of methodologies unmanageable.

The deficiencies with the life cycle model have been recognised by other researchers who have proposed solutions. Land (1982) proposed incorporating “futures analysis” as an additional phase of the life cycle model to overcome the rigidity of delivered information systems. Fitzgerald (1988, 1990) proposes the development of flexible information systems through improved systems analysis. In the same vein, Boogard (1994) uses the term “software crises” to describe the problems of the life cycle model and proposes a more flexible approach through data independence. However, all this research is within the methodologico-project paradigm and it does not share the philosophical orientation of this dissertation.

## **2.3 An Amethodological Approach for Systems Development**

There is other research which broadly shares the philosophical basis of this dissertation. That research is outside the methodologico-project paradigm and seeks alternates to the life cycle model. For example, Baskerville et al., (1996) argue for an amethodological approach to information systems development. They review published argumentation and evidence on an amethodological approach and themselves argue that its comparative consideration with the life cycle model leads to refocusing aims in research and education in information systems. This type of research is very limited. The Centre for Living Information Systems Thinking at Brunel University, where the present research is based, has such an approach as its main research aim.

It is arguable that other work in computer systems, as distinct from information systems, is akin to an amethodological approach. For instance, the work on evolutionary systems by Bosman and Sol (1982), Lehman (1984), and Crinnion (1991) is outside the life cycle model paradigm. However, Bjorn-Anderson (cited in Hawgood, 1982) insightfully noted that even evolutionary systems are not optimisable because it is not possible to predict all environmental change.

Other work has concentrated on alternate conceptions of information systems. Pawson et al. (1995) explain an amethodological approach which makes use of object oriented



techniques. Another interesting development described by Kelly (1995) is “data warehousing” which provides users direct access to databases and enables them to process data according to their situational (organisational) needs.

## **2.4 Tailorable Computer Systems for Changing Systems Usage**

A systems development approach which uniquely considers users’ situational needs rather than meeting predetermined requirements is most prominent in tailorable computer systems designs. The reason for invoking tailorable systems as part of the conceptual context set out in this chapter is that such systems are not assumed to be final products, as is the case with the life cycle model approach. By final product is meant meeting systems requirements by eliciting them in some total or final sense from potential users, who themselves may not be aware of their needs. The life cycle model engenders the notion that information systems can be finalised in terms of systems specification, which is contrary to the research findings supporting this dissertation. As tailorable computer system designs do not seek this kind of finality they are considered in this section for their potential contribution.

### **2.4.1 Conceptual Clarification of Tailorable Computer Systems**

Tailorability in systems is well-expressed as the degree of control users have over the functionality and operation of computer systems. Functionality is concerned with the processes or algorithms used by systems to take given inputs and produce required outputs, and with the ability of users to change those algorithms though not directly. The operational aspect is concerned with how systems may be used once delivered and with the ability of users to change the delivered mode of operation.

Trigg et al. (1987) have enunciated an important principle for tailorable systems which is critical to the conceptual context of this dissertation. They assume that it is impossible for systems designers to capture all conceivably required systems functionality, and add significantly that designers should enable users to tailor systems interactively from within systems interfaces. Trigg et al. (1987) cite “diversity”, “fluidity”, and “ambiguity” as inhibitors to users knowing all potentially required functionality (user requirements); more recently, this has been confirmed by Kjær and Madsen (1995).

There are various and confusing terms used in the literature on tailorable computer systems which need to be clarified and differentiated. From this literature various classifications of tailorable computer systems have been derived and are presented in this section. Some of the classes of analysis adopted are distilled from the literature, but other classes have not been addressed by researchers. These classes, therefore, emerged as the signposts for future research directions.

The literature on tailorable computer systems is meagre and not easily identifiable. Consequently it is difficult to evaluate because various and diverse terms are used for similar concepts. To further confuse any searches, terms that have been used in one research paper to describe tailorable computer systems have also been used in another paper to describe computer systems that cannot be categorised as tailorable. The field of tailorable computer systems is relatively new to computer science, which partially explains the lack of clarity of terminology and definition. Research papers in the field have been variously presented at diverse academic conferences on: usability of computer systems, human-computer interaction (HCI), information systems, computer-supported co-operative work (CSCW) and information management, and have similarly been published in disparate journals. Researchers have been working independently in this field at universities and commercial organisations supporting serious research, but more literature has emerged from commercial research centres than academic ones.

The available literature has been categorised by the terminology used in Table 2:1 below and references in brackets that follow refer to the Table. The term tailorable systems is accurately used in some papers to describe computer systems that provide control over systems operation and functionality to users (Category A). The same term is found in research papers which do not deal with what would be normally associated with tailorable systems (Category B); these researchers use automated techniques such as programming by example, thereby developing computer systems which actually remove control from users.

Systems which automate recurring computer usage tasks are termed “adaptable” by some researchers, but they are more appropriately termed automatic systems (Category C), because they automate tasks associated with computer systems usage. The same term “adaptable” is used in other research papers to describe computer systems that are actually tailorable (Category A, in particular see Browne et al., 1990.) Some research papers interchangeably



use the terms “customisation” and “tailorability”, and of these papers, some do not deal with issues to do with tailorability while others do (Category D).

The field of tailorable computer systems is further confused with that of fully automatic systems (Categories E(i) and E(ii)). In these papers computer systems which are described as “adaptable”, a term also used to describe tailorable systems, are more appropriately termed semi-automatic and automatic adaptable systems. This is so because such computer systems remove increasing degrees of control from users and assign power to automatic knowledge-bases to determine systems states. Users of these computer systems, far from being freely able to use or tailor them, are driven to dysfunctional behaviours, disguising their true intentions when using these systems because of fear of being controlled by managers (see Wahlster and Kobsa 1989 for details). This happens because users are afraid of being monitored by knowledge-bases that learn from users’ use of systems, and users begin to fear that knowledge of their working styles would be used by organisational authorities against them. Such systems also leave users feeling a lack of control (see for example, Norico and Stanley 1989). Other systems exhibit characteristics of tailorability but are termed adaptable (Category F).

Edmonds (1981) originally suggested various mechanisms to enable systems adaptation. Since then, various routes of research have resulted in the types of systems shown in Table 2:1. For example, giving computer systems entire control over operations and functionality (Categories C and E(ii)); giving a system and its users joint control (Category B, D and E (i)); using knowledge-bases to adapt systems use (Category E (ii)); or allowing users to control systems (Category A).

The feature of user-control is prominent in research papers on tailorable systems (Category A). This feature provides control over systems functionality to users. This is not true of research papers in semi-automatic systems (category B) and automatic systems (category C). In this line of research the issue of user-control is not central. In fact, computer systems produced by these researchers actually remove control from users. This happens because these systems use automation to various degrees; some systems are semi-automatic whilst others are fully automatic and utilise knowledge-base technology.

Table 2:1: Categorisation of Research Papers by Terminology Used

| Category  | Terminology                         | User Control Features   | Indicative Papers  |
|-----------|-------------------------------------|---|--|
| A         | Tailorable computer systems         | Emphasis on users' control over a computer system's operation and functionality                                       | Stallman (1981)<br>Browne et al. (1990)<br>Hesketh (1992)<br>Dourish (1993)<br>Cypher (1991) |
| B         | Semi-automatic systems              | A computer system and users share control over its operation, but users have no control over a system's functionality |  |
| C         | Automatic systems                   | A computer system has all the control over its operation and functionality, users have no control                     | Lerner (1989)  |
| D         | Customisation                       | An users has some control over a systems' user-interface, but not its functionality                                   | Mackay (1991)  |
| E:<br>(i) | Adaptable system:<br>Semi-automatic | A computer system and users share control over a systems operation, but not its functionality                         | Edmonds (1981)   |
| (ii)      | Automatic                           | A computer system has entire control over its operation and functionality   | Browne et al. (1990)   |
| F         | Adaptable systems                   | Similar to tailorable systems, with emphasis on increasing users' control   | Edmonds (1981)<br>Lehman (1984)  |

Research papers on customisation (category D) do deal with the issue of user-control. However, user-control in this line of research is trivial in terms of designing tailorable systems, because the emphasis is on control over interface customisation which does not deliver control over systems functionality. Part of this critique is also true of research papers in category E, where researchers have designed changeable systems, but the changes or adaptations only occur at the discretion of systems themselves. Much of the research in Category E (ii) is of this nature and relies on artificial intelligence programming to achieve research aims. Research in Category E (i) is different, as it gives users a partial option to decide whether change observed by a system is required. This is done by the system providing the option to users of whether the adaptation should take place or not. The research in Category E relies heavily on conceptions of user models of human-computer interaction, which is not the case with research in tailorable systems. Wherever abstractions of user types are used, they are somewhat cursory in comparison (for example, see MacLean et al. 1990).

Papers on customisation (category D) do not distinguish between “tailorability” and “customisation”, interchangeably using these terms to mean allowing changes to the “look



and feel” of systems interfaces. Computer systems that solely offer customisable interfaces should not be considered tailorable systems, examples of which are presented in the next section.

### **2.4.2 Existing Tailorable Computer Systems**

The “Xerox Tailorable Buttons” system is appropriately described by MacLean et al. (1990) as a user tailorable system. The system was developed by devising simple models of users and utilising participatory design methods. Xerox Tailorable Buttons uses object oriented design and object implementation, and provided users with user-interfaces consisting of tailorable “Buttons”. The system was interfaced with email so that user-tailored systems functionality designs and implementations may be shared among users. MacLean et al (1990) state that users can tailor Xerox Buttons on different levels with different systems properties and systems consequences, ranging from simple windows customisation on a desktop interface, to complex user-programming using fifth generation languages.

Hesketh (1992) confirms that a system is tailorable only if it allows users to modify both its appearance and functionality. He mentions appearance as an important aspect of tailorable systems, meaning the user-interface and the control users have over it. However, the crucial differentiator in his concept compared to customisable systems is the ability of users to modify the functionality of tailorable systems. It is this control over systems functionality that is a critical issue in designing systems tailorability for living information systems and is developed as the concept of deferred systems design in Section 5.2. In short, any conception of systems tailorability in living information systems must include user control over systems functionality. Hesketh (1992) called his system “Pearly Buttons” to differentiate it from Xerox Buttons.

There are some interesting ideas concerning flexible software in the literature on tailorable computer systems that are relevant for thinking about living information systems. The field data interpretation in Chapter 5 provides scope for the application of these ideas to designing living information systems. Before considering those ideas in Section 2.6, it is necessary to elaborate the fixed point theorem of information systems development in the next section. A reading of the fixed point theorem of information systems development provided the stimulus for this research and led to the critical questioning of the life cycle

model to compose the conceptual context, and for examining the ideas in tailorable computer systems for their relevance to designing living information systems.

## 2.5 The Fixed Point Theorem of Information Systems Development

The mock fixed point theorem of information systems is a characterisation of methodologico-project frameworks, and states that:

*"There exists some point in time when everyone involved in the system knows what they want and agrees with everyone else."* (Paul, 1993)

The theorem's extension is:

*"The fixed point in the theorem remains fixed for the project duration."*  
(Paul, 1993)

The fixed point theorem of information systems is a mock theorem formulated to reveal fundamental flaws in methodologico-project frameworks. A postulated simplified scenario of using methodologico-project frameworks which gives rise to this theorem might be typified as follows: methodologies assume systems analysts can provide a detailed specification of required functionality in a proposed information system; analysts in turn depend on users to know what systems functionality is required and expect users to communicate that to them in detail to enable data modelling. Users will often want additional functionality or require changes to those already stated; such adjustments are difficult and costly to do within predetermined project completion times and within predetermined budgets, and often meet developers' resistance. Analysts are frequently unable to communicate with users or understand their positions, making the whole requirements analysis reasoning unmanageable, and resulting in information systems developments that often do not meet their users' changing needs.

This line of dependency on users in systems development, with its emphasis on formal approval of specifications as noted by Powers and Dickson (1973), rests uneasily on a fallacious premise of methodologico-project frameworks. This premise is that users are



capable of knowing what is required from a proposed information systems development and, more significantly, that they are able to articulate unequivocally that knowledge to analysts. An equally insupportable premise is that analysts are capable of understanding users' requirements which invariably are stated in business nomenclature unfamiliar to them. Empirical evidence to support these premises is not available. On the contrary, plenty of examples reveal such attempts remain unfulfilled and lead to incomplete systems specifications (therefore information systems) and disappointed users and analysts (see for example Mouakket et al., 1994).

Assuming information requirements can be *fully known* in advance and *defined*, it is arguable whether potential users of information systems can *agree* on what is required. In reality, such agreement is not possible, except in the form of the ubiquitous system "sign-off". Methodologico-project frameworks further implicitly assume that the system specification resulting from initial systems analysis is the *right* or *correct* one. In the concept of deferred systems design developed in Section 5.4.3 it is assumed that no business information systems can be evaluated as right or correct in absolute terms.

It is the aspect of pre-determination of user requirements, and all that it entails, that leads methodologico-project frameworks to be mocked as the fixed point theorem of information systems. Methodologico-project frameworks assume constancy of user information needs, and therefore result in once-and-for-all information systems "solutions" that have to function in dynamic organisational environments.

The fixed-point theorem of information systems serves two imperative purposes in informing the present research. One, the theorem provides the essential context for evaluating tailorable systems literature, acting as a check to ensure that only relevant material is filtered for constructing the concept of systems tailorability. Two, the theorem is the essential catalyst to inform the construction of systems tailorability in living information systems development by ensuring that systems tailorability is a step beyond the fixed-point theorem of information systems itself (see Section 6.4 for a detailed discussion of this point). Thus the fixed point theorem provides the necessary catalyst for thinking of alternates to the life cycle model approach to developing information systems. Rather than rely on methodological prescriptions, Paul (1993) has called for intelligent thinking as the basis of information systems research and development.

The alternative conception of information systems as tailorable is different from information systems conceived as a result of using the life cycle model. This is so because the notion of systems tailorability provides a conception of information systems development and operation in environments where knowledge of what is required is uncertain, possibly even non-existent. Consequently there is likely to be disagreement on what is required because of the uncertainty and lack of knowledge. Moreover, the notion of tailorable information systems explicitly acknowledges changes in information systems' environments. Given organisational change (for examples see the descriptions of the case organisations in Chapter 4 ) it is necessary to enable tailoring of information systems by systems professionals (termed macro-tailoring) and by users (termed micro-tailoring or user control). An analysis of the field data confirms the need for both kinds of systems tailoring (see Section 5.4.2 for the empirical basis of the concept of user control).

The fixed point theorem provides an idealisation of why not to think of information systems development and usage as methodology based processes. However, the amethodological approach is still developing and there is not much understanding of what constitutes the development of information systems using non-methodological approaches. The spiral of change model developed in Chapter 6 is a conceptual attempt to inform such approaches and the notion of tailorable modelling developed in Appendix I is a tentatively proposed practical approach.

The interpretive results of the present research increase our understanding of what is required in systems which do not succumb to the fixed point theorem. The set of concepts developed in Chapter 5 might be regarded as potential constituents of living information systems, and the principle of deferred system's design decisions also developed in Chapter 5 may be regarded as a general principle for designing living information systems. With the goal of avoiding the fixed point theorem, the next section revisits tailorable computer systems to assess whether ideas from such systems can be applicable to thinking of living information systems designs.

## **2.6 Proposing Tailorable Information Systems**

There are aspects of tailorable computer systems which can be drawn upon for developing living information systems. These aspects largely agree with the philosophy of regarding information systems as continuous processes rather than as products. The relevance of



tailorable computer systems to thinking of information systems as continuous processes or living is that ideas from these systems may be developed further to apply to business information systems which avoid requiring systems developers eliciting a complete set of requirements at the outset as is the case with the life cycle model. For example, implicit in the literature on tailorable computer systems is the view that users will have different needs in the future, needs which developers or users cannot possibly know at the time of systems development.

The relevance for living information systems lies in making systems adaptable or tailorable to facilitate such future unknown and variable needs, and in providing users control over systems functionality and subsequent operation of delivered systems. Such control can be exercised by users as they learn what is required. The work on tailorability is best exemplified by MacLean et al. (1990) who sought to design the Xerox Tailorable Buttons system, which could subsequently be tailored by users (see Section 2.4.2 for details). The system was designed for users who were not expert developers but normal office workers. To enable them to tailor the system, mechanisms called “Buttons” were provided in the user interface. Users are reported to have tailored the system to match varying personal and organisational needs as they arose.

Another relevant idea is that users can be analysts, designers and developers of their own systems. Although this idea is not explicit in the literature it is possible to make this assertion from the evidence of the working tailorable systems cited in the previous section (see also Malone et al.’s, 1995 experiments with a tailorable system). By allowing users to tailor systems, some of the responsibilities and power of systems analysts and programmers is shifted to users (see Section 6.4.1 for a further discussion of this idea).

The type of thinking outlined above is pertinent to designing living information systems. By accepting that it is not possible to establish a definitive set of user requirements at the outset, systems designers would need to develop information systems which can be adapted or tailored subsequently by users. Thus the notion of tailoring is relevant to information systems which cannot be completely specified or defined in advance, systems such as the proposed tailorable information systems.

### 2.6.1 Issues of Research Methodology

The literature on the life cycle model and tailorable computer systems has been examined to inform the research design for the present research. Maxwell (1996) states that one purpose of examining relevant literature in the field of research is to review the debate on research methodology. So issues concerning research epistemology, research methods, and data collection and analysis in the tailorable computer systems field are worth considering because they inform new research.

The interpretivist research epistemology was selected for doing the present research because it has not been used in tailorable computer systems research. (A detailed discussion of the relevance of interpretivism for living information systems research is provided in Section 3.2). The literature examined does not cite the use of interpretivism. It is thought that interpretivism is capable of providing insights which may not be possible by using positivism, which Galliers (1991) states assumes an objective ontology because it regards reality as existing independently of the researcher. Rather than search for an “objective truth” as required by positivism, the present research recognises the relative subjectivity of the social and organisational context in which information systems are developed and used. Interpretivism is founded on relative subjectivity which makes it suitable for the present research. (For a brief discussion of the shortcomings of positivism for information systems research see Galliers and Land, 1987.)

The tailorable computer systems literature reviewed has not used the case study research method. Rather it has concentrated on developing prototype systems (for examples of prototypes see Edmonds and Guest, 1978; Stallman 1981; Henderson 1986; Easterby 1987; Trigg et al., 1987; Gibbs 1989; MacLean et al., 1990; Hesketh, 1992; and Malone et al., 1995). It is thought that the case study method combined with interpretivism provides greater scope for understanding the subjective social reality of humans involved in information systems development and usage (see Section 3.5 for a detailed discussion of this point). So this combination of interpretivism and case study permits the researcher to consider the different meanings and understandings of social and organisational situations that individuals and groups attach to their actions during the development and usage of information systems.



## 2.7 Conclusions

The conceptual context which informs this research has thus been set. The life cycle model is the dominant approach to information systems development and usage, though in reality the life cycle model contains no reference to actual information systems usage. The life cycle model's suitability for information systems development in changing organisations has been questioned by researchers who propose an amethodological approach. The present research is informed by the living information systems amethodological approach, and uses the notion of tailorable information systems as being capable of catering for changing organisations. Tailorable information systems address some of the life cycle model problems, particularly concerning the efficacy of establishing a complete set of user requirements.

By regarding information systems as tailorable some of the systems development concerns epitomised in the fixed point theorem are addressed. The notion of tailorable information systems does not require a definitive set of user requirements to be pre-determined. Consequently there is no assumption that potential users know or are capable of knowing their systems requirements. If obverse logic is applied to the fixed point theorem it can then be regarded as an acknowledgement of this type of uncertainty and dynamism in information systems development and usage, and this present research is designed to investigate these issues further. The actual research design is discussed in the next chapter.

### **3. An Interpretivist Research Approach for Investigating the Changing Organisational and Social Context of Systems Development and Usage**

#### **3.1 Introduction**

Both quantitative and qualitative methods were used to do this research, but the whole research is essentially a qualitative inquiry which uses interpretivism as an epistemology. As noted by Bernstein (1983), social relativism accepts equally each individual's or group's perspective on a particular phenomenon. As information systems are a complex mixture of technical artefacts and social systems composed of individual and group perspectives, it is necessary to select an epistemology which is capable of investigating this complex mixture to provide a better understanding. This is possible with interpretivism which is founded on social relativism.

The purpose of this research design is not to produce a procedure which other researchers may use to replicate the interpretations reported in this dissertation. Research replication is not an issue in interpretivist research. Walsham (1993) observes that interpretivism does not produce correct or incorrect theories but rather leads to interesting, or less interesting observations of the phenomenon studied. As there are only degrees of interesting ways of viewing the phenomenon with interpretivism, there is no emphasis on producing a research design which establishes objective causal relationships. Rather, interpretivism as applied in this research is used to understand and explain the complex social processes of information systems development and usage. By facilitating the development of rich insights of the phenomenon, interpretivism enables the construction of concepts which increase our understanding of the phenomenon (see Chapters 5 and 6 for concepts which emerged from this research).

In the next section the relevance of interpretivism to living information systems research is discussed. In section 3.3, the issue of research triangulation is addressed, and consequently the appropriateness of suitable research methods is considered. A discussion of the data sources used for data collection is developed in Section 3.4. The use of case studies with interpretivism is discussed in Section 3.5 and consideration is given in Section 3.6 as to how



interpretivist research may be evaluated. The final section summarises the reasons for the research design.

### **3.2 Interpretivism and Living Information Systems Research**

Interpretivism is particularly suited for living information systems research because it facilitates the study of the social aspects of human behaviour. Human behaviour is essentially social in organisations. Individuals have to interact with other individuals or groups to complete organisational tasks or achieve objectives. This interaction consists of organisational actions and the meanings attached to those actions.

By regarding information systems as living entities the social context, as the environment of information systems, becomes a topic of study. A major aspect of this living information systems environment is the question whether users have the ability to know exactly what they want in terms of information from systems and to be able to predict future needs. The social context also consists of conflictual interests among individuals or groups, which lead to political or stakeholder groupings (see Rouhonen (1991) for a discussion on stakeholder analysis). All this constitutes a complex social and organisational environment in which information systems are developed and used. This organisational and social environment may also be thought of as living, being composed essentially of humans.

The purpose of researching this complex organisational and social context of information systems development and usage is to determine its composition and to understand it. By understanding its composition and understanding it, researchers can explain it in terms of information systems development and usage. An understanding can be gained by quantitative research, though its sole use would not enable making sense of the meanings of individual and group actions. This type of understanding can be facilitated by qualitative research which enables the formation of concepts of the meanings that humans attach to their organisational behaviour.

A relevant reason for using interpretivism is its facility for developing such concepts. Walsham (1995) states that concept building is a relevant aspect of research, and that interpretive research leads to “rich insights” which provide relevance for gaining knowledge. Regarding information systems as living entities is a developing view in information systems research, and to enhance this development there is a need for supportive concepts. Such

concepts can be constructed by using interpretivism, and such concepts provide a focus for our thinking.

In contrasting positivist quantitative research with interpretivism, Nissen et al., (1991) observe that while quantitative research produces masses of statistical data, such an inquiry does not produce knowledge to progress information systems and, more critically, that the knowledge it produces is not always relevant. Interpretivism, which is essentially a qualitative inquiry, produces knowledge of relevance to understanding and explaining information systems in organisations. One aspect of relevance is the building of pertinent concepts to inform thinking in the field. Such conceptual frameworks may inform subsequent practice in living information systems designs.

There are other attributes of interpretivism that suit living information systems research. In interpretivism the researcher is not separated from the subject of research. The data is interpreted from the researcher's point of view, allowing the researcher's experiential data to be used (see Section 3.4 for a discussion on experiential data). These aspects of interpretivism suit living information systems research because the researcher is part of the complex social information systems environment being studied. So in interpretivism there is no emphasis on "objective" reporting of data as in positivism, or reporting data from participants' points of view as in ethnographic research as stated by Cavaye (1996). The data from the research is presented as interpreted by the researcher.

Unlike positivism with its hypotheses formulation there are no *a priori* constructs in interpretivist research designs. Cavaye (1996) states that interpretivism allows constructs to emerge whilst the researcher is in the field learning about and trying to understand the phenomenon. This type of emergence of constructs or concepts in the field is checked by using research triangulation to ensure validity.

The non-separation of the researcher from the object of study which allows the use of experiential data and the emergence of concepts are the foundations of forming what Walsham (1995) calls "rich insights" on the phenomenon being studied. By rich insights is meant the contribution of knowledge of significance or relevance, such as Zuboff's (1988) concept of "informate". By using interpretivism it is possible to work towards establishing such relevant knowledge in living information systems research.

The combination of interpretivism and the case study research method (which is discussed in Section 3.5) are particularly suited to investigating the answers to the questions set for this



research. The research questions concerning how information systems are developed and used in organisations were formulated to increase our understanding of information systems (see Section 1.4 for details of the research questions). Interpretivism applied through the case study method helps to focus the investigation of these questions and gives guidance on how to conduct it. Given the social and organisational context of the development and usage of information systems, interpretivism applied through case study is considered suitable for conducting the research. The general research questions concerning how information systems are developed and used were particularised in each of the cases studied (See Chapter 4 for details of the cases). By particularisation is meant investigating the research questions in the individual context of each case organisation.

### **3.3 Research Methods for Investigating Organisational and Social Processes**

The data was collected through a combination of quantitative and qualitative methods. A questionnaire was designed to survey initially the selected cases. This survey constituted the first phase of the research, which was exploratory and which aimed to gather descriptions of particular information systems and their environment in the case organisations. The purpose of the questionnaire was to survey the scene of information systems development and usage in the case organisations by reaching a wide spectrum of users. It was necessary to do this to gain an initial understanding of the cases and to use that understanding to inform the second phase of semi-structured interviews. The questionnaire was designed on the basis of information gleaned from readings of the relevant literature, some of which is cited in Chapter 2. Certain aspects of the questionnaire were informed by the experience and understanding of the researcher (see Section 3.4 for a discussion on using the researcher's experiences in qualitative research).

Once the questionnaire was designed it was piloted to assess its efficacy. The piloting helped remove any ambiguity in the set questions, ambiguities arising from differences in perceptions of the researcher and respondents, or culture or language used. The piloting also helped to decide the order in which the questions should be asked and whether, as a result of analysing the pilot data, other questions were needed.

The form of semi-structured interviews was used. While the questionnaire provided quantitative data on information systems usage patterns, it could not provide data on what

users thought or understood about the information systems they used. Semi-structured interviews were used to collect and understand the meanings and understandings which individuals and groups attach to their actions concerning information systems. The semi-structured format was used to allow interaction between the researcher and interviewees, and to enable interviewees to take the interview into areas that concerned them most (see Appendices E and F for details of the interview questions and interviewees respectively). The interviews were conducted at the case study sites in the offices of the interviewees to gain their confidence, and to set the meanings of the statements in the proper organisational context.

### **3.3.1 Triangulating Organisational and Social Sources of Data**

To reduce threats to the proposed explanations of the research data, it is necessary to ensure the veracity of the data collection process itself. By so doing, the validity of the proposed arguments based on the collected data is checked. So a necessary consideration when designing the research is ensuring the validity of the collected data.

The seminal work by Denzin (1978) provides us with the concept of research triangulation to check the validity of collected data. The purpose of research triangulation is to check the consistency of the data collected by one method against the data collected by one or more other methods. By collecting data through multiple methods and comparing it, any inconsistencies or contradictions can be addressed, thereby enhancing the validity of data collection procedures. In positive terms, research triangulation may produce data which confirms the other data sources, thereby strengthening the validity of the data already collected.

Jick (1979) explains that the triangulation metaphor is borrowed from navigation and military strategy, where multiple viewpoints are taken to locate an object's exact location. He argues that organisational researchers can similarly take multiple perspectives by collecting different kinds of data, and he concludes that by doing so researchers can improve their explanations of what is happening in the phenomenon being studied.

To ensure the validity of data collection procedures, this research used multiple forms of research triangulation. As noted above, a questionnaire was distributed to survey users' patterns of information systems usage. Semi-structured interviews were then used to further explore those patterns to gain a deeper understanding and to understand information systems



development itself. Depending on accessibility, systems documentation and other papers associated with systems were examined to form rounded views. Thus the internal consistency of the data was checked by the use of these multiple data collection methods.

An additional source of research triangulation was provided by the use of multiple cases. While the internal consistency of the data collected was checked by the various data collection methods, the data's overall consistency was checked by comparing data across case sites. Orlikowski (1993) similarly checked data across sites to confirm its validity in her interpretive study of CASE tools. This type of cross-site triangulation is necessary to increase the validity and value of concept formation and theoretical explanations proposed in Chapters 5 and 6 respectively. This is because the developed concepts and theoretical explanations purport to be analytic generalisations, which can be used to design living information systems through systems tailorability (see Section 6.3 for a further explanation of analytic generalisation.)

### **3.4 Identifying Data Sources for Information Systems Development and Usage**

To answer the proposed research questions and to ensure research triangulation, data on information systems development and usage needed to be collected from the various relevant sources in the case organisations. This required identifying data sources, which is now discussed in this section.

Maxwell (1996) observes that separating research from the researcher's "experiential data" cuts off a major source of insight, hypotheses, and validity checks. This type of experiential data is necessary and relevant to interpretivist research design. This is especially so because as detailed in Section 3.6, data analysis in interpretivist research consists of the researcher's interpretations of the data. So the research data is explained in the form of the researcher's interpretations. These interpretations are necessarily partly dependent on the researcher's own subjective experiences. For these reasons experiential data is an important data source, and it is used in this research.

Experiential data is used as a valuable data source in the University of Luton case organisation, where the researcher was employed at the time of doing the research. Being a member of the studied case organisation enabled the researcher to observe the organisational and social context of information systems development and usage as a real participant. Such

closeness to the studied phenomenon was valuable in terms of the insights and understanding it provided. This type of experiential data collection is termed “participatory observer” by Maxwell (1996).

The main sources of data were the systems developers and users themselves in the case organisations. The questionnaire survey was directed at users only, and the semi-structured interviews were undertaken with managers and administrators who used the information systems in the studied organisations, as well as with systems developers. Among the systems developers interviewed were systems managers, systems administrators and programmers. Systems developers were selected for interviews because of their important and influential role in information systems development (for details on interviewee selection see Appendix F).

Information systems users were considered an important source of data. To attempt to understand and meet the type of ontological information systems designs discussed in Section 1.2, it is necessary to understand users’ perceptions of information systems. This is necessary because ontological designing requires a knowledge of information systems users who are a significant and major part of what we understand as information systems. The purpose of interviewing users was to understand the subjective meanings they attached to information systems usage. This type of understanding can be used to inform better designs.

An additional source of data was systems documentation and other associated papers related to the studied information systems. Reference to these documents was considered necessary to cross-check some data from the questionnaire and to corroborate some interview data. The documents accessed depended on authority given. The documents examined ranged from original systems specifications to formal requests for amendments to systems functionality to provide new information outputs.

### **3.5 Case Study: Its Relevance for Interpretivist Living Information Systems Investigations**

Walsham (1995) observes that interpretivism as yet does not have its own research methods. Consequently, the question of how interpretivism should be applied arises. The answer ironically is to use the case study research method which has traditionally been used widely in positivist research. The case study method is particularly relevant to living information systems research because living information systems thinking is in its formative



stages. Roethlisberger (in Jacoby, 1995) states that case study based research is appropriate when research and theory are in their early stages as in living information systems research.

The case study method was selected for this study for several reasons. To study the research questions set out in Section 1.4, it is necessary to investigate the development and usage of information systems in real organisational and social contexts. These contexts can only be provided by actual business organisations. Walsham (1995) and Orlikowski and Baroudi (1991) state that the case study method for interpretivist research enables exploration of meanings and understandings which individuals and groups give to their actions or behaviour. In studying the development and usage of information systems, it is necessary to know what these meanings and understandings are for users and systems professionals.

In qualitative research where case studies are widely used, the particular outcomes of a case study are not necessarily generalisable to other cases. This feature of the case study method suites interpretivist research too. Interpretive case study outcomes are not meant to be generalised to all cases. This is particularly relevant in living information systems research, because living information systems are considered to be unique to each organisation. Case study generalisations as in positivist research should not be confused with “analytic generalisations”, which Orlikowski (1993) states are the outcome of interpretivist research (see Section 6.1 for further discussion of analytic generalisations).

The value of analytic generalisations is increased when multiple cases are used. Multiple cases provide multiple perspectives of the phenomenon and enable comparison or cross-sectional analysis. The strength of the consequent analytic generalisations is increased by addressing any inconsistencies or contradictions encountered in cross-sectional data analysis. Four case organisations were used for this research to strengthen the validity of the analytic generalisations drawn in Chapter 6.

The use of a case study also enables the capturing of the real situation and finer details of the context of the study. In terms of the present research, this means examining the actual events, or individuals’ and groups’ perceptions of the events related to systems development and usage. The circumstances surrounding these events can also be studied, because the phenomenon is studied in its real environment. The attribute of being able to study circumstances and environment is significant for this research because it has identified organisational change as a major factor in information systems development and usage.

A large number of variables and different aspects of the phenomenon can be studied by using a case study. Some of these variables may not have been envisaged in the research design. This aspect of case study research is particularly relevant for organisational and social processes, where unpredictable variables may be encountered and which need to be recorded. Maxwell (1996) states that the actual research process is often different from the research design. For these reasons it is necessary to discuss the actual research process as will be demonstrated in the next chapter.

An important attribute of a case study suitable to interpretivism is its facility to develop and refine concepts. Concepts provide a framework for guiding practice, and in particular may be studied further after the research is completed.

There are certain other features of the case study method which complement the interpretivist epistemology. Cavaye (1996) states that the case study method does not explicitly control or manipulate variables and that it studies a phenomenon in its actual context. He further adds that such a study aims at an in-depth understanding of the context of the phenomenon being studied, and that this leads to a contribution to knowledge by relating findings to generalisable theory. Orlikowski (1993) states that the combination of interpretivism and case study enables “discovery” which is part of any interpretive investigation. Both Cavaye’s (1996) and Orlikowski’s (1993) observations are considered suitable to understand and interpret empirically Paul’s (1993) concept of “living systems” and to discover concepts relevant to living information systems designs.

The inability of case study outcomes to be generalised statistically to the population is often stated as a weakness of its use. Statistical generalisation is not the aim of this research, so this relative weakness poses no real obstacle to using the case study method in this research. On the contrary, the benefits of using the case study method outlined above outweigh the shortcomings, as discussed in the next section. The combination of interpretivism and case study is used because of its complementarity.

This research used four case studies. The first case was a preliminary study to develop initial thinking and to pilot the survey questionnaire, and to conduct exploratory interviews. The feedback from this case study was used to improve the questionnaire and interview designs to apply to the other cases. The use of the other case studies is explained in Chapter 4.



### **3.5.1 Issues of Data Analysis: Generating Valid Interpretive Explanations of Information Systems Development and Usage**

Issues concerning data analysis design are discussed in this subsection. In particular, how collected data is analysed is an important consideration. Data analysis design is critical because the answers to the research questions are the outcome of data analysis. The “answers” in interpretivism are of course the interpretive explanations offered by the researcher. However, it is important to ensure that these explanations are valid. Therefore it is necessary to place appropriate emphasis on how collected data will be analysed to generate valid interpretive explanations. This issue is addressed in this section.

In qualitative research generally, an important element of the data analysis strategy is to analyse the data during the research process rather than as a whole at the end of its completion. This approach is applicable to interpretive research too because it enables the interpreted data to be checked for validness, and where necessary to revise the interpretations.

There are no definite rules for data analysis in interpretive research. Walsham (1995) who is a leading interpretive researcher, offers the following guidelines. He suggests that data analysis should consist of stating how the field interviews and other data were recorded, and explaining how the data was analysed, and explaining too how the data leads to the proposed theoretical explanation. He considers this to be the interpretive data analysis process. These issues form a part of the present research design, and other aspects became clearer during the actual research process. These aspects are appropriately dealt with in Chapter 4 where the implementation of the research design is discussed.

A valuable aspect of checking the interpretations arising from the data analysis is to consider alternate or competing explanations. This strategy would help prevent self-fulfilling prophecies. This issue of alternative explanations is considered more later when the validity of explanations of the research data is discussed.

Giving appropriate consideration to both research methods and data collection and analysis does not in itself ensure the validity of the findings. Maxwell (1996) concurs by stating that the validity of the arguments arising from the research cannot result from the use of sound research techniques alone. He argues that validity has to also be assessed in relationship to the purpose and circumstances of the research. He states that validity is not context independent, assessable solely by examining research methods or conclusions. This is

indeed is the case with interpretivist research, and is especially so because the data is analysed from the researcher's perspective as discussed in the following section.

Therefore the researcher's role in interpretivist research needs to be closely considered. Walsham (1995) states that the role of the researcher in interpretive data analysis is to draw interpretations of the data from the studied phenomenon. The validity of these interpretations *per se* cannot be assessed in any objective manner. Though to avoid invalid research, Walsham (1995) recommends clearly explaining how the data is analysed. By showing the paths of data analysis, the logic of interpretation used by the researcher can be followed. This role of the researcher contrasts with positivist researchers who seek to report objectively their investigations, and it also contrasts with action researchers who seek to make a positive influence on the phenomenon being studied.

The kind of research design discussed above has been used by other researchers. For example, Cavaye (1996) cites a number of researchers who have applied the interpretivist epistemology through the use of case study to investigate information systems. The present research design is informed by their research.

### **3.6 Evaluating Interpretivist Research**

Cavaye's (1996) criteria of evaluating interpretivist research to report the findings of the research have been used in this dissertation. He notes that interpretivist research is assessed by evaluating the researcher's interpretations of the data. The three evaluatory criteria consist of assessing the logic, subjectivity and adequacy of the study. These criteria are briefly considered in this section, and they have been applied in Chapters 5 and 6 where the research data had been interpreted.

The researcher's interpretation itself must be logical and consistent with the principles of logic. This does not mean the application of formal logic, but rather the observance of clear reasoning. The arguments of the interpretation must be consistent and clearly stated.

The subjectivity criterion evaluates whether the meanings and understandings of the individuals and groups participating in the research are reflected in the researcher's interpretation. This criterion needs to be applied carefully to evaluate interpretive research. Though the meanings and understanding of subjects is a necessary part of the researcher's interpretation, as Walsham (1995) states it is the researcher's interpretation of other people's interpretation that is being reported.



The adequacy criterion is used to examine whether the researcher's interpretation has grasped and explained the rationale behind observed actions and processes. The interpretation should explain the research participants' reports of the phenomenon being studied and provide a logical explanation of what is thought to be happening.

To qualify Cavaye's (1996) three criteria explained above, Walsham's (1993) comments regarding evaluating interpretivist research are invoked. Walsham (1993) explains that "correctness" is not an evaluative criterion in interpretivism. As interpretivism accepts a social relativist ontology, where multiple perspectives of the same phenomenon are possible and equally valid, there cannot be a single correct perspective. Instead, the evaluation should judge whether anything of interest is being added by the research to the body of knowledge in the field. Even this is not an absolute measure, as varying degrees of interesting contributions are possible.

### **3.7 Conclusions**

The overall purpose of the research design detailed in this chapter is to enable the formation of concepts and theory to explain information systems development and usage. To pursue this purpose, the application of the interpretivist epistemology through the case study research method to the phenomenon of information systems is considered appropriate, and both quantitative and qualitative data collection is designed into the research. Concept development and theoretical explanation, which are the interpretations of the research, is facilitated in the research design by using interpretive data analysis.

This research design is aimed at increasing our understanding of the social and organisational context in which information systems are developed and used. The design aims to understand the social context in which individuals and groups in organisations do their work and the influence that this context has on their behaviour regarding information systems development and usage. Moreover, the design enables the examination and understanding of the processes by which events and actions regarding information systems development and usage take place. The design of the case study into the research approach also facilitates the study of unanticipated phenomena and influences operating in the organisational and social context. This is possible because of the flexibility of addressing new issues as they arise that a case study allows.

Though the broad outlines of the research were clear during the research design and have been discussed in this chapter, the details emerged during the actual research. As Maxwell (1996) states, qualitative research is interactive and inductive. So the questionnaire survey was implemented first, and it provided material that was explored further in semi-structured interviews. The research questions themselves crystallised after the early returns from the questionnaire survey. These events are consistent with Maxwell's (1996) view that specific questions of interest for researching are the result of an interactive research design process, rather than being the starting point for that process. The actual organisations in which the research design unfolded as a process are discussed in the next chapter.



## **4. Information Systems Development and Usage in Changing Organisations**

### **4.1 Introduction**

This dissertation is based on research conducted in four case organisations. The research questions concerning the development and use of information systems were investigated in actual business companies and higher education institutions by using the research design discussed in the previous chapter as a guide for investigation. The particular case organisations were selected for the investigation because in different forms they present characterisations of organisational change. Most change in organisational objectives, policies or procedures affects the development and use of information systems in an organisation. The investigation focused on how such organisational change affects information systems. Two of the case organisations, Datatel Corporation and Ace Business Computers, are commercial companies which have to change their business practices to suit market needs. The University of Luton and Nene College of Higher Education are institutions of higher education which have been changing radically in the recent past to comply with government legislation which has introduced competition within the higher education sector.

The prime reason for selecting these case organisations is that most of their transactions or data are collected and processed using information technology. The use of information in the case organisations is facilitated by various types of computer systems, ranging from mainframe systems to networked micro-computers systems, and from in-house developed information systems to bespoke systems and use of software packages to develop information systems. As these case organisations use computer-based information systems they are suitable cases for the purposes of the present study.

The case organisations described in this chapter were also selected because of their appropriateness for studying the development and use of computer-based information systems. All the case organisations normally use information for managerial and administrative purposes. The information generated in the case organisations is used by middle and senior management to make decisions regarding resource deployment, financial

and management accounting, and strategy formulation. Information is also used by these case organisations to help with sales, administration and operational matters. All the selected case organisations are therefore involved in collecting and processing transactions to provide information to those who need it to make decisions. The use of multiple cases also provided the ability to compare and contrast data across organisations. By choosing the four cases the ability to compare data is increased, and thereby increasing the validity of the eventual data interpretation.

The use of information systems varied in the four cases. For all the case organisations the problem is not how to define information systems and then simply developing information systems using a systems development methodology. Rather the problem is one of changing organisational objectives, changing management and administration and the effect that this has on conceptions of and development and use of information systems. In brief, the problem is changing (living) organisations. It is possible to regard changing organisations as ill-defined organisations, and to argue for better definitions of organisations to enable definitive determination of information systems requirements. This kind of argument would be misconceived because it fails to recognise that change is a central feature of organisational life. Where organisations' objectives and administrative procedures change, it is not possible to define information systems. The two higher education case organisations are better regarded as networked organisations, where professionals from different departments come together on a changing basis to achieve specific temporary purposes and then disband. For this kind of ad-hoc working together it is not possible to define information systems requirements. The real problem in the case organisations is how to develop and use information technology in a changing environment. The suitability of the case organisations to the present study is depicted in Table 4:1, which is referred to in the sections later in the chapter.

To set the scene, descriptions of Datatel Corporation, University of Luton, Nene College of Higher Education, and Ace Business Computers are provided in sections 4.2, 4.3, 4.4 and 4.5 respectively. Some contextual description of each case is provided in these sections to explain how the case suits the purposes of the research. Section 4.6 discusses the actual research process applied in the case organisations by detailing the length of the research in each case organisation. Issues concerning the participants in the investigation, their profile, collection of data and its recording, the strategy used to access data and the identification of



sources of data is discussed in Section 4.7. That section also discusses issues concerning the validity of the whole data gathering process. Section 4.8 explains the need for data analysis during the actual research and Section 4.9 critically examines the limitations of the research methods used. In the final section concluding remarks are drawn.

Table 4:1: Suitability of the Case Organisations for Researching Dynamic Information Systems

|                                    | Environments        |                     |                                  |                        |
|------------------------------------|---------------------|---------------------|----------------------------------|------------------------|
|                                    | Datatel Corporation | University of Luton | Nene College of Higher Education | Ace Business Computers |
| Presence of Organisational Change  | Yes                 | Yes                 | Yes                              | Yes                    |
| Development of Information Systems | Yes                 | Yes                 | Yes                              | No                     |
| Use of Information Systems         | Yes                 | Yes                 | Yes                              | Yes                    |

The following four sections provide the contextual details of the case organisations. Brief descriptions of these case organisations and their markets and business concerns will serve to provide the context in which the study was conducted and set the backdrop. In each of the following four sections, after providing a description of the case organisation, its relevance to the research is discussed. Then a discussion of the organisational issues concerning the use of information technology is presented, issues which determine the way in which the particular case organisations use information technology for developing of information systems and the provision of information. This is followed by a description of the department or its equivalent which is charged with applying information technology to business operations. Finally, a description of a major information system within the case organisation is presented and the organisational issues affecting it are discussed. It is with reference to these particular information systems in each of the case organisations that the investigation was conducted.

## 4.2 Case 1: Datatel Corporation

This section present the Datatel Corporation case organisation. Some background to the case is provided and in Section 4.2.1 the changes affecting the case organisations are discussed. Section 4.2.2 is a discussion on how the organisation perceives the use of information technology in its business operations. In Section 4.2.3 the role of the

Management Information Systems Department is discussed. The effect of organisational change on the development and usage of a particular example information system the Field Engineering Management Information systems is discussed in Section 4.2.4.

The Datatel Corporation first began operating in the United Kingdom in the early seventies from its base in Texas, USA by appointing a local distributor for its products. The company's products may be categorised into three specific market activities concerning digital networking, office automation, and telecommunications. The company is recognised in the industry as a pioneer in local area network technology and markets the successful ARCNET which is a sophisticated modular local area network. Recently, the company has developed its ability to deliver software solutions to clients through its subsidiary called Datatel Direct.

Datatel Corporation also provides an operating system called Resource Management System (RMS), which it sells to its customers and which it uses itself. The RMS system is a multi-tasking and multi-user local area network which is compatible with all of Datatel Corporation's products, enabling the migration of software from smaller installations to larger systems, without any need for software or hardware adjustments. Datatel Corporation also produces the 7950, 7800, and 7700 micro-processors which are assembled and sold as micro-computers, though hardware production is now being curtailed because of lack of demand.

Five years ago the parent company in America was bought by a private investor, and while the US parent company was significantly restructured, its UK subsidiary has not been as adversely affected as its parent in the U.S.A. Datatel Corporation's market ranges from large national international telecommunication companies to medium sized businesses in need of network systems and telecommunications equipment or bespoke software. The company has sold its products to over 40,000 customers world-wide and installed over 8,000 networks. The company's customers are from the financial, health, pharmaceuticals, manufacturing and government sectors of the economy.

Datatel Corporation has been recently affected by fluctuations in the economy because of its reliance on contracts with large national companies, who themselves are directly affected by economic swings. At present the company is experiencing a downturn in sales, and it is confronting a large staff turnover, especially in the sales department. Datatel Corporation is concerned about its survival because of the recent downturn in sales and it has been



rationalising its operations wherever possible. Despite this concern, the company is confident it will survive its recent sales depression.

Given the changes in the market, the next section examines organisational change and its effect on information systems. Section 4.2.2 considers the role of information technology in the changing environment that the organisation finds itself in and Section 4.2.3 provides a brief description of the management information system department. An example of one of Datatel's information systems affected by organisational change is discussed in Section 4.2.4.

### **4.2.1 A Market Induced Organisational Change**

The Datatel Corporation presents a suitable case in which the study of how both external and internal change effects the development and use of information systems. As Table 4:1 above shows, Datatel Corporation is suitable as a case organisation because it meets all the three criteria necessary for undertaking the present investigation into how information systems are developed and used. One criteria is that the organisation should be experiencing or recently have experienced business change. Secondly, that the organisation should be involved in developing information systems. Thirdly, that the organisation should be using in-house developed systems, bespoke systems or industry standard information systems. The Datatel Corporation meets all three criteria.

Datatel Corporation is experiencing much organisational change. Until recently the company may be characterised as an hardware manufacturing company or product led. The company concentrated on discovering and making new computer and network systems involving both hardware and software and then vigorously marketing them.

Datatel Corporation is addressing how to keep operations going in the changing and increasingly competitive marketplace. The company's domination of the telecommunications network market has subsided, and it is having to explore new business opportunities. The changes in the company's external environment have affected its objectives and therefore its internal operations. Such changes have had an effect on the use of information systems. For example, as a result of a slump in sales of hardware products the company has made field engineering one of its priorities and so the Field Engineering Management Information Systems (FEMIS) has had to be amended (see Section 4.2.4 for details on FEMIS). There has been recent departmental reorganisation which has led to reduction in the size of its payroll, and as a result of that the normally buoyant culture of the company has changed, and staff

morale has been eroded. Some of the cause for the reduction in staff levels and low staff morale is the recent acquisition of the company's parent in the USA.

The company has had to react to tougher competition from rivals in the sector. To plan for the changing marketplace the company has made field engineering service a renewed objective. The company has also decided to develop its ability to provide software solutions through consultancy to its customers and to reduce and, in some cases, discontinue its hardware production. Datatel Direct has been established to deal with systems development consultancy.

Datatel Corporation was selected because it is experiencing a period of major change in its core operations. The company has had to move from being a supplier of telesales telecommunications hardware to a provider of software solutions because of its inability to compete in its historical market. This move has caused restructuring in the company's organisation and resulted in reduced staffing levels. This changing environment has had an affect on the role of information technology in the company.

#### **4.2.2 Gaining Value from Information Technology**

The use of information technology in the Datatel Corporation is now increasingly guided by certain business related issues and policies. Both the functional departments who want to make use of information technology and the Management Information Systems Department have to justify the investment in information technology for information systems purposes by reference to one or more of the company's four guiding policies.

The first policy is that any proposed investment should lead to a reduction in operating costs, and that submitted proposals should clearly show where the actual reductions in costs will occur. The second policy is that any proposed investment should lead to improvements in the efficiency of work practice. Therefore, any work processes or procedures affected by the proposed investment must demonstrably be improved, showing improvements in time savings, use of human resources or other recognised improvements. The third policy is that any proposed investment should demonstrate improvements in support for customer support systems such as the Field Engineering Management Information System discussed in Section 4.2.4 or development of other operational systems that contribute to improving customer support. The fourth policy is that investments should lead to the spread of electronic communications within the company. Already, the company makes extensive use of



electronic mail for communication among parties in systems development projects. Lately, developments have focused on the intranet to improve and increase electronic communications.

### **4.2.3 The Management Information Systems Department**

In contrast to Ace Business Computers discussed later, the Datatel Corporation has a formal systems department called Management Information Systems. This section describes the role of the Management Information Systems Department in the case organisation, its functions, and its systems development practice. Although the directorial responsibility for this Department rests with the Finance Director, the Department has its own specialist information technology manager. The Department manager has a long history of systems development and has been the Head since 1989. The Department has to develop information systems in the changing organisational circumstances described earlier. This has also meant that the Department has had to refocus its energies from providing both hardware and software solutions to its external clients to concentrating on software solutions through its subsidiary Datatel Direct.

The Department has a significant role in the company as it provides other functional departments with computer-based information systems which support the achievement of their departmental objectives. All the systems needs of the other departments are accommodated by the Management Information Systems Department. The Department has developed dedicated systems over the past twenty years, and as the needs of user departments change the provided systems have been accordingly changed, either through new systems developments or through enhancing existing systems.

The Department consists of the two divisions of systems development and systems operations. The systems development section is composed of a development manager, project managers, systems analysts, and programmers, and is supported by staff working on temporary contracts. The operations section is composed of an operations manager, systems engineers, and two systems operators.

The Department makes use of the standard Structured Systems Analysis and Development Methodology (SSADM 4) for systems development. The systems development methodology can be adapted to suit particular organisational environments, and the Management Information Systems Department do so from time to time. However, even the

adapted version of the methodology is not strictly adhered to during systems development because of the work practices of systems people (see Section 4.2.4 for further details) and because of the need to accommodate organisational change during systems development.

Some of the practical difficulties encountered by the Department when using SSADM concern the areas of planning and systems design. Though project plans are made they are difficult to adhere to because of changes in available resources such as the availability of expert programmers or reassignment of project leaders. Project plans are often changed because new systems tasks are identified which were not apparent during the planning phase. The same changing environment is encountered by systems designers. Potential users are likely to change their minds regarding required systems functionality, or they are simply unaware of what is required.

Systems developers do not adhere strictly to a design method but prefer to freely consult with users. This practice is part of the systems development culture at the Datatel Corporation, as many of the systems developers have migrated from other functional areas of the business. In this sense, systems design is an interactive process at Datatel Corporation, where consultation continuously happens between developers and users, often informally because of their familiarity with each other. The systems development culture is based on personal familiarity between developers and users who have established relationships over many years of working together. This culture of familiarity prevails in systems development, and is strengthened by the fact that some systems programmers and project managers have moved from functional areas of the business into systems development. These developers have brought with them the familiarity of working in other departments.

The Department manages various database systems. These database systems form the core of the information systems that support the company's operations and are critical to those operations. These systems are:

- InfoCalls Database System
- Quality Management System
- Purchase and Nominal System
- Sales Order Processing System
- Field Engineering Management Information System
- Customer Prospect System
- Sales Forecasting System



- Units Database System
- Spares Database System

Datatel Corporation uses various computer-based systems, some of which are technical network systems. The main customer oriented business system that Datatel Corporation uses is called the Field Engineering Management Information System (FEMIS). The FEMIS system processes financial and engineering logistics data. The company's sales are processed on the FEMIS system for accounting purposes, and its field engineering sales data is also processed on the same system. The system is currently the focus of attention because of its importance in supporting engineering sales contracts generation.

In addition, the Department provides services normally associated with the application of information technology in business. Some of the more important services include:

- a) Problem Solving.** Business problems which require information technology, either hardware or software, are addressed by the Department. Project managers and systems analysts are actively involved with other functional departments to help them recognise business problems which might benefit from the application of information technology. The Department also addresses organisational issues in terms of surfacing procedural or systems problems which require analysis.
- b) Development of Systems.** Company wide or core systems approved by the Board of Directors are developed by the Management Information Systems Department. These systems require much systems analysis effort and appropriate technical development skills. The systems listed in bullet form above fall into this category. These systems are developed in consultation with user departments to meet specific business requirements.
- c) Modification of Existing Systems.** The Management Information Systems Department makes alterations to existing systems as users' needs for information changes. The Department is responsible for maintaining an acceptable standard of hardware and systems performance, which is especially important when data processing volumes increase.
- d) Training.** The Management Information Systems Department is responsible for training employees to use developed systems, and to train new employees to use existing systems.
- e) Installation of Equipment and Support.** The Management Information Systems Department is responsible for setting up all hardware and software for users. All the company-wide digital networks are also set up and maintained by the Department. The Department also provides operations support in cases where users are unable to resolve the

problems themselves. This kind of support is available for both systems developed in-house and industry standard systems such as Microsoft products or other software houses' products.

#### **4.2.4 An Example Application: Field Engineering Management Information System**

Given the recent external changes in Datatel Corporation's market conditions, the company has decided to generate extra sales by securing field engineering contracts. These contracts are for repairing and maintaining systems that Datatel Corporation has sold to its customers. The company's decision to focus on this area has had an effect on the further development and use of the Field Engineering Management Information System (FEMIS). This section briefly describes the development and use of FEMIS.

The Field Engineering Control Centre is Datatel Corporation's hub for direct contact with its customers. The Centre processes the records of all systems fault calls that are undertaken by the Field Engineering Offices spread around the United Kingdom. When the Centre was first set up in the early days of the company all the fault calls were processed manually. The increase in the volume of fault calls resulting from an enlarged customer base necessitated an automated approach. Consequently, the computer-based Field Engineering Management Information System (FEMIS) was developed. FEMIS is now used to process all customer fault calls. The development of FEMIS is thought to produce a much higher level of profitability in the field engineering operations of the company. The FEMIS system has been enhanced to provide this kind of customer-oriented information because reports from FEMIS were being re-keyed by sales and engineering people onto their own portables for analysis. FEMIS now provides the field sales and engineering force with a customised operationally based reporting tool, which gives customers the statistical reports they want.

FEMIS was developed and is keenly maintained because of the high level of competition in field engineering. A project manager commented that the business has to react speedily to customer calls to remain competitive, and that FEMIS is continually changed to maintain a competitive edge over the company's rivals who are also bidding for maintenance contracts. For instance, some customers may want to change the information provided on repair tracking reports, and to satisfy that need FEMIS has to be amended and is now able to provide the required customised reports.



The actual development of FEMIS, and other in-house systems, consists of reference to an adapted version of the Structured Systems Analysis and Development Methodology (SSADM, v.4). The actual development of FEMIS consisted of “loose” reference to the adapted Structured Systems Analysis and Development Methodology. One Datatel Corporation developer commented that he feared “feasibility study paralysis” and preferred to begin development immediately rather than undergo a feasibility study which gave him no pragmatic information.

As the people involved in systems development at Datatel Corporation have been with the company for a long time, in some cases for fifteen to twenty years, much of the systems development is done on the basis of familiarity. A project leader commented that systems are developed on a “local level”, meaning that people like himself have moved from functional departments into systems development and are familiar with the users involved, and with the operations of the particular departments. This attitude of local level towards systems development means that in practice in-house systems, as opposed to those provided by Datatel Direct, are not developed with rigid reference to the prescribed structured methodology. All systems changes required by users at Datatel Corporation have to be channelled through the Management Information Systems Department.

### **4.3. Case 2: University of Luton**

This section presents the University of Luton case organisation. Some background to the case is first provided and then in Section 4.3.1 the effect of external and internal change on the organisation is discussed. In Section 4.3.2 is a discussion of how the University of Luton is learning to use information technology. The role of the Management Services Department, which is the name of the University’s information systems department, is discussed in Section 4.3.3. The effect of organisational change on a particular example information system the Higher Education Management Information System is discussed in Section 4.3.4.

The University of Luton is one of the newer universities established in 1993. The then college of higher education was busy meeting the criteria for granting of the charter to be recognised as a university when the Government decided to award university status automatically to all the old polytechniques. The University of Luton was actually granted its chartered status after meeting all the requirements of the Privy Council. The University of

Luton has the power to award its own taught degrees and research degrees. A wide range of degree programmes are offered by its five faculties.

The University of Luton has around 13,000 students recruited nationally, from the European Union and from overseas. Most of its students are recruited through the universities clearing system. The University is concerned about recruiting more of its students through the Universities Central Admissions System through firm offers. The University is keen on building a research capability, but is finding it difficult to recruit the right people. During the time of research the University was embarking on a period of consolidation after a period of rapid growth to gain university status. At present the University is confronting a financial crises, and the Finance Director and three other senior financial officers have resigned. To recover from the financial crises, the University is rationalising its academic structure and faculties and departments are being merged to save costs. This rationalisation is creating much uncertainty among administrative and academic staff.

The higher education sector in the United Kingdom has experienced radical change. This change has been initiated by the Government who have introduced market competitive forces into higher education. The Government have also introduced new higher education policies affecting universities' funding. These Government policies have affected the grants which students are given to undertake studies for degrees, with the emphasis being on a move away from grants towards other forms of self-finance like personal loans. Apart from these changes to the financial structure of higher education, the Government has also changed the mechanism by which higher education institutions validate their degree programmes.

This type of change has impacted on the two higher education case organisations, the University of Luton and Nene College of Higher Education (see Section 4.4. for details on the Nene case organisation). Since the University of Luton was granted its university status by the Privy Council in 1993, it has experienced much change to its organisation and funding. The University cannot now solely rely on funds from the Higher Education Funding Council for England (HEFCE). To survive in the highly competitive higher education sector, the University of Luton has had to target overseas student fee income as an area for potential growth. Closely allied to this is the university's drive to franchise its courses to other educational institutions in the United Kingdom and abroad, particularly in Greece and Singapore.



The University uses mini- and micro-computers, often networked, for teaching, administration, and management purposes. As this investigation is concerned with the administrative and management uses of information technology to develop information systems, this section provides descriptions of systems in these areas only.

#### **4.3.1 A Case of Permanent Organisational Change**

To understand information systems development and usage at the University of Luton it is necessary to appreciate the organisational climate. The University of Luton has been functioning as a changing organisation since the late eighties when it was a technical college. In the past five years the pace of change has been even greater as the then Luton College of Higher Education worked towards gaining university status. The change to university status has impacted the organisation's faculty structure, departmental structures within the faculties, management, and administration. This impact has been one of growth and rationalisation and re-rationalisation over the past five years. (This situation has at present come to a crisis because of financial problems). This type of continuous organisational change has impacted the use of information systems. Two important and fundamental changes in the organisation which affect information systems development and usage are the introduction of modularisation for degree programme awards and semesterisation. Both these organisational changes have had an impact on the development and usage of information systems, particularly the development and use of the Higher Education Management Information System or HEMIS for short (see Section 4.3.4 for details on HEMIS).

The University of Luton has experienced much internal change in the past five years. During that time it has successfully acquired resources, both material and staff resources, to be granted university status by the Privy Council. The change to university status has meant that academic faculties have been reorganised several times in the past, with some departments and faculties merging for rationalisation purposes. More academic and administrative staff have been hired to cope with the growth of the university, and new buildings have either been bought or acquired to accommodate the staff and students.

The changes to the University still continue at present. The University has developed a financial management problem, and to cut its large overdrafts the University is again rationalising its structure. In this rationalisation, faculties are being merged and staff redundancies of up to one hundred are planned.

The University of Luton and Nene College of Higher Education were selected because they provide clear examples of cases where organisational and environmental change is significant and rapid, and where such change determines how information systems are developed and used. The higher educational sector has undergone radical changes in recent years. Government policies have introduced a major restructuring of higher education in the United Kingdom, reducing a multiple tier system, where institutions of higher education and polytechniques existed beside traditional universities to a single tier of universities. These Government policies have also introduced elements of market competition, which have made the universities in the higher education sector compete for resources, particularly research funding, and their existence for the first time in recent history. It is in this environment of fundamental and rapid change that the University of Luton and Nene College of Higher Education have introduced the Higher Education Management Information System, which makes both these institutions appropriate for the present study. The University of Luton presents a suitable case in which to study how both internal and external organisational change affects the development and use of information systems.

It is in this atmosphere of organisational change that the Higher Education Management Information System (HEMIS) was conceived and developed, and its usage too has been in such a changing atmosphere. The Modular Credit Scheme Office of the University envisaged a substantial transformation of the organisation, control and administration of the Modular Credit Scheme by developing HEMIS. The benefits envisaged included reduction in time spent processing student records, reduction in costs of staff used to administer the Scheme, and providing both academics and students with a better service. With regard to the Modular Credit Scheme, HEMIS's benefit is in centrally logging and checking students' programme of study and module choices, and in providing vital information to academic managers to determine student progression on the next level of their study programme. HEMIS captures student data concerning assignment submissions, examination results and provides student grade profiles.

In terms of Table 4:1 presented in Section 4.1, the University of Luton is a suitable case organisation because it meets the three criteria necessary to facilitate the present investigation. In the past five to six years the University has experienced major changes to its purpose and therefore its organisation has been affected. The University's management and



administrative structures have been changed several times because of the changes imposed on it by government direction and legislation.

The choice of using the University of Luton as a case study is significant because of the comparison it affords with Nene College of Higher Education (see the next subsection for details on Nene.) These two case organisations both provide higher education and use the same system. To help them manage their modular and semesterised mode of study, they both use the Higher Education Management Information System (HEMIS). The HEMIS system is implemented on mainframe computers, and dumb terminals are provided to administrative staff to input student data.

The University of Luton is involved in developing and using information systems to facilitate its changing purpose, administration, and management. The University thus meets the three criteria of organisational change, the development of information systems and their use. One such system closely studied during the present investigation, which is discussed in Section 4.3.4, is the system developed to help administer the University's modular credit scheme.

### **4.3.2 Learning to Apply Information Technology**

It is in this environment of organisational change that the University of Luton is learning to apply information technology to its management and operations. The issues concerning information technology affecting the University of Luton are less clearly stated formally by the University and less complex than those of Datatel Corporation discussed in Section 4.2. The University is still learning to exploit information technology to achieve its objectives and support its organisational structures.

The University of Luton does not have a stated plan for developing the use of information technology, but it has formulated a strategic plan. This strategic plan contains statements on information systems development and usage. In the plan the implementation of "standardised office technology and a common user electronic communications network" is stated. The office technology referred to is word processing packages. The plan also states the need for growth in "computing resources" to match the increased student base. In particular, the plan refers to a "policy for the development of computerised MIS", based on a corporate integrated approach using relational database and networking technology. The targeted areas for computerised MIS are finance, personnel, student administration and estates. At present the

University is appraising the use of “voice digital and video traffic” across its three campuses. A MIS Quality Group composed of significant management representation has been set up to monitor the development of information systems in the University.

The University of Luton wants to use information technology for reducing administration costs, and for teaching and research. By applying information technology in the organisation the University wants to support management, administration, teaching, and research. So administrative functions such as student enrolments, programme monitoring and graduation are target application areas, as are payroll, stores and finance. For teaching purposes the development of an electronic library system and delivery of information to academic staff managing modular programmes are priorities.

The University’s policy of providing information technology to support academic and administrative staff varies across its five faculties and across the different departments in each faculty. For example, within the Faculty of Business, academic staff in the Department of Business Systems share a micro-computer between two faculty members, whereas staff in the Department of Accountancy and Finance each have a micro-computer. Staff in the Department of Marketing share, in some cases, one micro-computer among three or four staff. The whole faculty shares one laser printer and recently some departments have bought ink-jet printers for individual staff. This inconsistent picture is the same in other faculties and is primarily determined by consideration of the limited faculty budgets.

The application of information technology is more significant in the administrative functions of the University than in its management functions. All the five faculties of the University have a policy of automating faculty office administration. Secretarial and administrative staff are provided with Novel based networked IBM compatible 286, 386, 486 and Pentium micro-computers and industry standard operating systems and applications. Microsoft Windows 3.1 is the standard operating system used and Microsoft Word 6.1 and Microsoft Excel 6.2 are the provided text and number processing systems. The faculty administrative staff share one laser printer. To facilitate communications among University staff both academic and non-academic staff are provided with the Pegasus electronic mail system.

The unavailability of centralised information systems has meant that individuals have developed their own systems on their micro-computers. (This kind of use of information technology is an aspect of living information systems thinking as it corroborates the notion of



changing or living use of information technology dependent on specific situations). These personal information systems, like the use of spreadsheets to complement the Higher Education Management Information System by a modular field manager, indicate that information requirements of users cannot be centrally captured and that they are situation specific (see Section 5.6 for a discussion on the notion of situated systems).

A major area for applying information technology is in the management of the University's modular credit scheme for the award of graduate and post-graduate degrees. In accordance with government policy, the University had originally entered into a partnership with other higher education institutions to develop an information system to administer and manage its modular credit scheme. This information system is called the Higher Education Management Information System or simply HEMIS. The HEMIS system is run on a Digital Equipment Corporation VAX minicomputer (see Section 4.3.4 for details on HEMIS). The introduction of HEMIS has been a major learning experience for the University in developing information systems. Now the University is beginning to develop information systems like decision support systems and executive information systems to support higher management functions.

### **4.3.3 The Management Services Department**

The Management Services Department is the University's equivalent of an information systems department. The Department is headed by an experienced systems developer with major project management experience. As the University has no strength in systems development, the Department is small and serves to administer and maintain either industry standard systems or bespoke systems like the Higher Education Management Information System. The Department consists of the Head of Management Services and his assistant. There is also one other person who is a general assistant.

The demand for new information systems is increasing, but the Department is unable to meet it because of a backlog of enhancement maintenance. The Department is uneasy about how information systems are managed at present, but it has little time to take constructive action. For example, the data preparation and validation is very poor and it is easy for "bad" data to enter the system.

The systems professionals in the Management Services Department have had to develop the Higher Education Management Information System (HEMIS) in a changing or dynamic

organisational setting. This is an interesting scenario for the present study because it provides a pertinent illustration of this thesis's central argument that information systems are developed and used in a changing organisational setting, whether that change consists of major or continuous minor changes. Therefore it is argued that approaches to systems development that can cope with such variability are required. The life cycle model based approach to information systems development does not cope well with the kind of organisational change experienced by the University of Luton. The case data reveals that organisational change significantly affected HEMIS's development process, and that the developers had to cope with this change by sometimes not deviating from the life cycle methodology adopted for systems development. In practice this meant that users' requests for changes to requirements arising from changes in organisational needs were not enthusiastically received and sometimes denied.

Structured approaches to systems development are usable in a relatively static organisational environment, where things may be predictable. The changing organisational activities of the University of Luton described in Section 4.3.1 provide an interesting case to study structured systems development, where systems requirements are unclear or unpredictable because of changes to management and administration processes. The structured approach used to develop HEMIS relied on establishing a complete systems specification in this radically changing organisational context. Based on experiential data, establishment of an exact and unchanging systems specification is problematic when potential users are unclear of the administrative process that may eventually transpire.

#### **4.3.4 An Example Application: Higher Education Management Information System**

The University of Luton uses a mixture of off-the-shelf packages and bespoke information systems for administrative and managerial purposes. The University of Luton uses the Higher Education Management Information System (HEMIS) which it originally acquired from outside and has since had altered by the Management Services Department and the supplier Educational Management Information Systems (or EMIS for short) to meet specific and changing organisational needs. Apart from the University of Luton and Nene College of Higher Education, eight other higher education institutions funded the development of HEMIS by each contributing £5000 for its development. Only the University



of Luton and Nene College of Higher Education now actually use HEMIS. At the University of Luton the Modular Credit Scheme Head co-ordinated the HEMIS development project. The purpose of HEMIS is to centralise control of the Modular Credit Scheme for the Modular Office by providing centrally processed information. So HEMIS has been developed to organise and control the Modular Credit Scheme.

There is little understanding of the Modular Credit Scheme itself among those who are charged to implement it. This lack of understanding has had the effect that poor control mechanisms exist to administer the Scheme. Consequently the actual logging of student programme and module choices has been poorly performed by HEMIS, and the system has not efficiently supported student programme and module management. This is evidenced by the supply of outdated information to department heads, field managers, and module co-ordinators by the system.

The HEMIS system is a management information system application which allows systems professionals to write programs using the Structured Query Language (SQL) to generate customised management and administrative reports. HEMIS' core systems functionality is fixed and rigid. HEMIS's functionality can only be changed by the original developer Education Management Information Systems (EMIS), as opposed to the database structure which may be manipulated with SQL to provide different logical views of the database model. The use of SQL is limited to systems professionals and is not available to general users in the University. When radical changes to systems functionality are required, HEMIS has to be sent for re-programming by the vendor's development team. An example current at the time of the study was the Department of Education's requirement for specific information regarding students to be supplied via the Higher Education Statistics Agency. As a result of this change in the external environment of the organisations, the University had to commission the EMIS vendor to alter HEMIS's core functionality.

Given the kind of permanent organisational change happening at the University, the development of HEMIS could not proceed according to a predetermined systematic development process bounded by time and monetary constraints as in methodologico-project frameworks. The attempt to define the information requirements for HEMIS in an organisational context that is changing proved problematic for developers, and the result is that only some easy to identify and relatively stable administrative processes have been computerised as in traditional data processing systems. Systematic development processes

like systems development methodologies co-exist badly in changing situations like the University of Luton during the development of information systems.

HEMIS at present can only be described, in the view of one interviewee, as a transaction processing system, providing little information of value for management purposes. HEMIS is supposed to be seamless across central and faculty administration and management. This has not been the case because faculties continue to have their own documents to process student programme and module choices and assessments. It is possible for HEMIS to be enhanced to be a source of advantage to the University against its competitors, though the likelihood of such developments in the University's present financial climate of crisis is remote. Nevertheless, the impact of HEMIS on the administration and management of the Modular Credit Scheme is such that some administrators regard the management of the Scheme as impossible in the absence of HEMIS.

#### **4.4 Case 3: Nene College of Higher Education**

This section presents the Nene College of Higher Education case organisation. Some background to the case organisation is provided and then in Section 4.4.1 the effect of change on the case organisation is discussed. In Section 4.4.2 issues concerning the use of information technology in the case organisation are discussed. The role of the Information Technology Services Department is discussed in Section 4.4.3. Changing towards university status and its affects on a particular information systems the Higher Education Management Information System is discussed in Section 4.4.4.

Nene's Board of Governors has decided on a policy of achieving university status by the year 1999 or 2000, and calling itself the Northampton University. The College's ability to award its own taught degrees is one step towards achieving that aim. Nene does not yet have the power to award research degrees such as research masters or doctorates, but it has the intention of seeking these additional powers as it continues to develop its resource infrastructure and academic staff. When Nene has the power to award research degrees the Board of Governors intend to make an application to the Privy Council to be granted university status.

Nene College of Higher Education serves the higher educational needs of the local area in and around Northampton, but it also attracts overseas students. The College has a tradition of providing practical and vocational programmes, and it prides itself in providing good quality



teaching. Nene prides itself on the high quality of its academic courses. The College has received very favourable reports on its arrangements for assuring quality in education from the HEQC, and from the Higher Education Funding Council for England (HEFCE).

Nene provides Higher National Diploma, graduate and post-graduate programmes from three faculties, which are Applied Sciences, Arts and Social Sciences, and Management and Business. The Faculties also offer post-graduate research, post-experience and professional programmes. Nene has been granted the power to award its own undergraduate and post-graduate degrees by the Privy Council, and the College has exercised this power since 1995. Nene has satisfied the Higher Education Quality Council (HEQC) that its standard of taught Bachelor's and Master's degrees is equivalent to that of other universities in the United Kingdom.

Nene is developing a "research tradition" to support its research students in line with its policy of seeking university status. The research degree programmes of Master of Philosophy and Doctor of Philosophy are currently awarded by the University of Leicester. Nene has staff who are actively researching and publishing, and research students are recruited to the research interest areas of staff. Nene has also set up a Centre for Research with appropriate information technology resources where research students are housed.

Like all institutions of higher education, Nene College has had to manage the policy changes introduced by the Government in the recent past. It has done this in part by forming alliances with other higher education institutions as suggested by government agencies such as the Higher Education Funding Council for England. Nene has therefore entered into an agreement with Northampton College and Moulton College from the same region. This agreement is called the Northampton Compact and its aim is to share the experiences and resources of the three proximal colleges for mutual benefit. The aim of the Compact is to provide quality further and higher education, and to extend the choice and opportunities available for students. The College's major concern is to attract students.

Another partnership that Nene has entered into with other higher education institutions concerns the provision of management information systems. Nene has linked itself with ten other institutions to work out a specification for a bespoke information system to help manage its modular degree scheme. This information system is called the Higher Education Management Information System (HEMIS). One of the ten partners is the University of Luton. The government has directed higher education institutions to form such partnerships

where they share commonality. In the case of HEMIS, the partners share the same experience of introducing, administering and managing a modular credit scheme for graduate and post graduate degrees using information technology.

#### **4.4.1 Changing the Organisation Towards University Status**

Nene is a suitable site for the present investigation. The College meets all three criteria set out in Table 4:1 in Section 4.1 concerning the suitability of the case organisations to investigate how information systems are developed and used in changing environments. Like the University of Luton, Nene has had to cope with major change in the higher education sector but unlike the University of Luton Nene has had to cope with less major internal change. The education policy changes introduced by the Government has meant that Nene has had to reconsider its purpose, and the Board of Governors have decided that the College should aim to be recognised as a university by the year 2000.

Nene is an obvious choice for a case organisation to complement the choice of the University of Luton. Nene has formed a partnership with the University of Luton to develop an information system to administer and manage a modular credit scheme which they share in common. The ability to cross-check data is facilitated by selecting these two case organisations because of their use of the Higher Education Management Information System (HEMIS), and cross-checking data increases research triangulation .

For Nene the use of information technology is central to the process of changing to university status. The development of the information technology infrastructure for management, administration, teaching, and research is particularly important if the College is to obtain university status. In this change the development of HEMIS is considered a strategic issue (see Section 4.4.4 for details on the operation of HEMIS at Nene). The aim is to link electronically HEMIS to existing library and finance systems, and facilitate timetabling, which at present is done locally at Faculty level.

#### **4.4.2 Information Technology Related Issues**

Like the University of Luton, Nene has applied information technology to its teaching, administration, and management. The College uses industry standard software in the offices of its three faculties, and IBM compatible 286, 386, 486 and Pentium computers are networked and loaded with standard office applications. Microsoft Windows 3.1 is used as



the operating system on its micro-computers, and Microsoft Office is provided on all the personal computers for presentation, word and numerical processing. Nene uses DEC minicomputers for its automated payroll and financial systems.

Like the University of Luton, Nene has decided to automate its modular credit scheme. As stated above, Nene has entered into a partnership with other higher education institutions to commission the development of HEMIS .

In general terms, there is not a high level of understanding of information issues and even some negative attitudes exist, especially among academic staff. This is not improved by the inadequate representation of user groups during the development of HEMIS.

#### **4.4.3 The Information Technology Services Department**

Nene College has an Information Technology Services Department which provides systems for teaching, research, administration, and management purposes. The machines used for those purposes are Digital Equipment Corporation's VAX/Alpha minicomputers, Sun workstations, IBM personal computers and Apple Macintosh micro-computers. Nene is setting up a network to link all its disparate faculties, buildings, halls of residence and library systems into an integrated multi-site network called NENET.

The Information Technology Services Department provides various services to faculties and other management and administrative departments. The Department provides data preparation services to help user departments to capture the right data for the various systems used. User-departments who want to develop systems by themselves are given advice on the purchase of equipment and methods for systems development. This service is extended to the students too. The Department also provides technical support and manages the systems in use.

The Department participated as part of the user group during the development of the Higher Education Management Information System (HEMIS). The user group consisted of the ten higher education institutions, including the University of Luton, who agreed to develop jointly the HEMIS system. Systems developers from the vendor company Education Management Information Systems (EMIS) undertook planned meetings with the user group to discuss their problems, establish information requirements, and provided potential systems solutions. The Department is careful not to undertake large enhancements to HEMIS because of the additional cost and complexity of making changes, and it has a planned training

programme for users to ensure that proper use is made of the system. Nene's use of HEMIS is discussed in the next section.

#### **4.4.4 An Example Application: Higher Education Management Information System**

Nene uses the same bespoke Higher Education Management Information System (HEMIS) as the University of Luton. HEMIS's basic set up is the same in both the higher education case organisations, but there are differences in the way that HEMIS is used by the two case organisations. These differences are significant in terms of the research questions concerned with how information systems are developed and used, and how organisational variation and change affect that development and usage.

For instance, whereas the assessment module in HEMIS is used by the University of Luton to provide statistics on student progress, Nene does not use the same module. Instead, because of the different organisational structure at Nene, Microsoft Excel is used on a micro-computer to produce the assessment details for examination boards. Also, Nene makes more use of ad-hoc reporting from HEMIS, which the University of Luton does not. The use of ad-hoc reporting at Nene is possible because of comparatively easier communications procedures between the Registry, who operate HEMIS, and users.

Although HEMIS is operated by the Registry, it was developed with the involvement of the Information Technology Services Department and Registry. Unlike the University of Luton, Nene has actively involved potential HEMIS users, though Faculty involvement was restricted to providing details about courses. Of all the user groups the academic staff have been less willing to be involved. For developers and staff-users it has been a learning curve, and less involved staff have found it difficult to envisage something they have not been a part of or seen being developed.

Nene was a member of the committee that steered the development of HEMIS. This committee was charged with specifying the requirements from the proposed development. This proved difficult to do because of the different organisations involved with their differing needs, and changing organisational circumstances. For example Nene's modular credit scheme is less elaborate than that of the University of Luton, students at Nene have less choice in determining their programme of study, and Nene operate their HEMIS system on



the traditional academic term system compared to the semester mode used at the University of Luton.

The requirements stated by the committee were converted into a systems specification by the developer EMIS. The system is written in Oracle and was first run as a pilot before full implementation. Parallel implementation was not possible because of limited resources. As with the University of Luton, Nene's HEMIS system was not properly tested, consequently there were additional implementation problems. The actual system was delivered late, and had to be implemented in a rush to be ready for the commencing academic year.

The understanding of HEMIS's role in the organisation and its usefulness to the individual users is low among academic staff. Some academic staff do not see the need for HEMIS. This is explainable by the fact that the steering committee did not actively involve academic staff in its consultations. This may be a reason why academic staff are less willing to trust reports from HEMIS, and consequently they use self-developed systems. This type of locally developed system is consistent with practice at the University of Luton.

Nene has plans to develop an electronic link between HEMIS and UCAS to access directly admissions data. HEMIS provides financial information such as invoicing and Government returns, which are important financial aspects of the College's survival. The use of spreadsheets in the central assignments office means that HEMIS has to be able to interface with these systems to capture student grades data.

## **4.5 Case 4: Ace Business Computers**

This section presents the Ace Business Computers case organisation. Some background to the case organisation is first provided and then in Section 4.5.1 the effect on the organisation of change in focusing on customer satisfaction is addressed. In Section 4.5.2 the issue of directing information technology to maximise customer satisfaction is discussed. Ace Business Computers does not have an information technology department, so in Section 4.5.3 its use of information systems as perceived by the Finance Director is discussed. The changing role of the accounting information system in providing customer satisfaction is discussed in Section 4.5.4.

Ace Business Computers was established in 1988 by two partners to produce micro-computer solutions for business use. The two partners are graduates in computing and accounting and computing, and they combined their respective expertise to found the

company. They now serve as the managing director and the finance director of the company. Since its early days the company has expanded and it now has a total payroll of forty-seven employees, and a turnover of around £1.5 millions. The company has a basic organisation structure consisting of the managing director and three supporting directors in sales and marketing, production, and finance.

The company buys digital computer components and assembles computers for business clients. The company's market is regional, and it has built up its client base over ten years of trading. The wider market the company operates in is fluid and the company is concerned with maintaining its customer base. The company is refocusing its marketing and sales operations on providing its customers with individual or personalised service.

Until recently the company sold its products directly to business users. The Board of Directors felt that the company was better at producing the micro-computer systems than selling directly to customers, and so they decided to concentrate on their strength. Now the company is increasing its selling channels by also establishing a network of distributors and retailers appointed to sell its products.

#### **4.5.1 Changing the Organisation to Maximise Customer Satisfaction**

Ace Business Computers was selected for the present investigation for a number of reasons. One, the company is smaller in size and turnover compared with the other case organisations. This provides a comparison to assess whether organisational change and its affect on the development and use of information systems is found across all types of organisations irrespective of their size or turnover. Two, in contrast to the other three case organisations, Ace Business Computers only uses industry standard software to develop its information systems. This provides scope in the investigation to study how such systems are used and how organisational change affects them. Three, the company is currently heavily focused to provide customer satisfaction, and allows its sales managers to customise their service to suit the needs of individual customers. This kind of customer orientation has an affect on the way information systems are used, which provides an interesting field for the investigation, as discussed in the following subsections. The company operates in a very competitive micro-computer market, where customers' requirements have to be closely met. Failure to meet customers' requirements could result in loss of contracts. The case was selected to assess how information systems are used to provide the varied needs of customers.



The company has recently recognised that it has not concentrated on providing service to its customers, consequently it has decided to refocus its marketing on satisfying customers. This refocusing on customers has meant that the company has had to change the way it markets its products and change the way in which it maintains customer links once established. This entails using information technology to support marketing of the products and providing the sales and production departments with accurate information.

This change in customer orientation has meant that the use of the accounting information system has been affected. As there is a variation in the needs of the customers, the Finance Director who is responsible for systems provision, recognises that the accounting information system needs to be used in an adaptable way by the various sales managers to meet customers' differing needs (see Section 4.5.4 for details on the accounting information system).

#### **4.5.2 Directing Information Technology for Customer Satisfaction**

Ace Business Computers aims to focus its information systems to maximise the satisfaction it can deliver to its customers. The use of industry standard packages such as the Pegasus accounting system is directed towards enabling managers who have contact with customers to deliver a satisfactory service to them. The Finance Director who directs information technology usage in the company regards providing quality service to customers as very important. He enables managers to use information technology to deliver a high quality of service.

The Finance Director believes that the information technology usage must change as the organisation changes. These changes arise from external sources of competition, typically from other companies, and from internal sources such as the structure of the company or re-defining company objectives as in focusing on customer satisfaction. To change the business processes and associated information technology and information systems to react to an internal change, like the objective of getting products to customers quickly and providing better service, is the problem that the Finance Director is currently facing.

The Finance Director has encouraged end-user computing as a way of developing and supporting a customer oriented company. The information technology used to develop systems is not limited to a few expert developers. As the company is staffed with computer

literate people, the development of end-user computing is not problematic because of lack of expertise.

The use of information technology in Ace Business Computers is based on a strict adherence to a training programme. No member of staff is allowed to use systems that they have not been trained to use. Even though the culture of the company is highly technical because of the nature of its operations, the Finance Director insists that all users of the accounting information system are trained. The Finance Director is careful to avoid the financial consequences of a computational error by untrained users.

Whilst providing flexible usage of the accounting information system, the Finance Director is careful not to compromise security. To maintain the integrity of the accounting information system only authorised users are allowed to change sales analysis codes in the system.

### **4.5.3 Management Information Systems**

Ace Business Computers has no distinct department or section dedicated to exploiting information technology. The Finance Director is responsible for the provision of computer-based information systems to support decision-making. Decisions regarding systems are made by the Board of Directors and are heavily influenced by the Finance Director who has had experience in writing programme code. His educational and experiential background in finance and computing gives him an insight into the potential uses of information technology, and he is regarded in the company as the best suited person to direct its use.

The company uses industry standard software to develop its information systems. The Finance Director thought out two ground rules for developing information systems. One is that everything has to be “very easy to use” and two that systems should be resilient. In selecting the Pegasus system to develop an accounting information system, the Finance Director opted for a proven system rather than risking a new and unproved technology.

### **4.5.4 An Example Application: Accounting Information System**

Ace Business Computers regards planning as an important management activity, and the use of information systems for accounting purposes is viewed as contributing to the planning and control activity of management. The use of information systems is regarded as vital for management decision-making and for facilitating communications in the company. As well as



supporting decision-making and management communications, information from information systems is used to get a “better picture of particular situations”. In particular, the use of computer-based information systems is regarded as a support to management but not a substitute. For these reasons access to information systems by management staff is a company priority.

ACE Business Computers makes use of the Pegasus accounting system, which the company acquired as an off-the shelf information system “solution”, and was subsequently configured to meet the specific accounting policies and procedures of the company. Pegasus was described by one director as a “bought information systems skeleton that is configured to suit our need”. The system has a modular design and it can be re-structured using the modular format. Pegasus allows information systems professionals or other computer literate users to design their own company sales analysis codes, which facilitates sales analysis and decision making. These sales codes are regarded as particularly important for providing increased customer satisfaction because they afford better sales data analysis.

When permitting the flexible use of the accounting information system, the Finance Director is concerned that sales managers are aware of the consequences of errors in their systems. He has previously experienced slight computational errors leading to under-costed quotations, so he emphasises careful usage of the system to his subordinates.

The Finance Director regards information as critical, and seeks to “draw on more information” to improve efficiency. His aim is to improve the presentation of current information and then to develop other applications such as financial models. At present, the accounting information system is used as an analysis system to help record and analyse sales and customer accounts. This system saves time, provides accurate information and processes large volumes of data. It provides accurate information on what customers have bought and what volume of business is done by a particular customer or generated by a particular product. As the Finance Director said: “Our sales department is now information-rich.”

The accounting information system is capable of calculating costs against enquiries, quotes and sales. It provides daily reports to support quick decisions, especially on how to allocate marketing budgets. The system has freed sales people to concentrate on sales and enables the sensible use of marketing intelligence, all of which lets the company “be very competitive”.

The benefits of the system are that it is easy to use and is able to analyse customer and product sales data. The system is able to make forecasting efficient and makes quality assessment possible of the effect of differing prices and promotions. All of this provides better customer and market intelligence.

## **4.6 Researching Changing Organisations**

This section outlines how the research design discussed in the previous chapter was implemented in the changing case organisations presented in the previous sections. Doing the actual research is not a simple matter of implementing a research design. Maxwell (1996) comments that the qualitative research process consists of interactive design and induction, and he adds that the research unfolds in the field in a different way than originally designed. The researcher encounters aspects of the real situation which he cannot control or which were not considered in the original design and need to be accommodated in the research. Consequently the original design has to be flexible to absorb such encounters and the actual implementation of the research design has to negotiate the constraints posed by the real situation. It is necessary to discuss the research process because qualitative research according to Maxwell (1996) is evaluated in relation to the processes and circumstances of the research. This section describes those processes and circumstances.

The research process consisted of enhancing the original design by adding details that were encountered while carrying out the research, which is particularly possible using the case study research method as discussed in section 3.5. Thus the questions concerning what information systems to study, who to include in the investigation, how long to study the cases, and how to set-up and conduct the questionnaires and interviews, are all issues which became clear as the research unfolded. These issues are discussed in the remainder of this Chapter.

### **4.6.1 The Length of the Study**

It was not clear at the time of designing the research how long the study should last in each of the described case organisations. The actual time spent at each case organisation varied but on the whole data collection was done over a single time period. When subsequently interpreting the data, lack of clarity was dealt with by having informal chats with some participants. In this regard, this research may be regarded as process research



which allows for consideration of the dynamics and complexity of the object of study. By process research is meant that the investigation is not regarded as completed within a certain set time (see Walsham, 1993 for further details on process research). Variables like the number and length of interviews, the time the researcher was allowed to study documents, and access authorisation, all determined how long the study lasted.

At Datatel Corporation and Ace Business Computers much restriction was placed on both interview times and supervised document studies because of commercial pressures. The contacts in both these cases were careful to emphasise the limited time available to those participating in the investigation. The time spent studying systems documentation was supervised, and the supervisors' times were limited too. Being the larger of the two companies, around three weeks was spent at Datatel Corporation and twelve days at Ace Business Computers. During this time, interviews were planned in consultation with the respective contacts from personnel and department managers and then conducted, and various documents were studied (see Appendix H for details of the documents examined).

In contrast, there was a relatively relaxed atmosphere at the two higher education institutes. However, the researcher was conscious not to burden the participants in the investigation. Around five weeks were spent at the University of Luton distributing questionnaires and collecting them, and planning and conducting interviews and studying documents. As part of the participatory observation research method, the researcher spent one week of the five weeks reflecting on his experience of working with the Higher Education Management Information System (HEMIS) at the University of Luton. This time was spent making memo notes of the researcher's experiences as a user of HEMIS. Maxwell (1996) recommends making memo notes during the research and to put them in logical order subsequently to facilitate data analysis.

Around four days were spent at the Nene College of Higher Education. Some time was spent arranging interviews and conducting them, and the remainder was spent examining systems enhancement and other documents. Less time was spent at this case organisation because of the small volume of its systems operations. The College has only three full-time members in the Registry who manage the Higher Education Management Information System, of whom one is the systems administrator and two are data entry clerks.

A couple of days was spent doing member checks at Datatel Corporation and the University of Luton. Member checks are recommended by Maxwell (1996) to check the

validity of data analysis by referring back to the participants in the investigation. For the present research, this meant checking with members the validity of the interpretations made of the data (see Chapter 5 for details of the interpretations). As data was analysed during the research to develop relevant concepts, the results were checked with members of the study to ascertain their views of the interpretations. Member checking was useful in thus validating the interpretations made of the data. The questionnaire and interview participants in the research are discussed next.

## **4.7 The Participants in the Study**

People associated with the information systems in the case organisations constituted the main unit of analysis. Systems users at multiple levels of the organisation were selected, providing multiple perspectives on the development and usage of information systems. Secondary units of analysis were the departments in the case organisations. As four cases were studied, another secondary unit of analysis were the four case organisations themselves. The multiple cases used provided some categories of comparison, though this was not an explicit requirement of the research design.

It was not possible to state in the research design who would be the participants in the study. At that stage, the personnel structure of the case organisations was not known. At the two commercial case organisations, the actual selection of participants for the interview part of the study was a consultative process involving the representatives of the personnel department and the respective department heads. The researcher was involved in the consultations, but the final decision was made by the case organisation's representatives.

A wide participation of information systems users in the study was sought. For this reason, the questionnaire survey was used to form an overall picture of the usage of information systems in the case organisations. The total number of questionnaires distributed was 106 and the total returned was 92, giving an 87 per cent. response rate. The circulation of these questionnaires in the two commercial case organisations was beyond the researcher's control. The questionnaires were circulated by the representatives of the personnel managers in consultation with other managers. (See Appendix D, table titled "Company" for a detailed breakdown of the returns by organisation.) As it is not known on what basis the questionnaires were distributed in the two commercial case organisations, it is not possible to comment on whether any bias in the data may have occurred. The representatives were made



aware of the need to distribute the questionnaire widely and evenly among all types of users of the information systems identified (see the earlier sections in this Chapter for descriptions of the particular information systems).

At Datatel Corporation the Operations Manager was interviewed. The MIS Manager has the overall responsibility for systems development and operation in the company and reports directly to the Finance Director. The Operations Manager is responsible for the daily operations of the suite of programmes that constitute the MIS and other systems in the company, and she reports to the MIS Manager. An experienced systems programmer was also interviewed, as well as a junior systems programmer. The Operations Manager and the senior systems programmer were interviewed to understand how they interpreted the systems development process. Interviews with users was limited, so one person in the sales department who is active in using the MIS system was interviewed.

At Ace Business Computers only the Finance Director was interviewed. The company did not authorise any other interviews. However, the Finance Director proved valuable because of the information he was able to give from his vantage point. He is a competent developer of systems and a heavy user too. His overall knowledge of the company's operations provided insights into information systems usage there.

The selection of interviewees at the two educational institutes was determined by the researcher himself in consultation with the interviewees. Three interview participants were involved in the investigation at the University of Luton. The Management Services Manager who is responsible for the Higher Educational Management Information System (HEMIS) was interviewed. His responsibilities include enhancement maintenance and customised report generation, and he answers directly to the Deputy Vice Chancellor. As HEMIS is bespoke software, this manager and his department are not themselves involved in its development. The second interview was with the Chief Administrator of the University's Modular Credit Scheme (MCS). She is answerable to the Manager of the MCS. The Chief Administrator is in direct contact with the university academic and administrative staff involved in the MCS and she relays their information needs to the Management Services Manager. The third interview was with an academic who is responsible for managing a cognate academic area called the Business Systems Field, and his title is Field Manager. The Field Manager manages the collection of taught subjects which constitute the Field. The Field

Manager relies heavily on HEMIS for information to manage the Field and prepare for examination boards, so he is a prime user of information systems.

The final participant at the University of Luton was the researcher himself. Being employed at the University at the time of the study, the researcher made use of experiential data for the investigation. The researcher was employed as academic faculty and made use of HEMIS to administer modules in the MCS. Being a member of the organisation provided the researcher with detailed inside knowledge of the issues concerning users and systems professionals and the use of HEMIS. The researcher's experiential data was collected by making memo notes detailing the instances when HEMIS was encountered by the researcher.

At the Nene College of Higher Education the Academic Registrar was interviewed. She is the equivalent of the Management Services Manager at the University of Luton. The Academic Registrar has two staff to help her administer HEMIS, and she is answerable to the Vice Chancellor directly. One module leader was also interviewed as a user of HEMIS.

The participants in the study may be divided into two groups. The first group consists of those who took part in the questionnaire survey, which is discussed in the next section, and the second group consists of those who took part in the programme of interviews. The selection of both these groups in the two commercial case studies was determined by the researcher in consultation with the participating organisations.. The researcher is aware of the bias that may result in the data where he had no sole control over selecting the participants in the investigation.

#### **4.7.1 Profile of Questionnaire Respondents**

The questionnaire respondents comprised employees with a variety of organisational roles, ranging from executives (five per cent.) to administrative staff (57 per cent.), and belonged to three departments (marketing, finance and administration, and production). This demarcation is rough because academic participants in the two educational institutes may not neatly fall into any of the categories provided. The majority of the respondents were administration staff (57 per cent.). The remainder consisted of middle managers (sixteen per cent.), senior managers (eight per cent.), executives (five per cent.), and other staff (twelve per cent.). The dominant age group was between twenty and twenty-nine (47 per cent.), the second dominant was thirty and thirty-nine (22 per cent.). The gender groups were forty-two



per cent. male and fifty-seven per cent. female. (Further detailed analysis of the data is shown in the various tables in Appendix D).

The questionnaire survey acted as the first phase of the investigation followed by the interviews. Table 4:2 details the number of questionnaires distributed and returned in each of the four case organisations. The questionnaire enabled a statistical descriptive survey to be done of the users of the identified information systems and gathered information on a large number of users. This would not be possible using interviews alone.

**Table 4:2 : Case Study Organisations - Questionnaire and Interview Responses**

| Company Name                  | Questionnaires distributed | Questionnaires returned |
|-------------------------------|----------------------------|-------------------------|
| Datatel Corporation           | 38                         | 38 (100%)               |
| ACE Business Computers        | 14                         | 14 (100%)               |
| University of Luton           | 20                         | 6 (30%)                 |
| Nene College Higher Education | 34                         | 34 (100%)               |

Various patterns of information systems usage is gleaned from the questionnaire data, which provided some material for the interview phase of the investigation. For example, many of the respondents believed that they had control over the information systems they used. This fact was pursued in the interviews with systems professionals who denied the existence of such control. The questionnaire data was thus enriched with the addition of qualitative data from interviews. The qualitative interview data revealed users' motivations and meanings with regard to information systems usage which the questionnaire data could not provide. The investigation used the two quantitative and qualitative research methods in conjunction with each other to provide an enriched data set. Qualitative research such as interviews blends with quantitative methods by providing a more thorough understanding of users' perceptions.

#### **4.7.2 Data Collection and Recording Process**

The data collection and recording varied from that initially envisaged during the research design discussed in Chapter 3. The actual research process concerning data collection and recording is constrained by real, organisational circumstances. This subsection describes the

data collected to understand the social and organisational aspects of the development and usage of the information systems identified for the study.

To facilitate the investigation a variety of information was gathered through the questionnaire survey, interviews and document studies. To form a view of the official position of the case organisations, an initial examination of their mission statement was intended. The two commercial companies surprisingly did not have written mission statements, but the two higher education institutions did. A reading of the mission statements provided an indication of the aims that the identified information systems were designed to support.

To form an appreciation of the structure of the case organisations their organisation charts were examined. These were gleaned from the company reports for Datatel Corporation. For the University of Luton and the Nene College of Higher Education internal newsletters were used. A chart was sketched by the Finance Director for Ace Business Computers, who are a private limited company and therefore not legally obliged to publish their internal affairs. These charts were useful during the interview stage to pinpoint the official roles of the participants in the investigation.

The time spent by the researcher in the case organisations was additionally used to appreciate their different cultures. Information on the culture of the systems department and users' departments was gleaned during the interviews. The two commercial case organisations had clear lines of authority and responsibilities while the two higher education institutions, though formally structured, varied in their behaviour in practice.

Some data was gathered on the organisational history of information systems development at the two higher education institutes. Direct contact with the developers of the Higher Education Management Information System (HEMIS) was not permitted by the Management Services Department, thus all the data on HEMIS was gathered from interviews and document studies at the University of Luton. However, as the subjects interviewed were not the original developers of HEMIS, their accounts were cross-checked where possible by examining systems documents.

Data was collected on the usage of systems development methodologies and CASE tools. Although it was not possible to interview the developers of the HEMIS system used at the University of Luton and the Nene College of Higher Education, it was established that an in-house structured systems development methodology was used to develop HEMIS, and that



the SELECT Professional CASE tool was used for project management. SELECT is an Integrated-CASE tool which enables total computerised management of systems development projects. Data was collected on users' roles in the systems development process, and on their organisational roles and their tasks in the case organisations. Data on training users to use systems was collected too.

An important category of data collected concerned managerial attitudes and views. In interviews with systems developers and users, questions concerning users' control or power over systems development were fielded. The attitudes and views of the two groups of developers and users differed on this issue and are fully discussed in Chapter 5.

So the focus of data collection was the social context of information systems development and usage, and developers and users were the prime units of data collection. The participants' roles in the case organisations as developers or providers of information systems and workers or users of information systems were examined. The key providers of information systems and users were interviewed. Users' need for information for organisational work purposes was investigated in the context of business objectives, policies and management styles, and in particular their individual organisational tasks using the questionnaire.

The collected data was recorded in different ways for the questionnaire survey and the interviews. The questionnaires were sent out on A4 paper with Likert-like scales and boxes for users to complete. Thus the questionnaire survey was recorded on forms (see Appendix A for the research questionnaire). The returned forms were entered into the SNAP software tool for statistical data analysis (see Appendices B and C for further details on using SNAP for the research).

The interviews were audio recorded using a micro-cassette recorder. The recordings were transcribed verbatim soon after (a sample of the semi-structured interviews is provided in Appendix G). The use of the audio-recorder permitted the researcher to concentrate on the interviewees' responses and not have to worry about capturing the data in note form. However, as points of interest arose, they were recorded as notes in a notebook. Later, while transcribing the interviews, memo notes were also made. Maxwell (1996) recommends making memo notes as an aide memoir to facilitate subsequent data analysis. The memo notes can be points that require clarification or the researcher's early interpretations of the data. The actual analysis of questionnaire and interview data was not left till after the study was completed. The data was analysed during the research to provide initial understanding of

the development and usage of information systems and to provide informed views on subsequent interviews.

### **4.7.3 Data Collection Access Strategy**

Access to the case organisations varied. The two commercial case organisations closely controlled the researcher's access to their staff, systems, and documentation. The researcher had to accept the ground rules set by personnel departments in the two commercial case organisations who acted as representatives of the companies and who facilitated the research. The rules were stipulated for obvious commercial reasons but the control was supervisory rather than absolute.

In the two commercial case organisations, the questionnaires were distributed by the personnel manager's representative or his deputy after consultation with the researcher and department heads. The interview subjects were selected through a similar consultation process involving the researcher, the department heads and the personnel manager. Care was taken to follow up data collected in these circumstances by examining systems documentation where possible.

The access to data sources was relatively freer in the two higher education institutions. The questionnaires were freely distributed by the researcher at the University of Luton and in consultation with the Academic Registrar at the Nene College of Higher Education. However, the response rate was poorer compared with the two commercial case organisations (See Appendix D, table titled Company for a breakdown). The subjects for interviews were selected with their agreement by the researcher at the University of Luton and in consultation with the Academic Registrar at the Nene College of Higher Education.

The outcomes of the research can be affected by the restrictions to data sources. The access to data sources in the two commercial case organisations was controlled but not prevented. However, the relatively freer access permitted at the two higher education institutions enables the subsequent data analysis to be tempered. By cross-checking the collected data between the two groups of case organisations with differing access to data the validity of the eventual data interpretation increases. This approach to data analysis recognises the care needed to avoid bias in the final data analysis. The next subsection is a discussion on data validity issues.



#### **4.7.4 Data Sources and Validity of Interpretations**

The use of multiple data sources enabled cross-referencing and cross-checking the gathered data to check its validity and so ensure the validity of subsequent interpretations. The data sources and research methods were identified in the research design. The use of multiple research methods is considered to ensure the validity of the data collected. Consequently various data sources were used to carry out research triangulation. So the questionnaire survey collected data from numerous users of information systems in the case organisations, and the interviews collected data from systems developers and users, whilst the document studies provided data on the procedures and processes concerning the development and subsequent use of information systems.

Data gathered from the semi-structured interviews provided the possibility of thinking of deeper explanations of systems development and usage, which would not be possible from questionnaire returns alone. The interview data was cross-checked among the different case organisations to ensure consistency, and where possible it was cross-checked against the data collected by the different research methods used. For example, systems developers in two case organisations stressed in interviews that users should not be given control over information systems development processes because they feared that inexperienced users would compromise the integrity of information systems. In the other two case organisations, systems developers initially had the same response, but asserted that users may be given control over certain information systems processes if the right technology is available. One interpretation that can be drawn from this is that the idea of users controlling information systems processes is not impractical and that it may be welcomed by some (progressive) systems developers ( see Section 5.4.2, for the conceptual development of this idea).

### **4.8 Concurrent Data Analysis: Gaining a Better Understanding During the Investigation**

As both questionnaire and interview data were analysed during the research, and interpretations such as those concerning users' control over information systems processes were drawn, it became necessary to check the validity of the data sources as an aspect of implementing the research. Maxwell (1996) states that the validity of the research is the

correctness or credibility of the researcher's explanation, interpretation, conclusions or other kind of account. The correctness of the interpretations drawn during the research, which is here referred to as concurrent data analysis, was assessed by cross-checking the data to ensure logical consistency as described in the previous section.

A necessary reason for concurrent data analysis is to check the developing reasoning to support potential interpretations. Links or inconsistencies in the reasoning can be addressed while the researcher is still in the field. This may involve conducting more interviews or where possible re-opening interviews already done, or checking other relevant sources of data. Thus making qualitative research an interactive design process as described by Maxwell (1996), the interaction being between the initial research design and the subsequent data analysis which requires corroboration.

The need for concurrent data analysis is greater in interpretivist research such as this one which seeks to develop concepts relevant to information systems development and usage. As discussed in Chapter 1 (See Section 1.3 for details), the overall purpose of the research undertaken is to develop appropriate concepts to inform ontological designs for living information systems. As the concepts developed in this dissertation emerge from the data, it is important to ensure the correctness of the data. By doing concurrent data analysis any discrepancies in the data can be addressed during the research.

So the practice of analysing the data after the research is completed was not adopted. Analysing the data concurrently during the research process was an aspect of the original research design. The validity of the research is a recurring issue which is not limited to one particular area of the research. This approach of analysing the data during the research is used in interpretative research and qualitative research generally (see for example Walsham, 1993). The data was analysed during the research to make clear the line of evidence to facilitate the overall, theoretical explanation given in Chapter 6. The logical links or inconsistencies in the data were established and worked out respectively during the research, thus providing the researcher the opportunity to check the explanations or interpretations.

## **4.9 Limitations of the Questionnaire and Interview Designs**

The Datetel Corporation case organisation required strict confidentiality, which meant that the researcher did not have direct access to administer the questionnaire or freely select who to interview. The case study organisation nominated intermediaries, who in some cases



were systems professionals. The intermediaries administered the questionnaire and selected personnel for interviews. A problem with the interview data in this case organisation concerns its quality. It was not possible to access relevant documents to assess the veracity of the interviewees' statement. The restricted access probably results in a different picture of the organisation than would have emerged if freer access had been permitted.

People who refused to respond to the questionnaire as a whole or some of its questions and those who were not selected to be interviewed (by intermediaries and researchers), might have different views and attitudes from those who did respond and were selected for interviews. It is not possible to know their interpretation of the development and usage of information systems through the research methods used. Occasionally, users failed to answer specific questions on the questionnaire. Obviously it is not possible to know why the questions were not answered and therefore their reasons cannot be considered in the research. The fact that they are not represented in the research means to that extent the data is not fully representative of users. However qualitative research does not distinguish small differences as well as large-scale quantitative research, and qualitative studies are not necessarily representative of the population of interest to the researcher. This was the case with only one case study organisation, where intermediaries selected the interviewees. At the University of Luton the questionnaire response rate was the lowest (thirty-three per cent.), but the researchers had free access to interviewees.

Although the case study research method is valuable, it should not be treated as providing conclusive evidence. In essence, case studies are a one-time study done at a particular period in time. The adequacy of a research method depends on the purpose of the research and the questions being asked. A combination of research methods was required because of the diverse mixture of questions being asked in the research. However, interviewing was constrained by limitations imposed by one of the four case organisations, who did not allow the researcher free access to staff.

The question concerning user control over information systems in the questionnaire produced conflicting data. Whereas users felt they had control over the information systems they used, in subsequent interviews systems professionals stated users had no control. This contradictory finding suggests that the relevant questions required more definition, even though a clause had been added in the relevant question to explain the term "functionality."

However, these apparently conflicting views sharply illustrate the different meanings stakeholders attach to their action concerning information systems.

## 4.10 Conclusions

The result of this investigation into the four case organisations is the observation that information systems development and usage happens in changing case organisations. The use of structured approaches for systems development is problematic when factors of organisational change impinge on systems development. Changes in executive decisions, management and administrative policies, and in organisational procedures, all affect the process of establishing information systems needs and the process of systems usage. These kind of changes affect the systems specification process, with the result being that systems are not “specified” as required by the life cycle model of systems development discussed in Section 2.2.

The actual research process as outlined in this Chapter did not deviate in significant areas from the broad outlines of the research design discussed in Chapter 3. So it was possible to apply the interpretivist epistemology to the investigation using the case study research method. Both interpretivism and case study were critical aspects of the research design, and they were implemented as envisaged. Similarly, the actual data collection methods, questionnaires, interviews, and document study, were implemented as envisaged.

Adjustments had to be made in other areas. The distribution of the questionnaire was dependent on the restrictions placed by the two commercial case organisations. Similarly, in the same case organisations the interviewees were not selected by the researcher, but in consultation with representatives of the organisation. It was originally envisaged that both the questionnaire distribution and interviewee selection would be controlled by the researcher alone. In this respect the actual research process varied from the research design. This could not be avoided because of the commercial logic governing the two commercial case organisations.

Ensuring the validity of the collected data was on the whole possible, as required in the research design. In situations where access to data sources such as particular individuals, groups or documents was restricted by the research facilitators, alternative sources were sought to strengthen the validity of the interpretations put on the data. These interpretations are discussed in Chapter 5.



## **5. Data Interpretation: The Concept of Deferred system's design for Changing Information Systems Environments**

### **5.1 Introduction**

This investigation set out to understand and explain how information systems are developed and used in the selected case organisations. This chapter presents an interpretative understanding of that development and usage, and it does so by explaining how the research data has been analysed. In interpretivist research the outcome of data analysis are the interpretations which the researcher puts on the data. Walsham (1995) states that interpretative researchers do not report objective facts. Rather they are reporting their interpretations from other peoples' interpretations of the actual phenomenon studied. This chapter reports the understanding gained from the investigation in the form of the researcher's interpretation.

One form that interpretations can take is concept development, which Walsham (1995) regards as a valid outcome of interpretivist research. Concepts add to our existing understanding, and they provide a critical focus for further developments in knowledge and debate among researchers. Preece (1994) offers a useful distinction between a "thing" and a "concept". He states that a thing exists independently in space and time, whereas an idea exists in one or more minds. Physical objects are things, as are events and actions, or written ideas. A concept is formed or thought in the mind. This understanding of a concept suits interpretive research because it regards a concept as a class of things. The things that form the concepts developed in Section 5.4 below are the empirical data collected from the investigation, and these things are the experiences, meanings and understandings of the participants in the research in terms of their events and actions connected with the development and usage of information systems.

The interpretation is founded on the normative philosophical outlook outlined in Section 1.2, which regards making the design of information systems consistent with the ways in which human organisational work is done. The proposed interpretation in this Chapter serves a dual purpose. First, to understand the collected data from the researcher's point of view or offer his interpretation of the data. Second, and critically, to direct research towards

ontological designs of information systems. In this second respect, the interpretation is constructive in contributing to debate on living information systems and changing the way we think about and perceive information systems in organisations.

This dual purpose of the interpretations made may be put in terms of the purposes of research epistemologies. Orlikowski and Baroudi (1991) regard positivism, interpretivism and critical theory to be three research philosophies in the information systems research tradition. The first purpose of understanding the data from the researcher's viewpoint draws on the interpretivist research tradition. The second purpose of contributing to the debate on living information systems draws on Critical Theory. Critical Theory was invoked in Section 1.2 as forming a part of the philosophical outlook in this dissertation. The main argument of Critical Theory relevant to this dissertation is that the research act should enable improvements in the human condition. These improvements are to liberate humans from alienation and domination by others or by objects such as information technology (see Habermas (1972) for a full exposition of Critical Theory). So the interpretations proposed serve to increase both our understanding of information systems and to improve the social or human condition in organisations with respect to computer-based information systems. The latter is pursued by proposing the development of tailorable information systems based on the deferred system's design principle (see Section 5.4.3 for details on the design principle).

This chapter develops concepts based on the empirical data, postulates the second order concept of deferred system's design and derives from that concept the tailorable information systems design principle of deferred system's design decisions. This is done by organising the chapter as follows. The next section considers issues concerning interpretive data analysis and discusses the difficulties arising in drawing interpretations. The validity of the interpretation is dependent on the internal validity of the data, so Section 5.3 discusses concept formulation in connection with research triangulation. Sections 5.2 and 5.3 thus set the ground for explaining the actual concept formulation process in Section 5.4, and the development of the second order concept of deferred system's design. The following section, Section 5.5, returns to the issue of the validity of the concepts developed by considering the empirical basis of the interpretation. Section 5.6 provides a general discussion on the interpretation, considers the possibility of alternative explanations or interpretations, and examines the implications for practice and theory, as well as considering other issues. Section 5.7 completes the chapter with some conclusions.



## 5.2 Developing the Concept of Deferred system's design

This section is a discussion of the process of concept development. The data interpretation is partly based on Benbasat et al.'s (1987) guidelines for using case studies as a research method for information systems studies. These guidelines suggest that the researcher presents the contextual and data richness of the study. Some of the context is detailed in the descriptions of the cases in Chapter 4. Other aspects will be discussed in Section 5.4, where the concepts are developed. That Section also presents the paraphrased versions of the interview data, as well as some of the quantitative data.

Benbasat et al. (1987) also state that the data analysis should consist of clear “chains of evidence” to support the interpretations, and that the interpretations should be defensible. Again, evidence is provided by the paraphrased interview data and the quantitative questionnaire survey data. The criterion of evidence in interpretive research however needs to be qualified. Walsham (1995) asserts that the result of data analysis in interpretive research is the interpretation of the data formed by the researcher. To ensure that such interpretations are based on valid data precautions were taken to corroborate the concepts. These precautions entailed ensuring appropriate data triangulation.

Walsham (1995) asserts that one of the purposes of interpretive data analysis is to develop “second order concepts”. He argues that the knowledge resulting from interpretive research should increase our understanding of what is happening in the object of study and explain why. This type of understanding should lead to the development of concepts which transcend the pure reporting of empirical evidence arising from the research. Second order concepts are the type of knowledge which adds to or changes our way of thinking about the object of study. For example, Zuboff's (1988) concept of “informaté” is a second order concept. This concept encapsulates her empirical evidence that information technology not only automates work but also produces new information which requires greater intellectual skills to manage. A second order concept proposed in this interpretation is the concept of *deferred system's design*, which is introduced in Section 5.4.3.

The prime focus of data analysis is the content of the data. By content is meant the themes and issues voiced by the interviewees. Maxwell (1996) states that data analysis strategies have to be consistent or comparable to the questions being asked. As the interview questions sought the views, opinions, meanings, and understandings that information systems

developers and users of information systems attached to their actions, it is appropriate to identify the themes and issues which emerge from the data. This type of content analysis entails identifying categories in the data. Its application here is to identify themes and issues relevant to information systems development and usage. The identified themes and issues are the foundation for the developed concepts. As discussed below, some initial categories supporting the concept formulation were inherent in the questionnaire and were pursued further in the interviews. These concepts were developed while data was concurrently interpreted throughout the research.

The actual data analysis was a continuous process. This began with examining the first returns of the questionnaire survey. An analysis of these returns provided some initial categories of interest which were pursued further in the interviews. For example, some questionnaire respondents stated that they had functional control over the information systems they used. This provided material to use in the interviews with systems professionals who argued that such user conceptions were false in terms of the technology available to them. As these first interviews were completed they were transcribed and analysed. An understanding of this interview data informed subsequent interviews. Thus the process of data analysis was continuous or concurrent with the research itself. This type of concurrent data analysis is useful for understanding how information systems were being used and developed in the case organisations, and it produced categories of themes and issues which formed the basis of subsequent interpretations, as discussed in Sections 4.6 to 4.8 which dealt with the actual research process.

Similarly, the interpretive concepts were not developed at the end of the research, rather their construction was a continuous process too. This process began during the interview stage of implementing the research, when qualitative data first become available. However, the roots of some concepts are evident in the design of the survey questionnaire, the probable consequence of experiential data informing the questionnaire design. For example, one question that was posed in the questionnaire survey concerned the level of stability of users' organisational tasks and responsibilities. The data reveals that the organisational tasks and responsibilities of users of information systems change frequently, accounting for around 68 per cent. of users' experiences. This type of work fluidity meant that users of information systems needed new information. When this data was triangulated in interviews, the interview subjects confirmed the fluidity of their tasks and responsibilities.



The thinking developed from this type of data is that both organisational work and the need for information are subject to change. It became evident that information systems are developed and used in a changing organisational environment. This changing organisational environment with respect to information systems is termed here a dynamic information systems environment. The dynamic information systems environment consists of, among other things, changing organisational tasks and responsibilities and consequent changing information requirements. This dynamic information systems environment is construed as the concept of organisational variability. Developing interpretive concepts from empirical data is problematic, as discussed in the next subsection.

### 5.2.1 Difficulties of Interpreting the Data

Various difficulties were encountered whilst interpreting the data. The difficulties arise because of the task of making sense of the meanings and understandings that questionnaire respondents and interviewees attach to their actions in terms of information systems, and their development and usage. This problem is compounded because it is the researcher's interpretation of subjects' meanings and understandings or actions that is being proposed.

An initial difficulty encountered concerned the mechanism for categorising the meanings, understandings and actions of interviewees. The problem faced concerned how the large volume of quantitative and qualitative data could be analysed to enable concept formulation. This categorisation was eventually based on two meta-categories which facilitated the process of categorisation. The first meta-category addressed how the data related to the *information technology* used in the case organisations. The second addressed how the data related to the case *organisations* themselves and the use of *information systems* in them. These meta-categories acted as the mechanism for categorising the data for interpretive concept development (see Section 5.4 for further details on concept formulation.)

The meta-categories of information technology, information systems, and organisations, address the question of how to categorise the data, and also aid in overcoming apparent inconsistencies in the data. The apparent inconsistencies are the different terms and language used by users of information systems and developers in the four case organisations. The categorisation process required careful consideration to make the data construable. Interviewees used varying terminology, some of it unique to their particular organisation. The

different terminology used had to be reconciled to enable data comparison and categorisation, and subsequent conceptualisation. The reconciliation included referring back to interviewees where possible for confirmation after data interpretation, though the final interpretation of the data is the researcher's. Another source used to reconcile different terminology was systems documentation which was useful particularly when understanding the individuals' actions directed at systems. For example, when interacting with customers at the Ace Business Computers case organisation users of information systems sought to set-up personalised sales analysis codes. The relevant systems change logs were checked to confirm the occurrence of this type of action relating to systems.

Another problem concerned deciding what constituted alike data from the semi-structured interviews for purposes of comparison across the case organisations. The semi-structured nature of the interviews meant that it was not possible to ask the same questions to all the interviewees. This problem was overcome by the researcher deciding whether the data fitted one of the three meta-categories (information technology, information systems and organisations) and that way determining the data's relevance for each concept developed.

### **5.2.2 Critical Social Theory**

An overview of Critical Theory is provided in this subsection. How Critical Theory has informed the development of concepts is explained. The discussion is based on Lyytinen and Klein's (1985) argument for using Critical Theory to inform information systems research.

The purpose of Critical Theory is to ensure that research leads to improvements in the area of study. Improvements to the area of study can be made by critically examining existing practices and assumptions, particularly those concerning power relationships. So it is "Critical" because it questions fundamental assumptions. Improvements are necessarily made by asking what ought to be done, which is more subjective than simply asking how an existing practice should be done.

Critical Theory has been applied to information systems research (see for examples Lyytinen and Klein 1985, Hirschheim and Klien, 1989, and Orlikowski and Boroudi, 1991). In terms of the research, Critical Theory has been used to interpret the imbalances in power relationships and resources between systems professionals and information systems users. Such imbalances are inadvertently or deliberately created by technology oriented information systems development methodologies.



A fundamental concept in Critical Theory is that society and its parts are “highly dynamic”. The empirical data analysed in later sections corroborates this view of human organisations. The dynamism results from human social processes in organisations. The development and usage of information systems is such a dynamic social process, which interacts with the physical world of information technology. By viewing information systems development and usage in terms of Critical Theory, the scope is broadened for interpreting the empirical data in the form of the five sub-concepts and the second order concept of deferred system’s design. The resulting conception of tailorable information systems enabled through deferred system’s design decisions facilitates, in terms of Critical Theory, practical and emancipatory knowledge interests which are discussed below.

Human social interaction is categorised into four ideal types in Critical Theory. One, instrumental action is concerned with how humans can control and manipulate their physical environment. Information systems development methodologies based on positivism may be classified into this type. Two, strategic action is concerned with the political processes involved in social interaction, with how power is gained or lost in pursuing certain strategies. The other two ideal types, communicative action and discursive action, are concerned with achieving mutual understanding through language. Agreement, common understanding of norms, meaning and values, and maintaining social relationships are all aspects of communicative action.

Human knowledge is referred to as “knowledge interests” in Critical Theory, and its pursuit is categorised into three types of knowledge interests. One, the technical knowledge interest is concerned with the efficient control of the physical world. Two, the practical knowledge interest is concerned with assisting historic understanding of oneself and others. Three, the emancipatory knowledge interest is concerned with achieving free, open communication and with facilitating the requisite conditions for such communication to happen. It is this third type of emancipatory knowledge interest that has informed the development of the concept of deferred system’s design. By questioning the total systems control of systems professionals, and because deferred system’s design decisions puts some control in the hands of information systems users, a form of emancipation is achieved.

The development of the five sub-concepts and the second order concept of deferred system’s design, discussed later in this chapter, is thus based on communicative and discursive action, and emancipatory knowledge interest in Critical Theory. Communicative

and discursive social action are concerned with achieving mutual understanding through language, and as information technology is used for human communication in the case organisations, these two types of actions informed the development of concepts. Whilst acknowledging that information technology is used to increase organisational effectiveness, the data interpretation has aimed to improve human understanding in terms of communication and redress social and political power imbalances concerning information technology. In doing so, new concepts and values in information systems research and development can be generated.

The concepts developed later in Section 5.4 are related to Critical Theory as elaborated above. Specifically, the concept of organisational variability is based on the central tenant of dynamic social processes in Critical Theory. The concepts of user interface, usability and systems functionality are aspects of technical knowledge interests. They are aimed at increasing control over the physical environment of information technology. The concept of user-control is aimed at improving the emancipation knowledge interest. Shifting some power over information systems to users would provide them with control over information management. The second order concept of deferred system's design is to facilitate communicative processes in organisations. By designing information processes specific to organisational situations, users of information systems can improve their communication. As deferred system's design decisions places control over information systems in the hands of users, it is improving the emancipatory knowledge interest. So practical and emancipatory knowledge is provided through the technical knowledge of deferred system's design and tailorable information systems.

To bring about change in existing thinking and practices in information systems development and usage, change which would improve the present situation, the data is thus interpreted on the basis of Critical Theory.

### **5.3 Concept Formulation and Triangulation**

For the concepts developed in this Chapter to be valid it is necessary to ensure the veracity of the data itself. As briefly discussed in Section 5.2, triangulation was used to reconcile differences in the terminology used by the participants in the investigation, and it was generally used to strengthen the validity of the developed concepts. Triangulation was applied in four ways.



First, triangulation was done across different data sources. Multiple informants were used in the interviews, such as systems managers, systems programmers, managers, sales persons, and administrators who either developed or used the studied information systems (see Appendix F for notes on the interviewees). These people were from different departments and affiliations and so could provide diverse views and perspectives on information systems development and usage. Second, as elaborated in Section 3.3.1, triangulation was done across different data collection methods. So interviews, a questionnaire survey, document analysis and participatory observation were all used. Third, there was constant comparison of data within and across the case organisations. This was done to force confrontation among the emerging interpretations and thereby enabling the emergence of competing or newer interpretations. Fourth, a final member check was done by returning to a couple of the case organisations with the emerged concepts to validate their acceptance by some of the participants in the investigation. The final interpretations however remain the researcher's.

### **5.3.1 Critical Theory and Information Technology in Organisations**

This subsection is an explanation of the reasoning to support the data interpretation in terms of concept development. The basis of developing and using automated information systems in organisations is information technology. Together, information technology and organisations provide the rationale for interpreting data as both the sub-concepts and the concept of deferred system's design. In interpreting data, the aim is to bridge the gap between information technology and changing organisations such that the interpretation enables communication and discussion among users of information systems.

To develop the concepts, both the existing use of information technology to develop information systems and notions of organisations were questioned. Information technology is used in organisations to capture, store, and process certain organisational transactions, those transactions which are a legal requirement or which an organisation wants for management purposes. To do this, amongst other mechanisms, the mechanism of user interface, computer systems usability and systems functionality are used. Though usability and systems functionality are not explicitly recognised in methodologies, these mechanisms have been adapted as sub-concepts here to reflect the empirical data such as to inform the development of living information systems, as shown in subsection 5.4.2.

The adaptation is founded on the view that information systems should enable communicative and discursive actions, and that it should lead to emancipatory knowledge as explained earlier when discussing Critical Theory in terms of information systems development.

To enable communicative and discursive actions through information systems it is necessary for users of information systems to have control. This control needs to be over the capture, storage, and processing of organisational transactions, which would be used to produce required information. This type of control over the functioning of information systems is termed user-control, and developed as a sub-concept later.

Communication and discussion in organisations is dependent on organisational conditions, both past and present. Such conditions in the case studies varied over time. This variation is explained as the organisational variability sub-concept. The sub-concepts of user-control and organisational variability have been explicitly linked to the sub-concept systems functionality in the form of the deferred system's design concept. The functionality of information systems has to be flexible in changing organisations, which is possible by making design sensitive to organisational conditions.

The fundamental reason supporting the development of the concept of deferred system's design is to progress user emancipation in terms of information technology in organisations. In methodologico-project frameworks the control over information systems development and usage rests with systems professionals. Even when participation by potential users is encouraged in methodologies, it is restricted because of the lack of technical knowledge that users have. Users would gain more control over information systems if they were allowed to determine their own systems design, and to do so in particular and changing organisational situations. This type of information systems design contributes to the emancipatory knowledge interest in Critical Theory discussed earlier, and is the reason for developing the concept.

## **5.4 Deriving Concepts for Systems Tailorability**

Once the data has been collected, the question of what sense can be made of it arises. The approach taken here is to find a suitable way of interpreting the data which categorises it, and then allows the categories to be developed into concepts. To aid the initial categorisation process, the widely accepted distinction between information technology and information



systems is used. These form two meta-categories. Information technology and information systems are treated here as meta-categories because they provide an acceptable way for treating the data. The acceptability arises from the fact that information systems are enabled by information technology, and that this distinction is used in practice to develop and use computer-based information systems in organisations. Systems developers' and users' actions, meanings, and understandings of information systems can be interpreted through these two meta-categories.

The use of the meta-categories is also made because the large volume of questionnaire data and the interview data collected during the investigation needs to be analysed, and to do that the data needs to be simplified. The simplification is done by identifying themes and issues running through all the data in terms of the meta-categories and thus forming independent categories of the data. This categorisation process is the basis on which the concepts are subsequently developed.

#### **5.4.1 Meta-Categories for Data Interpretation**

The meta-categories facilitate the treatment of the data by enabling questions of the particular data items in terms of whether the data related to information technology, organisations, or information systems. The themes and issues emerge from the data by posing relevant information technology and information systems questions of the data. Regarding information technology some example questions posed of the data were as follows. What does the data mean in terms of hardware, software or systems interfaces? What do developers and users of information systems understand by information technology? What appears to be the role of information technology in the organisation? What specific aspects of information technology most concern developers and users of information systems? Regarding information systems some example questions posed of the same data were as follows. What do users of information systems and developers understand by information and information systems? What is the flow of information they expect? How should that information be delivered? How does users' organisational work relate to information systems via information technology? What specific aspects of information systems most concern users and developers? This kind of questioning results in interpretations from the researcher's point of view using empirical data.

The meta-categories enable sensible and pragmatic treatment of the data. The meta-categories themselves and the questions generated from them, as set out above, act as a mechanism for interpreting the data by filtering it through issues relevant in information systems and its enabler of information technology. The philosophical orientation necessary for interpreting the data through the meta-categories is derived from Paul's (1993) thesis of regarding information systems as "living". The meta-categories underpinned by the philosophical orientation act as a prism for interpreting the data, which refracts the collected data into interpretative concepts for developing living information systems. The actual data interpretation is now dealt with.

### **5.4.2 Systems Tailorability Sub-Concepts**

In this subsection the data is interpreted to develop five sub-concepts. These sub-concepts are: organisational variability, user control, systems functionality, systems usability, and user interface. They are referred to as sub-concepts because they are subsequently used to develop the concept of deferred system's design. It is this concept of deferred system's design which is the potential mechanism for delivering systems tailorability in living information systems.

Using the identified meta-categories, the data has been interpreted as five sub-concepts based on the distinctions of information systems, organisations, and information technology. These sub-concepts form the basis for developing the concept of deferred system's design for tailorable information systems, the deferred system's design concept is discussed in Section 5.4.3. Table 5:1 below lists the sub-concepts and is illustrative of the process by which the data was analysed to develop them. It shows that by questioning the data using the meta-categories identified above various categories of themes and issues emerge, as shown in the first column. These themes and issues are: internal and external factors causing organisational change, the actual change in terms of organisational policies, procedures and processes, the effect of this change on users' information needs, the usability of the information systems to complete the changed tasks or responsibilities of users of information systems, and finally, the effectiveness of the systems interfaces to deliver the changed information needs. Sample data to support the extraction of these themes and issues is presented in the second column. The final column gives the themes and issues a sub-concept name. The five sub-concepts of organisational variability, user control, systems functionality, systems usability, and user interface, are now elaborated further.



Table 5:1: The Interpretative Sub-Concepts

| Themes and issues emerging from the data   | Sample supporting evidence   | Sub-Concept label          |
|--|--|----------------------------|
| Both internally and externally influenced changes occur to users' tasks, responsibilities, organisational objectives, etc.                     | Nearly 70 per cent. of users' tasks and responsibilities changed. Some causes of the organisational change are: management decisions, new technology, new organisational objectives, processes and procedures.   | Organisational Variability |
| Users' need for information changes as tasks and responsibilities change, but users have no control over information systems processes.        | Nearly 82 per cent. of respondents only received either all or partial changed information required sometimes. Around 27 per cent. of respondents' changed information required ranged from 50 to 100 per cent. Users of information systems devised their own ways of getting the required information by using other available information technology. | User Control               |
| Organisational policies, processes and procedures change because of internal and external factors, but the information system is unresponsive. | Organisational changes in management decisions cause changes to policies, processes and procedures.  | Systems Functionality      |
| Systems cannot be used to deliver the information required to complete changing tasks and responsibilities                                     | Around 46 per cent. of users' information needs are met by the provided information systems.   | Systems Usability          |
| No mechanisms are available to change systems, or irrelevant data input or output screens. No on-line help facilities                          | Though the user interfaces are generally well designed, they do not cater for specific organisational task. User interfaces are customised for specific task requirements.   | User Interface             |

Note: A further sample of questionnaire data analysed on SNAP is given in Appendix D and a sample of interview data is given in Appendix G.

Organisational Variability

In this subsection the data is interpreted to develop the concept of organisational variability. The concept of organisational variability in information systems environments emphasises the fact that human organisations are not static. The evidence from the case organisations shows that organisations are affected by both internal and external factors of organisational change, which together are termed here organisational variability. *Organisational variability* with respect to information occurs over three dimensions. First, users' information needs vary over time and within and across organisational tasks and responsibilities. Second, users' frequency of use of information systems varies. Third, users'

vary the quantity and granularity of the information they require, largely as a response to the requirements to complete their organisational tasks and responsibilities. Organisational variability has an affect on both the development of information systems and its subsequent usage, and this is now evidenced using descriptive statistical data and qualitative interview data.

The data shows that the organisational tasks and responsibilities of users of information systems do change. The questionnaire survey data reveals that nearly 70 per cent. of users' organisational tasks and responsibilities had changed. Further statistical analysis reveals that all the respondents who worked for more that ten years in the organisation experienced change in their tasks and responsibilities. Four-fifths of the respondents who worked for five to ten years, and one in two who worked for less than three years, all experienced organisational changes to their duties and responsibilities (see Appendix D for further tables of quantitative data). This data is corroborated by interview subjects at Datatel Corporation, the University of Luton and the Nene College of Higher Education. A Datatel Corporation Sales Manager stated that his responsibilities were likely to change because of changes in customer needs. The change in responsibilities meant that he had need for newer or different information.

This type of organisational change consequently effects the usage of information systems. The organisational changes in tasks and responsibilities affected users' information requirements. Twenty-two per cent. of the users of information systems across the four case organisations stated that their decision-making had been inhibited because the information systems they used did not supply the required information. Significantly, 51 per cent. of the users of information systems did not answer this question, and of these nearly 19 per cent. were executive to middle managers. This lack of response is explained by one executive at the Ace Business Computers case organisation as concerning the different interests of the user groups and developers. The issue is sensitive because of different stakeholders' interests.

The effect of organisational variability is not restricted to users of information systems alone. Organisational change also affected the development of information systems in the four case organisations studied. At both the University of Luton and the Nene College of Higher Education, organisational change affected the implementation of the Higher Education Management Information System (HEMIS). During the development of HEMIS at the University of Luton and the Nene College of Higher Education, there was fluidity and



organisational change in both the case organisations (see Section 4.3 and 4.4 for descriptions of this kind of organisational change). Though the HEMIS system is designed to process data for a modular degree scheme based on awarding credits for successful passes, it could not adequately cater for organisational changes to policies and procedures of that scheme. The two higher education institutes have implemented modularity in different ways, which is one area in which HEMIS had to cope. Within each institute organisational changes in terms of policy and procedure to the modularity scheme have occurred with which HEMIS found difficulty coping. For example, at the University of Luton the internal boards of examiners requested information on the academic profile of students to inform their decision-making concerning awarding of grades and progression to the next level of study. HEMIS was not designed to provide this information at the internal stage of the examination assessment and progression process. A Field Manager at the University of Luton expressed the view that HEMIS did not reflect the organisational functions it should have been designed to meet. The Field Manager said he had to use the Excel spreadsheet to process vital data in preparation for both internal and external examination boards (see Appendix G for a sample of interview data).

The Academic Registrar at the Nene College of Higher Education felt that the HEMIS system was not suited for her particular organisation. HEMIS should have supported the management of a new modular degree credit scheme which allows the organisation to offer flexible degree programmes to its students. The Academic Registrar felt that many amendments to HEMIS were required because it failed to support adequately the modular scheme. This also meant that she had to use other information technology. For instance, she had to devise the alternative of using a spreadsheet package on a micro-computer to process required information, she then attached the spreadsheet workbook containing the processed information to email messages to lectures to convey the information. (This kind of usage of information technology at the University of Luton, Nene College of Higher Education and Datatel Corporation is supportive of the view that information technology enabled information systems are living entities.)

The empirical data reveals various causes for the type of organisational change or organisational variability discussed above. The causes or factors of organisational change are listed in Table 5:2 below. Respondents were permitted to give multiple answers to the question concerning causes of organisational change. The most significant factor of

organisational change is management decisions, accounting for 35 per cent. of organisational variability. The next most significant is organisational changes to the use of information technology, accounting for 33 per cent. of organisational variability, and then organisational processes and procedures which account for 26 per cent of organisational variability. This kind of organisational change is evident both during the development of information systems and when information systems are subsequently used. So it can be concluded that the actual information systems development, implementation and usage environment is dynamic.

The impact of the kind of organisational variability described above on the provision of information systems is the gap of information that is produced between what is required and what is available. Generally, users of information systems in the case organisations were dissatisfied with this information gap. Eighty-seven per cent. of the users of information systems were dissatisfied because changes in organisational tasks were not met by a commensurable change in information needs from operational information systems.

**Table 5:2: Factors of Organisational Change**

| Base                                 | (91) |
|--------------------------------------|------|
|                                      | %    |
| Management decisions                 | 33   |
| New or enhanced technology           | 33   |
| Organisational process or procedures | 26   |
| Job description                      | 18   |
| Organisational objectives            | 18   |
| Organisational tasks                 | 16   |
| Personnel                            | 15   |
| Colleagues' work practices           | 11   |
| Other                                | 4    |

This fact was further explored in an interview at Datatel Corporation, where a Sales Manager expressed the view that information systems developers do not appreciate the way work is actually done. The information systems provided result in dissatisfaction over the lack of required information, inadequate systems functionality, and inappropriate user interfaces.



The result of this kind of organisational variability in terms of the usefulness of information systems is that methodologico-project bound systems lag behind variable organisational needs. The Operations Manager at Datatel Corporation stated that all their time is spent “enhancing and fixing old ones (systems)”, accounting for the fact that organisational variability results in much systems professionals’ time being spent in keeping systems current. Such a lag was also apparent at the two higher education institutes. The Academic Registrar at the Nene College of Higher Education apologetically stated that the Higher Education Management Information System (HEMIS) is “not used as intended.” Since its delivery it has not matched the organisation’s work patterns. The Academic Registrar lamented that they had to get the “best out of it (HEMIS)”. This is also true of HEMIS’ operation at the University of Luton as experienced by the researcher’s role as a user there.

The lag of information provision in the circumstances of variable organisational needs however is not so great at the Ace Business Computers case organisation. The Pegasus system at Ace Business Computers was re-configured to match the way sales work is done. The systems’ functionality is tailored to match the functional needs of the organisation, and in particular to suite customer needs. This is particularly the case with information concerning the company’s sales to clients. The company’s policy is to offer personalised service to its clients and the system is configured to meet each client’s different needs. The Finance Director at Ace Business Computers stated that each client has a “different type of attitude” and that they “strongly believe” in personalised service and matching their system to support that service.

The effect of organisational variability on the development of systems is that systems are delivered which do not match variable organisational work patterns or user requirements for information. The Field Manager at the University of Luton stated that the Higher Education Management Information System (HEMIS) was affected by organisational changes to the University’s procedures, development time allowed, funding, and lack of agreement on systems requirements among the ten parties involved. He cited organisational changes to student module combination prohibitions as an example of procedural change with which HEMIS could not cope. The Chief Administrator at the same organisation stated that the systems requirements definition did not account for non-returning students, so HEMIS could not process that data and that it had to be processed manually. The Field Manager further stated that rather than adhering to a structured development approach the developers of

HEMIS ended up with a “fire-fighting” attitude. This is also the experience of the Nene College of Higher Education and Datatel Corporation.

Systems professionals largely control the development and usage of information systems studied, and the organisational variability experienced by users of information systems is not immediately reflected in the information systems that are provided for them to use. The Operations Manager at Datatel Corporation stated that users of information systems control information systems through the Management Information Systems Department. However, users’ requests for changes to systems functionality are not unquestioningly done by the Department. The required organisational changes are first examined by systems analysts for feasibility, and only implemented if found to be technically feasible, sometimes ignoring organisational needs. This scenario existed at all the four case organisations. At the University of Luton examination boards’ requests for new information on management reports were noted by systems intermediaries but often did not materialise because it was not feasible to implement.

Systems professionals are reluctant to give control to users of information systems because they fear disruptions to systems operations. The Operations Manager at Datatel Corporation stated that because users of information systems could not agree on what was required from systems, allowing them control could lead to conflicts. The Finance Director responsible for systems at Ace Business Computers expressed his fear more graphically. The Management Services Manager at the University of Luton was concerned that the integrity of the system may be compromised by allowing users of information systems to make changes.

Systems professionals were also concerned about allowing users of information systems control because of the way users behave. The way users of information systems behave is essentially the organisational variability described above. For example, the Operations Manager at Datatel Corporation stated that departments have “vested interests”, and wanted things done differently. A systems programmer at the same organisation rather poignantly stated that users of information systems are “never going to agree” on what is required from systems.

The actual behaviour of users with respect to information systems they use indicates that users of information systems do want to control the development and usage of systems. The Field Manager at the University of Luton stated that degree programme management were not included in the development of the Higher Education Management Information System



(HEMIS). The development was controlled by systems professionals from the Management Services Department. After HEMIS was delivered the Field Manager used a spreadsheet to compile information for examination boards because HEMIS could not provide the required information. The Field Manager stated that he would like more decision support information to come from HEMIS. Similarly, the Chief Administrator of the Modular Credit Scheme stated that she would like to make changes to HEMIS herself. This type of use of information technology to match organisational variability is interpreted here to suggest a need for user control over information systems. This issue of user control is now considered.

## User Control

The development of the concept of user control is thought to be a logical extension of the data on organisational variability. With the evident kind of organisational variability existing in the case organisations, it is logical to place some control of the development and usage of information systems in the hands of users of information systems. By *user control* is meant a device or interface widget which enables users of information systems to manipulate information systems to match the type of organisational variability observed. This means giving users of information systems the political and technical power to direct or determine system states. This interpretation is consistent with Dearden's (1972) comment discussed in the introductory chapter about the absurdity of thinking that systems experts alone can cater for all the information needs of a company. This is especially true when it is realised how much organisational variability exists, with which the development and usage of information system has to cope.

There are two types of systems control distinguishable from the field data. The datum concerning the user spreadsheets at the University of Luton and Nene College of Higher Education, and the re-keying of data onto portable computers by salesmen at the Datatel Corporation to process data has been cited earlier. This type of user control over information technology is termed here as *micro-tailoring* of systems. Micro-tailoring is directed at adapting information systems to suit particular organisational tasks and responsibilities, and is affected by users. The other type of control is *macro-tailoring*. Macro-tailoring is affected by systems professionals and is directed at adapting information systems' core functionality to match major or fundamental changes in the organisation. An example of macro-tailoring is the fact that some of the core functionality for the Higher Education Management Information

System (HEMIS) at the University of Luton and Nene College of Higher Education had to be reprogrammed by systems professionals to meet the requirement of the Department of Education to supply information on students to the Higher Education Statistics Agency.

The questionnaire survey data reveals that 69 per cent. of users of information systems across the four case organisations thought they had control over the operation of the information systems they used. This result leads to the puzzling view that users perceive that they exercise control over information systems. To gain a clearer understanding of this data, the issue was pursued in interviews. In the interviews systems developers expressed a contrary view. A developer at Datatel Corporation stated that users of information systems exercise control over the trivial operation of information systems, but have no power over systems functionality. This was confirmed by developers at the two higher education institutes too. A HEMIS developer at the University of Luton stated that new systems requirements stated by the Modular Credit Scheme Office are restricted by the available finance. A senior Scheme administrator commented that more reports from HEMIS need to be changeable by users of the system and that other functions such as email could be interfaced with HEMIS to enable better communications among staff.

The attitude of some progressive systems professionals is not wholly negative to users of information systems getting more than trivial control over systems. They recognise that some users of information systems would like more control, but the conditions under which they are willing to allow users control are dependent on the availability of the right information technology. The Management Services Manager at the University of Luton is willing to give control to users of information systems where it is feasible to do so. For instance, he is allowing users of HEMIS to control their own reporting codes. The Academic Registrar at the Nene College of Higher Education will be making use of a special computer tool called Explorer for administrators and academic staff to use on the Higher Education Management Information System. This tool will enable users to write their own reports on a local basis by setting up workbooks which users can use to “manipulate some data into their own formats.”

The Finance Director at Ace Business Computers allows users of information systems to build up varying sales analysis codes because he recognises that managers have “different attitudes”. He is keen to develop systems that support sales and which closely suit trading and working patterns of users of information systems.



Though users of information systems are allowed some control over the systems they use in the four case organisations, they have no control over the systems functionality and some 85 per cent of users rely on systems professionals to make required changes for them. To be effective in the kind of organisational variability described earlier, users of information systems require control over systems functionality. This concept of systems functionality is now considered.

## Systems Functionality

The data used to develop the concept of organisational variability underpins the concept of *systems functionality* too. Variations in users' organisational tasks and responsibilities give rise to the need for new or different information. To provide that kind of variable information it is necessary to build systems functionality which itself can be varied. The functionality of information systems developed and used in dynamic information systems environments, must itself be variable. By systems functionality is understood the ability of information systems to take inputs and process them to provide required information, but the algorithms used to do the processing must themselves be variable.

This interpretation of systems functionality links it directly to organisational variability. So the preponderance of organisational change in terms of variations of users' tasks and responsibilities, and the organisational processes as illustrated in the sub-section on organisational variability, means that information systems functionality has to be variable too. Around 47 per cent. of the users of information systems stated that they needed the information systems they used to be amended because of changes to their organisational tasks. In an environment of organisational variability, users' information needs change, so around 27 per cent. of users of information systems stated that their information needs changed by more than 50 per cent. This data is contrary to the view of the Operations Manager at the Datatel Corporation who said that users of information systems only wanted to change report outputs and not actual systems functionality.

The above shows that there is a direct link between organisational variability and the functionality of information systems. This link can be regarded as the responsiveness of information systems functionality to organisational variability. Generally, this responsiveness is weak in the information systems studied. The questionnaire survey however reveals that 63 per cent. of users of information systems regarded systems to be responsive to organisational

change. This apparent fact was pursued in the interviews and it was ascertained that the kind of responsiveness users of information systems were referring to was trivial needs like changes to report items. Organisational changes in their tasks and responsibilities and the consequent need for wholly different information was not reflected in the information systems. Consequently 82 per cent. of the users of information systems did not receive all the required information all of the time.

The inappropriateness of systems functionality to match organisational variability is summed up by the Field Manager at the University of Luton. He said that the Higher Education Management Information System (HEMIS) is not an information system but a "piece of computing plus software." HEMIS has no systems functionality to match this user's needs in terms of administering a Field in the Modular Credit Scheme. To complement the usage of HEMIS, academic and administrative staff develop their own systems using spreadsheets and databases on micro-computers. This kind of changing usage of information systems was not considered when requirements for HEMIS were first being established. While this picture is true of three of the case organisations, it is not true of Ace Business Computers. The Finance Director at Ace Business Computers emphasised that their use of the Pegasus system could be likened to a skeleton which was fleshed-out to match his company's operations.

The general unresponsiveness of the studied information systems is attested to by developers and users of information systems alike. The Field Manager at the University of Luton emphasised the difficulty of amending HEMIS's functionality. He cited student module combination prohibitions as an example and said that the required systems change can only be implemented by the original developers, Educational Management Information Systems, who would have to make changes to the core system code. The Field Manager also would like HEMIS to support the control of time-tabling and monitoring of student attendance. Similarly, the Management Services manager at the same organisation said that HEMIS's "code is fixed and rigid."

The effect of this kind of fixed and rigid code or unresponsiveness of information systems on organisations is that systems generally are not used as intended. This is to be expected, as the particular organisation for which the systems were developed has moved on because of organisational variability. For instance, the Academic Registrar at the Nene College of Higher Education said that new functionality had to be added to HEMIS because of the widespread



educational changes in the organisation. She said that the assessment module in HEMIS was not used as intended by the developers, because their organisational procedures were now different compared to when the systems requirements were first established. The Chief Administrator at the University of Luton concurred when she said that the use of HEMIS had changed since its installation.

To cater for organisational variability the Operations Manager at the Datatel Corporation stated that systems are designed by taking “account of all the things that can happen.” Though the actual workings of the systems studied showed that not all requirements are predictable. A related point is that systems developers at the Datatel Corporation presume they know what users of information systems want. A systems programmer made this bold statement: “We know how the company works.” This sums up the general attitude of systems professionals towards users of information systems at Datatel Corporation and Ace Business Computers. Systems professionals at the two higher education institutions shared a tempered version of this attitude.

If systems are to be responsive to organisational variability, it is necessary for systems functionality to be variable too. Generally, this was not evident in the case organisations studied. The unresponsiveness of information systems can be attributed to the adoption of the methodologico-project paradigm for developing and using information systems discussed in Section 2.2.

## Systems Usability

The concept of systems usability is based on user interface studies in the field of human computer interaction, where the usability of interface designs is assessed. The criteria used for assessment are effectiveness, learnability, flexibility and users’ attitudes to the designed interfaces (see Nielson, 1993 for an extensive account on interface usability). The idea of usability has been re-conceptualised here to encompass the whole information system, and may be regarded as users’ ability to achieve specific and variable organisational tasks or responsibilities using information systems. This type of information system usability is termed *systems usability* here. It is necessary to consider the use of information systems in these terms because of the evidenced organisational variability. Given such organisational variability it is necessary for systems to be usable in such a way that they can be employed to

support changing organisations. The criteria of effectiveness, flexibility, learnability and users' attitudes are now applied to interpret the data in terms of systems usability.

The effectiveness of the information systems studied is dependent on the available systems functionality. The Operations Manager at the Datatel Corporation stated that their systems enhancement work has to be prioritised. This prioritisation meant that users of information systems are not provided with the systems functionality they require when they require it. In that sense, the provided systems are ineffective. This is also true of the Higher Education Management Information System (HEMIS) at the two educational organisations.

The experience of Ace Business Computers case organisation contrasts with the above. The Pegasus accounting information system is quite effective because users can make changes to it to suit their different and variable work patterns. At the Nene College of Higher Education the HEMIS system is not usable in the same way. There the Academic Registrar stated that work has to be moulded around HEMIS. Rather than supporting organisational work, HEMIS forces different ways of doing work, which was not envisaged as a consequence of introducing HEMIS. HEMIS may be regarded as an ineffective system. Systems usability means that users' organisational work should be facilitated by information systems, which HEMIS fails to do effectively at the Nene College of Higher Education.

The systems studied are generally made learnable by systems developers. At the Nene College of Higher Education, customised on-line help has been built into HEMIS to make the system usable. Generally, interfaces on the systems studied were usable according to the questionnaire respondents. Some 57 per cent. stated that their interfaces were usable. There are various kinds of things that make systems usable. (The figures in brackets refer to respondents who agree.) These things are: formatting of output (73 per cent.), display of all required information (45 per cent.), use of appropriate wording (16 per cent.), and avoiding unnecessary detail (25 per cent.).

The issue of flexibility of systems has been addressed in the subsection above dealing with the concept of systems functionality.

Users' attitudes to information systems varied across the case organisations. At the University of Luton the Field Manager was frustrated at having to work with HEMIS because it lacked responsiveness to organisational needs. The researcher's own experiential data from the University of Luton engenders a similar attitude of frustration. His needs for information on students taking his modules were not met by HEMIS, and like the Field Manager the



researcher used other means supported by other information technology, such as spreadsheets. A more acute feeling was expressed by an academic user of HEMIS at the Nene College of Higher Education. He stated that he lacked confidence in HEMIS' ability to make the modular scheme efficient. A sales manager user at the Datatel Corporation felt that he had no choice but to use the provided systems.

The concept of systems usability is critical. It is critical because the pace of organisational variability demands user control over systems functionality, which in turn means that systems functionality has to be usable. The concept of systems usability also has bearing on the philosophical outlook outlined in Section 1.2. If systems designers are to avoid engendering mechanised behaviour in humans in organisations it is necessary for systems to be usable in the type of organisational variability described earlier. An important aspect of systems usability are user interfaces, and this is discussed next.

## **User Interface**

The concept of user interfaces is central in computer systems designs. An interactive user interface is the medium through which a user can operate a given information system, and it facilitates the dialogue between a user and the system. The user interface is a significant part of the software code that makes up a particular system, taking up to 40 per cent. of systems code according to Browne et al. (1990).

The questionnaire survey data reveals that 57 per cent. of the users of information systems in the case organisations believed they could manipulate the information systems they used via user interfaces. By manipulation they understood the inputting of data for processing and subsequently calling up the information. It is significant that 36 per cent. of the users of information systems believed they could not manipulate the information systems they used through the user interface. This issue should have been dealt with further in the interviews but was overlooked.

From the users' perspective the user interface fulfils the function of providing information for organisational tasks or undertaking responsibilities. As the data reveals there to be organisational variability, the user interface needs to facilitate making variations to systems functionality to enable information systems to remain responsive to users' organisational needs. In this manner, the user interface is being conceptualised to link directly with organisational work. The Management Services Manager at the University of Luton said that

special user interfaces had to be coded to match users' specific working patterns. Extra menus were added to user interfaces on the Higher Education Management Information System (HEMIS) to facilitate particular types of organisational work. Some special interfaces were designed to replace the original data entry mechanisms provided on HEMIS. The Management Services Manager allowed the possibility of users of information systems designing systems interfaces themselves to capture new data or allow restructuring of existing inputs.

The concept of user interfaces, though not original, is re-conceptualised here to match directly with organisational variability or with individual or group working patterns. To cater for organisational variability user interfaces need to be more than just the human-computer boundary between a system and a user. Interfaces need to be the medium through which systems functionality may be altered. This is particularly significant for designing living information systems. This means that user interfaces need to be the medium for user designed alterations to systems. This type of systems designing is coined deferred system's design decisions and is discussed in the next section.

### **5.4.3 The Principle of Deferred system's design for Changing Organisations**

The sub-concepts developed in section 5.4.2 form the basis for the second order concept of *deferred system's design*. Each of the developed sub-concepts in the previous subsection points to the notion that users of information systems themselves should be able to design information systems for the variable or changing organisational situations they encounter. Allowing users of information systems to do this type of systems designing is coined deferred system's design and is postulated as a second order concept emerging from the data. The sub-concepts developed in the previous subsection provide sufficient inductive reasoning to propose that users of information systems should be allowed to design system's for the variable organisational situations in which they have to complete their organisational tasks and responsibilities.

The deferred system's design concept emerges out of observations from the cases studied that planned information systems are actually developed and used in a variable or changing organisational environment. The phase of systems requirements determination in methodologico-project frameworks is often superseded by organisational events which



change objectives, policies and procedures, and which mean that users' need for information changes too. Designing information systems purely on the basis of requirements specification results in information systems that tend to dissatisfy users and results in the use of systems in other ways than intended or planned (see the data tables in Appendix D). Most critically they result in organisational work being moulded around the delivered system, rather than the system facilitating variable organisational work designed to achieve business objectives. The deferred system's design concept encapsulates the thesis argument proposed here that since the life cycle model cannot keep pace with organisational variability as discussed in Section 2.2, information systems should be designed to allow users themselves to make systems design decisions in changing organisations. A variant of this type of systems designing is evident in the Pegasus accounting information system used at the Ace Business Computers case organisation, which is configured or designed to meet changing organisational needs.

The concept of deferred system's design may be extended into an information systems design principle. The principle is named *deferred system's design decisions*. The principle is the view that because the data reveals there to be organisational variability which makes information systems environments dynamic, information systems should be designed in such a way as to enable users of information systems to make the actual systems design decisions, depending on the organisational situations in which information systems will be used. By allowing users to so configure systems, the information systems become responsive to users' situational needs, and so deferring systems design decisions to them. The deferred system's design principle aims to lead designers to think of information systems development and usage in a "living" way, by making the actual design of information systems sensitive to the social and organisational context as discussed in Chapter 4 in which systems must function.

The developed sub-concepts of organisational variability, user control, systems functionality, systems usability, and user interface are subsumed in the concept of deferred system's design. By allowing users of information systems to make deferred system's design decisions it is possible for them to:

- meet organisational variability in terms of information needs as they encounter it
- exercise control over the information systems they use to perform organisational tasks and responsibilities
- vary the functionality of the delivered information systems

- use the information as they want and finally
- do all this through the user interface which delivers the deferred system's design mechanism.

By deferring systems design decisions, information systems can be made *tailorable* by users. The principle of deferred system's design decisions is a radically different view which proposes that information systems development and usage should take the form of users taking actions regarding information systems in variable organisational situations. The principle concurs with Suchman (1994) who argues that intelligent computer systems designs should consider the non-planned nature of most human behaviour, which she calls actors' "situational actions", which may be compared or likened to the concept of organisational variability developed earlier. Suchman (1994) asserts that human behaviour is more accurately explained as situational action, where humans react to actual or perceived situations rather than behave according to plans formulated in advance. This bears out much of the data from the present research and which was presented in the previous sections. In such changing organisations the notion of making information systems tailorable by users through the mechanism of deferred system's design makes sense.

In contrast, most researchers in information systems development have modelled themselves on computer scientists and the notion of planned or engineered systems, as discussed in Section 2.2. The essence of human behaviour for Suchman (1994) is "shared understanding" or "mutual intelligibility" in which the meanings people attach to their behaviour or actions are not observable, and therefore not subject to plans or engineerable. Her observations concerning the reification of human behaviour by designers of intelligent machines is thus applicable to the life cycle model discussed in Section 2.2 and attested to by observations from the present investigation as discussed in this section. The principle of deferred system's design decisions is aimed at producing information systems designs that do not reify human behaviour in business organisations, where much human activity is dependent on organisational change.

Paul (1993) has made an observation not too dissimilar to Suchman's (1994), which takes the form of the mock fixed point theorem of information systems discussed in Section 2.5. Paul (1993) specifically argues that the methodological approach to information systems development ignores the changing nature of business organisations, an argument which is



supported by the data from this research. In that sense, information systems development methodologies may be regarded as being reificatory. Rather than regard information systems as essentially the meanings and understandings that people attach to data and information, as evidenced in the concept of organisational variability formulated earlier, and meanings which are likely to change in varying situations, methodological systems development attempts to capture and codify those “unobservable” meanings in planned or engineered information systems. This view of changing meanings and understanding of information among users of information systems is termed ontological information exchanges and is further elaborated in Section 6.4.2. The principle of deferred system’s design decisions has been formulated to cater for variable and unobservable meanings, and provides the basic approach to designing *tailorable information systems* in which systems functionality is capable of coping with organisational variability in terms of the different meanings attached to information by users of information systems.

The principle of deferred system’s design decisions encompasses the five developed sub-concepts. Clearly, by deferring systems design decisions to users, the three concepts of organisational variability, user control and systems functionality are incorporated. The medium for enabling deferred system’s designing is of course the user interface, the fourth concept. The final concept of systems usability is more inherent than explicit in the principle. It is inherent because users of information systems cannot take deferred system’s design decisions unless the system is usable.

The idea of deferring systems design decisions to users of information systems is, in Walsham’s (1995) words, a “rich insight” into living information systems designs. Such insights are possible through interpretive research. This insight is consistent with Paul’s (1993) view that businesses are living systems, and the deferred system design decisions principle overcomes the mock fixed point theorem of information systems by recognising the diversity and fluidity of organisational situations and allowing users of information systems to make systems design decisions in such variable situations.

## **5.5 Validating Deferred system’s designing**

In this section the issues concerning the validity of the interpretations made in this Chapter are first discussed and then consideration is given to alternative explanations of the

case data. Evidence from other research which concurs with the interpretations made here is then finally considered.

The set of developed sub-concepts (organisational variability, user control, systems functionality, systems usability, and user interfaces), the second order concept of deferred system's designs and its derivative design principle are posited as empirically valid. The data which supports the concepts and the principle have been checked for internal consistency using triangulation. As the data was collected from real organisations that adds further validity.

The value of the interpretations made is further strengthened by the data being sourced from multiple case organisations. The same picture of organisational variability with respect to information systems development and usage is found in all the four case organisations. The type of organisation or size or the organisational purpose, whether commercial or educational, makes little difference to the dynamism of information systems environments.

An often quoted aspect of assessing the empirical validity of the results of a study in the literature on research is to consider and evaluate alternative explanations of the data. Note that considering alternative *explanations* is not the same as considering alternative *interpretations*. The latter would be acceptable in interpretivist research and would not be regarded as conflicting with the interpretations already made because of the social relativist basis of interpretivism.

One established alternative explanation is to redress users' dissatisfaction with delivered information systems by involving them in the information systems development process (see for example Mumford, 1993 or Schuler and Namioka, 1993 for details of this approach). The main objection with this view is that the power to decide systems designs still rests with systems professionals, and the user participation approach does not at all address the occurrence of organisational variability in systems designs or in the process of designing systems. Most significantly though, the user participation explanation is rooted in the methodologico-project paradigm which was discussed in Section 2.2 as being inappropriate for changing organisations.

There are various explanations of the software process. For example, the prototyping model, the rapid application development model and the evolutionary software process model. However, like other explanations for conducting better systems specifications or predicting organisational change (see for example Land, 1982 or Fitzgerald, 1988) these models are



bound in the same methodologico-project paradigm. It is in fact the methodologico-project paradigm which itself failed, on the whole, to deliver responsive information systems in the case organisations. Any explanations of the data based on the methodologico-project paradigm will be answerable to Paul's (1994) fixed point theorem of information systems development and account for how the paradigm deals with organisational variability.

There is supportive evidence to strengthen the view developed in this dissertation that information systems development and usage needs to explicitly recognise the variable nature of organisational life. Waema (1990) in his study of information systems in financial services argues that senior management doubted the effectiveness of structured design approaches for the strategy and planning of new information systems because of lack of progress and lack of relevance in a fast changing environment.

Another aspect of validation is whether the general observations made on the basis of the investigation support or contradict similar research by others. The general outcome of the present investigation is the observation that information systems environments are dynamic. Both the development and usage of information systems is subject to organisational change. This observation concurs with other research by Gause and Weinberg (1989) and Baskerville et al. (1992), which was discussed in Section 2.2.

## **5.6 Enabling Changing Organisations with Situated Systems**

In this section a discussion on the deferred system's design concept is developed drawing on the philosophical outlook presented in Section 1.2. The purpose of the discussion is to broaden the perspective on thinking of living information systems as enabled by *systems tailorability* by using deferred system's design as a systems design principle. It is necessary to so broaden the perspective on the concept of deferred system's design because eventually the question of making generalisations from the research data arises, as undertaken in Chapter 6.

The principle of deferred system's design decisions proposed to develop systems which enable users of information systems to make their own design decisions in particular organisational situations is significant. Designing information systems for static environments and for dynamic environments poses different sets of issues and problems for systems developers and researchers. The life cycle model discussed in Section 2.2 seems adequate for designing information systems that do not encounter much organisational change, but it is

inadequate for designing information systems that have to cope with a changing environment during development and after implementation or during systems usage. The development and usage of information systems in the case organisations used life cycle based methods and techniques or structured approaches, and the views of the interviewees suggest that the methods have not kept pace with the organisational changes taking place in their respective organisations.

The deferred system's design decisions principle addresses Dearden's (1972) concern regarding the concentration of systems development power in the hands of few qualified systems professionals. It does so by diffusing the responsibility and power of developing and using information systems to those who will make use of them in actual organisational situations. This is done by deferring the design decisions to users of information systems, who would make systems designs decisions to tailor systems to their variable organisational situations. This kind of deferred system's design approach would go beyond the present situation in the case organisations where professionals retain power over design decisions by employing such mechanisms as developer and user liaison groups or providing regulated enhancement maintenance to systems. Systems professionals recognise that users of information systems want and need control over the systems they use, as witnessed in the provision of user tools such as Explorer (subsection 5.4.2). The deferred system's design decisions principle contributes to thinking on this kind of development in user control over information systems, but it does so in a much broader sense.

By catering for variable organisational needs the deferred system's design principle does not succumb to Paul's (1993) fixed point theorem of information systems development. The fact that agreement between developers and users of information systems and among users in the case organisations was difficult to reach indicates that systems designed on the basis of deferred design decisions may cater for reconciling such differences. Users' ability to take deferred design decisions would vary a delivered information system to suit dynamic systems environments, so making information systems "live" by catering for users' particular information needs. The design principle is practical in as much as it concurs with Suchman's (1994) notion of "situated actions." She argues that better human-computer interface designs are possible if they allow users to control their interaction with computer systems depending on users' particular situations. The deferred system's design decisions principle is formulated to allow actions on information systems development and usage to be similarly situated.



To some extent the concept of deferred system's design questions the mentality of using projects in systems development. The use of projects in the case organisations meant that systems were rushed out because of time and budget limitations and, consequently, lacked the required functionality in terms of providing relevant information. The development procedures at the Datatel Corporation reveal instances where the pressure of time and budget constraints led to compromising requirements specifications. Users of these systems were dissatisfied with them. By allowing users to shape information systems using deferred system's design decisions, the design principle caters for growing or continuously developing systems according to organisational needs. So the design principle contributes, in Winograd and Flores' (1993) terms, to ontological systems designing. This is because taking deferred design decisions does not automate or mechanise interaction between humans and computers, and allows users to grow the systems they use. As this growth or continuous development is determined by the actual organisational context in which users of information systems find themselves, the resultant systems are truly ontological.

In the discussion so far, users of information systems may be regarded as a homogenous group with respect to age or gender. Except for two instances there are generally no significant variations across age or gender groups (see Appendix D for a detailed breakdown of the cross tabulations). The first exception concerns variations in information needs. The male group had a larger variation (76 per cent.) than the female group (54 per cent.) This is explainable by the fact that males tended to be in positions likely to be affected by the factors of organisational change identified in Table 5:2, Section 5.4.2. The second exception concerns the responsiveness of information systems to organisational variability. The male group perceived information systems to be more responsive (79 per cent.) than the female group (50 per cent.) This anomaly was explained by ascertaining in the interviews that the type of responsiveness perceived concerned trivial data input and output functions.

Taking together the above points on diffusing systems responsibility and power to users of information systems, making information systems live, and allowing users to grow information systems, it may be conjectured that the deferred system's design decisions principle may lead to greater user satisfaction, as users would be in control of their own designed systems varied to meet their particular organisational needs.

Care is needed in deploying the deferred system's design decisions principle to information systems development. It may be argued by some, especially by systems

professionals, that the magnitude and quality of organisational variability in the information systems environment does not warrant this kind of user control. This was the general view of systems professionals in the case organisations, though progressive systems professionals admitted the need for user control if the right technology is available.

The concept of user control over the development and usage of information systems is a radical departure from accepted theory and practice in information systems development and research. Certain issues and problems still require further investigation. For instance, at the Datatel Corporation case organisation conflicts arose between two user groups over the formatting of customer data files. At present such conflict is mediated by systems professionals who retain control over the development and operation of information systems. By diffusing power to users of information systems through deferred system's designing, and so making information systems tailorable by users, such conflictual systems change would have to be reconcilable in systems terms.

By positing the principle of deferred system's design decisions, the research data has been interpreted as revealing a dynamic organisational information systems environment. However, certain questions regarding suitable conceptions of information systems arise by making this interpretation. The proposed deferred system's design principle contributes to designing "living" information systems, but the specific form of such systems is still an open question. Issues regarding how and who should develop such systems also still remain to be properly addressed. These concerns are addressed by introducing the notion of tailorable information systems as one possible alternative conception, and the notion is developed theoretically in Chapter 6.

## 5.7 Conclusions

This chapter has provided an interpretation of the data from the case organisations based on the notion of developing living information systems. The interpretation has resulted in the formulation of concepts based on the distinctions of information technology, organisations, and information systems. The distinctions were used as meta-categories to analyse the case data. The case data was further generalised as the concept of deferred system's design and from it was derived a living information systems design principle, called deferred system's design decisions. The notion of tailorable information systems which cater for dynamic



environments was finally introduced as one particular application of the design principle. The purpose of the data interpretation done in this chapter is not to suggest that this is the only interpretation possible, though certainly the developed concepts and principle are supported by case data.

The data reveal a dynamic organisational environment in which information systems are developed and used. In such an environment, the use of structured methods of systems development based on the life cycle model lead to user dissatisfaction with delivered systems. To accommodate the dynamic organisational environment and increase user satisfaction the principle of deferred system's design decisions was proposed.

The next chapter proposes a theoretical interpretation of the data which incorporates the deferred system's design decisions principle.

## **6. Incorporating Deferred System's Design into the Spiral of Change Model of Tailorable Information Systems**

### **6.1 Introduction**

In this chapter an interpretive theoretical explanation of the empirical data is discussed. An attempt is made to explain the data in terms that generalise it to provide a basis for thinking of the relevance of the research undertaken to other organisations and other researchers' interpretations in terms of the development and usage of information systems. The proposed generalisation provides a model for thinking of living information systems in terms of deferred system's designing or systems tailorability, and the notion of tailorable information systems is proposed as one way of accounting theoretically for the type of organisational change observed in the case organisations. The generalisations themselves form the basis for proposing for further research a computer tool called Hyper-Tmodeller to facilitate the understanding of tailorable information in organisations generally.

Commenting on the role of theory in information systems Keen stated that data alone do not generate theories, rather that theories are generated by researchers (in Nissen et al, 1991). Although Keen's comments concerned the development of theory based on positivist research in information systems, this view of the researcher's role in theory development is quite pertinent to interpretivist theory formulation too. As discussed in Section 5.1, the interpretivist researcher does not only report objective facts, but rather he reports his own interpretation of other peoples' interpretation of the phenomenon under investigation (see Walsham, 1995 for a fuller discussion). Consequently, the theoretical explanation of the case data developed in this chapter is the researcher's interpretation of what happened regarding information systems development and usage in the case organisations studied.

An important facet of theory is its general applicability. Walsham (1995) details four types of generalisations possible from interpretivist research, some of which have been used in this dissertation. One, the data may be generalised as concepts. The nature of concepts was



discussed in Section 5.1 and the concept of deferred system's design was developed in Chapter 5 (see Section 5.6 for details). Two, the data may lead to drawing specific implications for the actual object of study. (This was not the purpose of the present investigation and so no specific implications for the case organisations are drawn). Three, the data may lead to the construction of "rich insights" to provide deeper understanding of the subject. The principle of deferred system's design decisions (proposed in Section 5.4.3) is put forward as one such rich insight into developing living information systems. Finally, the data may be used to generate theories, which is the purpose of this chapter.

The next section in this chapter examines the relationship between concepts and theory and considers how concepts may be used to develop interpretivist intersubjective theories. In Section 6.3 the spiral of change model of tailorable information systems is postulated as one theoretical explanation of the case data. In Section 6.4, the spiral of change model is compared with the fixed point theorem of information systems development to show how the model diverges from the theorem, and how it may be used to inform an interpretivist design philosophy for developing living information systems. Section 6.5 discusses the implications for practice of the concept of deferred system's design, the principle of deferred system's design decisions, and the spiral of change model. The final Section completes the chapter with some concluding remarks.

## **6.2. From Concepts to Intersubjective Theory**

The reason for considering theory is to explain and understand in general terms the studied organisations and their development and use of information systems. The purpose is to know thoroughly how human interaction with respect to information systems happens in organisations and why it happens that way. For this purpose, Preece (1994) considers concepts and ideals as an essential part of thinking for the development of theory. Theories are explained by Preece (1994) as links, patterns, or systems of thought by which concepts and ideals are linked and which provide the real power of explanation and understanding. The concepts developed in Chapter 5 are tentatively linked into a theoretical explanation in the form of the spiral of change model of tailorable information systems in this chapter.

Theory in interpretivist research is regarded as sharing the researcher's subjective views of the world with other researchers. This sharing of one's particular views of the world with other researchers is termed "intersubjective theory" by Walsham (1995). He states that there

are no correct or incorrect theories in the interpretivist research tradition, only interesting and less interesting ways to view the world. Theories are interesting to the researcher in the first instance, and they may be of interest to others. However, that does not preclude interpretivist theory from testing, which may be done by subjecting the theory to verbal and written discourse. The testing may compare, evaluate, and improve the proposed theory. This type of testing leads to broader judgements of the theory's value to be made. The final result is the creation of "intersubjectively tested theoretical approaches", and this type of intersubjective theory may be of value to a broader group than a single individual (the researcher). It is this approach of developing intersubjective theory that is adopted here.

The view that systems development should be regarded as a continuous process and that information systems should be tailorable, as depicted in the intersubjective spiral of change model developed in Section 6.3, is one such shared view as it is accepted by other researchers too. For example, Probate (1997) supports the view that the distinction between developing and using information systems is actually blurred, and concurs with the view that information systems should be made tailorable. Gardner and Patel (1996) have used the spiral of change model to develop further the ideas for a hypertext based document management system called the Fully Integrated Environment for Layered Development (or FIELD) and Stamoulis et al., (1996) have used the notion of systems tailorability to propose a tailorable systems architecture. Gardner et al., (1996) have used the spiral of change model to improve simulation model specifications, and Gardner et al., (1995) invoked the concept of deferred system's design in relation to systems tailorability as an alternative to methodologico-project frameworks.

It is recognised that theories provide a way of seeing and not seeing, and this is especially pertinent if the theories are intersubjective. Nevertheless, theories provide understanding and guidance for practice and therefore they are worthwhile to construct. By generating a theoretical explanation it is possible to draw specific implications for practice (see Section 6.5 for comments on the relationship between theory and practice and Appendix I for the proposed Hyper-Tmodeller CASE tool).

In developing intersubjective theory, it is worth noting that the human aspects of information systems should not be isolated from theories about the human condition in general. Walsham (1995) considers information systems to have holographic properties which, to some extent, necessitate information systems researchers to consider previous



theories about human life and in particular philosophical thought. This makes sense, as the finding and gathering of information is a key aspect of the human condition, particularly so in business organisations. In this regard, Habermas' (1972) Critical Theory was discussed in Section 1.2 as an aspect of the philosophical outlook informing the present research, and it was invoked in Chapter 5 to develop the concept of deferred system's design as a way of improving the quality of human interaction with computer-based information systems.

### **6.3 The Spiral of Change Model of Tailorable Information Systems**

In this section the spiral of change model of tailorable information systems is developed as an explanation of the data concerning the development and usage of information systems. This is done by interweaving the concept of deferred system's design and systems tailorability in the processes that compose the development and usage of information systems in business organisations. The notion of systems tailorability is analysed as a hierarchy of computer-based information systems. The developed model is then cross referenced with the case data to show its relevance for interpreting actual practice. The whole should be regarded as supporting the notion of living information systems development.

To explain the data theoretically it is necessary to organise, or in Preece's (1994) terms, to "link" or systematise the interpretive concepts developed in Chapter 5. The basis of this organisation is the relationships among the concepts, and the network of these relationships form a system or theoretical whole which aids us to understand better the development and usage of information systems. As Orlikowski (1993) notes, interpretive generalisations of the type of intersubjective theory are "analytic generalisations" which differ from typical statistical generalisations based on samples of a population. The generalisations in interpretive theory building is of concepts and patterns. The spiral of change model developed in this section is of this type of generalisation. The concept of deferred system's design serves to explain the observed changing organisations and to suggest by way of theoretical postulation that tailorable information systems offer one way of catering for dynamic information systems environments, such as the ones described for the case organisations in Chapters 4 and 5.

It is difficult to achieve flexibility in information systems whilst keeping to the imperative to get systems developed because of budgetary and time constraints. By regarding information systems development as a continuous process, as depicted in the spiral of change

model, it is possible to encourage flexibility in systems development and at the same time improve the acceptance of systems and their life expectancy. This is possible because development approaches based on the spiral of change model would have to be sensitive to organisational change, which in information systems developmental terms means sensitive to changing user requirements.

In the systems investigated, systems design decisions were normally taken by systems designers who are considered experts in information systems development. These systems design decisions are made before a system is delivered to its eventual users who form an integral part of the information system, in terms of the organisational usage they make of it. The systems design decisions made by systems experts are about the functionality of the systems delivered and the form and content of their data inputs and information outputs. The concept of deferred system's design decisions is a fundamental aspect of the spiral of change model of tailorable information systems. The concept posits that systems design decisions should be deferred to users to make when using systems in particular, individual or group, changing organisational situations. This type of deferred system's designing gives rise to the notion of tailoring information (systems) to suit individual or group needs for information. So a central feature of tailorable information system is differing systems design decisions to users.

By regarding information systems as composed of deferred system's designing it is possible to conceive of information systems development and usage as a spiral of change; changes in design decisions concerning systems functionality, data inputs and information outputs, and in the information technology to be used, all of which are caused by factors of organisational change discussed in Section 5.4.2 and by changes in the way humans work in organisations.

Deferring design decisions to users requires user-controllable mechanisms. The notion of deferring design decisions in the spiral of change model may be analysed into constituent parts or the sub-concepts developed in Section 5.4, which are: organisational variability, user control, systems functionality, systems usability, and user interface. These sub-concepts are themselves derived from the empirical data. Figure 6:1 shows three of these constituent parts, user control (systems control), user interface (systems interface), and systems functionality. By providing user control over these components of an information system, aspects such as



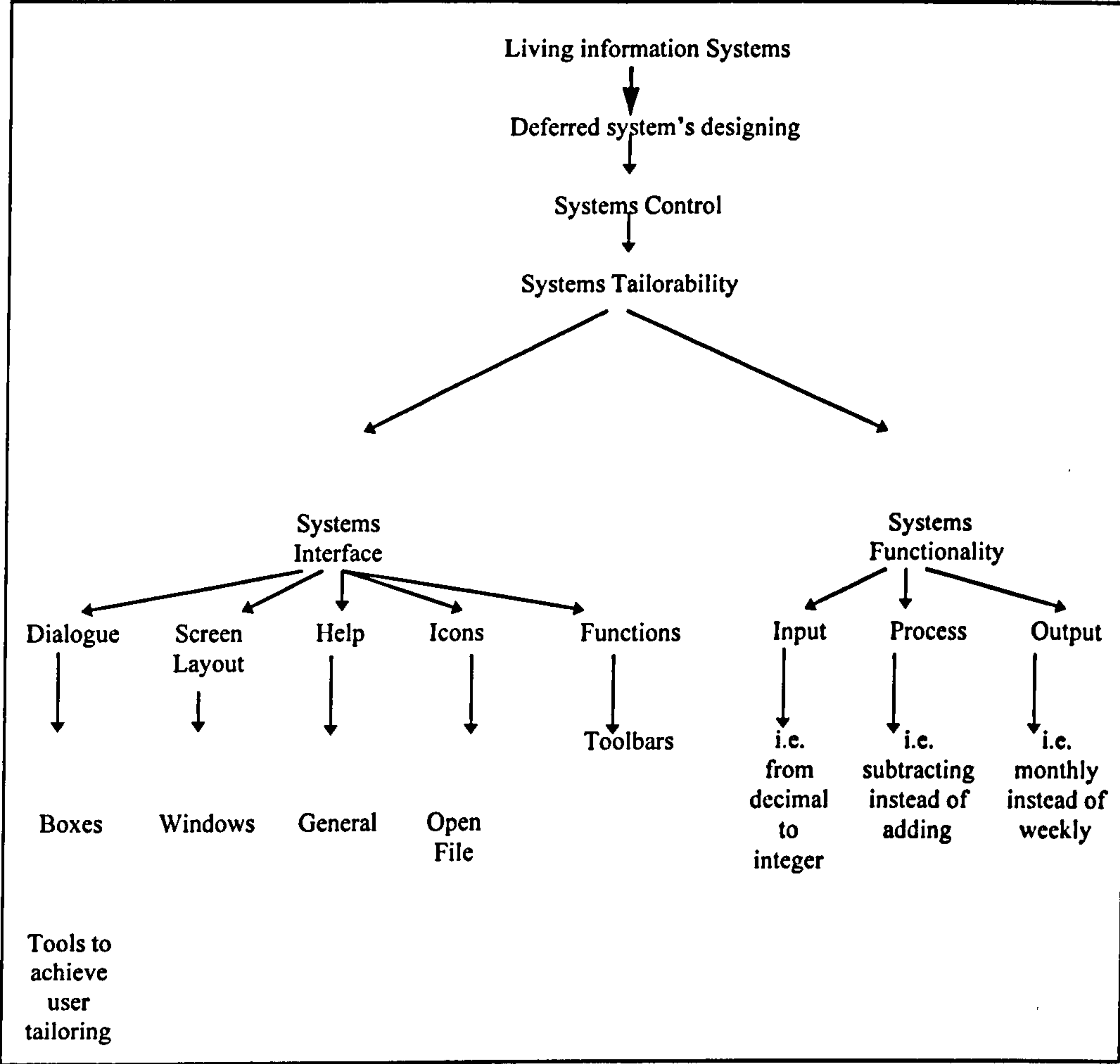
the human-computer dialogue in the user interface and inputs to systems functionality can be tailored by users to suit situational needs and so cater for organisational variability.

Figure 6:1 may be regarded as a way of realising living information systems, and the hierarchy in the Figure is itself a valuable conceptual form for analysing the concept of deferred system's design decisions into smaller components to aid the development of user-control mechanisms. For instance, the systems tailorability hierarchy is a valuable conceptual aid for analysing deferred system's designing in systems tailorability. At the top of the hierarchy is the concept of living information systems itself; an idea seeking a realisation. The subsequent levels of the systems tailorability hierarchy are stages that move towards that realisation, until the bottom level is reached, where the concept acquires a practical application in terms of actual software mechanisms. The concept at this final level in the hierarchy is an actualisation, with the provision of tailoring tools (software mechanisms) which allow living information systems to be tailored.

A distinguishing feature of tailoring is that information systems design decisions are deferred to users. These decisions concern among other things the functionality of information systems. User control over trivial aspects of interface aesthetics does not equal systems tailorability. A prerequisite of systems tailorability is that systems design decisions concerning functionality should be deferred to users to make when using information systems in particular organisational settings.

Certain fundamental constructs need to be present if a conception of systems tailorability is to be consistent with the notion of living information systems. Systems tailorability may be analysed into its five constituent conceptual constructs as stated above: organisational variability, user control, systems functionality, systems usability, and user interface. By their inclusion in the spiral of change model, these conceptual constructs may be regarded as enabling change in information systems. For example, Figure 6:1 shows the two major postulated components of systems tailorability: systems interfaces and systems functionality as the forked paths. By providing interactive control to users over these two components, aspects such as dialogue for the interface and input for the functionality, can be tailored by users to suit particular and changing organisational needs.

Figure 6:1: A Hierarchical Analysis of Systems Tailorability



The hierarchical analysis of systems tailorability may be illustrated with some case data. Users were given specific user interfaces to facilitate their work needs at the University of Luton. This accounts for the left-hand side of the hierarchy, where human computer dialogues can be altered. At Nene College of Higher Education it has been decided to make an end-user tool called Explorer available to users. Explorer enables users of the Higher Education Management Information System to extract specific information, and so its use can be varied to suit different organisational situations. This accounts for the right hand side of the hierarchy, where the systems functionality is configured in a different way than originally delivered. Another illustration of the hierarchy in terms of user control is the use of alternative information technology by users of information systems in the Datatel Corporation, the University of Luton, and Nene College of Higher Education. Users at these



case organisations used spreadsheets to achieve organisational tasks that should have been supported by the provided respective information systems. The hierarchical analysis of systems tailorability shown in Figure 6:1 is thus an explanation in systems terms of the actual information systems usage environment in the case organisations.

The research data shows various factors of organisational change (see Table 5:2) which lead to changes in the organisational tasks of information systems users. It is this type of organisational change which makes the concept of deferred system's designing useful in the spiral of change model. Of these factors of change, processes and procedure and new or enhanced technology together account for nearly sixty per cent. of organisational change which require information systems to be responsive. The largest factor of change is management decisions (33 per cent.). The case data shows that the information systems provided in the case organisations lack quality, timing, and quantity of information delivered in the context of such organisational change. Only thirteen per cent. of users were "satisfied", the remainder were unsatisfied because the information systems were unable to meet their changing information needs.

To account for this kind of organisational change and need for variable information, it is necessary to introduce the concept of change as being central to the spiral of change model as depicted in Figure 6:2. Both the systems development process and systems usage process has to accommodate organisational change. So organisational change is an important theoretical consideration in systems development and usage.

In the spiral of change model, information technology is the generic term used to encompass all digital technology and other technology which is necessary for computer-based information systems. This includes user interfaces and end-user tailoring tools such as Explorer used at the Nene College of Higher Education case organisation. The generic term "humans" encompasses all human aspects such as the need for information, management decision making and user control over information systems, as well as social, psychological, and political amongst others shown in Figure 6:2. The generic term "organisations" encompasses all organisational issues such as setting of objectives, power and political considerations, and meeting competition to survive, as well as individual and group organisational tasks.

The lines of the triangle in the spiral of change model depict relationships among the connecting variables, relationships which are derived from the case data. Information systems

are related to users and to organisations. End users are related to organisations and to information systems. Organisations are related to users and information systems. These relationships themselves are governed by and depend on organisational change, shown by the arched lines within the triangle.

The spiral of change model may be described as a causal model. The variables of humans, information technology, organisations, and organisational change, are at their most elemental form, and are causally linked along the lines of the triangle, and by the effects of organisational change. The spiral of change model engenders the notion that no aspect of living information systems should be considered to be unaffected by change. For this reason, living information systems should be regarded as underdeveloped and in need of continuous development using deferred system's design.

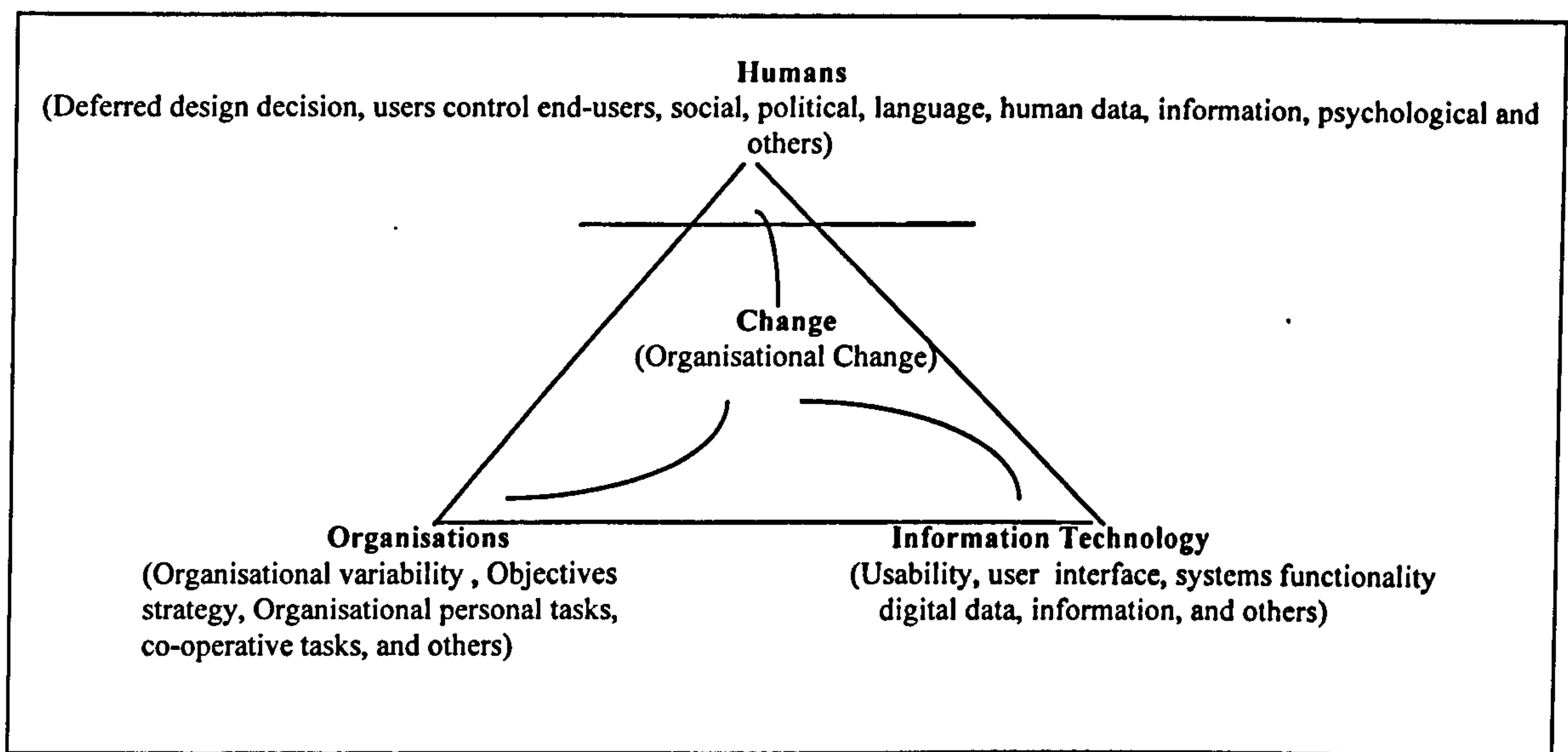
The case data support the view that information systems development and usage takes place in a changing or dynamic social environment. In Chapter 5, the data was generalised as the five sub-concepts which lead to the second order concept of deferred system's designs (see Section 5.4 for details). To form a theory this data requires to be reduced further as in the spiral of change model in terms of humans, information technology, organisations, and organisational change. These are postulated as variables causally related as shown in Figure 6:2.

The spiral of change model provides a concise view of the need for systems tailorability through deferred system's design, and it links in an explanatory fashion the variables of humans, information technology, organisations, and organisational change. The concept of deferred system's designs reflects this dynamic social organisational environment of developing and using information systems. It is necessary to incorporate the principle of deferred system's designing in systems development and usage, to provide a way of viewing systems development as catering for organisational change.

The concept of deferred system's design is incorporated in the spiral of change model by regarding deferred system's design as the complement of organisational change. Given that organisational change is prevalent during the development and usage of information systems, it is necessary to develop a mechanism which can cater for such change. That mechanism is deferred system's designing.



Figure 6:2: The Spiral of Change Model of Tailorable Information Systems



It is this dynamic social environment which forms the basis of the proposed *spiral of change model of tailorable information systems*. The spiral of change model is a useful theoretical view of the relationship among humans, information technology, organisations, and organisational change. Tailorable information systems may be understood to mean the ability of developers and users to change the systems functionality of developing and delivered information systems through a interactive user interfaces by making deferred design decisions to meet variable information needs arising from changes in an organisation's external or internal environment. The systems tailorability sub-concepts developed in Section 5.4.2 are organised and their relationships explored around the spiral of change model. The model supports the view that information systems development and usage should be adaptable to changes that take place in organisations.

The spiral of change model may be interpreted to mean that information systems are always in need of continuous development rather than ever being fully developed, as thought in methodologico-project frameworks. In this sense, in Paul's (1993) terms there are no right or wrong information systems, which affirms the interpretivist view that each user and organisation is unique. The spiral of change model engenders the view that information systems development and usage should be regarded as a continuous process facilitated by systems tailorability or deferred system's designing, rather than as a discrete event bounded by project constraints such as time and budget considerations.

### 6.3.1 Boehm's Spiral Model of Software Development and Enhancement

In this section a comparison is provided between the spiral of change model presented above and Boehm's (1988) Spiral Model of Software Development and Enhancement. Boehm's model is a risk-driven approach to software development projects which differs significantly from the model developed in this dissertation. His usage of terms like "hypothesis", "test", and "fails" would imply that his model is based on positivism, whereas the epistemology adopted here is subjectivism.

Boehm's (1988) spiral model treats software development as projects. As such the model does not recognise organisationally specific aspects of information systems or human information needs as discussed in Section 5.5. Although Boehm calls his model a "process model" it may be termed a method because it requires discrete steps to implement. The developed software using the model is termed a "product", which may be classified as succumbing to the fixed point theorem as classified in Table 6:3. Moreover, control over systems development is kept in the hands of professional systems developers, and only considers users at the end of each cycle by involving them in a "review".

The process model has been applied to improving software productivity but not to the development of business information systems. It is not clear how the type of organisational change evidenced in the case organisations can be accommodated. So the process model does not explicitly recognise business change.

Boehm's spiral model allows flexible metamorphic usage. The spiral model can take the form of the waterfall model, evolutionary development model, or prototyping, depending on the risks involved in the development project. Because it allows this to happen, the spiral model may be classified into the methodologico-project framework, which the spiral of change model presented above attempts to avoid.

## 6.4 Beyond the Fixed Point Theorem with the Spiral of Change Model

Before discussing the practical implications of the spiral of change model in Section 6.5, it is necessary to consider first the model in relation to the mock fixed point theorem of information systems development discussed in Section 2.5. By viewing information systems development and usage in terms of the spiral of change model as continuous processes, succumbing to the fixed point theorem is avoided. How this is avoided is now discussed by



comparing some aspects of the fixed point theorem and the spiral of change model itself. The basic contention in this section is that viewing information systems development and usage in terms of the spiral of change model is a divergence from the methodologico-project paradigm discussed in Section 2.2. The following discussion is summarised with example case data in Table 6:3.

One view held by developers and researchers in the methodologico-project framework is that information systems are products. The case data however shows that there is continuous change in systems requirements both during systems development and after implementation. It is difficult to deliver a product which is not definable in terms of the necessary definitive and comprehensive systems specifications. The deliverance of a product assumes that its users know what they require and have unequivocally stated that requirement to developers. This is not the picture that emerges from the case data. On the contrary, the data shows that there is a continuous change in systems requirements arising from organisational change. So unlike the fixed point theorem, the spiral of change model views information systems as continuous processes affected by organisational change and not as products (see Section 6.4.2 for a further elaboration of this view).

It is clear from the investigation that systems development approaches which assume that potential users of information systems are able to know what is required from systems and to communicate that information successfully to systems professionals are unsuccessful in achieving their aims, as the Higher Education Management Information Systems (HEMIS) at the University of Luton and Nene Collage of Higher Education shows. The attempt to establish a complete set of systems requirements for HEMIS was not successful and new requirements rose during systems design. The fixed point theorem's basic assumption is that users know what is required from potential systems and can agree these requirements among themselves and with systems professionals. This view is not supported by the case data. Systems professionals were unable to recognise the perspectives on the organisations and requirements for information that users of information systems had, and some professionals at the Datatel Corporation case organisation even presumed to know what users required. Similarly, users from different functional departments at the Datatel Corporation could not agree on specific data formats for reports. It is this kind of diversity that the spiral of change model seeks to recognise as an explicit aspect of systems development and usage.

Table 6:3 Beyond the Fixed Point Theorem with the Spiral of Change Model

| Fixed Point Theorem of Information Systems Development   | Spiral of Change Model of Tailorable Information Systems  |
|--|---|
| Information Systems are products   | Information systems are regarded as continuous processes in changing organisations (or as ontological exchanges, see Section 6.4.2). Organisational factors of change cause information requirements to change too, requiring tailorable information systems.   |
| Requires a comprehensive systems specification that is agreeable to all stakeholders. So assumes that users know what is required. | It is assumed that users do not know in all required detail what they want. User requirements are likely to change because of organisational change. So it is necessary to enable users to tailor systems. For example provision of flexible reporting at Datatel Corporation.  |
| Systems can be developed as projects.  | As continuous processes, information systems are always amended to match changing organisational situations in the search for improvements. For example, changing deadlines on projects or shortage of finance at the University of Luton and Nene College of Higher Education prevented changes being made to IEMIS.   |
| A systems is either right or wrong and is a once-and-for-all “solution” to a “problem”.  | Users do not perceive information systems that way. They need different information at different times, depending on factors of organisational change as shown in Table 5:2.  |
| Analysis, design and implementation are discrete events bound in business projects.  | As users use information technology in varying organisational situations, they perform situation-specific analysis, design and implementation. For example the use of spreadsheets at the University of Luton and Nene College of Higher Education, provision of Explorer at Nene College of Higher Education, and specific user interfaces at the University of Luton. |

Wastell (1996) has shown how the methodological approach to systems development may be regarded as a form of social defence. The social defence idea is that systems professionals use structured techniques and methods to develop systems because they need to justify their actions. This idea has some bearing on the conclusions of the present investigation. At the Datatel Corporation an adapted version of SSADM is the accepted way of developing systems, but systems analysts and systems programmers confirmed that it was loosely



followed. However it provided them with a defence to justify what they were doing when required. Similarly, at the University of Luton and Ace Business Computers case organisations developers were keen to emphasise the systematic nature of their work.

Methodological approaches to systems development result in static models of information systems. In contrast, the case data reveals a dynamic need for information caused by organisational factors of change such as management decisions and changes to objectives, procedures, and processes. The spiral of change model recognises this type of dynamic need for information by considering it in modelling tailorable information systems (see Sections 6.5 and Appendix I for practical implications of the spiral of change model for modelling tailorable information systems).

#### **6.4.1 Analysis, Design, Development and Implementation**

By regarding information systems development and usage as centrally influenced by organisational change as shown in the spiral of change model, the discrete activities of systems analysis, design, development, and implementation found in the methodologico-project paradigm become questionable. At Nene College of Higher Education and the University of Luton, the linear progression from analysis to design to systems construction failed to account sufficiently for the changes taking place in the respective organisations during systems development. By completing these phases as discrete events in systems development, systems professionals were reluctant to consider alterations to design arising from organisational change.

Users of information systems at Ace Business Computers, Nene College of Higher Education and the University of Luton carried out a form of continuous analysis, design, development and implementation when they used spreadsheets for processing student data, data mining tools like Explorer or set their own sales analysis codes for sales purposes. The need to view analysis, design, development, and implementation as continuous processes in the life of information systems, rather than as discrete events in a methodology bound in a business project, is relevant because users' need for information varied according to the specific and changing organisational situations they encountered. Such variations caused by organisational changes were met by using information technology flexibly to meet specific needs.

The spiral of change model of tailorable information systems recognises that users need to change the functionality of delivered information systems, and to do that they will need to analyse, design and then implement their designs. This type of continuous usage of information systems would be a logical outcome of using deferred system's designing. In making this recognition, it should also be realised that tailorable information systems shifts some power and responsibility for analysis, design, and implementation onto users.

#### **6.4.2 Information Systems As Human Ontological Exchanges**

The investigation supporting this dissertation is informed by the notion of "living" information systems and the wider philosophical outlook discussed in Section 1.2. Regarding information systems environments as being dynamic has been evidenced in Chapter 5. It is this dynamic or living environment consisting of humans, information technology, organisations, and organisational change, as depicted in the spiral of change model, which supports the need for systems tailorability in the form of deferred system's designing.

In such a dynamic environment information systems may be regarded as a medium for exchanging information about the organisation. These exchanges are based on the specific and unique perceptions of individuals and groups in the organisation, their views of what is happening in the organisation, and what they think should be happening. It is evident from a reading of the interview data that systems developers and users of information systems have such differing views and concerns. This type of exchange of information is here termed ontological exchanges of information because it is the differing perceptions of developers and users that make up information systems, which themselves enable further exchanges of information from relative perspectives and understandings of organisations and individuals' roles in them.

This characterisation of information systems as ontological exchanges is consistent with the case data. Users had different perceptions of what roles they had in the organisation and that determined how they used the provided information systems. At the Ace Business Computers case organisation the Finance Director commented that each manager had a "different attitude" which determined how the provided information systems would be used. At the Datatel Corporation case organisation a systems programmer recognised different stakeholder interests by commenting that user-departments had "vested interests". It is the



facilitation of these different perspectives and their exchanges via computer-based information systems that is termed as ontological exchanges here.

It is worth comparing this view of information systems as ontological exchanges with Hirschheim et al.'s (1995) identification of four paradigms in information systems development, and what their ontological and epistemological foundations are. They identified four information systems development paradigms which they call "functionalism", "radical structuralism", "social relativism" and "neohumanism". These paradigms are divided on the basis of whether they use the objective epistemology (functionalism and radical structuralism) or the subjective epistemology (social relativism and neohumanism). Within each epistemology the division reflects whether the paradigm views the world as ordered (functionalism and social relativism) or conflictual (radical structuralism and neohumanism).

Regarding information systems as ontological exchanges would compare with the social relativist and neohumanist paradigms of information system development. Information systems facilitate socially defined purposes such as control, sense-making and supporting claims by creating and exchanging meaning in organisations. Using these paradigms, the idea of achieving of systems tailorability through deferred system's design would be categorised as social relativist or neohumanist approach to information systems development. Indeed that would be acceptable to thinking of information systems as living entities.

## **6.5 Implications for Modelling Information Systems**

Regarding information systems development and usage as a changing or continuous process, as depicted in the spiral of change model, has implications for practice. The value of the spiral of change model is that it may aid our practical knowledge about building information systems that are responsive to changing organisations' socially constructed dynamic environments, and it acts as a medium for communicating the intersubjective theory to others. The spiral of change model itself may be regarded as an aid to thinking about constructing tailorable information systems, as proposed in Section 2.6. This section discusses the practical implications of the spiral of change model in terms of thinking about systems tailorability in information systems.

Models of information systems informed by the spiral of change model would need to incorporate organisational variability of the type discussed in Section 5.4.2. One way of doing this is to model organisational variability itself, and to use that to develop skeletal systems

capable of adapting to organisational change. A CASE tool called Hyper-Tmodeller is proposed in Appendix I to aid this kind of tailorable information systems modelling.

It is not possible to define systems specifications in the detail required by the methodologico-project paradigm. It has been shown in Chapter 5 that issues such as potential users' inability to know all systems requirements in advance, the likelihood of changes to stated requirements arising because of organisational change, and lack of agreement among users, all these issues undermine attempts to build systems based on predetermined specifications. This type of uncertainty arising from organisational change is depicted in the spiral of change model by the central variable of change. The fundamental assumption of the model is that nothing in information systems should be regarded as fixed or permanent.

The spiral of change model may be used to consider information systems models based on the principle of deferred system's design decisions discussed in Section 5.4.3. Modelling information systems on the bases of the principle of deferred design decisions would not have to rely on an accurate and complete set of systems specifications, and so such models would not be "definitions" of information systems as understood by current practice. The very use of the principle of deferred design decisions is a recognition that complete and accurate definitions are not possible because of uncertainty caused by organisational change. It is necessary consequently to defer systems design decisions to users until they know what is needed in particular organisational situations. In this sense models of information systems functionality would match organisational variability. By providing a mechanism such as systems tailorability for situation specific alterations, the deferred design decisions principle recognises that actual information (ontological) exchanges based on information systems are too complex to model. In the spiral of change model it is not proposed that all the contents of a proposed information systems be modelled. By modelling deferred system's design decisions into information systems, it is recognised in the spiral of change model that users of information systems should be able to tailor information systems to specific and variable organisational situations and information needs. In this respect, the spiral of change model concurs with Suchman's (1994) thesis of situated actions. The spiral of change model has been used by Stamoulis et al., (1996) to propose a conceptual tailorable systems architecture, which incorporates user-tailoring and they describes a systems architecture in terms of organisational variability.



By incorporating the principle of deferred system's design decisions into models of information systems, the role of users of information systems needs to be re-examined in systems development. In current practice the concept of "user participation" describes a role for users of potential information systems where their input to systems design is controlled by systems professionals, and because of lack of knowledge of using systems development methodologies and techniques users are restricted to a cursory form of participation. The notion of users involved in a continuous process of analysis, design, and implementation is inherent in the principle of deferred system's design decisions. The deployment of deferred system's design would put full control into the hands of users of information systems, and not be mediated by systems professionals as is the case in participatory methods for information systems development. This type of activity was observed in the case organisations where users made use of spreadsheets or set up sales analysis codes to design their own channels of information flow. It is interesting to note that Hirschheim and Newman (1991) regard as mythical the idea that systems professionals (developers) are generally the best people for making systems design decisions.

Based on the spiral of change model, information systems development and usage is conceived of as a continuous or spiral process. The kind of organisational change observed in the case organisations during systems development and usage supports this view of regarding development as a continuous process. This contrasts with current approaches such as the life cycle model which regards systems development as a linear process bound in a specific time period which is the business project, and the life cycle model does not consider subsequent usage of information systems.

Information technology in the spiral of change model is not regarded as a technological imperative, but rather as a "socially constructed" tool. The Chief Administrator in the Modular Credit Scheme Office at the University of Luton case organisation stated that developers provide them with systems and say "that is the way it is". The Chief Administrator asked rhetorically "why is it their way always?" It is interesting to note that Orlikowski's (1992) study concludes with a similar theoretical conceptualisation of technology as socially constructed in organisations. To enable information technology to be used in a way which accommodates users of information systems and thus allow its social construction, it is necessary to enable that social process. This socially constructed view of

information technology is facilitated by the Hyper-Tmodeller CASE tool which is discussed in Appendix I.

### **6.5.1 The Spiral of Change Model Applied to Datatel**

A hypothetical application of the Spiral of Change Model to the Datatel Corporation case organisation is discussed in this subsection. The aim is to assess how the practice of developing and using information systems might differ using the spiral of change model in Datatel Corporation. The discussion is based on five aspects of structured approaches used in Datatel Corporation, namely: regarding information systems as products, seeking a definitive systems specification, regarding information systems development as a business project, seeking a “solution” to a “problem”, and developing information systems as discreet events consisting, in broad terms, of analysis, design, code, test, and implementation. These aspects are presented in Table 6:3 as characteristic of the fixed point theorem.

The view in Datatel Corporation that information systems are products, in some sense separated from humans, would be different given the spiral of change model. In the spiral of change model information systems are regarded as integral aspects of human action in organisations. The relationship between humans and information about the organisation they work in is regarded as symbiotic in the spiral of change model. Given such a relationship information systems cannot be regarded as products separate from humans. Indeed, practice in Datatel Corporation confirms this view, as one project manager stated that users of information systems are involved throughout a system’s development, and not only at the prescribed states. In regarding information as predefinable, structured approaches remove information from its contextual usage, making it into a deliverable product. On the contrary, in regarding information systems as continuous processes the spiral of change model makes information living. Information was indeed living in Datatel Corporation, as witnessed by the “local” level of information systems development and usage. By local is meant the close, intertwined relationship between the changing organisational needs and the development process.

If information systems are not regarded as products, as in the spiral of change model, then the practice of seeking a definitive systems (product) specification would not apply in Datatel Corporation. Users of information systems in Datatel Corporation only become aware of certain information needs during the course of their work. The need for certain information



changes as organisational conditions change. Such information cannot be predefined. For example, the Field Engineering Management Information Systems (FEMIS) required major enhancement maintenance when securing field engineering contracts became a primary objective in the company. Developing and using information systems on the basis of the spiral of change model would eliminate the time spent in seeking detailed systems specifications from potential users. Indeed, an awareness of the need for certain information often arises only in the situation where the information is required.

The third issue of regarding information systems development in terms of a business project does not apply in the spiral of change model. By not regarding information systems development as projects, certain spurious measures of information systems success such as delivery on time and within set budgets, would be removed. The major enhancement work on FEMIS at Datatel Corporation was assigned to a project team. As stated earlier, information and humans have a symbiotic relationship. This relationship cannot be spuriously bound in an arbitrary time period which is what a project is. Thus the practice of regarding information systems as projects would not apply if the spiral of change model is used in Datatel Corporation.

The fourth issue concerns reducing human information needs to a 'problem'. It is not clear how usage of information systems can be reduced to a definable problem. Given that changes in organisational conditions affect information systems usage, reducing information systems usage to a problem is questionable. The particular usage of FEMIS at Datatel Corporation was determined by changes in organisational conditions, caused by changing market conditions. Even regarding information systems development as a definable problem is highly questionable in changing organisations. A definable problem with one or more solutions is possible in relatively stable conditions. Where conditions vary, there are likely to be many dynamic parameters, both known and unknown. In human organisations, especially in dynamic organisations, a myriad of variables are involved which cannot be held constant for the duration of information system's development or during its usage. The spiral of change model regards certain aspects of human behaviour in organisations as changeable or unknowable which cannot be reduced to a problem. Thus if the spiral of change model is applied in Datatel Corporation, then information systems would not be regarded as problems with attainable solutions achieved using systematic and structured methodologies. In this regard, the principle of deferred system's design decisions explained in Section 5.4.3 is an

acknowledgement of the inability to define information systems as a “problem” to be “solved”.

The final issue of regarding information systems development in structured approaches as discrete events consisting of analysis, design, and implementation would cease in Datatel Corporation if the spiral of change model is applied. Information systems development and usage would become a continuous process dependent on specific and changing organisational needs, facilitated by deferred system’s design decisions. So given the changing market conditions affecting the use of FEMIS, users of FEMIS could design and implement their requirements to meet certain organisational conditions.

The principle of deferred system’s design decisions addresses the five issues discussed above. By deferring system’s design decisions to users, information systems are not regarded as products, whose exact parameters can be defined and pre-specified, and developed in a methodologico-project framework. Since information and humans are regarded as integral aspects, no problem is assumed, whose solution constitutes an information system. On the contrary, deferred system’s design is an acknowledgement that information systems development and usage cannot be regarded as problems to be solved in a systematic and structured manner.

## 6.6 Conclusions

This chapter has postulated an intersubjective theoretical explanation of the case data in terms of the spiral of change model of tailorable information systems. The spiral of change model was introduced as an alternative to the mock fixed point theorem of information systems development and its implications for practice were discussed. By exploring the user requirements elicitation problem it is argued that one of the more significant barriers to development of information systems may be facilitated by Hyper-Tmodeller. Hyper-Tmodeller is proposed as a practical CASE tool to aid tailorable information systems development and is itself based on the systems design philosophy of the spiral of change model. The theoretical explanation given in this chapter is one possible reading of the data but it is the pertinent one for this researcher. As Walsham (1995) states, interpretive researchers report their own interpretation of other people’s interpretations. The spiral of change model is this researcher’s explanation of the phenomenon of information systems development and usage in the case organisations studied.



## 7. Conclusions and Further Research

### 7.1 Introduction

This final chapter of the dissertation concludes the research. In drawing the dissertation to a conclusion, it is necessary to discuss any shortcomings in the actual research which only became apparent in retrospect. Also it is important to consider how the research may be furthered. In this chapter Section 7.2 is a summary of the argument of the thesis of developing living information systems through systems tailorability for changing organisations. In Section 7.3 some conclusions are drawn from the dissertation argumentation. The shortcomings of the present research and therefore scope for further research are discussed in Section 7.4.

### 7.2 Summary

In Chapter 1 the life cycle model was introduced as the dominant thinking on information systems development. The view that a group of systems professionals using the life cycle model or systems development methodologies based on it could not cope with the diverse needs for information in organisations was voiced. To research alternative thinking Paul's (1993) mock fixed point theorem of information systems development was invoked, and a philosophical ground formed which sought to develop living information systems and which included the notion of designing ontological systems and considering the ethical issues in information systems development.

The purpose of this research was set out as understanding information systems development and usage in changing business organisations and to produce concepts and theories relevant for information systems designs that could cope with such changing organisational environments. This quest was informed by the notion of living information systems in which business processes are recognised to be changing or living. Consequently the thinking underpinning living information systems design is to use information technology in business organisations in such a way as to match the living or changing organisations themselves. The ideas in the literature on tailorable computer systems closely resemble this

notion of living information systems. That literature was reviewed critically in Chapter 2. The mock fixed point theorem of information systems development was invoked to make explicit that information systems requirements in business organisations are uncertain and variable. This view of information usage in organisations matched the work on tailorable computer systems, and together they informed the research questions concerning information systems development and usage in changing organisations.

The research focused on the organisational and social aspects of information systems development and usage. An appropriate method for acquiring knowledge of these organisational and social aspects of information systems is interpretivism. By using quantitative and qualitative research methods as discussed in Chapter 3, the organisational and social aspects of information systems were investigated through interpretivism. Interpretivism was used because it facilitates the development of concepts and theories by allowing the researcher to interpret the data subjectively. This is considered important because the outcome of data interpretation is relevant concepts and theories for information systems development and usage.

The investigation was done in four case organisations, as discussed in Chapter 4, where business change is a critical and dominant feature of organisational life. The purpose being to understand how information systems are developed and used in changing organisations. These organisations have to use information technology in unstable organisational conditions, where business strategies, objectives, policies, processes, and procedures are likely to change. The aim of the case research was to understand how individuals and groups in the organisations behave in such conditions with respect to information systems development and usage, and to understand the meanings they attach to their actions .

The contribution of this research to thinking of information systems as living entities is the empirical observation presented in Chapter 5 that information systems development and usage is affected by factors of organisational change. Factors like changing business strategies, objectives, management decisions, policies, and procedures. From this observation and other research data was developed the concept of deferred system's design and the mechanism of systems tailorability. These two have been proposed to cater for the development and usage of information systems in changing organisations, where information requirements cannot be defined exactly and where such requirements are likely to change anyway. The notion of tailorable information systems has been put forward as being



appropriate in such changing organisations. To understand better the influence of factors of organisational change on information needs of users a CASE tool, Hyper-Tmodeller, has been proposed as further research.

The Hyper-Tmodeller is proposed on the assumption that potential users of information systems cannot know exactly all their information requirements from a proposed information systems development. It is also assumed that once information requirements are known, they need to be so designed in information systems as to make them tailorable by users as and when their organisational conditions change. The view of information systems development and usage as changing developed in the spiral of change model, assumes that users' information requirements are too complex to be determined completely at the outset of systems development. So the proposed Hyper-Tmodeller introduces the notion of tailorable information to keep information systems responsive and relevant to changing organisational situations.

To draw generalisations the spiral of change model of tailorable information systems was developed in Chapter 6. The spiral of change model is proposed as a theoretical explanation of information systems development and usage in the case organisations studied. The model is proposed on the empirical observation that there are many factors of organisational change which prevent information systems definitions as required by the life cycle model of information systems development. The spiral of change model was contrasted with the fixed point theorem of information systems development to show how it diverges from the theorem. The purpose of the generalised spiral of change model is to inform thinking on methodological approaches to information systems development (and usage), and in particular to show information systems development in living information systems terms as continuous processes.

The thesis informing this research may be summarised as follows. A view is formed that business organisations are not static entities but rather that they are dynamic or changing entities. The problem regarding information systems is how they should be developed and used in such changing organisations. The mechanism of systems tailorability, the concept of deferred system's design, the spiral of change model of tailorable information systems, and the proposed Hyper-Tmodeller all have been proposed as a way of thinking about developing information systems in changing organisations.

## 7.3 Conclusions

The research set out to understand how information systems are developed and used in changing business organisations. The data from the case organisations shows that the practice of information systems development and its subsequent usage takes place in changing organisations. Therefore information systems development and usage needs to cater for changes in organisational conditions during systems development and subsequent usage. Systems tailorability, deferred system's design, the spiral of change model, and the proposed Hyper-Tmodeller are contributions to that understanding in terms of developing (and using) living information systems in changing organisations.

The principle of deferred system's designing is a contribution to thinking on developing living information systems. To cater for changing organisations information systems themselves need to be adaptable or living. When designing information systems, by thinking of deferring actual systems design decisions to users of information systems to make in particular organisational situations, the relevance of information systems to the needs of individuals, groups and departments in organisations increases. The application of information technology to changing business organisations to develop information systems is enhanceable by incorporating deferred system's designing into information systems designs.

Regarding information systems functionality as tailorable, as proposed in the concept of systems tailorability, is a further contribution to developing living information systems. By allowing users of information systems to tailor them to suit particular organisational conditions the relevance of information systems to organisational needs increases. Systems tailorability has been proposed as a mechanism for delivering living information systems which can cater better for changeable organisations. In particular, systems tailorability accounts better for the way in which information systems are actually used by individuals, groups or departments in organisations.

The spiral of change model of tailorable information systems has been proposed as a theoretical contribution to living information systems development. Given that information systems development and usage takes place in changing organisations it is necessary to view information systems development and usage as dynamic processes. The spiral of change model depicts information systems development and usage as such dynamic processes, and



accounts better for the changing environment of information systems development and usage than the life cycle model.

Deferred system's designing, systems tailorability, and the spiral of change model all provide a foundation for thinking of alternatives in the practice and theory of information systems development. The CASE tool Hyper-Tmodeller draws on these ideas and has been proposed for further research as a practical tool better suited for changing information systems development and usage environments.

These ideas should not be thought of as predictive generalisations. These ideas are not predictions or prescriptions for information systems development and usage. They simply add to our understanding of the use of information technology in business organisations, and in particular they provide better understanding of the development and usage of information systems in changing organisations.

It is necessary to develop amethodological approaches for information systems development and usage. The important thing to understand regarding the development of amethodological approaches is the usage aspect of information systems. An amethodological example of the usage aspects of information systems put forward in this dissertation is systems tailorability. In this regard, the concept of deferred system's design and the spiral of change model as explanations of information systems development and usage is a significant improvement on the fixed point theorem of information systems characterisation of systems development.

Finally, 'knowledge workers' are now recognised as an increasingly important aspect of organisations where innovation is critical (Nonaka, 1991). Systems tailorability may be extended to apply to knowledge workers. The concept of deferred system's design can be used to allow professionals to design systems to filter relevant knowledge.

## **7.4 Further Research**

The issue of further research arises from two perspectives. One, it may be necessary to conduct further research to address weaknesses stemming from the research itself. The weaknesses may be to do with the actual research design itself, the process of implementing the design which includes data gathering, and data analysis. Secondly, further research may

be necessary to examine the actual outcomes of the data analysis, which in this case are the interpretations made of the research data. These two aspects of further research are addressed in this final section of the dissertation. The weaknesses stemming from the research itself are discussed in this section by considering the ontology, epistemology, axiology, and rhetoric of the research undertaken.

It is assumed that the organisational and social reality or ontology is holistic and that information systems are developed and used in this “living” reality. Consequently the actual investigation itself was ongoing rather than controlled. The participants in the investigation had real organisational responsibilities to fulfil and tasks to complete. Their responses to the questionnaire survey and semi-structured interviews may have been constrained by organisational authoritative structures and political considerations. (The particular shortcomings of the research methods used were discussed in Section 4.9). So this research is particularly relevant to those researchers who regard the ontology of information systems development and usage as holistic or living.

Given this holistic view of reality, an appropriate method for studying it, or epistemology, is interpretivism. The researcher is part of the holistic reality and cannot in some sense objectively detach himself from the study. In this regard, interpretivism itself is limited to the subjective views of the researcher. It is possible for alternative views of the same data to be formed by other researchers. The research data is interpreted through the researcher’s view of the case organisations or the world.

This view of the world includes the researcher’s values, or axiology, as being important influences in the interpretations made. As the research data has been interpreted by the researcher his values regarding the use of information technology in business, humans, and their organisation to do work for material gain are part and parcel of the explanations put forward and understanding gained. It is assumed that humans want to use information technology flexibly in organisations, this is borne out by the research data. It is also assumed that the role of the researcher in society is to better the human condition where possible, hence Critical Theory was invoked in Section 1.2.

The actual language, or rhetoric, of the dissertation has been subjective (as opposed to objective). In this regard, the validity of the mechanism of systems tailorability, the concept of deferred system’s design, the spiral of change model, and the proposed Hyper-Tmodeller



all are dependent on the context of the research. The organisations studied exhibited the central feature of change, and in this context the above are valid.

The outcomes of this research should not be regarded as a prescription for developing living information systems. That would be contrary to Paul's (1993) notion of living information systems and how they should be developed. The mechanism of systems tailorability, the concept of deferred system's design, the spiral of change model, as a view of information systems development and usage in changing organisations, and the proposed Hyper-Tmodeller are subjective interpretations of the research data. Though these subjective ideas may be shared by other researchers, as indeed they are, they should not be thought of as a *method* for developing living information systems. Rather they should be thought of as contributing to thinking of information systems as living entities, and as adding to thinking on amethodological approaches to systems development.

The idea of systems tailorability is limited to those organisations where organisational change is prevalent and where there is a need to keep information systems relevant to variable organisational needs. The interpretations made in this dissertation may not be relevant to organisations where change is less of an issue and information systems do not have to be responsive to change (though it is difficult to think of examples of such human organisations).

Given the problem of making information systems responsive or relevant to changing organisations, it has been assumed that allowing users to tailor systems may provide a different perspective on some of the problems in systems development and usage, particularly concerning the determination of information needs and subsequent changes to delivered systems. The notion of user-tailoring of information systems may not be a viable proposition in many organisations where authoritative and hierarchical structures prevail rather than democratic and flat structures.

Concerning the research design, it may be necessary to spend more time than had been allocated in each of the case organisations as an observer. This would provide additional data on the actual process of systems development and usage as they occur. This observational data, which was not part of the original design, could then be compared with the data from the questionnaire survey and semi-structured interviews. The comparison would be useful because it would either support the interpretations made or lead to their revision.

The interpretations drawn may also be improved by doing a longitudinal study of the case organisations or indeed of other cases in other sectors of business. The one-time study of the case organisations may have resulted in the collection of biased data concerning such issues as organisational change, the role of information technology, and information systems in the case organisations. These may be evaluated in other cases to check the strength of their generalisation in the form of the spiral of change model.

The actual outcomes of the research, the interpretations drawn, provide much material for further research. The mechanism of systems tailorability, the concept of deferred system's design, the spiral of change model of tailorable information systems, and the proposed Hyper-Tmodeller all need further investigation. Their finer details and how they can be used in information systems development and usage remain unknown.

As discussed in Section 3.5, one benefit of using the case study research method is that it generates concepts which may be topics of further research. The concept of deferred system's design is one such important concept for developing living information systems. The utility of the concept for developing living information systems needs to be ascertained. In particular, questions arise as to how the concept can be incorporated in information systems development and usage such that it operationalises the idea of making systems tailorable.

Similarly, the proposed Hyper-Tmodeller requires to be fully elaborated and implemented as a prototype. Hyper-Tmodeller's use in information systems development needs to be tried and its usefulness for understanding systems tailorability needs assessed.

An aspect of the concept of deferred system's design for further research is how its use would affect legacy systems in organisations. In theoretical terms, it could be argued that by deploying deferred system's designing in information systems the incidence of legacy systems may be reduced. The life of information systems can be prolonged by deferred system's designing, as systems would be changed in accordance with the needs of the individual, groups or organisational change.

To understand the role of deferred system's design in systems development, case studies which closely examine particular information systems development projects are needed. The issue of examining the effect of organisational change on information requirements determination can be more closely studied. Consequently the actual mechanism of deferred system's design in living information systems designs can be further explored and determined.



A particular subject for further research is the use of tailoring tools to allow systems to be tailored. In some of the case organisations use was made of tools like Explorer to allow users to create their own information to suite particular needs of a situation. To properly facilitate systems tailorability it is necessary to examine how the need for such tailoring tools arises and what form these tools should take. In this regard, it is necessary to understand what kind of user interfaces are required to enable efficient use of such tailoring tools.

When the concept of systems functionality was developed in Section 5.4.2, it was commented that the algorithms used to do the processing must themselves be variable. The question of how to design variable algorithms to develop the mechanism of deferred system's designing in such a way that it matches the kind of changing organisations found in the four case studies is an issue for further research.

An important aspect of further research concerns the philosophical outlook sketched out in Section 1.2. The notion of living information systems requires extensive philosophical and theoretical elaboration. The spiral of change model is a tentative beginning. To form deeper philosophical and theoretical understanding of living information systems designs, more empirical research is needed. Such research may cover in varying depth information technology itself, humans, or organisations, the three variables in the spiral of change model.

Ironically, a better understanding of the spiral of change model may be gained by studying laterally actual methodological systems development. The causes for insufficient information requirements definition, constraints of time and budgets, the relationships between changing organisational tasks and information requirements can all be studied during systems development. If such studies are done from the stance of amethodological systems development then the actual events normally dismissed as irritants in the methodological approach can be thought of as constituting empirical data to use to develop living information thinking.

Finally, the spiral of change model of tailorable information systems has been proposed as a significant divergence from the fixed point theorem of information systems development. The model is tentatively proposed because it does not contain sufficient detail for practical systems development though that was not the intention. For the model to be considered as an amethodological approach to information systems development, pragmatic details in terms of the hows need to be further researched.

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# **Appendix A:**

## **Research Questionnaire**



## **Research Questionnaire Distribution**

The research questionnaire, survey was distributed in the four case organisations: Datatel Corporation, the University of Luton, Nene College of Higher Education, and Ace Business Computers. At the Datatel Corporation case organisation the research questionnaire was distributed to user of information systems in consultation with a representative from the personnel department and departmental heads. At the Ace Business Computers case organisation the research questionnaire was distributed in consultation with the Finance Director. In both these organisations the physical distribution and collection of the questionnaire was done by representatives of the case organisations. The research questionnaire was freely distributed and collected by the researcher at the University of Luton and Nene College of Higher Education.

## Research Questionnaire

The objective of this questionnaire is to gather your perceptions of information systems you use to complete your organisational tasks and responsibilities. Your perceptions will aid in analysing the match of provided information systems to your requirements of information for completing organisational tasks and responsibilities. The analysis of your responses will facilitate consequent interviews with some respondents.

Please tick the relevant boxes or circle items where asked.

1. In what way would you describe your organisational tasks?

|                          |                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Executive                | Senior Manager           | Middle Manager           | Administration           | Other                    |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

2. In which department do you work?

|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
| Production               | Administration/France    | Marketing                | Other                    |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

3. How many years have you been on the same job working with information systems?

|                          |                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Less than 3              | 3 - 5                    | 5 - 10                   | 10 - 20                  | More than 20             |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



4. Have your duties and responsibilities requiring information from information systems altered during the course of your existing job?

Yes

No

☐☐

5. What caused the changes in your duties and responsibilities?

(Please circle more than one answer if applicable)

- 1. Official job description
- 2. Organisational task practice
- 3. Influence of colleagues' work practices
- 4. Organisational objectives or strategies
- 5. Colleagues
- 6. Processes and procedures of your organisation
- 7. New or enhanced technology
- 8. Management decisions
- 9. Other - please state:

6. Do you believe the existing information system caters for your current information needs?

Always

Most of the time

Partly

Rarely

Not at all

☐☐☐☐☐

7. In relation to your organisational tasks and responsibilities, does the information system provide you with all the information required to make decisions?

|                           |                              |                               |                                  |                          |
|---------------------------|------------------------------|-------------------------------|----------------------------------|--------------------------|
| All information<br>always | All information<br>sometimes | Partial information<br>always | Partial information<br>sometimes | Never                    |
| <input type="checkbox"/>  | <input type="checkbox"/>     | <input type="checkbox"/>      | <input type="checkbox"/>         | <input type="checkbox"/> |

8. Have your organisational tasks been altered over the course of your job?

|                            |                          |                          |                          |                          |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Increased<br>significantly | Small<br>increase        | Remained<br>same         | Small<br>decrease        | Significant<br>decrease  |
| <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

9. Has there been a change in your information needs as a result of (8) above?

|                          |                          |
|--------------------------|--------------------------|
| Yes                      | No                       |
| <input type="checkbox"/> | <input type="checkbox"/> |

10. If the answer to (9) above is Yes, how much has your information needs changed?  
(Please tick a box.)

|                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0                        | 10                       | 20                       | 30                       | 40                       | 50                       | 60                       | 70                       | 80                       | 90                       | 100%                     |

11. Has the information system you are using been able to provide you with your changed information needs?

|                          |                          |
|--------------------------|--------------------------|
| Yes                      | No                       |
| <input type="checkbox"/> | <input type="checkbox"/> |

12. If the answer to (11) is Yes, how well did the information system fulfil your changing needs? (Please tick a box.)

|                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0                        | 10                       | 20                       | 30                       | 40                       | 50                       | 60                       | 70                       | 80                       | 90                       | 100%                     |

13. Has the information system you are using been amended because of changes in your organisational tasks?

|                          |                          |
|--------------------------|--------------------------|
| Yes                      | No                       |
| <input type="checkbox"/> | <input type="checkbox"/> |

14. If the answer to (13) is Yes, how would you describe the amendments?  
(Please circle one item)

- 1. Timely amendments and accurate information
- 2. Delayed amendments and accurate information
- 3. Timely amendments and not accurate information
- 4. Delayed amendments and not accurate information
- 5. Currently under amendment



15. If the answer to (13) is No, in your judgement, do you believe that current provision of information inhibits you to reach better decisions?

Yes                  No

16. When you require information that is not currently available to you from the information system, what do you do? (Please circle one item)

- 1. Seek the information from the information systems department
- 2. Change the program so that the information is readily available to you
- 3. Nothing. Base my decision on the existing information
- 4. Refuse to undertake the task
- 5. Ask my superior to get hold of the information for me

17. Do you exert control over the functionality of the information system you use? i.e. Can you change the data processing done by the information system or do you request this information from the information systems department?

Own control                          Request changes to the information systems department

18. How would you describe the interface to your information system?

Very usable                  Usable                  Partly Usable                  Non-usable

**TEXT CUT  
OFF IN  
ORIGINAL**

19. Does the interface of your information system provide you with the power to manipulate information?

Yes

No

☐☐

20. Is your information system interactive? (i.e. dose it use dialogue boxes?)

Yes

No

☐☐

21. Does the format and content of information displayed on the screen help you to interact with the system?

Yes

No

☐☐

22. If the answer to (21) is Yes, please specify in detail by circling one or more answers if applicable.

1. Displays all the information required
2. Uses appropriate wording
3. Avoids unnecessary detail
4. Displays appropriate graphics
6. Uses appropriate icons
7. Uses conventionally accepted upper and lower case text



- 8. Uses graphic borders around different groups of information
- 9. Displays important information in a prominent place to catch your eyes
- 10. Uses helpful menus
- 11. Provides on-line help

23. How old are you?

|                      |                      |                      |                      |                      |
|----------------------|----------------------|----------------------|----------------------|----------------------|
| Less than 20         | 20-30                | 30-40                | 40-50                | 50 or over           |
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |

24. Are you a male or female?

|                      |                      |
|----------------------|----------------------|
| Male                 | Female               |
| <input type="text"/> | <input type="text"/> |

25. Please enter below any comments you feel important regarding the information systems you are provided with and use.

Thank you for taking the time to participate in this research.

**Appendix B:**

**Research Using SNAP2**

## Introduction

This Appendix is a discussion of the use of SNAP2 as a data analysis tool. The use of a quantitative research questionnaire for the research meant that the collected data had to be subsequently analysed. For this purpose SNAP2 was chosen because of its ease of use and extensive statistical analysis capability. The research questionnaire given in Appendix A had to be designed in accordance with the way in which SNAP2 requires data inputs. These aspects of the research questionnaire and SNAP2 itself are discussed in this section.

## The Research Process Using SNAP2

For the purpose of analysing the data collected by the questionnaire the SNAP2 software tool was used. This required formulating closed questions in the questionnaire to enable numeric analysis, although space was provided at the end of the research questionnaire for respondents to add textual comments.

Questions in the formal questionnaire need to be set up as *variables* in SNAP2, so each question is treated as a variable by SNAP2. This enables extensive cross-tabulation for analytic purposes (see Appendix D for examples of cross tabulation analysis of the data). The possible responses to a particular question need to be encoded using numeric or alphanumeric codes, before they can be entered onto SNAP2. For instance, a specific code, from 1 to 5, is given for each of the five possible responses to question one. Respondents' replies are entered into SNAP2 according to these codes. SNAP2 also requires other parameters to be completed for each variable. For example, position and length, type or class (single), meaning that respondents choose only one of the possible responses to a set question. To prevent data entry errors SNAP2 enables a format mask to be defined. The format mask is akin to a template and ensures that correct data types are entered.

The data is analysable using various statistical methods in SNAP2. SNAP2 is able to produce graphical charts of the cross tabulated data. For instance, cross tabulations are possible to compare the response to two or more of the set questions. The purpose of this type of data analysis was to get a feel for users' information environment before proceeding onto the more interpretive semi-structured interview stage of the research. Data analysis using



SNAP2 aided in structuring the structured aspects of the semi-structured interviews by illuminating contextual issues in each of the case organisations.

In the remainder of this Appendix the process of designing the research questionnaire for use with SNAP2 is discussed.

## **1. Questionnaire Design**

The questionnaire has been designed using closed questions to enable subsequent processing of responses on SNAP2. If open questions had been used they would have to be converted to closed type questions using SNAP2's coding facility, though some of the data quality may have been lost because of the decisions to be made by the researcher on how to allocate codes subsequently.

## **2. Pilot Survey**

A pilot of the research questionnaire was done to test its acceptance by respondents. There are several reasons for doing a pilot test. The piloting helped to remove any ambiguity in the set questions, ambiguities arising from the cultural differences or differences of perceptions of the researcher and respondents. There are differences in language between the researcher and respondents which were removed by piloting. The particular order of the questions was rearranged to follow logically, as the order of the questions may cause different responses. The pilot revealed a need for additional questions, such as respondents ages and gender. Finally, the pilot test was used to gauge the amount of time it took respondents to answer the questions in the questionnaire. The questionnaire can be shortened or lengthened depending on how long respondents take to complete it. The aim was to avoid a lengthy questionnaire as respondents may become disinterested in completing it.

## **3. Coding the Questionnaire**

The responses were coded alpha-numerically onto SNAP2. The coding of the questionnaire questions is done to enable subsequent statistical analysis on SNAP2. The coded questions can be used to do cross tabulations.

## 4. Setting up Variables

A variable in SNAP2 corresponds to a question in the questionnaire. The variable specification table is shown in Appendix C. To illustrate the variable specification process Appendix C is used. Q001 is in the first row of the first column of the variable specification table in Appendix C and identifies the company (case organisation). Q002 is in the second row of the table and identifies the first question in the questionnaire concerning respondents' organisational tasks in terms of:

- Executive                1
- Senior Manager       2
- Middle Manager       3
- Administration       4
- Other                    5

Code 5 in the fifth column denotes that fact that there are five options for the respondents to choose from. The position and length in columns six and seven refer to the location of the particular response in the dataset. The type in column eight refers to whether the response has been pre-coded or not, pre-coded questions limit respondents to set responses as shown above. The final column in the table is class, this can be either single or multiple. A single class indicates that respondents can only choose one response as in the above example and a multiple class indicates that they can choose more than one response.

## 5. Setting up the Format Mask

The format mask in SNAP2 is set up and used to ensure correct data entry. Each of the questions in the questionnaire and its particular responses occupy a single data entry line in the data file. The width of the data file is set according to the number of responses. Each question occupies a specific position along the line in a data file, and a raw data file has the file extension .ddf. The format mask restricts what can be entered in each of the set positions in a data entry line. The data entry follows this step.

## 6. Checking the data

A number of measures were taken to ensure the validity of the collected data. For example, Question 14 in the questionnaire should have only been answered by those respondents who indicated the option “No” in the previous question. This checking is done by comparing equivalence of the actual responses to both the questions, they should be 13 for both, the number of respondents who responded “No” in question 12.

The actual statistical processing of the data is done by SNAP2, thus saving much effort and time.

## 7. Analysing the data

The collected data can be analysed in various ways in SNAP2. Samples of some data analysis are given in Appendix D. The range of analysis modes are:

- bar charts
- cross tabulations
- absolute responses
- responses as a percentage of total responses
- responses as a percentage of raw data
- responses as a percentage of column responses
- all the above as a percentage of respondents
- frequency tables



**Appendix C:**

**SNAP2 Variable Specification Table**

VARIABLES SPECIFICATION FOR SNAP2

| Variable Label |                                   | Sequice Status Codes Pos Len Type |        |    |    |   | Class    |          |
|----------------|-----------------------------------|-----------------------------------|--------|----|----|---|----------|----------|
| Q001           | Company Name                      | 10                                | ACTIVE | 4  | 1  | 1 | PRECODED | SINGLE   |
| Q002           | Organisational Tasks              | 20                                | ACTIVE | 5  | 2  | 1 | PRECODED | SINGLE   |
| Q003           | Department                        | 30                                | ACTIVE | 3  | 3  | 1 | PRECODED | SINGLE   |
| Q004           | Number of years on the same job   | 40                                | ACTIVE | 5  | 4  | 1 | PRECODED | SINGLE   |
| Q005           | Altered Duties & responsibilities | 50                                | ACTIVE | 2  | 5  | 1 | PRECODED | SINGLE   |
| Q006           | Causes of changes in duties       | 60                                | ACTIVE | 9  | 6  | 2 | PRECODED | MULTIPLE |
| Q007           | IS caters for your organ needs    | 70                                | ACTIVE | 5  | 8  | 1 | PRECODED | SINGLE   |
| Q008           | IS provides all required inform   | 80                                | ACTIVE | 5  | 9  | 1 | PRECODED | SINGLE   |
| Q009           | Have your tasks altered           | 90                                | ACTIVE | 5  | 10 | 1 | PRECODED | SINGLE   |
| Q010           | Changes in information needs      | 100                               | ACTIVE | 2  | 11 | 1 | PRECODED | SINGLE   |
| Q011           | How much have info needs changed  | 110                               | ACTIVE | 9  | 12 | 1 | PRECODED | SINGLE   |
| Q012           | Fit of IS with changed info need  | 120                               | ACTIVE | 2  | 13 | 1 | PRECODED | SINGLE   |
| Q013           | How well IS fit changed info nee  | 130                               | ACTIVE | 9  | 14 | 1 | PRECODED | SINGLE   |
| Q014           | IS amendment due to changed info  | 140                               | ACTIVE | 2  | 15 | 1 | PRECODED | SINGLE   |
| Q015           | Description of amendment          | 150                               | ACTIVE | 5  | 16 | 1 | PRECODED | SINGLE   |
| Q016           | Provision of info inhibits D-M    | 160                               | ACTIVE | 2  | 17 | 1 | PRECODED | SINGLE   |
| Q017           | Request of info not available     | 170                               | ACTIVE | 5  | 18 | 1 | PRECODED | SINGLE   |
| Q018           | Control over functionality        | 180                               | ACTIVE | 2  | 19 | 1 | PRECODED | SINGLE   |
| Q019           | Description of the interface      | 190                               | ACTIVE | 4  | 20 | 1 | PRECODED | SINGLE   |
| Q020           | Interface enables manipulation    | 200                               | ACTIVE | 2  | 21 | 1 | PRECODED | SINGLE   |
| Q021           | Interactive IS                    | 210                               | ACTIVE | 2  | 22 | 1 | PRECODED | SINGLE   |
| Q022           | Format helps interaction          | 220                               | ACTIVE | 2  | 23 | 1 | PRECODED | SINGLE   |
| Q023           | Reasons behind good interaction   | 230                               | ACTIVE | 11 | 24 | 2 | PRECODED | MULTIPLE |
| Q024           | Age                               | 240                               | ACTIVE | 5  | 26 | 1 | PRECODED | SINGLE   |
| Q025           | Gender                            | 250                               | ACTIVE | 2  | 27 | 1 | PRECODED | SINGLE   |

**Appendix D:**

**Sample Analysis of Questionnaire Survey Data**



## Table of Content for Appendix D

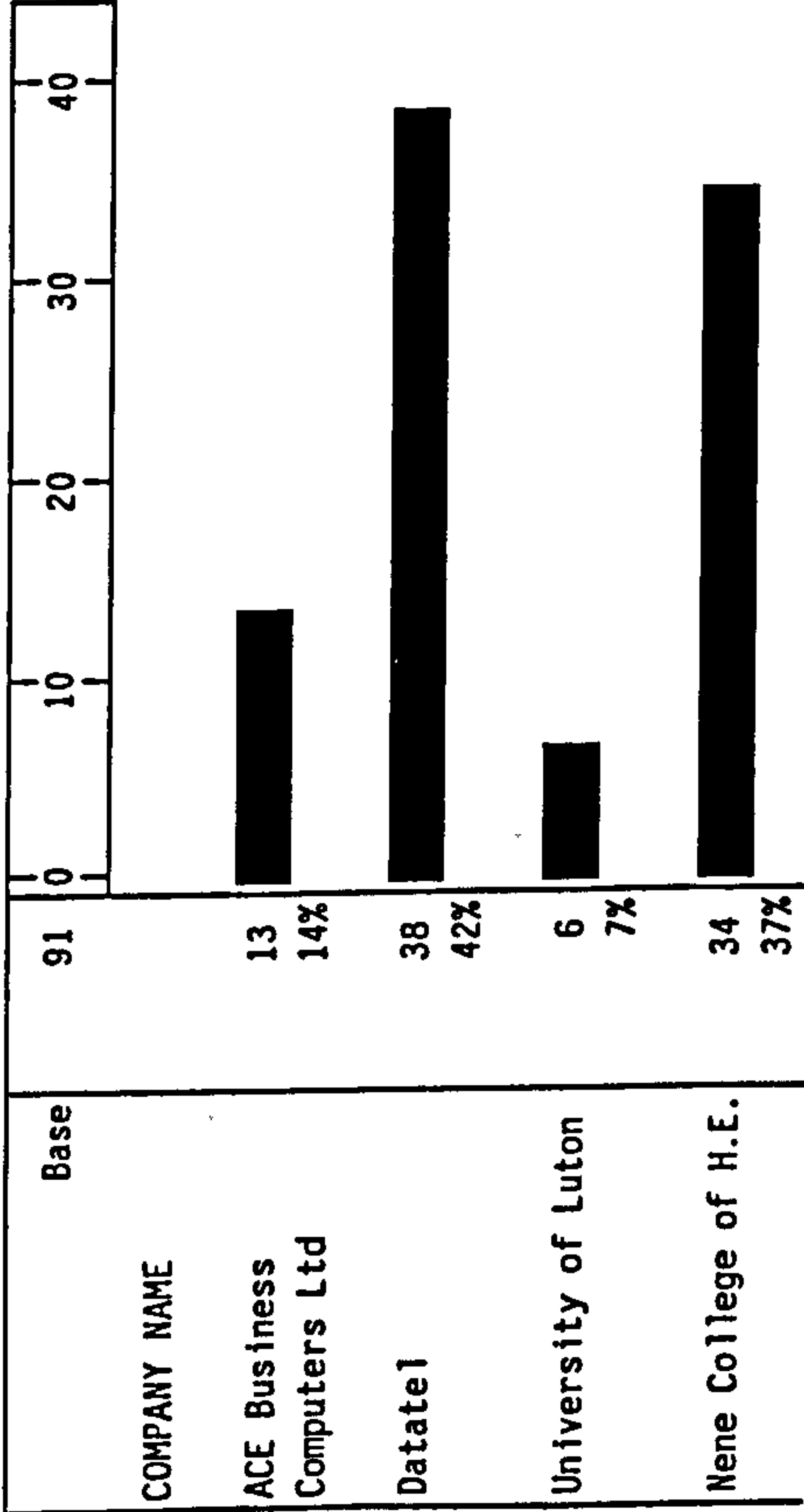
| Label  | Questionnaire<br>Number | Page Number |
|--|-------------------------|-------------|
| Company  | -                       | 177         |
| Description of Organisational Tasks  | 1                       | 178         |
| Department   | 2                       | 179         |
| Number of Years in the Same Job  | 3                       | 180         |
| Altered Duties During the Course of the Job  | 4                       | 181         |
| Factors of Organisational Change   | 5                       | 182         |
| Ability of Information System to Provide<br>Information for Current Job                                  | 6                       | 184         |
| Measure of Quantity and Timing of Information<br>Changes in Organisational Task While in the<br>Same Job | 7                       | 185         |
| Changes in Information Needs as a Result of<br>Changes in Organisational Tasks                           | 8                       | 186         |
| Measure of Changes in Information Needs  | 9                       | 187         |
| Ability of Information Systems to Provide for<br>Changes Information Needs                               | 10                      | 188         |
| Level of Fulfillment of Changes Needs by<br>Information System   | 11                      | 190         |
| Amendment of Information System Due to<br>Changes in Organisational Tasks                                | 12                      | 191         |
| Description of the Amendment   | 13                      | 193         |
| Unavailability of Information from Unchanged<br>Information Systems Inhibits Decision Making             | 14                      | 194         |
| Access to Information Not Currently Available  | 15                      | 195         |
| Control Over the Functionality of the<br>Information System  | 16                      | 196         |
| Description of the Interface   | 17                      | 197         |
| Power Provided by the Interface to Manipulate<br>the Information System                                  | 18                      | 198         |
| Interactiveness of the Information System  | 19                      | 199         |
| Interactiveness Resulted by Information<br>Displayed on Screen   | 20                      | 200         |
| Factors Resulting to Information Displayed<br>Becoming Interactive                                       | 21                      | 201         |
| Age  | 22                      | 202         |
| Sex  | 23                      | 204         |
|  | 24                      | 205         |
| Tables on pages 206 to 262 are cross tabulations<br>of the above results                                 |                         |             |

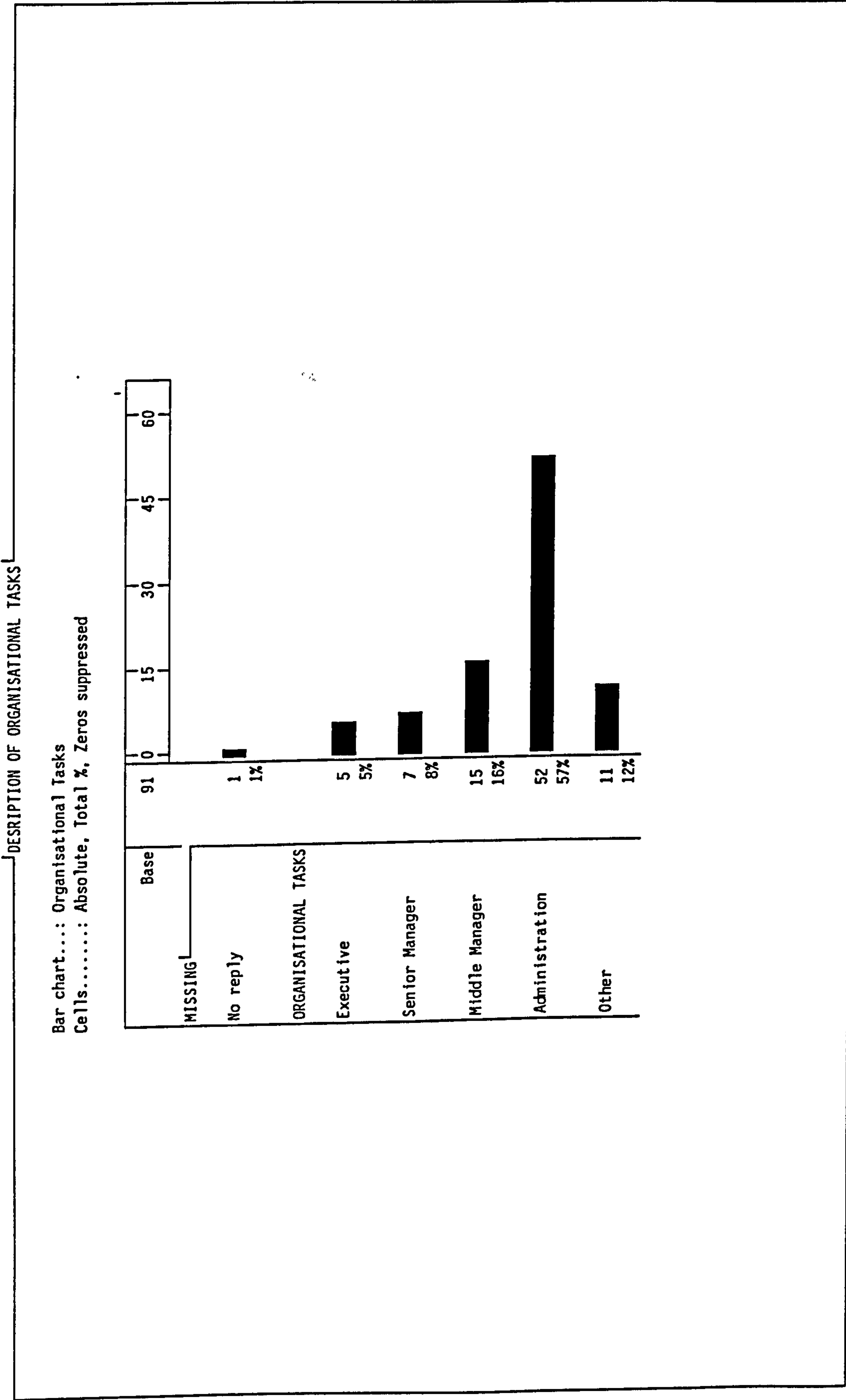
The Development and Usage of Information Systems

COMPANY

Bar chart....: Company Name

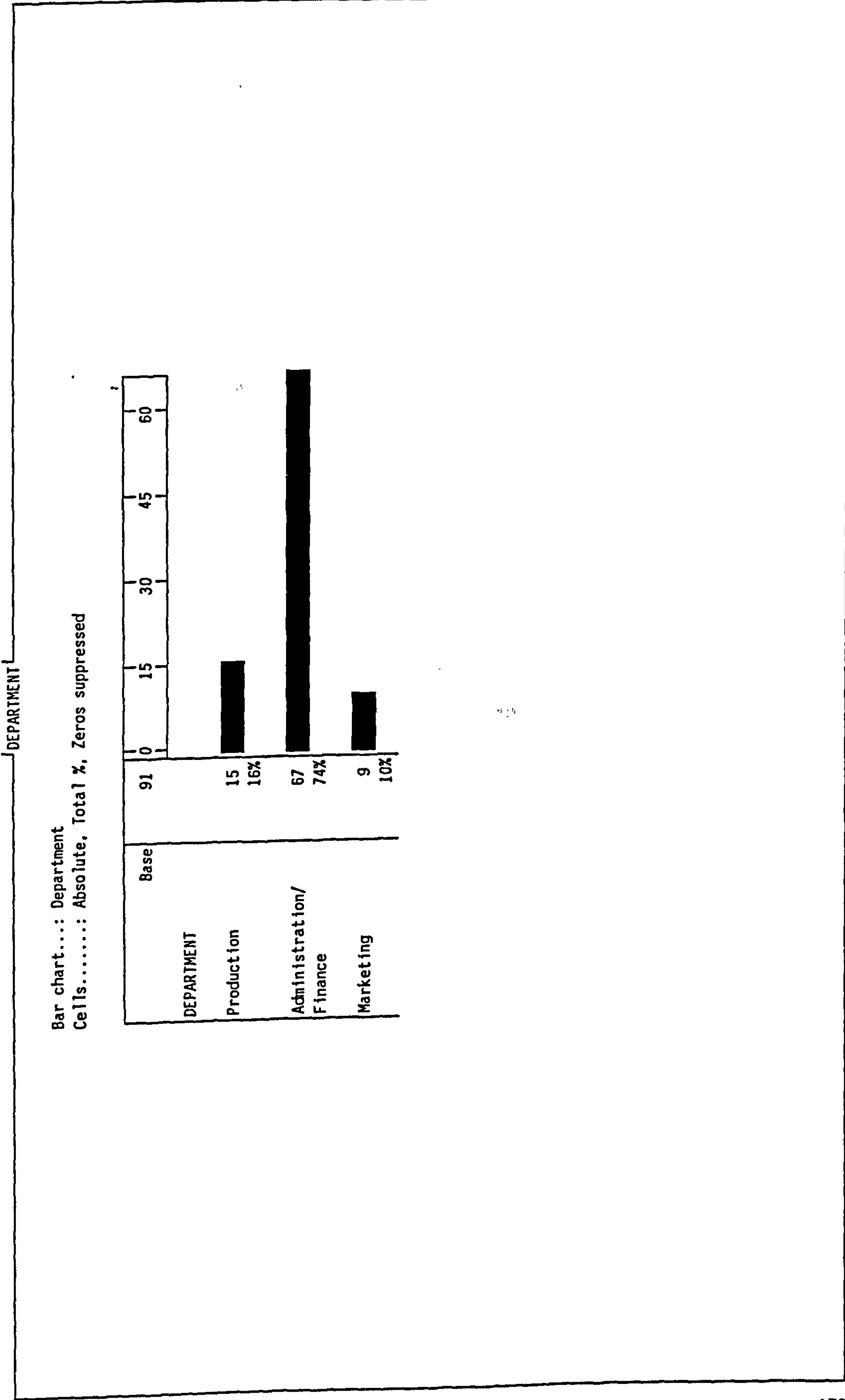
Cells.....: Absolute, Total %, Zeros suppressed



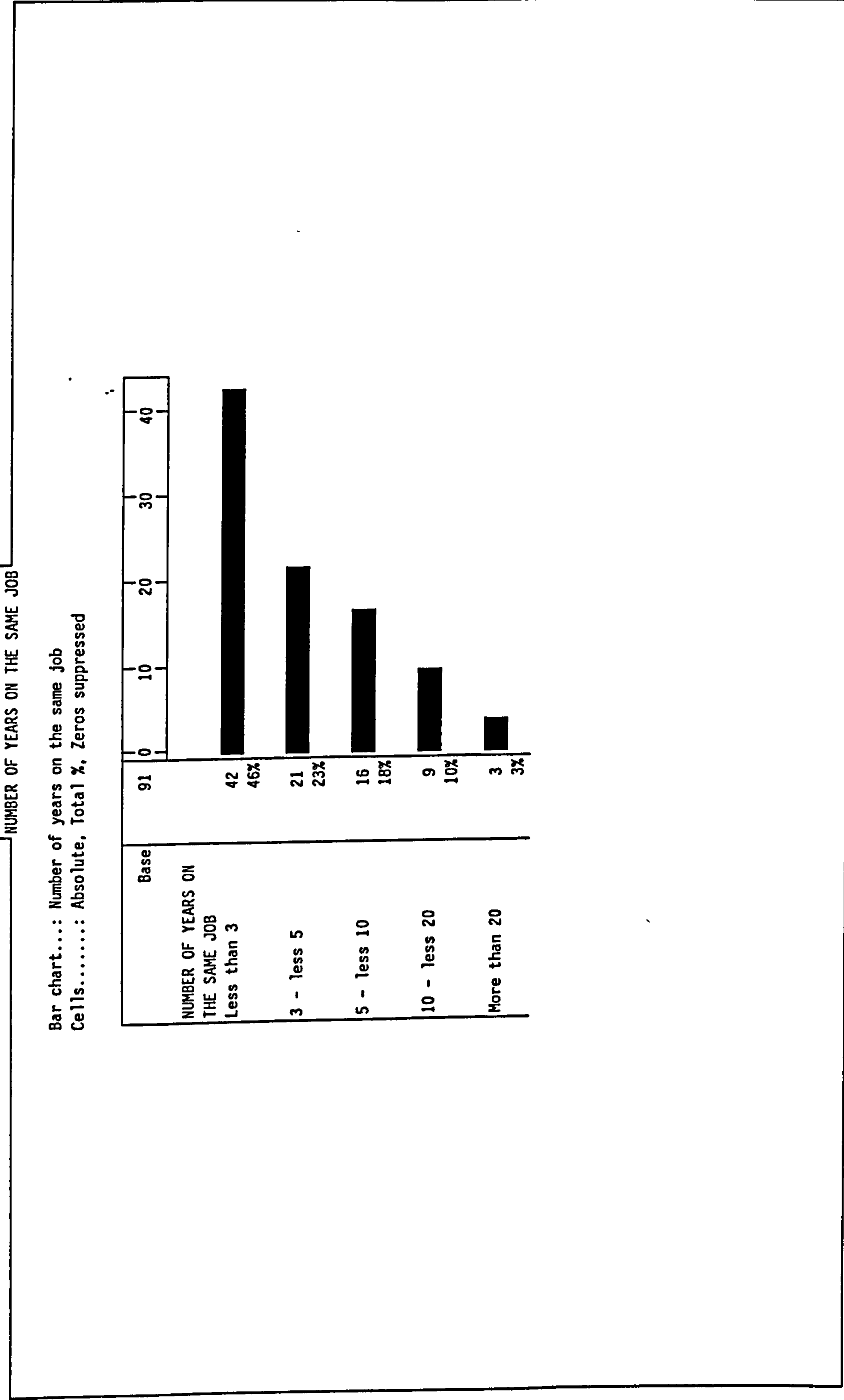




The Development and Usage of Information Systems

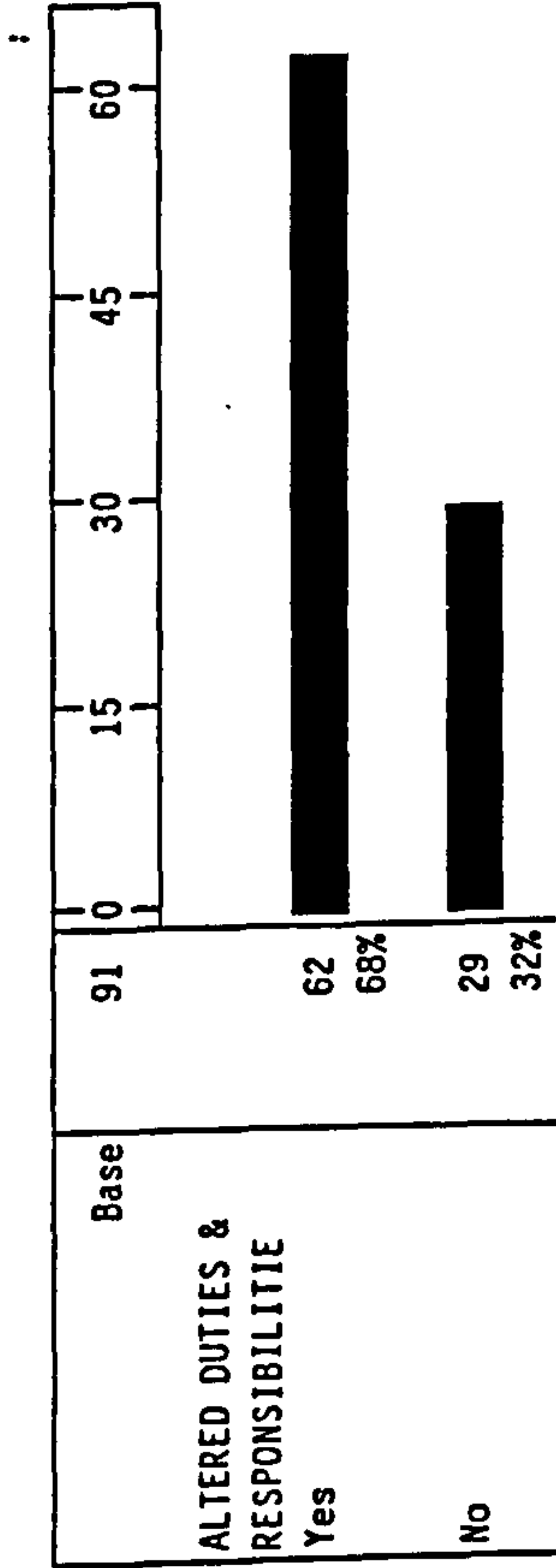


The Development and Usage of Information Systems



ALTERED DUTIES DURING THE COURSE OF THE JOB

Bar chart....: Altered Duties & responsibility  
Cells.....: Absolute, Total %, Zeros suppressed





FACTORS OF CHANGE

Frequencies.: Causes of changes in duties  
Cells.....: Absolute, Total %, Zeros suppressed

|                             |           |
|-----------------------------|-----------|
| Base                        | 91        |
| MISSING                     |           |
| No reply                    | 29<br>32% |
| CAUSES OF CHANGES IN DUTIES |           |
| Job description             | 16<br>18% |
| Organ task practice         | 15<br>16% |
| Colleagues work practices   | 10<br>11% |
| Organisational objectives   | 16<br>18% |
| People                      | 14<br>15% |
| Processes and procedures    | 24<br>26% |
| New or enhanced technology  | 30<br>33% |
| Management decisions        | 32        |

The Development and Usage of Information Systems

FACTORS OF CHANGE

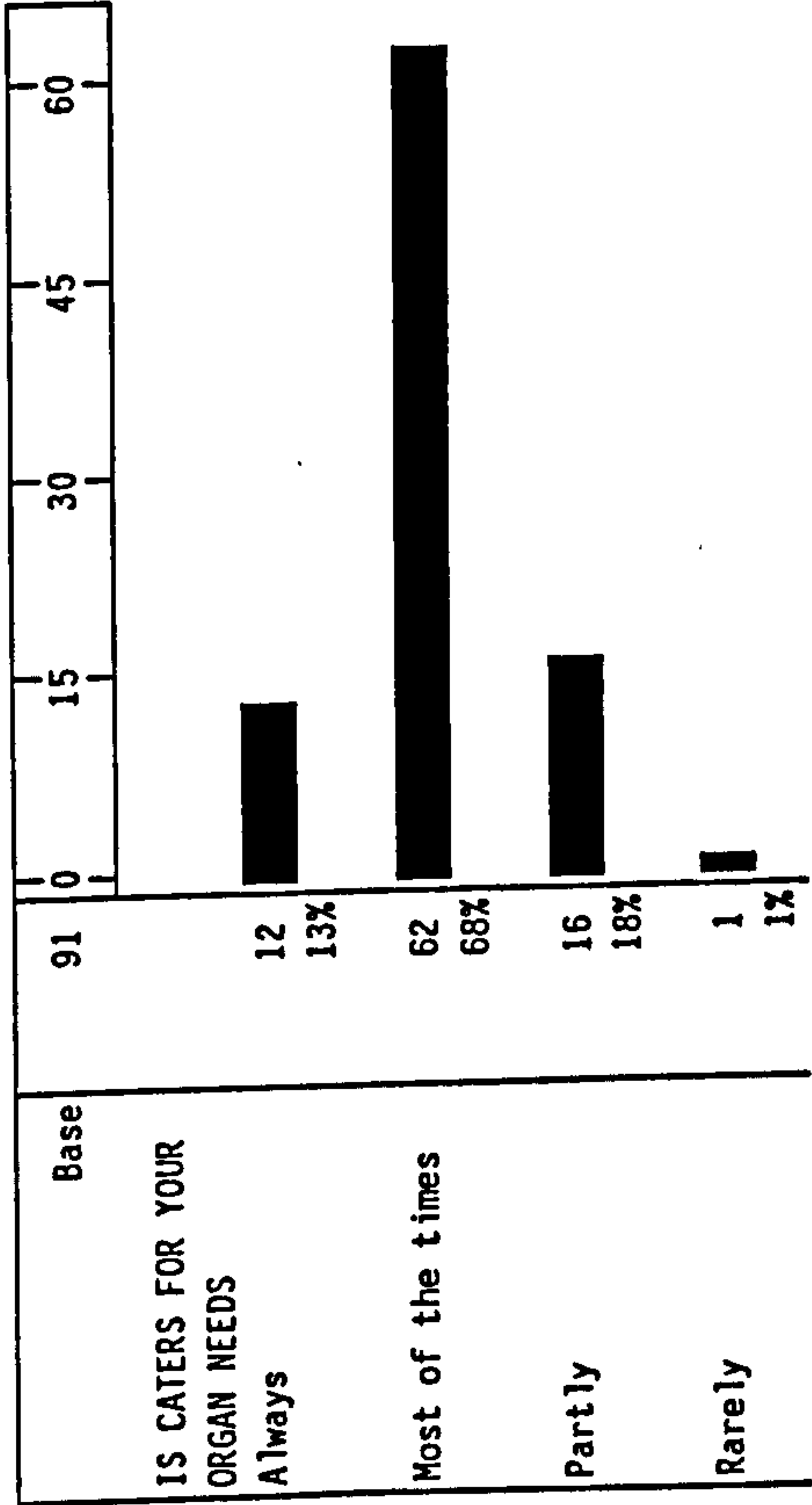
Frequencies.: Causes of changes in duties  
Cells.....: Absolute, Total %, Zeros suppressed

|       |     |
|-------|-----|
| Base  | 91  |
|       | 35% |
| Other | 4   |
|       | 4%  |

The Development and Usage of Information Systems

ABILITY OF INFO SYSTEM TO PROVIDE INFO FOR CURRENT INFO NEED

Bar chart....: IS caters for your organ needs  
Cells.....: Absolute, Total %, Zeros suppressed

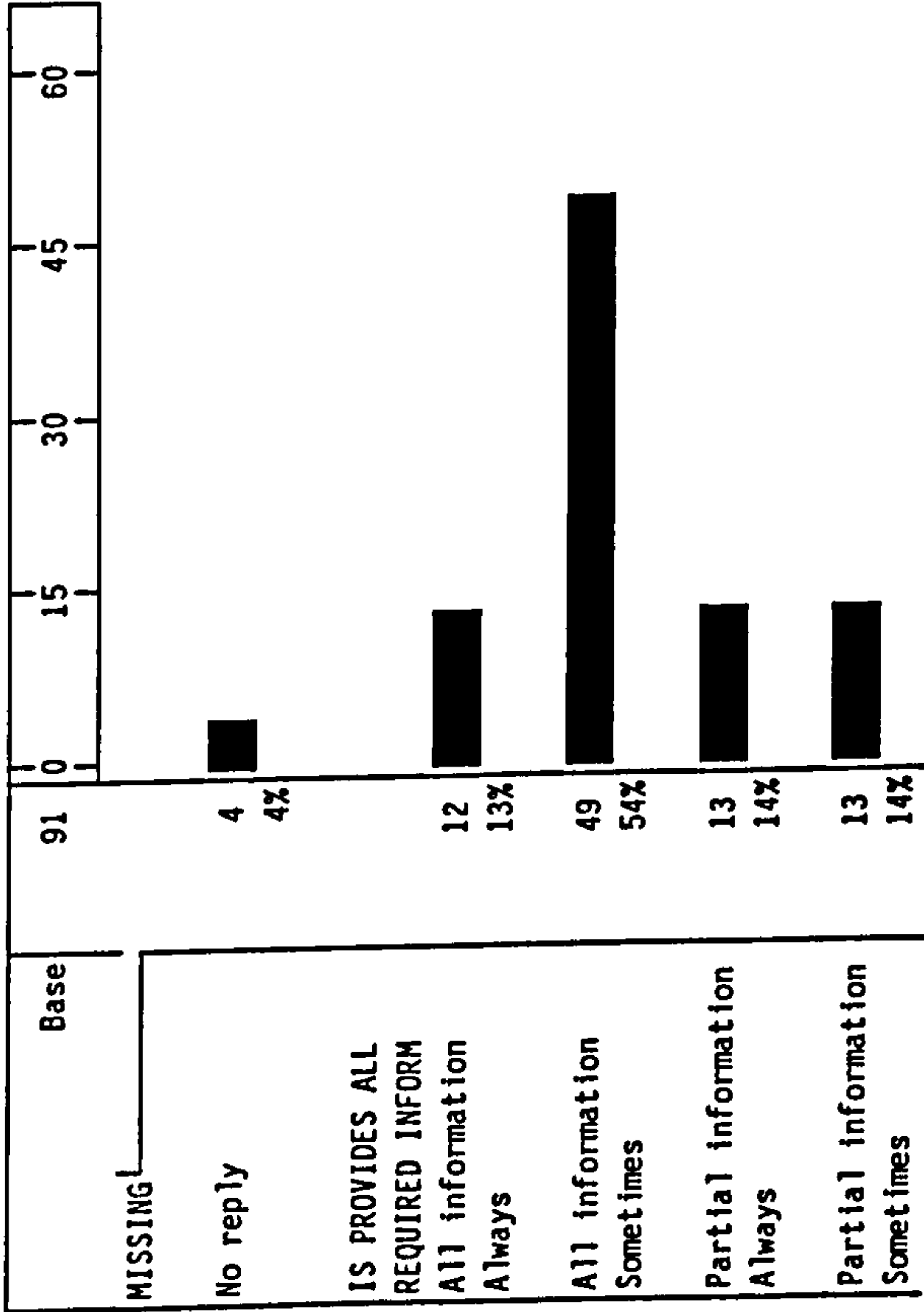




The Development and Usage of Information Systems

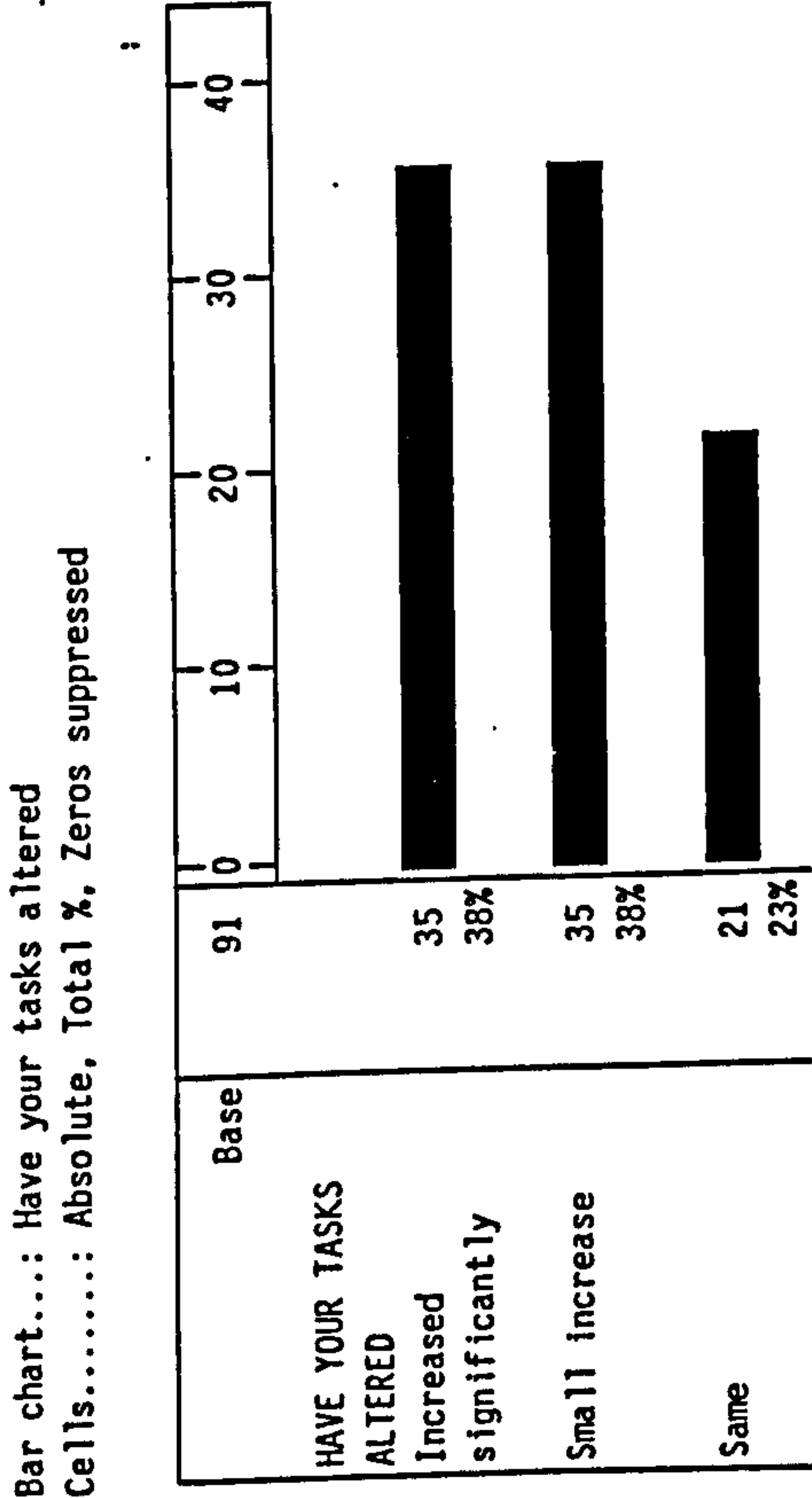
MEASURES OF QUANTITY AND TIMING OF INFORMATION

Bar chart....: IS provides all required inform  
Cells.....: Absolute, Total %, Zeros suppressed



The Development and Usage of Information Systems

CHANGES IN ORGAN TASKS WHILE ON THE SAME JOB

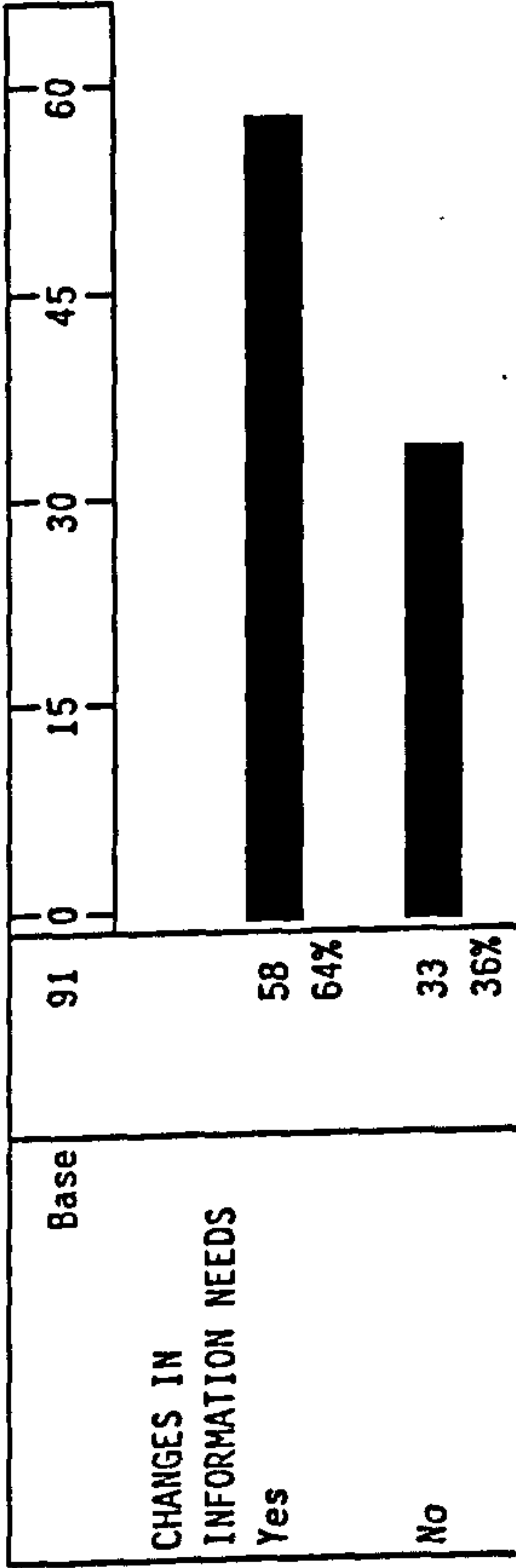


The Development and Usage of Information Systems

CHANGES IN INFO NEEDS AS A RESULT OF CHANGES IN ORGAN TASKS

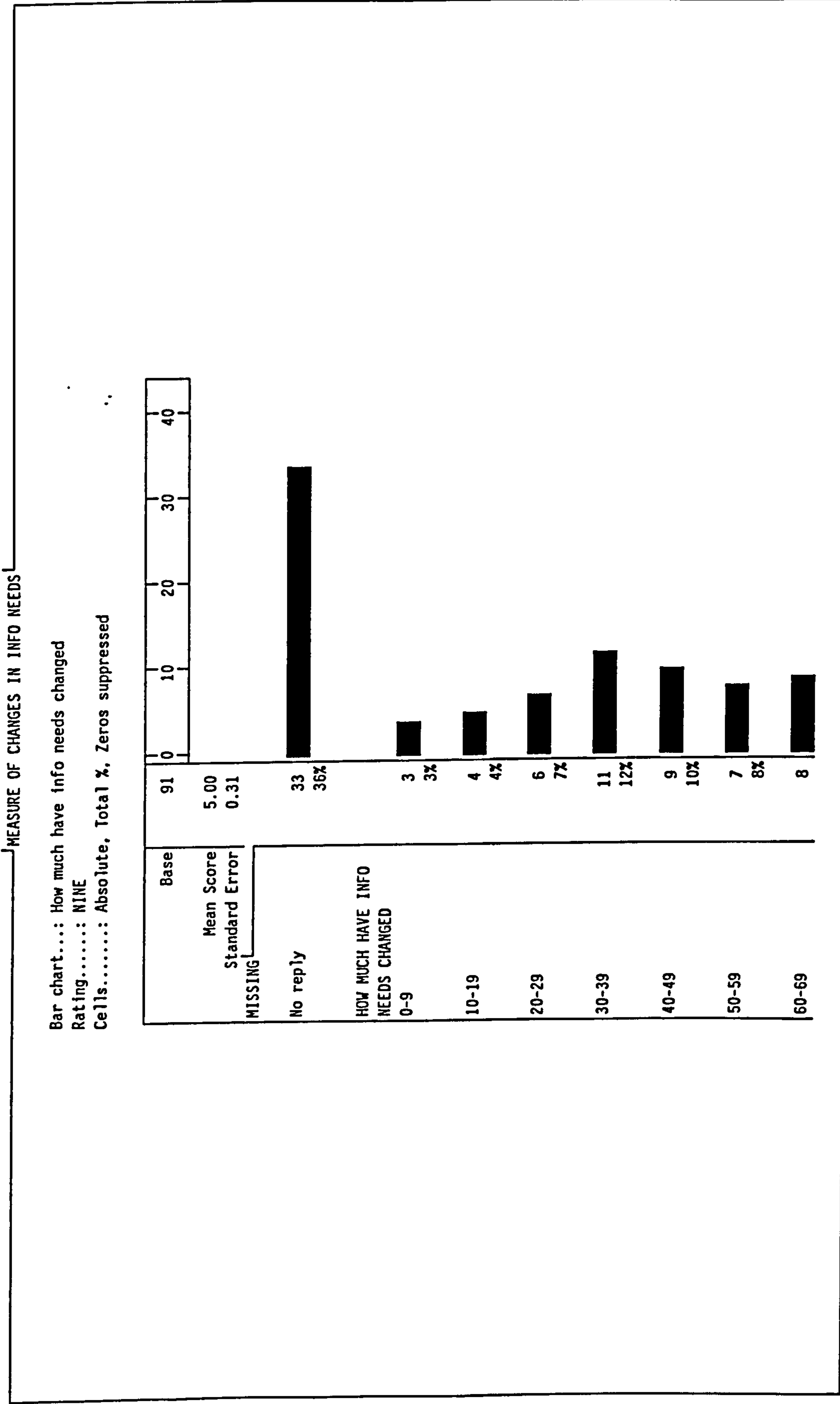
Bar chart....: Changes in information needs

Cells.....: Absolute, Total %, Zeros suppressed





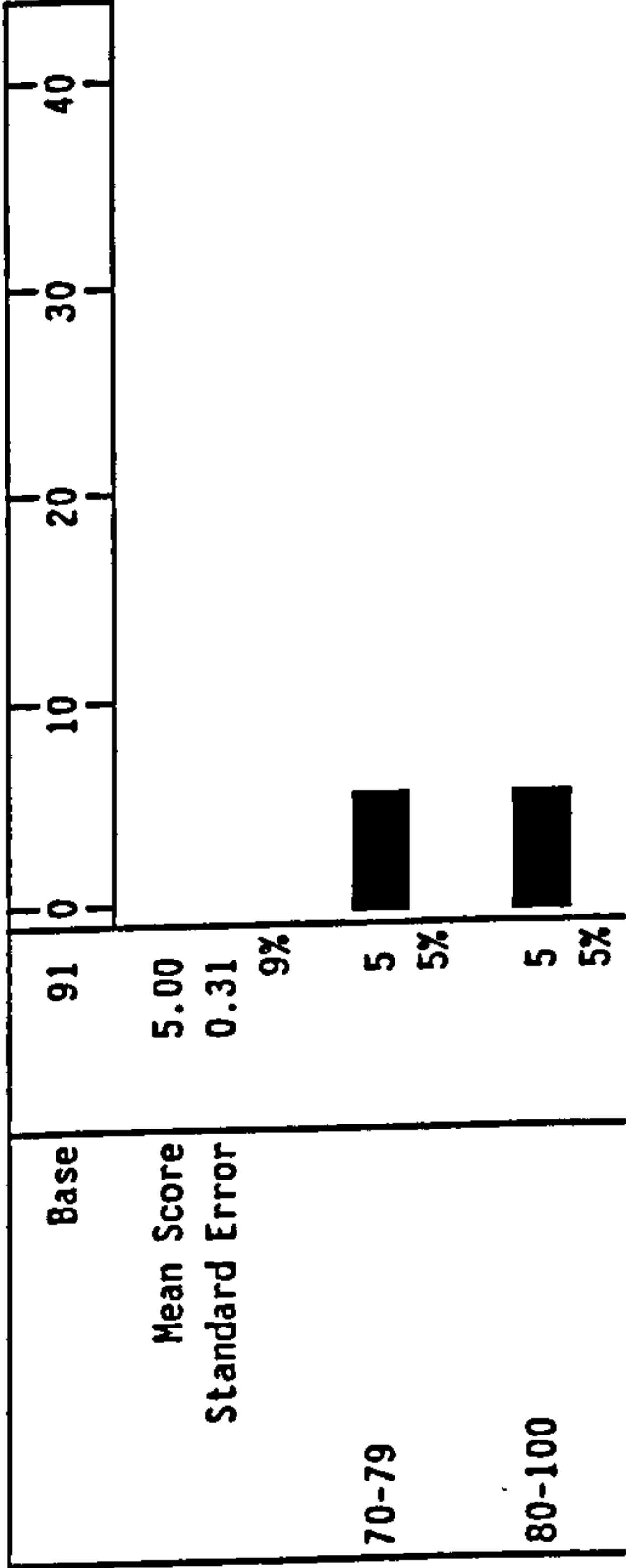
The Development and Usage of Information Systems



The Development and Usage of Information Systems

MEASURE OF CHANGES IN INFO NEEDS

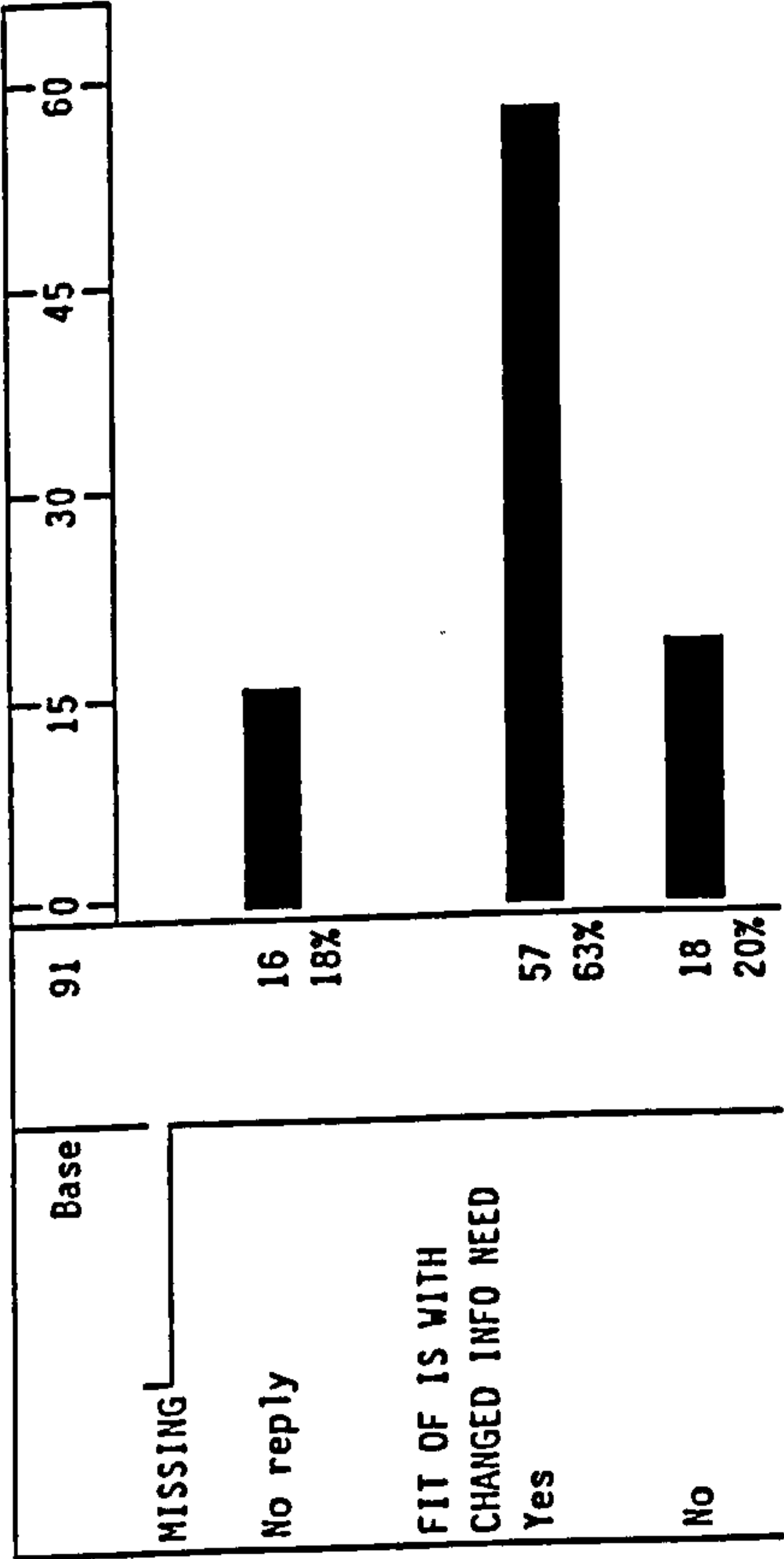
Bar chart....: How much have info needs changed  
Rating.....: NINE  
Cells.....: Absolute, Total %, Zeros suppressed



The Development and Usage of Information Systems

ABILITY OF INFO SYSTEM TO PROVIDE FOR CHANGED INFO NEEDS

Bar chart....: Fit of IS with changed info need  
Cells.....: Absolute, Total %, Zeros suppressed





The Development and Usage of Information Systems

LEVEL OF FULFILLMENT OF CHANGED NEEDS BY INFO SYSTEM

Frequencies.: How well IS fit changed info nee  
Rating.....: NINE  
Cells.....: Absolute, Total %, Zeros suppressed

| Base                                | 91        |
|-------------------------------------|-----------|
| Mean Score                          | 6.00      |
| Standard Error                      | 0.28      |
| MISSING                             |           |
| No reply                            | 35<br>38% |
| HOW WELL IS FIT<br>CHANGED INFO NEE |           |
| 20-29                               | 3<br>3%   |
| 30-39                               | 9<br>10%  |
| 40-49                               | 11<br>12% |
| 50-59                               | 12<br>13% |
| 60-69                               | 5<br>5%   |
| 70-79                               | 6<br>7%   |
| 80-100                              | 10        |

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LEVEL OF FULFILLMENT OF CHANGED NEEDS BY INFO SYSTEM

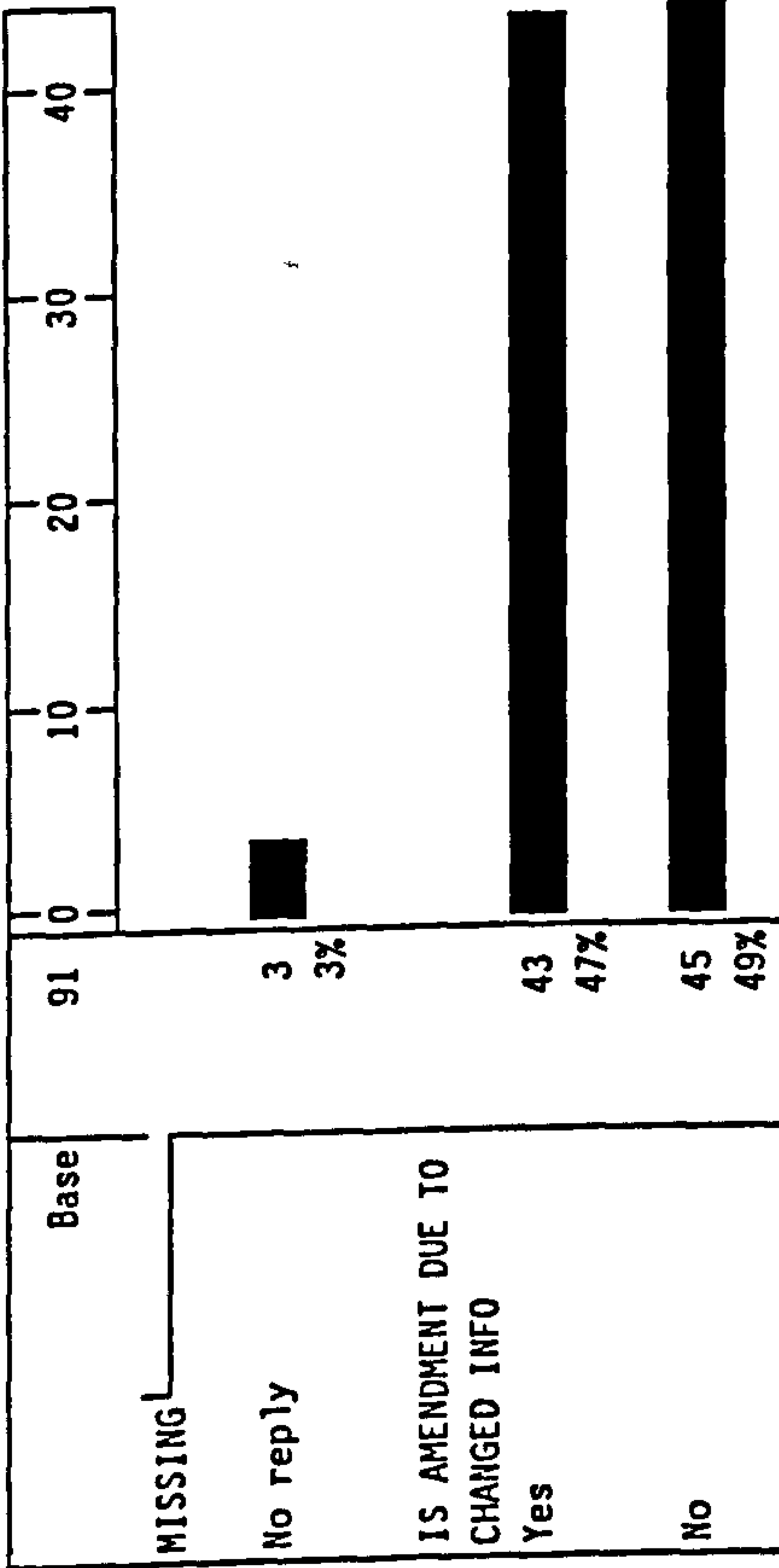
Frequencies.: How well IS fit changed info nee  
Rating.....: NINE  
Cells.....: Absolute, Total %, Zeros suppressed ..

|                |      |
|----------------|------|
| Base           | 91   |
| Mean Score     | 6.00 |
| Standard Error | 0.28 |
|                | 11%  |

The Development and Usage of Information Systems

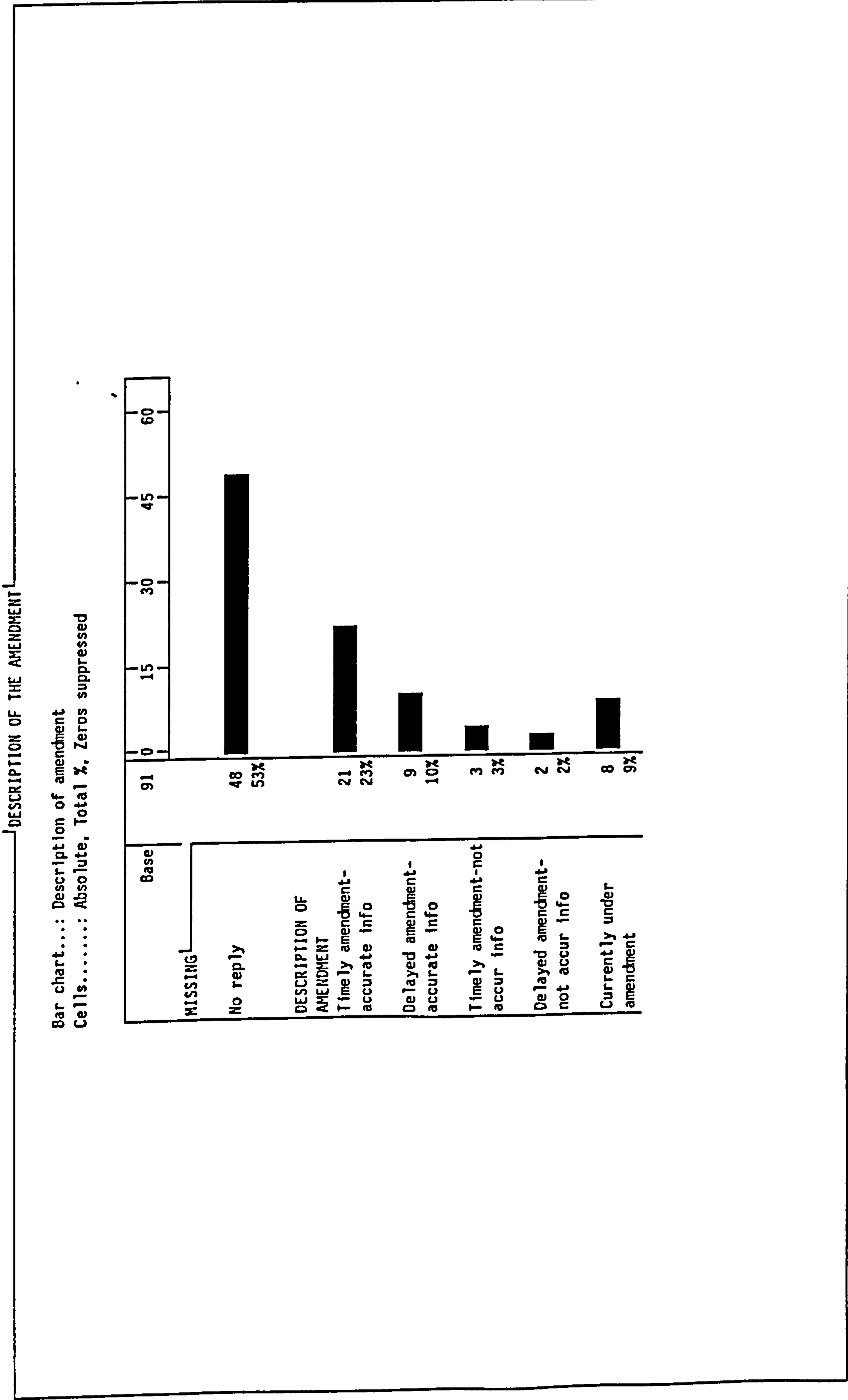
AMENDMENT OF INFO SYSTEM DUE TO CHANGES IN ORGAN TASKS

Bar chart....: IS amendment due to changed info  
Cells.....: Absolute, Total %, Zeros suppressed





The Development and Usage of Information Systems



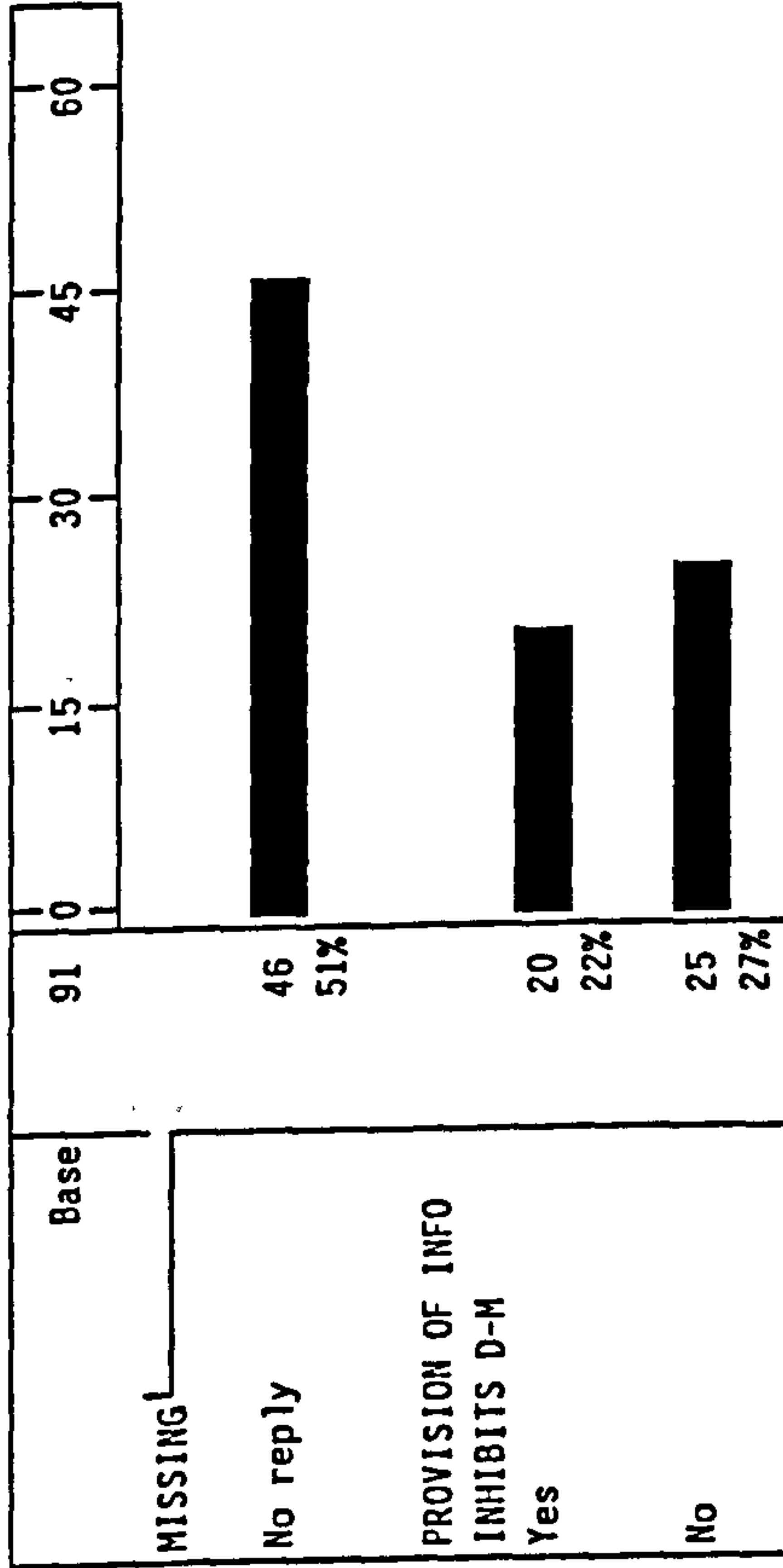
SNAP

Nandish V. Patel - Deferred Systems Design

The Development and Usage of Information Systems

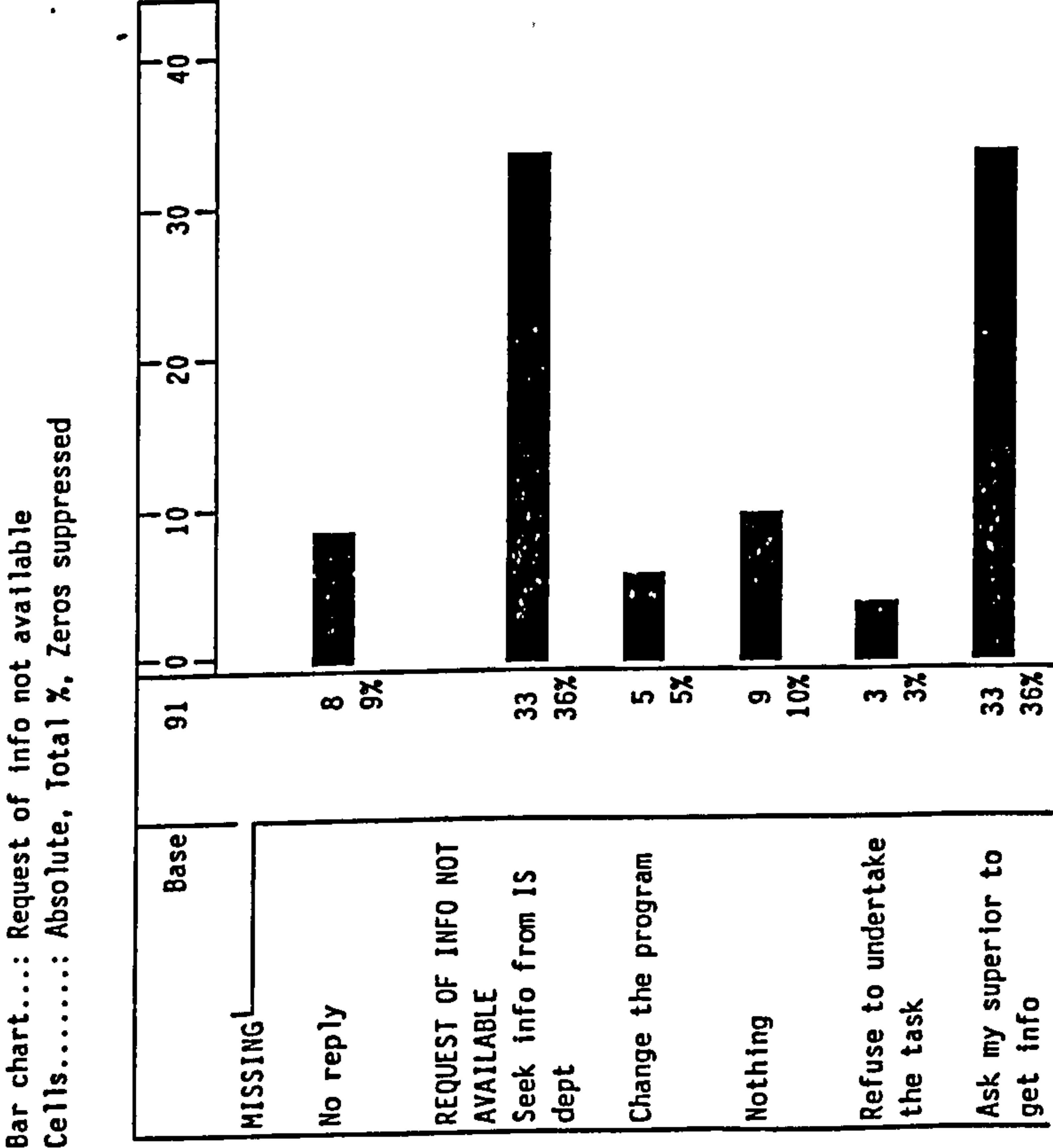
AVAILABILITY OF INFO FROM UNCHANGED INFO SYSTEM LIMITS DECIS

Bar chart....: Provision of info inhibits D-M  
Cells.....: Absolute, Total %, Zeros suppressed



The Development and Usage of Information Systems

ACCESS TO INFO THAT IS NOT CURRENTLY AVAILABLE

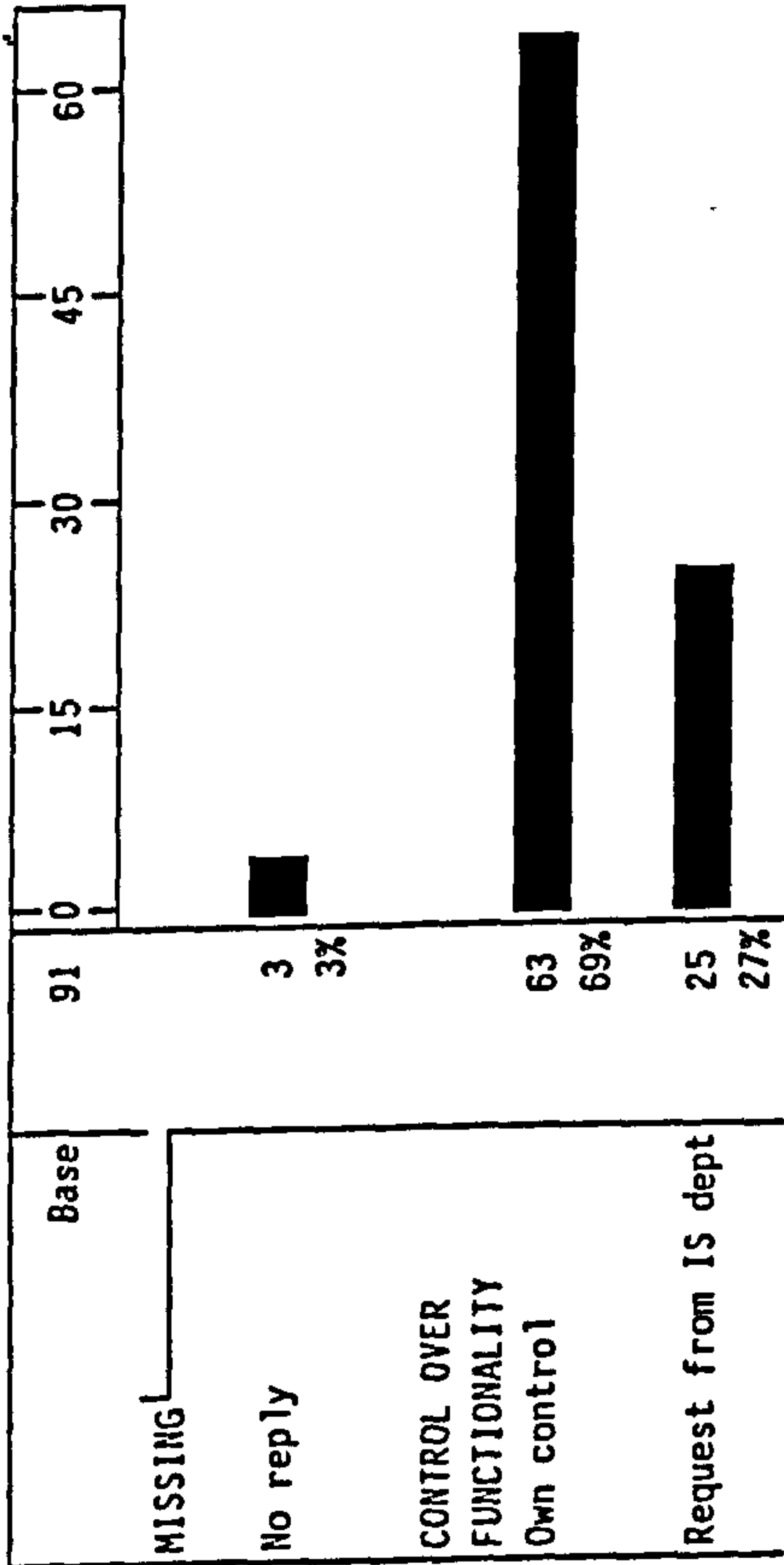


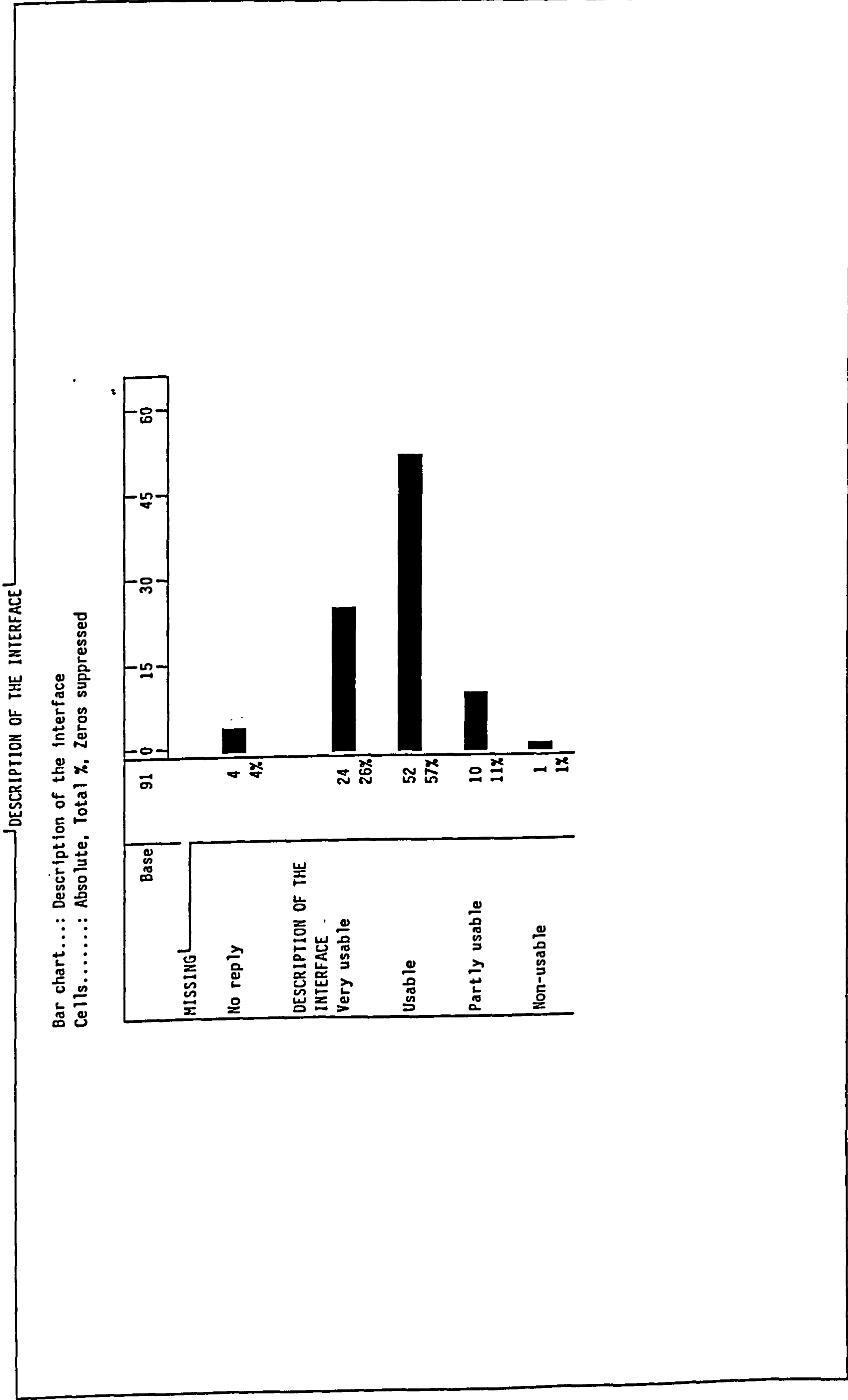


The Development and Usage of Information Systems

CONTROL OVER THE FUNCTIONALITY OF THE INFO SYSTEM

Bar chart....: Control over functionality  
Cells.....: Absolute, Total %, Zeros suppressed

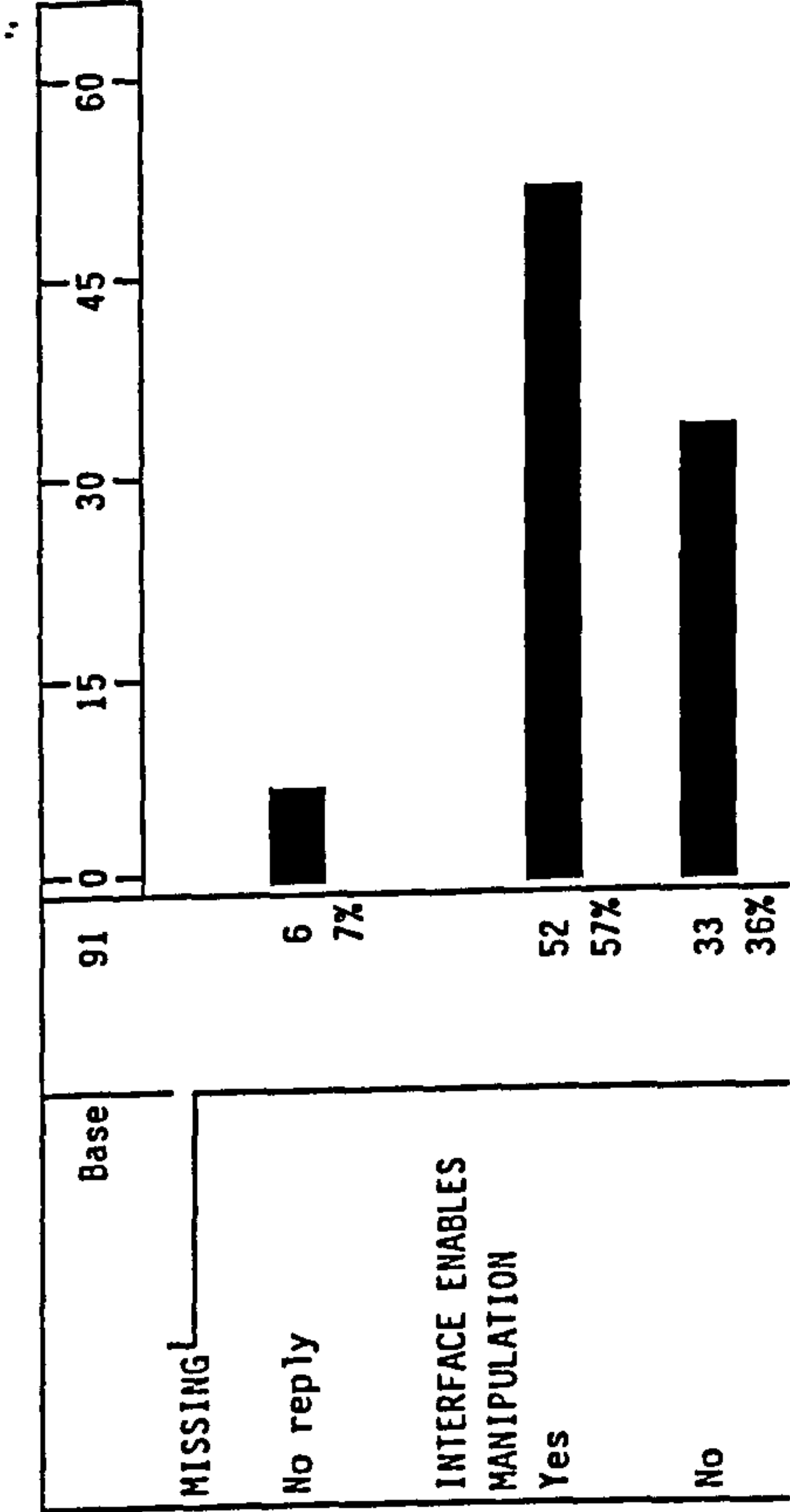




The Development and Usage of Information Systems

POWER PROVIDED BY THE INTERFACE TO MANIPULATE THE INFO SYSTEM

Bar chart....: Interface enables manipulation  
Cells.....: Absolute, Total %, Zeros suppressed

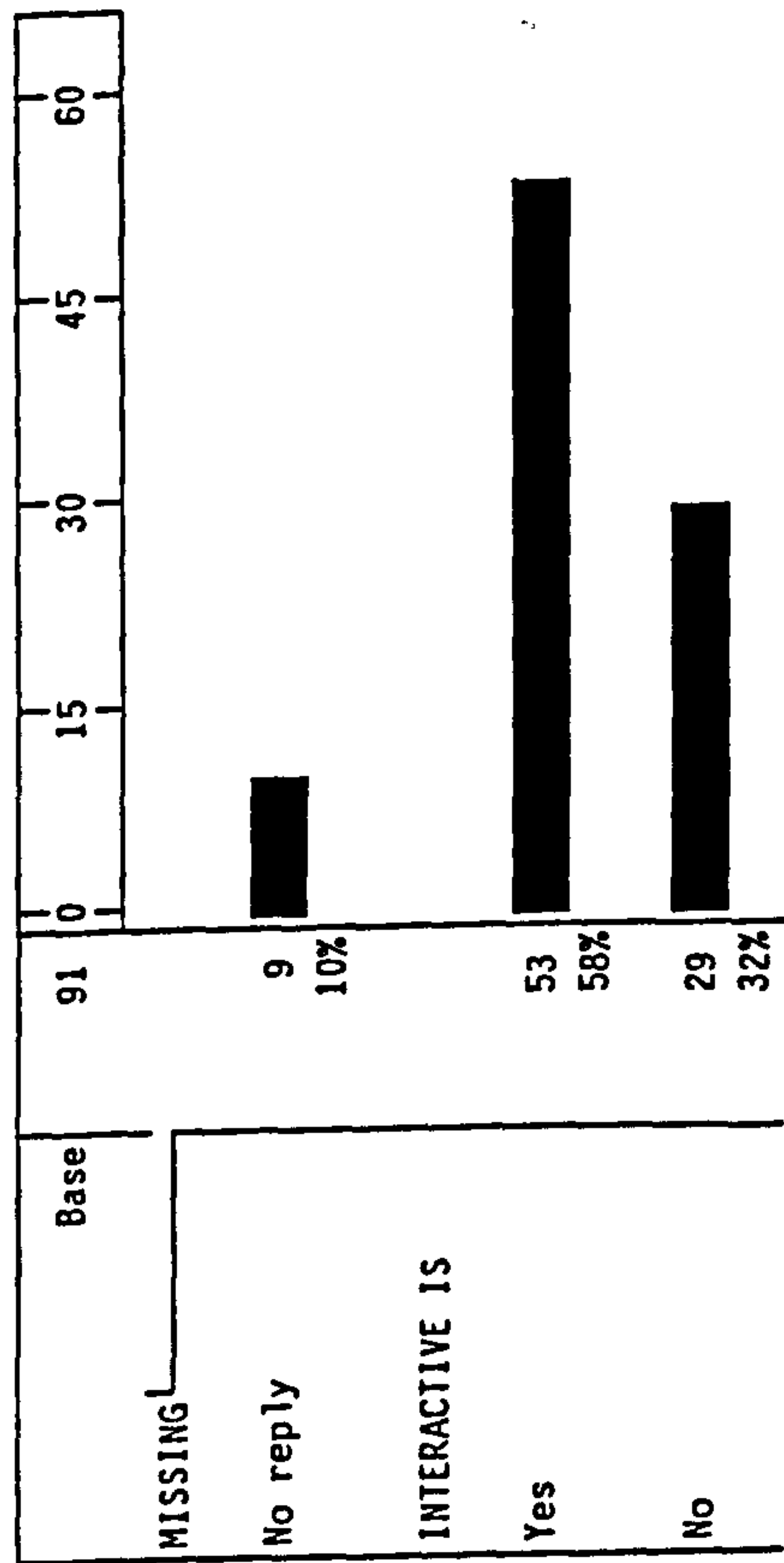




INTERACTIVENESS OF THE INFO SYSTEM

Bar chart....: Interactive IS

Cells.....: Absolute, Total %, Zeros suppressed

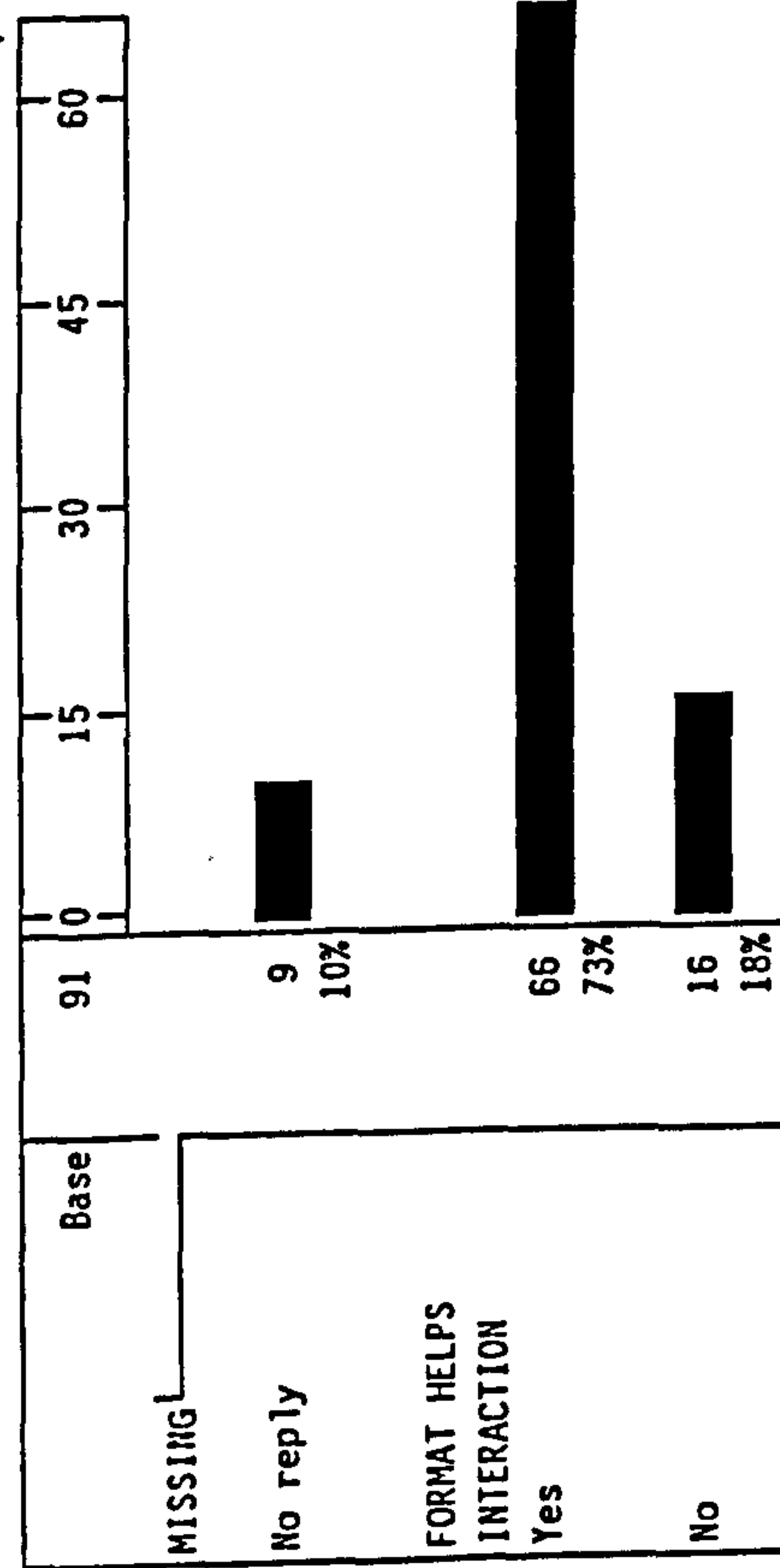


## The Development and Usage of Information Systems

## INTERACTIVENESS RESULTED BY INFO DISPLAYED ON SCREEN

Bar chart....: Format helps interaction

Cells.....: Absolute, Total %, Zeros suppressed



FACTORS RESULTING TO INFO DISPLAYED BECOMING INTERACTIVE

Frequencies.: Reasons behind good interaction  
Cells.....: Absolute, Total %, Zeros suppressed

| Base                            | 91        |
|---------------------------------|-----------|
| MISSING                         |           |
| No reply                        | 26<br>29% |
| REASONS BEHIND GOOD INTERACTION |           |
| Displays all info               | 41<br>45% |
| Uses appropriate wording        | 15<br>16% |
| Avoids unnecessary details      | 23<br>25% |
| Displays appropriate graphics   | 3<br>3%   |
| Uses appropriate colours        | 2<br>2%   |
| Uses appropriate icons          | 12<br>13% |
| Uses upper/lower text           | 10<br>11% |
| Uses graphic borders            | 4         |

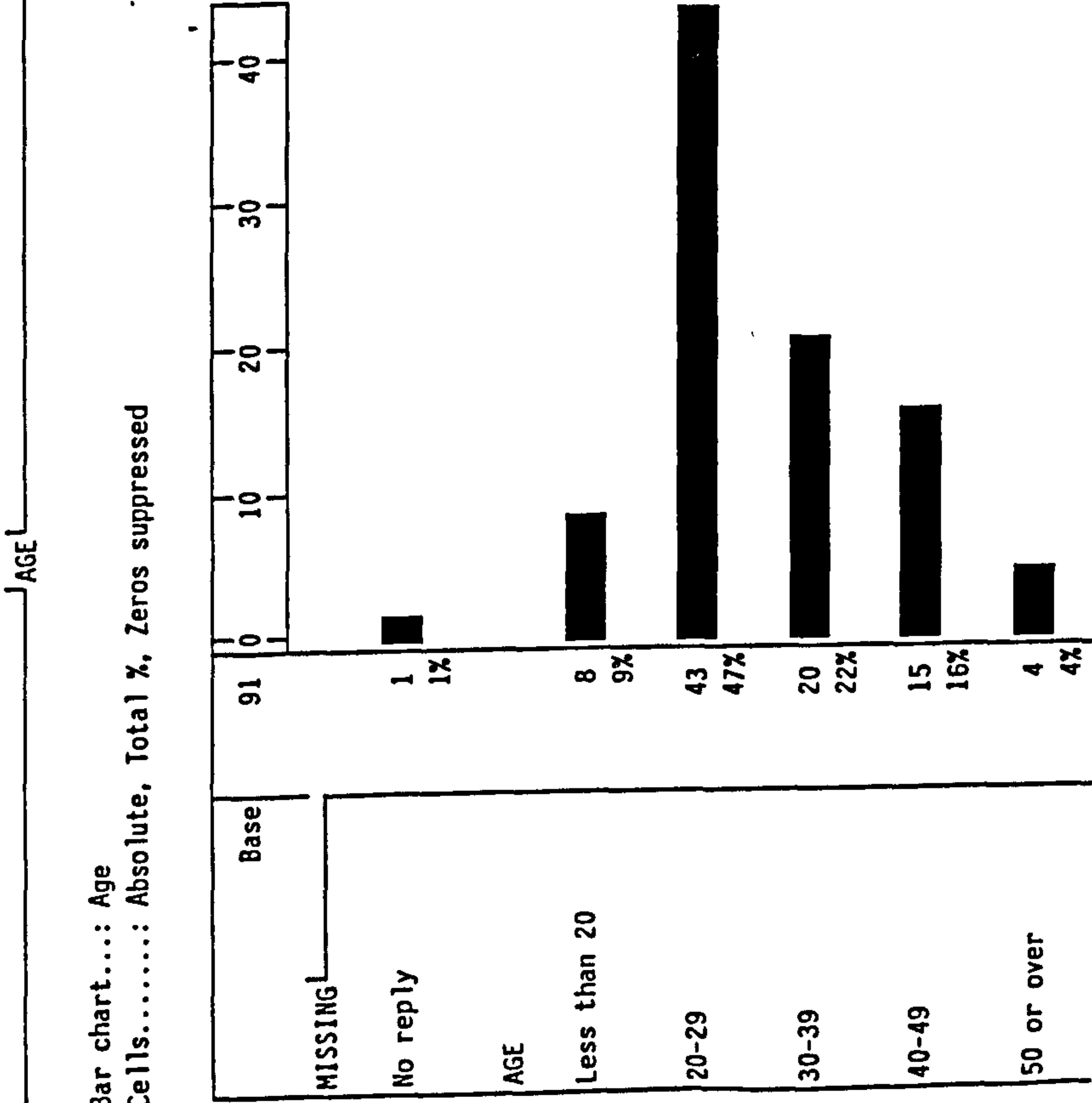


FACTORS RESULTING TO INFO DISPLAYED BECOMING INTERACTIVE

Frequencies.: Reasons behind good interaction  
Cells.....: Absolute, Total %, Zeros suppressed

| Base                     | 91        |
|--------------------------|-----------|
|                          | 4%        |
| Displays important info  | 14<br>15% |
| Uses helpful menus       | 34<br>37% |
| Provides on-line support | 9<br>10%  |

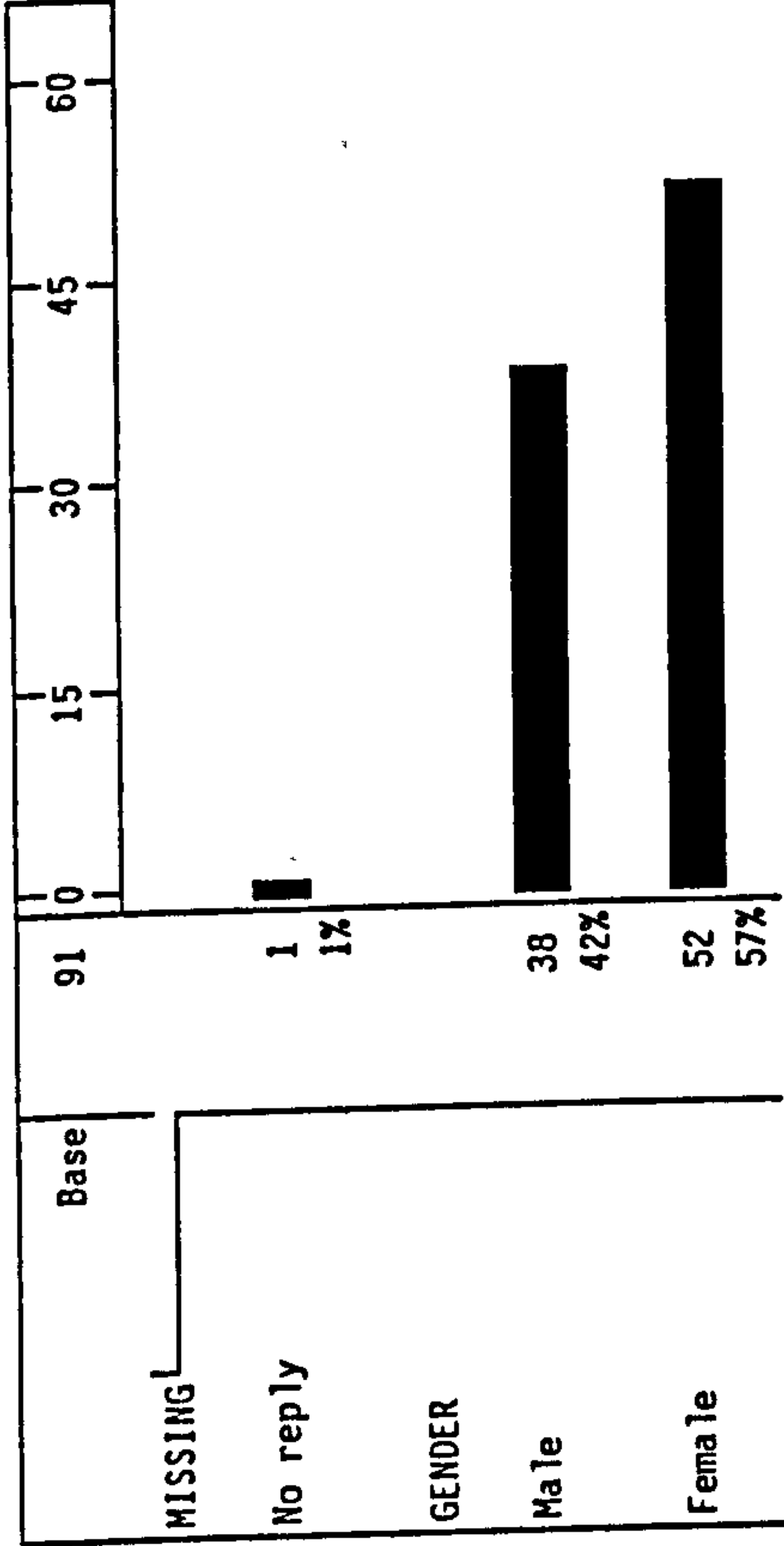
The Development and Usage of Information Systems



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SEX

Bar chart....: Gender  
Cells.....: Absolute, Total %, Zeros suppressed





Q001 BY Q024:Q025

Rows.....: Company Name  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

| COMPANY NAME               | Missing   |           | Age          |           |           |          |            | Gender    |           |
|----------------------------|-----------|-----------|--------------|-----------|-----------|----------|------------|-----------|-----------|
|                            | Base      | No reply  | Less than 20 | 20-29     | 30-39     | 40-49    | 50 or over | Male      | Female    |
| Base                       | 91        | 1         | 8            | 43        | 20        | 15       | 4          | 38        | 52        |
| ACE Business Computers Ltd | 13<br>14% | 0<br>0%   | 2<br>25%     | 9<br>21%  | 2<br>10%  | 0<br>0%  | 0<br>0%    | 10<br>26% | 3<br>6%   |
| Datatel                    | 38<br>42% | 0<br>0%   | 6<br>75%     | 17<br>40% | 7<br>35%  | 6<br>40% | 2<br>50%   | 23<br>61% | 15<br>29% |
| University of Luton        | 6<br>7%   | 0<br>0%   | 0<br>0%      | 4<br>9%   | 1<br>5%   | 1<br>7%  | 0<br>0%    | 0<br>0%   | 6<br>12%  |
| Nene College of H.E.       | 34<br>37% | 1<br>100% | 0<br>0%      | 13<br>30% | 10<br>50% | 8<br>53% | 2<br>50%   | 5<br>13%  | 28<br>54% |

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The Development and Usage of Information Systems

Q002 BY Q024:Q025

Rows.....: Organisational Tasks  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                      | Missing   |           | Age          |           |          |           |            | Gender    |           |
|----------------------|-----------|-----------|--------------|-----------|----------|-----------|------------|-----------|-----------|
|                      | Base      | No reply  | Less than 20 | 20-29     | 30-39    | 40-49     | 50 or over | Male      | Female    |
| Base                 | 91        | 1         | 8            | 43        | 20       | 15        | 4          | 38        | 52        |
| MISSING              |           |           |              |           |          |           |            |           |           |
| No reply             | 1<br>1%   | 0<br>0%   | 0<br>0%      | 1<br>2%   | 0<br>0%  | 0<br>0%   | 0<br>0%    | 1<br>3%   | 0<br>0%   |
| ORGANISATIONAL TASKS |           |           |              |           |          |           |            |           |           |
| Executive            | 5<br>5%   | 0<br>0%   | 0<br>0%      | 1<br>2%   | 2<br>10% | 2<br>13%  | 0<br>0%    | 5<br>13%  | 0<br>0%   |
| Senior Manager       | 7<br>8%   | 0<br>0%   | 0<br>0%      | 2<br>5%   | 3<br>15% | 1<br>7%   | 1<br>25%   | 6<br>16%  | 1<br>2%   |
| Middle Manager       | 15<br>16% | 0<br>0%   | 0<br>0%      | 6<br>14%  | 5<br>25% | 2<br>13%  | 2<br>50%   | 9<br>24%  | 6<br>12%  |
| Administration       | 52<br>57% | 1<br>100% | 3<br>38%     | 28<br>65% | 9<br>45% | 10<br>67% | 1<br>25%   | 11<br>29% | 40<br>77% |
| Other                | 11<br>12% | 0<br>0%   | 5<br>63%     | 5<br>12%  | 1<br>5%  | 0<br>0%   | 0<br>0%    | 6<br>16%  | 5<br>10%  |

Q003 BY Q024:Q025

Rows.....: Department  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

| DEPARTMENT                 | Missing |          | Age          |     |       |       |       | Gender  |        |
|----------------------------|---------|----------|--------------|-----|-------|-------|-------|---------|--------|
|                            | Base    | No reply | Less than 20 |     | 20-29 | 30-39 | 40-49 | or over | 50     |
|                            |         |          |              |     |       |       |       |         |        |
|                            | 91      | 1        | 8            | 43  | 20    | 15    | 4     |         |        |
|                            |         |          |              |     |       |       |       | Male    | Female |
| Production                 | 15      | 0        | 2            | 7   | 3     | 3     | 0     | 12      | 3      |
|                            | 16%     | 0%       | 25%          | 16% | 15%   | 20%   | 0%    | 32%     | 6%     |
| Administration/<br>Finance | 67      | 1        | 4            | 34  | 15    | 10    | 3     | 21      | 45     |
|                            | 74%     | 100%     | 50%          | 79% | 75%   | 67%   | 75%   | 55%     | 87%    |
| Marketing                  | 9       | 0        | 2            | 2   | 2     | 2     | 1     | 5       | 4      |
|                            | 10%     | 0%       | 25%          | 5%  | 10%   | 13%   | 25%   | 13%     | 8%     |



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Q004 BY Q024:Q025

Rows.....: Number of years on the same job  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                                 | Missing <sup>1</sup> Age <sup>1</sup> |          | Less <sup>1</sup> |       |       |       |            | Gender <sup>1</sup> |        |
|---------------------------------|---------------------------------------|----------|-------------------|-------|-------|-------|------------|---------------------|--------|
|                                 | Base                                  | No reply | than 20           | 20-29 | 30-39 | 40-49 | 50 or over | Male                | Female |
| Base                            | 91                                    | 1        | 8                 | 43    | 20    | 15    | 4          | 38                  | 52     |
| NUMBER OF YEARS ON THE SAME JOB |                                       |          |                   |       |       |       |            |                     |        |
| Less than 3                     | 42                                    | 0        | 6                 | 20    | 11    | 5     | 0          | 13                  | 29     |
|                                 | 46%                                   | 0%       | 75%               | 47%   | 55%   | 33%   | 0%         | 34%                 | 56%    |
| 3 - less 5                      | 21                                    | 1        | 2                 | 12    | 3     | 3     | 0          | 9                   | 11     |
|                                 | 23%                                   | 100%     | 25%               | 28%   | 15%   | 20%   | 0%         | 24%                 | 21%    |
| 5 - less 10                     | 16                                    | 0        | 0                 | 10    | 5     | 1     | 0          | 8                   | 8      |
|                                 | 18%                                   | 0%       | 0%                | 23%   | 25%   | 7%    | 0%         | 21%                 | 15%    |
| 10 - less 20                    | 9                                     | 0        | 0                 | 1     | 1     | 5     | 2          | 5                   | 4      |
|                                 | 10%                                   | 0%       | 0%                | 2%    | 5%    | 33%   | 50%        | 13%                 | 8%     |
| More than 20                    | 3                                     | 0        | 0                 | 0     | 0     | 1     | 2          | 3                   | 0      |
|                                 | 3%                                    | 0%       | 0%                | 0%    | 0%    | 7%    | 50%        | 8%                  | 0%     |

Q005 BY Q024:Q025

Rows.....: Altered Duties & responsibility  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                                 |     | Missing Age |          | Age          |       |       |       |            | Gender |        |
|---------------------------------|-----|-------------|----------|--------------|-------|-------|-------|------------|--------|--------|
|                                 |     | Base        | No reply | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over | Male   | Female |
| ALTERED DUTIES & RESPONSIBILITY | Yes | 91          | 1        | 8            | 43    | 20    | 15    | 4          | 38     | 52     |
|                                 |     | 62          | 1        | 2            | 28    | 14    | 13    | 4          | 30     | 31     |
|                                 |     | 68%         | 100%     | 25%          | 65%   | 70%   | 87%   | 100%       | 79%    | 60%    |
|                                 | No  | 29          | 0        | 6            | 15    | 6     | 2     | 0          | 8      | 21     |
|                                 |     | 32%         | 0%       | 75%          | 35%   | 30%   | 13%   | 0%         | 21%    | 40%    |

| Q006 BY Q024:Q025   |         |          |              |       |       |        |            |      |        |
|---|---------|----------|--------------|-------|-------|--------|------------|------|--------|
| Rows.....: Causes of changes in duties<br>Columns.....: Q024:Q025<br>Cells.....: Absolute, Column %, Zeros suppressed |         |          |              |       |       |        |            |      |        |
|   | Age     |          |              |       |       | Gender |            |      |        |
|   | Missing | No reply | Less than 20 | 20-29 | 30-39 | 40-49  | 50 or over | Male | Female |
| Base  | 91      | 1        | 8            | 43    | 20    | 15     | 4          | 38   | 52     |
| MISSING   |         |          |              |       |       |        |            |      |        |
| No reply  | 29      | 0        | 6            | 15    | 6     | 2      | 0          | 8    | 21     |
|   | 32%     | 0%       | 75%          | 35%   | 30%   | 13%    | 0%         | 21%  | 40%    |
| CAUSES OF CHANGES IN DUTIES   |         |          |              |       |       |        |            |      |        |
| Job description   | 16      | 1        | 0            | 9     | 2     | 3      | 1          | 5    | 10     |
|   | 18%     | 100%     | 0%           | 21%   | 10%   | 20%    | 25%        | 13%  | 19%    |
| Organ task practice   | 15      | 0        | 1            | 7     | 5     | 2      | 0          | 8    | 7      |
|   | 16%     | 0%       | 13%          | 16%   | 25%   | 13%    | 0%         | 21%  | 13%    |
| Colleagues work practices   | 10      | 0        | 1            | 5     | 4     | 0      | 0          | 3    | 7      |
|   | 11%     | 0%       | 13%          | 12%   | 20%   | 0%     | 0%         | 8%   | 13%    |
| Organisational objectives   | 16      | 1        | 0            | 6     | 5     | 2      | 2          | 7    | 8      |
|   | 18%     | 100%     | 0%           | 14%   | 25%   | 13%    | 50%        | 18%  | 15%    |
| People  | 14      | 1        | 1            | 7     | 3     | 2      | 0          | 6    | 7      |
|   | 15%     | 100%     | 13%          | 16%   | 15%   | 13%    | 0%         | 16%  | 13%    |



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| Q006 BY Q024:Q025                                |         |          |              |       |       |       |            |      |        |
|--|---------|----------|--------------|-------|-------|-------|------------|------|--------|
| Rows.....: Causes of changes in duties           |         |          |              |       |       |       |            |      |        |
| Columns.....: Q024:Q025                          |         |          |              |       |       |       |            |      |        |
| Cells.....: Absolute, Column %, Zeros suppressed |         |          |              |       |       |       |            |      |        |
|  | Missing |          |              |       |       | Age   |            |      |        |
|  | Base    | No reply | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over | Male | Female |
| Base   | 91      | 1        | 8            | 43    | 20    | 15    | 4          | 38   | 52     |
| Processes and procedures                         | 24      | 1        | 0            | 11    | 7     | 3     | 2          | 10   | 13     |
|  | 26%     | 100%     | 0%           | 26%   | 35%   | 20%   | 50%        | 26%  | 25%    |
| New or enhanced technology                       | 30      | 0        | 1            | 11    | 8     | 8     | 2          | 14   | 16     |
|  | 33%     | 0%       | 13%          | 26%   | 40%   | 53%   | 50%        | 37%  | 31%    |
| Management decisions                             | 32      | 0        | 0            | 16    | 9     | 6     | 1          | 16   | 16     |
|  | 35%     | 0%       | 0%           | 37%   | 45%   | 40%   | 25%        | 42%  | 31%    |
| Other  | 4       | 0        | 1            | 1     | 1     | 1     | 0          | 4    | 0      |
|  | 4%      | 0%       | 13%          | 2%    | 5%    | 7%    | 0%         | 11%  | 0%     |

| Q007 BY Q024:Q025                                |         |          |              |       |       |       |            |      |        |  |        |  |
|--|---------|----------|--------------|-------|-------|-------|------------|------|--------|--|--------|--|
| Rows.....: IS caters for your organ needs        |         |          |              |       |       |       |            |      |        |  |        |  |
| Columns.....: Q024:Q025                          |         |          |              |       |       |       |            |      |        |  |        |  |
| Cells.....: Absolute, Column %, Zeros suppressed |         |          |              |       |       |       |            |      |        |  |        |  |
|  | Missing |          |              |       |       | Age   |            |      |        |  | Gender |  |
|  | Base    | No reply | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over | Male | Female |  |        |  |
| Base   | 91      | 1        | 8            | 43    | 20    | 15    | 4          | 38   | 52     |  |        |  |
| IS CATERS FOR YOUR ORGAN NEEDS                   |         |          |              |       |       |       |            |      |        |  |        |  |
| Always   | 12      | 0        | 1            | 3     | 4     | 4     | 0          | 7    | 5      |  |        |  |
|  | 13%     | 0%       | 13%          | 7%    | 20%   | 27%   | 0%         | 18%  | 10%    |  |        |  |
| Most of the times                                | 62      | 0        | 5            | 33    | 13    | 8     | 3          | 27   | 35     |  |        |  |
|  | 68%     | 0%       | 63%          | 77%   | 65%   | 53%   | 75%        | 71%  | 67%    |  |        |  |
| Partly   | 16      | 1        | 1            | 7     | 3     | 3     | 1          | 4    | 11     |  |        |  |
|  | 18%     | 100%     | 13%          | 16%   | 15%   | 20%   | 25%        | 11%  | 21%    |  |        |  |
| Rarely   | 1       | 0        | 1            | 0     | 0     | 0     | 0          | 0    | 1      |  |        |  |
|  | 1%      | 0%       | 13%          | 0%    | 0%    | 0%    | 0%         | 0%   | 2%     |  |        |  |

The Development and Usage of Information Systems

| Q008 BY Q024:Q025                                |         |          |              |       |       |       |            |        |        |  |
|--|---------|----------|--------------|-------|-------|-------|------------|--------|--------|--|
| Rows.....: IS provides all required inform       |         |          |              |       |       |       |            |        |        |  |
| Columns.....: Q024:Q025                          |         |          |              |       |       |       |            |        |        |  |
| Cells.....: Absolute, Column %, Zeros suppressed |         |          |              |       |       |       |            |        |        |  |
|  | Missing |          |              |       |       | Age   |            |        |        |  |
|  | Base    | No reply | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over | Gender |        |  |
|  |         |          |              |       |       |       |            | Male   | Female |  |
| Base   | 91      | 1        | 8            | 43    | 20    | 15    | 4          | 38     | 52     |  |
| MISSING  |         |          |              |       |       |       |            |        |        |  |
| No reply   | 4       | 0        | 0            | 0     | 2     | 1     | 1          | 0      | 4      |  |
|  | 4%      | 0%       | 0%           | 0%    | 10%   | 7%    | 25%        | 0%     | 8%     |  |
| IS PROVIDES ALL REQUIRED INFORM                  |         |          |              |       |       |       |            |        |        |  |
| All information Always                           | 12      | 0        | 2            | 3     | 3     | 4     | 0          | 6      | 6      |  |
|  | 13%     | 0%       | 25%          | 7%    | 15%   | 27%   | 0%         | 16%    | 12%    |  |
| All information Sometimes                        | 49      | 1        | 4            | 29    | 9     | 3     | 3          | 23     | 25     |  |
|  | 54%     | 100%     | 50%          | 67%   | 45%   | 20%   | 75%        | 61%    | 48%    |  |
| Partial information Always                       | 13      | 0        | 1            | 4     | 3     | 5     | 0          | 4      | 9      |  |
|  | 14%     | 0%       | 13%          | 9%    | 15%   | 33%   | 0%         | 11%    | 17%    |  |
| Partial information Sometimes                    | 13      | 0        | 1            | 7     | 3     | 2     | 0          | 5      | 8      |  |
|  | 14%     | 0%       | 13%          | 16%   | 15%   | 13%   | 0%         | 13%    | 15%    |  |



The Development and Usage of Information Systems

Q009 BY Q024:Q025

Rows.....: Have your tasks altered

Columns.....: Q024:Q025

Cells.....: Absolute, Column %, Zeros suppressed

..

|                         | Missing |          | Age          |       |       |       |            | Gender |        |
|-------------------------|---------|----------|--------------|-------|-------|-------|------------|--------|--------|
|                         | Base    | No reply | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over | Male   | Female |
| HAVE YOUR TASKS ALTERED | 91      | 1        | 8            | 43    | 20    | 15    | 4          | 38     | 52     |
| Increased significantly | 35      | 0        | 1            | 14    | 7     | 9     | 4          | 19     | 16     |
|                         | 38%     | 0%       | 13%          | 33%   | 35%   | 60%   | 100%       | 50%    | 31%    |
| Small increase          | 35      | 1        | 2            | 21    | 8     | 3     | 0          | 13     | 21     |
|                         | 38%     | 100%     | 25%          | 49%   | 40%   | 20%   | 0%         | 34%    | 40%    |
| Same                    | 21      | 0        | 5            | 8     | 5     | 3     | 0          | 6      | 15     |
|                         | 23%     | 0%       | 63%          | 19%   | 25%   | 20%   | 0%         | 16%    | 29%    |

The Development and Usage of Information Systems

Q010 BY Q024:Q025

Rows.....: Changes in information needs  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                              |     | Missing Age |          |              |       |       | Gender |            |      |        |
|------------------------------|-----|-------------|----------|--------------|-------|-------|--------|------------|------|--------|
|                              |     | Base        | No reply | Less than 20 | 20-29 | 30-39 | 40-49  | 50 or over | Male | Female |
| CHANGES IN INFORMATION NEEDS | Yes | 91          | 1        | 8            | 43    | 20    | 15     | 4          | 38   | 52     |
|                              |     |             |          |              |       |       |        |            |      |        |
|                              |     |             |          |              |       |       |        |            |      |        |
|                              |     |             |          |              |       |       |        |            |      |        |
|                              | No  | 58          | 1        | 1            | 28    | 11    | 13     | 4          | 29   | 28     |
|                              |     | 64%         | 100%     | 13%          | 65%   | 55%   | 87%    | 100%       | 76%  | 54%    |
|                              |     |             |          |              |       |       |        |            |      |        |
|                              |     |             |          |              |       |       |        |            |      |        |
|                              | No  | 33          | 0        | 7            | 15    | 9     | 2      | 0          | 9    | 24     |
|                              |     | 36%         | 0%       | 88%          | 35%   | 45%   | 13%    | 0%         | 24%  | 46%    |

The Development and Usage of Information Systems

Q011 BY Q024:Q025

Rows.....: How much have info needs changed  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                                  | Missing   |           |              |           |          | Age      |            |          |           |  | Gender |  |
|----------------------------------|-----------|-----------|--------------|-----------|----------|----------|------------|----------|-----------|--|--------|--|
|                                  | Base      | No reply  | Less than 20 | 20-29     | 30-39    | 40-49    | 50 or over | Male     | Female    |  |        |  |
| Base                             | 91        | 1         | 8            | 43        | 20       | 15       | 4          | 38       | 52        |  |        |  |
| MISSING                          |           |           |              |           |          |          |            |          |           |  |        |  |
| No reply                         | 33<br>36% | 0<br>0%   | 8<br>100%    | 15<br>35% | 8<br>40% | 2<br>13% | 0<br>0%    | 8<br>21% | 25<br>48% |  |        |  |
| HOW MUCH HAVE INFO NEEDS CHANGED |           |           |              |           |          |          |            |          |           |  |        |  |
| 0-9                              | 3<br>3%   | 0<br>0%   | 0<br>0%      | 1<br>2%   | 2<br>10% | 0<br>0%  | 0<br>0%    | 2<br>5%  | 1<br>2%   |  |        |  |
| 10-19                            | 4<br>4%   | 1<br>100% | 0<br>0%      | 1<br>2%   | 0<br>0%  | 2<br>13% | 0<br>0%    | 2<br>5%  | 1<br>2%   |  |        |  |
| 20-29                            | 6<br>7%   | 0<br>0%   | 0<br>0%      | 5<br>12%  | 0<br>0%  | 1<br>7%  | 0<br>0%    | 2<br>5%  | 4<br>8%   |  |        |  |
| 30-39                            | 11<br>12% | 0<br>0%   | 0<br>0%      | 7<br>16%  | 2<br>10% | 0<br>0%  | 2<br>50%   | 5<br>13% | 6<br>12%  |  |        |  |
| 40-49                            | 9<br>10%  | 0<br>0%   | 0<br>0%      | 3<br>7%   | 1<br>5%  | 5<br>33% | 0<br>0%    | 3<br>8%  | 6<br>12%  |  |        |  |



The Development and Usage of Information Systems

Q011 BY Q024:Q025

Rows.....: How much have info needs changed  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|        | Missing |          |              |       |       | Age   |            |      |        |  | Gender |        |
|--------|---------|----------|--------------|-------|-------|-------|------------|------|--------|--|--------|--------|
|        | Base    | No reply | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over | Male | Female |  | Male   | Female |
|        |         |          |              |       |       |       |            |      |        |  |        |        |
| 50-59  | 91      | 1        | 8            | 43    | 20    | 15    | 4          | 38   | 52     |  |        |        |
|        | 7       | 0        | 0            | 3     | 1     | 2     | 1          | 5    | 2      |  |        |        |
|        | 8%      | 0%       | 0%           | 7%    | 5%    | 13%   | 25%        | 13%  | 4%     |  |        |        |
| 60-69  | 8       | 0        | 0            | 5     | 2     | 1     | 0          | 5    | 3      |  |        |        |
|        | 9%      | 0%       | 0%           | 12%   | 10%   | 7%    | 0%         | 13%  | 6%     |  |        |        |
| 70-79  | 5       | 0        | 0            | 1     | 3     | 1     | 0          | 4    | 1      |  |        |        |
|        | 5%      | 0%       | 0%           | 2%    | 15%   | 7%    | 0%         | 11%  | 2%     |  |        |        |
| 80-100 | 5       | 0        | 0            | 2     | 1     | 1     | 1          | 2    | 3      |  |        |        |
|        | 5%      | 0%       | 0%           | 5%    | 5%    | 7%    | 25%        | 5%   | 6%     |  |        |        |

The Development and Usage of Information Systems

Q012 BY Q024:Q025

Rows.....: Fit of IS with changed info need  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                                  | Missing   |           | Age          |           |           |           |            | Gender    |           |
|----------------------------------|-----------|-----------|--------------|-----------|-----------|-----------|------------|-----------|-----------|
|                                  | Base      | No reply  | Less than 20 | 20-29     | 30-39     | 40-49     | 50 or over | Male      | Female    |
| MISSING                          | 91        | 1         | 8            | 43        | 20        | 15        | 4          | 38        | 52        |
| No reply                         | 16<br>18% | 0<br>0%   | 2<br>25%     | 7<br>16%  | 5<br>25%  | 2<br>13%  | 0<br>0%    | 3<br>8%   | 13<br>25% |
| FIT OF IS WITH CHANGED INFO NEED |           |           |              |           |           |           |            |           |           |
| Yes                              | 57<br>63% | 1<br>100% | 1<br>13%     | 29<br>67% | 11<br>55% | 11<br>73% | 4<br>100%  | 30<br>79% | 26<br>50% |
| No                               | 18<br>20% | 0<br>0%   | 5<br>63%     | 7<br>16%  | 4<br>20%  | 2<br>13%  | 0<br>0%    | 5<br>13%  | 13<br>25% |

**Nandish V. Patel - Deferred Systems Design**



Q013 BY Q024:Q025

Rows.....: How well IS fit changed info nee  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|        |       | Age     |          |              |       |       |       | Gender     |      |        |
|--------|-------|---------|----------|--------------|-------|-------|-------|------------|------|--------|
|        |       | Missing | No reply | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over | Male | Female |
| Base   |       | 91      | 1        | 8            | 43    | 20    | 15    | 4          | 38   | 52     |
|        | 70-79 | 6       | 0        | 0            | 1     | 2     | 3     | 0          | 4    | 2      |
|        |       | 7%      | 0%       | 0%           | 2%    | 10%   | 20%   | 0%         | 11%  | 4%     |
| 80-100 |       | 10      | 0        | 0            | 5     | 4     | 0     | 1          | 6    | 4      |
|        |       | 11%     | 0%       | 0%           | 12%   | 20%   | 0%    | 25%        | 16%  | 8%     |

JQ014 BY Q024:Q025

Rows.....: IS amendment due to changed Info  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                                  | Missing |          |              |       |       | Age   |            |      |        |  | Gender |  |
|----------------------------------|---------|----------|--------------|-------|-------|-------|------------|------|--------|--|--------|--|
|                                  | Base    | No reply | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over | Male | Female |  |        |  |
| Base                             | 91      | 1        | 8            | 43    | 20    | 15    | 4          | 38   | 52     |  |        |  |
| MISSING                          |         |          |              |       |       |       |            |      |        |  |        |  |
| No reply                         | 3       | 0        | 1            | 0     | 2     | 0     | 0          | 1    | 2      |  |        |  |
|                                  | 3%      | 0%       | 13%          | 0%    | 10%   | 0%    | 0%         | 3%   | 4%     |  |        |  |
| IS AMENDMENT DUE TO CHANGED INFO |         |          |              |       |       |       |            |      |        |  |        |  |
| Yes                              | 43      | 0        | 1            | 21    | 10    | 9     | 2          | 19   | 24     |  |        |  |
|                                  | 47%     | 0%       | 13%          | 49%   | 50%   | 60%   | 50%        | 50%  | 46%    |  |        |  |
| No                               | 45      | 1        | 6            | 22    | 8     | 6     | 2          | 18   | 26     |  |        |  |
|                                  | 49%     | 100%     | 75%          | 51%   | 40%   | 40%   | 50%        | 47%  | 50%    |  |        |  |

The Development and Usage of Information Systems

Q015 BY Q024:Q025

Rows.....: Description of amendment  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                                  | Missing |          | Age          |       |       |       |            | Gender |        |
|----------------------------------|---------|----------|--------------|-------|-------|-------|------------|--------|--------|
|                                  | Base    | No reply | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over | Male   | Female |
| Base                             | 91      | 1        | 8            | 43    | 20    | 15    | 4          | 38     | 52     |
| MISSING                          |         |          |              |       |       |       |            |        |        |
| No reply                         | 48      | 1        | 7            | 23    | 9     | 6     | 2          | 19     | 28     |
|                                  | 53%     | 100%     | 88%          | 53%   | 45%   | 40%   | 50%        | 50%    | 54%    |
| DESCRIPTION OF AMENDMENT         |         |          |              |       |       |       |            |        |        |
| Timely amendment-accurate info   | 21      | 0        | 1            | 11    | 4     | 4     | 1          | 10     | 11     |
|                                  | 23%     | 0%       | 13%          | 26%   | 20%   | 27%   | 25%        | 26%    | 21%    |
| Delayed amendment-accurate info  | 9       | 0        | 0            | 4     | 3     | 1     | 1          | 5      | 4      |
|                                  | 10%     | 0%       | 0%           | 9%    | 15%   | 7%    | 25%        | 13%    | 8%     |
| Timely amendment-not accur info  | 3       | 0        | 0            | 1     | 2     | 0     | 0          | 1      | 2      |
|                                  | 3%      | 0%       | 0%           | 2%    | 10%   | 0%    | 0%         | 3%     | 4%     |
| Delayed amendment-not accur info | 2       | 0        | 0            | 0     | 1     | 1     | 0          | 0      | 2      |
|                                  | 2%      | 0%       | 0%           | 0%    | 5%    | 7%    | 0%         | 0%     | 4%     |
| Currently under amendment        | 8       | 0        | 0            | 4     | 1     | 3     | 0          | 3      | 5      |
|                                  | 9%      | 0%       | 0%           | 9%    | 5%    | 20%   | 0%         | 8%     | 10%    |



Q016 BY Q024:Q025

Rows.....: Provision of info inhibits D-M  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                                | Missing |          | Age |              |       |       |       | Gender     |    |
|--------------------------------|---------|----------|-----|--------------|-------|-------|-------|------------|----|
|                                | Base    | No reply | 1   | 8            | 43    | 20    | 15    | 4          | 52 |
|                                |         |          |     |              |       |       |       |            |    |
|                                |         |          |     | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over |    |
| MISSING                        | 91      |          |     |              |       |       |       |            |    |
| No reply                       | 46      | 0        | 0   | 24           | 10    | 9     | 3     | 22         |    |
|                                | 51%     | 0%       | 0%  | 56%          | 50%   | 60%   | 75%   | 42%        |    |
| PROVISION OF INFO INHIBITS D-M |         |          |     |              |       |       |       |            |    |
| Yes                            | 20      | 1        | 3   | 6            | 5     | 4     | 1     | 12         |    |
|                                | 22%     | 100%     | 38% | 14%          | 25%   | 27%   | 25%   | 23%        |    |
| No                             | 25      | 0        | 5   | 13           | 5     | 2     | 0     | 18         |    |
|                                | 27%     | 0%       | 63% | 30%          | 25%   | 13%   | 0%    | 35%        |    |

Q017 BY Q024:Q025

Rows.....: Request of info not available  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                               | Missing |          |              | Age   |       |       |            |  | Gender |        |
|-------------------------------|---------|----------|--------------|-------|-------|-------|------------|--|--------|--------|
|                               | Base    | No reply | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over |  | Male   | Female |
| MISSING                       | 91      | 1        | 8            | 43    | 20    | 15    | 4          |  | 38     | 52     |
| No reply                      | 8       | 0        | 0            | 3     | 2     | 3     | 0          |  | 2      | 6      |
| REQUEST OF INFO NOT AVAILABLE |         |          |              |       |       |       |            |  |        |        |
| Seek info from IS dept        | 33      | 0        | 1            | 11    | 7     | 11    | 3          |  | 20     | 13     |
|                               | 36%     | 0%       | 13%          | 26%   | 35%   | 73%   | 75%        |  | 53%    | 25%    |
| Change the program            | 5       | 0        | 0            | 4     | 1     | 0     | 0          |  | 4      | 1      |
|                               | 5%      | 0%       | 0%           | 9%    | 5%    | 0%    | 0%         |  | 11%    | 2%     |
| Nothing                       | 9       | 0        | 1            | 5     | 3     | 0     | 0          |  | 4      | 5      |
|                               | 10%     | 0%       | 13%          | 12%   | 15%   | 0%    | 0%         |  | 11%    | 10%    |
| Refuse to undertake the task  | 3       | 0        | 2            | 1     | 0     | 0     | 0          |  | 1      | 2      |
|                               | 3%      | 0%       | 25%          | 2%    | 0%    | 0%    | 0%         |  | 3%     | 4%     |
| Ask my superior to get info   | 33      | 1        | 4            | 19    | 7     | 1     | 1          |  | 7      | 25     |
|                               | 36%     | 100%     | 50%          | 44%   | 35%   | 7%    | 25%        |  | 18%    | 48%    |

Q018 BY Q024:Q025

Rows.....: Control over functionality  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                            | Missing |          | Age          |       |       |       |            | Gender |        |
|----------------------------|---------|----------|--------------|-------|-------|-------|------------|--------|--------|
|                            | Base    | No reply | Less than 20 | 20-29 | 30-39 | 40-49 | 50 or over | Male   | Female |
| Base                       | 91      | 1        | 8            | 43    | 20    | 15    | 4          | 38     | 52     |
| MISSING                    |         |          |              |       |       |       |            |        |        |
| No reply                   | 3       | 0        | 0            | 1     | 2     | 0     | 0          | 1      | 2      |
|                            | 3%      | 0%       | 0%           | 2%    | 10%   | 0%    | 0%         | 3%     | 4%     |
| CONTROL OVER FUNCTIONALITY |         |          |              |       |       |       |            |        |        |
| Own control                | 63      | 0        | 7            | 31    | 12    | 10    | 3          | 27     | 36     |
|                            | 69%     | 0%       | 88%          | 72%   | 60%   | 67%   | 75%        | 71%    | 69%    |
| Request from IS dept       | 25      | 1        | 1            | 11    | 6     | 5     | 1          | 10     | 14     |
|                            | 27%     | 100%     | 13%          | 26%   | 30%   | 33%   | 25%        | 26%    | 27%    |



The Development and Usage of Information Systems

Q019 BY Q024:Q025

Rows.....: Description of the interface  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                              | Missing   |           | Age          |           |          |           |            | Gender    |           |
|------------------------------|-----------|-----------|--------------|-----------|----------|-----------|------------|-----------|-----------|
|                              | Base      | No reply  | Less than 20 | 20-29     | 30-39    | 40-49     | 50 or over | Male      | Female    |
| MISSING                      | 91        | 1         | 8            | 43        | 20       | 15        | 4          | 38        | 52        |
| No reply                     | 4<br>4%   | 0<br>0%   | 0<br>0%      | 1<br>2%   | 3<br>15% | 0<br>0%   | 0<br>0%    | 1<br>3%   | 3<br>6%   |
| DESCRIPTION OF THE INTERFACE |           |           |              |           |          |           |            |           |           |
| Very usable                  | 24<br>26% | 0<br>0%   | 2<br>25%     | 10<br>23% | 6<br>30% | 4<br>27%  | 2<br>50%   | 16<br>42% | 8<br>15%  |
| Usable                       | 52<br>57% | 0<br>0%   | 6<br>75%     | 25<br>58% | 9<br>45% | 10<br>67% | 2<br>50%   | 18<br>47% | 34<br>65% |
| Partly usable                | 10<br>11% | 1<br>100% | 0<br>0%      | 6<br>14%  | 2<br>10% | 1<br>7%   | 0<br>0%    | 3<br>8%   | 6<br>12%  |
| Non-usable                   | 1<br>1%   | 0<br>0%   | 0<br>0%      | 1<br>2%   | 0<br>0%  | 0<br>0%   | 0<br>0%    | 0<br>0%   | 1<br>2%   |

Q020 BY Q024:Q025

Rows.....: Interface enables manipulation  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                                   | Missing <sup>L</sup> Age <sup>L</sup> |           |              |           |           |          |            | Gender    |           |
|-----------------------------------|---------------------------------------|-----------|--------------|-----------|-----------|----------|------------|-----------|-----------|
|                                   | Base                                  | No reply  | Less than 20 | 20-29     | 30-39     | 40-49    | 50 or over | Male      | Female    |
| Base                              | 91                                    | 1         | 8            | 43        | 20        | 15       | 4          | 38        | 52        |
| MISSING <sup>L</sup>              |                                       |           |              |           |           |          |            |           |           |
|                                   | No reply                              | 6<br>7%   | 0<br>0%      | 4<br>9%   | 2<br>10%  | 0<br>0%  | 0<br>0%    | 1<br>3%   | 5<br>10%  |
| INTERFACE ENABLES<br>MANIPULATION |                                       |           |              |           |           |          |            |           |           |
|                                   | Yes                                   | 52<br>57% | 1<br>100%    | 6<br>75%  | 25<br>58% | 9<br>45% | 8<br>53%   | 3<br>75%  | 23<br>61% |
| No                                | 33<br>36%                             | 0<br>0%   | 2<br>25%     | 14<br>33% | 9<br>45%  | 7<br>47% | 1<br>25%   | 14<br>37% | 19<br>37% |

| Q021 BY Q024:Q025                                |           |           |              |           |          |           |            |           |           |
|--|-----------|-----------|--------------|-----------|----------|-----------|------------|-----------|-----------|
| Rows.....: Interactive IS                        |           |           |              |           |          |           |            |           |           |
| Columns.....: Q024:Q025                          |           |           |              |           |          |           |            |           |           |
| Cells.....: Absolute, Column %, Zeros suppressed |           |           |              |           |          |           |            |           |           |
|  | Missing   |           |              |           | Age      |           |            |           | Gender    |
|  | Base      | No reply  | Less than 20 | 20-29     | 30-39    | 40-49     | 50 or over | Male      | Female    |
| Base   | 91        | 1         | 8            | 43        | 20       | 15        | 4          | 38        | 52        |
| MISSING  |           |           |              |           |          |           |            |           |           |
| No reply   | 9<br>10%  | 0<br>0%   | 0<br>0%      | 3<br>7%   | 5<br>25% | 1<br>7%   | 0<br>0%    | 1<br>3%   | 8<br>15%  |
| INTERACTIVE IS                                   |           |           |              |           |          |           |            |           |           |
| Yes  | 53<br>58% | 1<br>100% | 5<br>63%     | 25<br>58% | 9<br>45% | 10<br>67% | 3<br>75%   | 26<br>68% | 26<br>50% |
| No   | 29<br>32% | 0<br>0%   | 3<br>38%     | 15<br>35% | 6<br>30% | 4<br>27%  | 1<br>25%   | 11<br>29% | 18<br>35% |



| Q022 BY Q024:Q025  |           |           |              |           |           |           |            |           |           |
|--|-----------|-----------|--------------|-----------|-----------|-----------|------------|-----------|-----------|
| Rows.....: Format helps interaction<br>Columns.....: Q024:Q025<br>Cells.....: Absolute, Column %, Zeros suppressed |           |           |              |           |           |           |            |           |           |
|  | Age       |           |              |           |           | Gender    |            |           |           |
|  | Missing   | No reply  | Less than 20 | 20-29     | 30-39     | 40-49     | 50 or over | Male      | Female    |
| Base   | 91        | 1         | 8            | 43        | 20        | 15        | 4          | 38        | 52        |
| MISSING  |           |           |              |           |           |           |            |           |           |
| No reply   | 9<br>10%  | 1<br>100% | 0<br>0%      | 3<br>7%   | 2<br>10%  | 3<br>20%  | 0<br>0%    | 2<br>5%   | 6<br>12%  |
| FORMAT HELPS INTERACTION   |           |           |              |           |           |           |            |           |           |
| Yes  | 66<br>73% | 0<br>0%   | 6<br>75%     | 32<br>74% | 13<br>65% | 11<br>73% | 4<br>100%  | 31<br>82% | 35<br>67% |
| No   | 16<br>18% | 0<br>0%   | 2<br>25%     | 8<br>19%  | 5<br>25%  | 1<br>7%   | 0<br>0%    | 5<br>13%  | 11<br>21% |

| Q023 BY Q024:Q025   |           |           |              |           |           |          |            |           |           |
|---|-----------|-----------|--------------|-----------|-----------|----------|------------|-----------|-----------|
| Rows.....: Reasons behind good interaction<br>Columns.....: Q024:Q025<br>Cells.....: Absolute, Column %, Zeros suppressed |           |           |              |           |           |          |            |           |           |
|   | Missing   |           |              |           |           | Age      |            |           |           |
|   | Base      | No reply  | Less than 20 | 20-29     | 30-39     | 40-49    | 50 or over | Male      | Female    |
| Base  | 91        | 1         | 8            | 43        | 20        | 15       | 4          | 38        | 52        |
| MISSING   |           |           |              |           |           |          |            |           |           |
| No reply  | 26<br>29% | 1<br>100% | 1<br>13%     | 10<br>23% | 10<br>50% | 4<br>27% | 0<br>0%    | 7<br>18%  | 18<br>35% |
| REASONS BEHIND GOOD INTERACTION   |           |           |              |           |           |          |            |           |           |
| Displays all info   | 41<br>45% | 0<br>0%   | 4<br>50%     | 19<br>44% | 8<br>40%  | 9<br>60% | 1<br>25%   | 20<br>53% | 21<br>40% |
| Uses appropriate wording  | 15<br>16% | 0<br>0%   | 0<br>0%      | 7<br>16%  | 4<br>20%  | 3<br>20% | 1<br>25%   | 5<br>13%  | 10<br>19% |
| Avoids unnecessary details  | 23<br>25% | 0<br>0%   | 1<br>13%     | 14<br>33% | 5<br>25%  | 1<br>7%  | 2<br>50%   | 16<br>42% | 7<br>13%  |
| Displays appropriate graphics   | 3<br>3%   | 0<br>0%   | 1<br>13%     | 0<br>0%   | 1<br>5%   | 0<br>0%  | 1<br>25%   | 1<br>3%   | 2<br>4%   |
| Uses appropriate colours  | 2<br>2%   | 0<br>0%   | 0<br>0%      | 1<br>2%   | 1<br>5%   | 0<br>0%  | 0<br>0%    | 1<br>3%   | 1<br>2%   |

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Q023 BY Q024:Q025

Rows.....: Reasons behind good interaction  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|                          | Missing Age |          | Age          |           |          |          |            | Gender    |           |
|--------------------------|-------------|----------|--------------|-----------|----------|----------|------------|-----------|-----------|
|                          | Base        | No reply | Less than 20 | 20-29     | 30-39    | 40-49    | 50 or over | Male      | Female    |
| Base                     | 91          | 1        | 8            | 43        | 20       | 15       | 4          | 38        | 52        |
| Uses appropriate icons   | 12<br>13%   | 0<br>0%  | 1<br>13%     | 5<br>12%  | 3<br>15% | 3<br>20% | 0<br>0%    | 6<br>16%  | 6<br>12%  |
| Uses upper/lower text    | 10<br>11%   | 0<br>0%  | 1<br>13%     | 7<br>16%  | 1<br>5%  | 0<br>0%  | 1<br>25%   | 5<br>13%  | 5<br>10%  |
| Uses graphic borders     | 4<br>4%     | 0<br>0%  | 0<br>0%      | 2<br>5%   | 1<br>5%  | 0<br>0%  | 1<br>25%   | 4<br>11%  | 0<br>0%   |
| Displays important info  | 14<br>15%   | 0<br>0%  | 2<br>25%     | 10<br>23% | 2<br>10% | 0<br>0%  | 0<br>0%    | 7<br>18%  | 7<br>13%  |
| Uses helpful menus       | 34<br>37%   | 0<br>0%  | 3<br>38%     | 21<br>49% | 5<br>25% | 3<br>20% | 2<br>50%   | 14<br>37% | 20<br>38% |
| Provides on-line support | 9<br>10%    | 0<br>0%  | 1<br>13%     | 5<br>12%  | 0<br>0%  | 2<br>13% | 1<br>25%   | 5<br>13%  | 4<br>8%   |



The Development and Usage of Information Systems

Q024 BY Q024:Q025

Rows.....: Age  
Columns.....: Q024:Q025  
Cells.....: Absolute, Column %, Zeros suppressed

|              | Missing   |           |              |            |            |            |            | Age       |           | Gender |  |
|--------------|-----------|-----------|--------------|------------|------------|------------|------------|-----------|-----------|--------|--|
|              | Base      | No reply  | Less than 20 | 20-29      | 30-39      | 40-49      | 50 or over | Male      | Female    |        |  |
| MISSING      | 91        | 1         | 8            | 43         | 20         | 15         | 4          | 38        | 52        |        |  |
|              |           |           |              |            |            |            |            |           |           |        |  |
| No reply     | 1<br>1%   | 1<br>100% | 0<br>0%      | 0<br>0%    | 0<br>0%    | 0<br>0%    | 0<br>0%    | 0<br>0%   | 0<br>0%   |        |  |
| AGE          |           |           |              |            |            |            |            |           |           |        |  |
| Less than 20 | 8<br>9%   | 0<br>0%   | 8<br>100%    | 0<br>0%    | 0<br>0%    | 0<br>0%    | 0<br>0%    | 1<br>3%   | 7<br>13%  |        |  |
| 20-29        | 43<br>47% | 0<br>0%   | 0<br>0%      | 43<br>100% | 0<br>0%    | 0<br>0%    | 0<br>0%    | 21<br>55% | 22<br>42% |        |  |
| 30-39        | 20<br>22% | 0<br>0%   | 0<br>0%      | 0<br>0%    | 20<br>100% | 0<br>0%    | 0<br>0%    | 6<br>16%  | 14<br>27% |        |  |
| 40-49        | 15<br>16% | 0<br>0%   | 0<br>0%      | 0<br>0%    | 0<br>0%    | 15<br>100% | 0<br>0%    | 7<br>18%  | 8<br>15%  |        |  |
| 50 or over   | 4<br>4%   | 0<br>0%   | 0<br>0%      | 0<br>0%    | 0<br>0%    | 0<br>0%    | 4<br>100%  | 3<br>8%   | 1<br>2%   |        |  |

The Development and Usage of Information Systems

Q004 BY Q001:Q002:Q003

Rows.....: Number of years on the same job  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

|   | Company Name                            |         |                        |                            | Organisational Tasks |                   |                   |                     | Department |                 |                                 |                |     |
|---|---|---------|------------------------|----------------------------|----------------------|-------------------|-------------------|---------------------|------------|-----------------|---------------------------------|----------------|-----|
|   | ACE Busi-<br>ness Co-<br>mputers<br>Ltd | Datatel | University<br>of Luton | Nene<br>College<br>of H.E. | Exe-<br>cutive       | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other      | Pro-<br>duction | Adminis-<br>tration/<br>Finance | Mar-<br>keting |     |
| Base  | 91                                      | 13      | 38                     | 6                          | 34                   | 5                 | 7                 | 15                  | 52         | 11              | 15                              | 67             | 9   |
| NUMBER OF YEARS ON<br>THE SAME JOB<br>Less than 3 | 42                                      | 7       | 9                      | 5                          | 21                   | 1                 | 1                 | 3                   | 29         | 7               | 4                               | 36             | 2   |
|   | 46%                                     | 54%     | 24%                    | 83%                        | 62%                  | 20%               | 14%               | 20%                 | 56%        | 64%             | 27%                             | 54%            | 22% |
| 3 - less 5  | 21                                      | 1       | 13                     | 1                          | 6                    | 1                 | 1                 | 4                   | 12         | 3               | 3                               | 14             | 4   |
|   | 23%                                     | 8%      | 34%                    | 17%                        | 18%                  | 20%               | 14%               | 27%                 | 23%        | 27%             | 20%                             | 21%            | 44% |
| 5 - less 10                                       | 16                                      | 5       | 8                      | 0                          | 3                    | 2                 | 3                 | 3                   | 7          | 1               | 5                               | 10             | 1   |
|   | 18%                                     | 38%     | 21%                    | 0%                         | 9%                   | 40%               | 43%               | 20%                 | 13%        | 9%              | 33%                             | 15%            | 11% |
| 10 - less 20                                      | 9                                       | 0       | 6                      | 0                          | 3                    | 1                 | 2                 | 2                   | 4          | 0               | 2                               | 5              | 2   |
|   | 10%                                     | 0%      | 16%                    | 0%                         | 9%                   | 20%               | 29%               | 13%                 | 8%         | 0%              | 13%                             | 7%             | 22% |
| More than 20                                      | 3                                       | 0       | 2                      | 0                          | 1                    | 0                 | 0                 | 3                   | 0          | 0               | 1                               | 2              | 0   |
|   | 3%                                      | 0%      | 5%                     | 0%                         | 3%                   | 0%                | 0%                | 20%                 | 0%         | 0%              | 7%                              | 3%             | 0%  |

The Development and Usage of Information Systems

Q005 BY Q001:Q002:Q003

Rows.....: Altered Duties & responsibility  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

| ALTERED DUTIES & RESPONSIBILITY | Company Name               |     |     | Organisational Tasks |     |     |                      |     |     |           | Department     |     |                   |  |       |            |                        |           |  |
|---------------------------------|----------------------------|-----|-----|----------------------|-----|-----|----------------------|-----|-----|-----------|----------------|-----|-------------------|--|-------|------------|------------------------|-----------|--|
|                                 | ACE Business Computers Ltd |     |     | University of Luton  |     |     | Nene College of H.E. |     |     | Executive | Senior Manager |     | Middle Management |  | Other | Production | Administration/Finance | Marketing |  |
|                                 | Base                       |     |     | Data of              |     |     | of                   |     |     |           |                |     |                   |  |       |            |                        |           |  |
|                                 |                            |     |     |                      |     |     |                      |     |     |           |                |     |                   |  |       |            |                        |           |  |
|                                 |                            |     |     |                      |     |     |                      |     |     |           |                |     |                   |  |       |            |                        |           |  |
| Yes                             | 91                         | 13  | 38  | 6                    | 34  | 5   | 7                    | 15  | 52  | 11        | 15             | 67  | 9                 |  |       |            |                        |           |  |
| No                              | 62                         | 11  | 23  | 4                    | 24  | 3   | 6                    | 14  | 33  | 5         | 13             | 45  | 4                 |  |       |            |                        |           |  |
|                                 | 68%                        | 85% | 61% | 67%                  | 71% | 60% | 86%                  | 93% | 63% | 45%       | 87%            | 67% | 44%               |  |       |            |                        |           |  |
|                                 | 29                         | 2   | 15  | 2                    | 10  | 2   | 1                    | 1   | 19  | 6         | 2              | 22  | 5                 |  |       |            |                        |           |  |
|                                 | 32%                        | 15% | 39% | 33%                  | 29% | 40% | 14%                  | 7%  | 37% | 55%       | 13%            | 33% | 56%               |  |       |            |                        |           |  |

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The Development and Usage of Information Systems

| Q006 BY Q001:Q002:Q003   |              |  |           |                        |                            |                |                   |                   |                     |          |                 |                                 |                |
|--|--------------|--|-----------|------------------------|----------------------------|----------------|-------------------|-------------------|---------------------|----------|-----------------|---------------------------------|----------------|
| Rows.....: Causes of changes in duties<br>Columns.....: Q001:Q002:Q003<br>Cells.....: Absolute, Column %, Zeros suppressed |              |  |           |                        |                            |                |                   |                   |                     |          |                 |                                 |                |
|  | Company Name |  |           |                        | Organisational Tasks       |                |                   |                   | Department          |          |                 |                                 |                |
|  | Base         | ACE Busi<br>ness Co-<br>mputers<br>Ltd | Datatel   | University<br>of Luton | Nene<br>College<br>of H.E. | Exe-<br>cutive | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other    | Pro-<br>duction | Adminis-<br>tration/<br>Finance | Mar-<br>keting |
| Base   | 91           | 13                                     | 38        | 6                      | 34                         | 5              | 7                 | 15                | 52                  | 11       | 15              | 67                              | 9              |
| MISSING  |              |  |           |                        |                            |                |                   |                   |                     |          |                 |                                 |                |
| No reply   | 29<br>32%    | 2<br>15%                               | 15<br>39% | 2<br>33%               | 10<br>29%                  | 2<br>40%       | 1<br>14%          | 1<br>7%           | 19<br>37%           | 6<br>55% | 2<br>13%        | 22<br>33%                       | 5<br>56%       |
| CAUSES OF CHANGES IN<br>DUTIES   |              |  |           |                        |                            |                |                   |                   |                     |          |                 |                                 |                |
| Job description  | 16<br>18%    | 3<br>23%                               | 3<br>8%   | 2<br>33%               | 8<br>24%                   | 0<br>0%        | 3<br>43%          | 2<br>13%          | 11<br>21%           | 0<br>0%  | 5<br>33%        | 11<br>16%                       | 0<br>0%        |
| Organ task practice  | 15<br>16%    | 4<br>31%                               | 7<br>18%  | 0<br>0%                | 4<br>12%                   | 0<br>0%        | 2<br>29%          | 7<br>47%          | 3<br>6%             | 2<br>18% | 4<br>27%        | 11<br>16%                       | 0<br>0%        |
| Colleagues work<br>practices   | 10<br>11%    | 2<br>15%                               | 3<br>8%   | 0<br>0%                | 5<br>15%                   | 0<br>0%        | 1<br>14%          | 2<br>13%          | 5<br>10%            | 2<br>18% | 2<br>13%        | 8<br>12%                        | 0<br>0%        |
| Organisational<br>objectives   | 16<br>18%    | 0<br>0%                                | 8<br>21%  | 0<br>0%                | 8<br>24%                   | 1<br>20%       | 1<br>14%          | 3<br>20%          | 10<br>19%           | 1<br>9%  | 0<br>0%         | 14<br>21%                       | 2<br>22%       |
| People   | 14<br>15%    | 2<br>15%                               | 7<br>18%  | 0<br>0%                | 5<br>15%                   | 0<br>0%        | 1<br>14%          | 5<br>33%          | 6<br>12%            | 2<br>18% | 5<br>33%        | 9<br>13%                        | 0<br>0%        |
| Processes and<br>procedures  | 24<br>26%    | 6<br>46%                               | 5<br>13%  | 2<br>33%               | 11<br>32%                  | 2<br>40%       | 4<br>57%          | 6<br>40%          | 12<br>23%           | 0<br>0%  | 4<br>27%        | 19<br>28%                       | 1<br>11%       |
| New or enhanced  | 30           | 3                                      | 11        | 4                      | 12                         | 2              | 3                 | 3                 | 18                  | 3        | 6               | 21                              | 3              |

Q006 BY Q001:Q002:Q003

Rows.....: Causes of changes in duties  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

| Company Name         |     | Organisational Tasks        |     |                            |     |                |     |                   |     |                   |       | Department                      |     |                 |  |                |  |
|----------------------|-----|-----------------------------|-----|----------------------------|-----|----------------|-----|-------------------|-----|-------------------|-------|---------------------------------|-----|-----------------|--|----------------|--|
|                      |     | Uni-<br>versity<br>of Luton |     | Nene<br>College<br>of H.E. |     | Exe-<br>cutive |     | Senior<br>Manager |     | Middle<br>Manager |       | Admini-<br>stration/<br>Finance |     | Pro-<br>duction |  | Mar-<br>keting |  |
| Base                 |     | Datatel                     | Ltd | 38                         | 6   | 34             | 5   | 7                 | 15  | 52                | Other |                                 |     |                 |  |                |  |
| Base                 | 91  | 13                          |     | 38                         | 6   | 34             | 5   | 7                 | 15  | 52                | 11    | 15                              | 67  | 9               |  |                |  |
|                      | 33% | 23%                         |     | 29%                        | 67% | 35%            | 40% | 43%               | 20% | 35%               | 27%   | 40%                             | 31% | 33%             |  |                |  |
|                      | 32  | 7                           |     | 10                         | 3   | 12             | 2   | 1                 | 9   | 18                | 1     | 4                               | 27  | 1               |  |                |  |
| Management decisions | 35% | 54%                         |     | 26%                        | 50% | 35%            | 40% | 14%               | 60% | 35%               | 9%    | 27%                             | 40% | 11%             |  |                |  |
|                      | 4   | 2                           |     | 2                          | 0   | 0              | 0   | 0                 | 0   | 1                 | 3     | 3                               | 0   | 1               |  |                |  |
| Other                | 4%  | 15%                         |     | 5%                         | 0%  | 0%             | 0%  | 0%                | 0%  | 2%                | 27%   | 20%                             | 0%  | 11%             |  |                |  |
|                      |     |                             |     |                            |     |                |     |                   |     |                   |       |                                 |     |                 |  |                |  |

Q007 BY Q001:Q002:Q003

Rows.....: IS caters for your organ needs  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

|                                | Company Name               |         |                     | Organisational Tasks |           |                |                |                | Department               |         |           |
|--------------------------------|----------------------------|---------|---------------------|----------------------|-----------|----------------|----------------|----------------|--------------------------|---------|-----------|
|                                | ACE Business Computers Ltd |         |                     |                      |           |                |                |                | Administration/Marketing |         |           |
|                                | Base                       | Datatel | University of Luton | Nene College of H.E. | Executive | Senior Manager | Middle Manager | Administration | Production               | Finance | Marketing |
| Base                           | 91                         | 13      | 38                  | 6                    | 34        | 5              | 7              | 15             | 52                       | 11      | 9         |
| IS CATERS FOR YOUR ORGAN NEEDS |                            |         |                     |                      |           |                |                |                |                          |         |           |
| Always                         | 12                         | 2       | 8                   | 0                    | 2         | 3              | 1              | 2              | 5                        | 1       | 2         |
|                                | 13%                        | 15%     | 21%                 | 0%                   | 6%        | 60%            | 14%            | 13%            | 10%                      | 9%      | 22%       |
| Most of the times              | 62                         | 10      | 27                  | 6                    | 19        | 1              | 5              | 12             | 34                       | 9       | 5         |
|                                | 68%                        | 77%     | 71%                 | 100%                 | 56%       | 20%            | 71%            | 80%            | 65%                      | 82%     | 56%       |
| Partly                         | 16                         | 0       | 3                   | 0                    | 13        | 1              | 1              | 1              | 12                       | 1       | 2         |
|                                | 18%                        | 0%      | 8%                  | 0%                   | 38%       | 20%            | 14%            | 7%             | 23%                      | 9%      | 22%       |
| Rarely                         | 1                          | 1       | 0                   | 0                    | 0         | 0              | 0              | 0              | 1                        | 0       | 0         |
|                                | 1%                         | 8%      | 0%                  | 0%                   | 0%        | 0%             | 0%             | 0%             | 2%                       | 0%      | 0%        |



| Q008 BY Q001:Q002:Q003   |              |   |           |          |                                    |                |                   |                   |                     |          |                 |                                 |                |
|--|--------------|---|-----------|----------|------------------------------------|----------------|-------------------|-------------------|---------------------|----------|-----------------|---------------------------------|----------------|
| Rows.....: IS provides all required inform<br>Columns.....: Q001:Q002:Q003<br>Cells.....: Absolute, Column %, Zeros suppressed |              |   |           |          |                                    |                |                   |                   |                     |          |                 |                                 |                |
|  | Company Name |   |           |          | Organisational Tasks               |                |                   |                   |                     |          | Department      |                                 |                |
|  | Base         | ACE Busi-<br>ness Co-<br>mputers<br>Ltd | Datatel   | of Luton | Uni-<br>versity College<br>of H.E. | Exe-<br>cutive | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other    | Pro-<br>duction | Adminis-<br>tration/<br>Finance | Mar-<br>keting |
| Base   | 91           | 13                                      | 38        | 6        | 34                                 | 5              | 7                 | 15                | 52                  | 11       | 15              | 67                              | 9              |
| MISSING  |              |   |           |          |                                    |                |                   |                   |                     |          |                 |                                 |                |
| No reply   | 4<br>4%      | 0<br>0%                                 | 0<br>0%   | 0<br>0%  | 4<br>12%                           | 0<br>0%        | 0<br>0%           | 0<br>0%           | 4<br>8%             | 0<br>0%  | 0<br>0%         | 4<br>6%                         | 0<br>0%        |
| IS PROVIDES ALL<br>REQUIRED INFORM   |              |   |           |          |                                    |                |                   |                   |                     |          |                 |                                 |                |
| All information<br>Always  | 12<br>13%    | 2<br>15%                                | 8<br>21%  | 1<br>17% | 1<br>3%                            | 3<br>60%       | 1<br>14%          | 2<br>13%          | 4<br>8%             | 2<br>18% | 4<br>27%        | 6<br>9%                         | 2<br>22%       |
| All information<br>Sometimes   | 49<br>54%    | 8<br>62%                                | 25<br>66% | 4<br>67% | 12<br>35%                          | 0<br>0%        | 4<br>57%          | 10<br>67%         | 26<br>50%           | 8<br>73% | 11<br>73%       | 34<br>51%                       | 4<br>44%       |
| Partial information<br>Always  | 13<br>14%    | 0<br>0%                                 | 5<br>13%  | 1<br>17% | 7<br>21%                           | 1<br>20%       | 2<br>29%          | 1<br>7%           | 9<br>17%            | 0<br>0%  | 0<br>0%         | 11<br>16%                       | 2<br>22%       |
| Partial information<br>Sometimes   | 13<br>14%    | 3<br>23%                                | 0<br>0%   | 0<br>0%  | 10<br>29%                          | 1<br>20%       | 0<br>0%           | 2<br>13%          | 9<br>17%            | 1<br>9%  | 0<br>0%         | 12<br>18%                       | 1<br>11%       |

| Q009 BY Q001:Q002:Q003                           |              |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |
|--|--------------|------------------------------|----------------------|----------------------|----------------------|----------------|----------------|-----------------|-------|-------------|-------------------------|------------|-----|
| Rows.....: Have your tasks altered               |              |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |
| Columns.....: Q001:Q002:Q003                     |              |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |
| Cells.....: Absolute, Column %, Zeros suppressed |              |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |
|  | Company Name |                              |                      |                      | Organisational Tasks |                |                |                 |       | Department  |                         |            |     |
|  | Base         | ACE Busi-ness Co-mputers Ltd | Uni-versity of Luton | Nene College of H.E. | Exe-cutive           | Senior Manager | Middle Manager | Admini-stration | Other | Pro-duction | Adminis-tration/Finance | Mar-keting |     |
| Base   | 91           | 13                           | 38                   | 6                    | 34                   | 5              | 7              | 15              | 52    | 11          | 15                      | 67         | 9   |
| HAVE YOUR TASKS ALTERED                          |              |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |
| Increased significantly                          | 35           | 9                            | 12                   | 3                    | 11                   | 3              | 5              | 7               | 16    | 3           | 8                       | 24         | 3   |
|  | 38%          | 69%                          | 32%                  | 50%                  | 32%                  | 60%            | 71%            | 47%             | 31%   | 27%         | 53%                     | 36%        | 33% |
| Small increase                                   | 35           | 2                            | 17                   | 1                    | 15                   | 0              | 1              | 7               | 21    | 6           | 6                       | 26         | 3   |
|  | 38%          | 15%                          | 45%                  | 17%                  | 44%                  | 0%             | 14%            | 47%             | 40%   | 55%         | 40%                     | 39%        | 33% |
| Same   | 21           | 2                            | 9                    | 2                    | 8                    | 2              | 1              | 1               | 15    | 2           | 1                       | 17         | 3   |
|  | 23%          | 15%                          | 24%                  | 33%                  | 24%                  | 40%            | 14%            | 7%              | 29%   | 18%         | 7%                      | 25%        | 33% |

Q010 BY Q001:Q002:Q003

Rows.....: Changes in information needs  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

| Company Name                    |      | Organisational Tasks                |          |                            |          |                | Department        |                   |                     |           |                 |                                 |                |
|---------------------------------|------|-------------------------------------|----------|----------------------------|----------|----------------|-------------------|-------------------|---------------------|-----------|-----------------|---------------------------------|----------------|
|                                 |      | Uni-<br>versity College<br>of Luton |          | None<br>College<br>of H.E. |          | Exe-<br>cutive | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other     | Pro-<br>duction | Adminis-<br>tration/<br>Finance | Mar-<br>keting |
| CHANGES IN<br>INFORMATION NEEDS | Base | 91                                  | 13       | 38                         | 6        | 34             | 5                 | 7                 | 15                  | 52        | 11              | 67                              | 9              |
|                                 | Yes  | 58<br>64%                           | 8<br>62% | 26<br>68%                  | 4<br>67% | 20<br>59%      | 4<br>80%          | 6<br>86%          | 12<br>80%           | 31<br>60% | 4<br>36%        | 42<br>63%                       | 5<br>56%       |
|                                 | No   | 33<br>36%                           | 5<br>38% | 12<br>32%                  | 2<br>33% | 14<br>41%      | 1<br>20%          | 1<br>14%          | 3<br>20%            | 21<br>40% | 7<br>64%        | 25<br>37%                       | 4<br>44%       |



Q011 BY Q001:Q002:Q003

Rows.....: How much have info needs changed  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

| Company Name |  | Organisational Tasks                 |         |                            |     |                |     |                   |     |                   |     | Department                              |     |                     |
|--------------|--|--------------------------------------|---------|----------------------------|-----|----------------|-----|-------------------|-----|-------------------|-----|---|-----|---------------------|
|              |  | Unit-<br>versity College<br>of Luton |         | Nene<br>College<br>of H.E. |     | Exe-<br>cutive |     | Senior<br>Manager |     | Middle<br>Manager |     | Adminis-<br>tration/<br>Pro-<br>duction |     | Mar-<br>ket-<br>ing |
| Base         |  | Ltd                                  | Datatel | Ltd                        | of  | Luton          |     |                   |     |                   |     |   |     |                     |
| 91           |  | 13                                   | 38      | 6                          | 34  | 5              | 7   | 15                | 52  | 11                | 15  | 67                                      | 9   |                     |
| 33           |  | 5                                    | 13      | 2                          | 13  | 1              | 0   | 4                 | 21  | 7                 | 4   | 25                                      | 4   |                     |
| 36%          |  | 38%                                  | 34%     | 33%                        | 38% | 20%            | 0%  | 27%               | 40% | 64%               | 27% | 37%                                     | 44% |                     |
| 3            |  | 0                                    | 1       | 0                          | 2   | 0              | 1   | 0                 | 2   | 0                 | 0   | 3                                       | 0   |                     |
| 3%           |  | 0%                                   | 3%      | 0%                         | 6%  | 0%             | 14% | 0%                | 4%  | 0%                | 0%  | 4%                                      | 0%  |                     |
| 4            |  | 0                                    | 1       | 1                          | 2   | 0              | 0   | 1                 | 3   | 0                 | 0   | 4                                       | 0   |                     |
| 4%           |  | 0%                                   | 3%      | 17%                        | 6%  | 0%             | 0%  | 7%                | 6%  | 0%                | 0%  | 6%                                      | 0%  |                     |
| 6            |  | 1                                    | 4       | 0                          | 1   | 0              | 0   | 1                 | 3   | 2                 | 2   | 3                                       | 1   |                     |
| 7%           |  | 8%                                   | 11%     | 0%                         | 3%  | 0%             | 0%  | 7%                | 6%  | 18%               | 13% | 4%                                      | 11% |                     |
| 11           |  | 1                                    | 5       | 0                          | 5   | 0              | 2   | 1                 | 7   | 1                 | 2   | 8                                       | 1   |                     |
| 12%          |  | 8%                                   | 13%     | 0%                         | 15% | 0%             | 29% | 7%                | 13% | 9%                | 13% | 12%                                     | 11% |                     |
| 9            |  | 1                                    | 2       | 0                          | 6   | 0              | 3   | 1                 | 5   | 0                 | 2   | 7                                       | 0   |                     |
| 10%          |  | 8%                                   | 5%      | 0%                         | 18% | 0%             | 43% | 7%                | 10% | 0%                | 13% | 10%                                     | 0%  |                     |
| 7            |  | 1                                    | 5       | 0                          | 1   | 1              | 0   | 2                 | 3   | 1                 | 0   | 5                                       | 2   |                     |
| 8%           |  | 8%                                   | 13%     | 0%                         | 3%  | 20%            | 0%  | 13%               | 6%  | 9%                | 0%  | 7%                                      | 22% |                     |
| 8            |  | 1                                    | 4       | 1                          | 2   | 0              | 0   | 1                 | 6   | 0                 | 2   | 6                                       | 0   |                     |

Base

MISSING!

No reply

HOW MUCH HAVE INFO  
NEEDS CHANGED

0-9

10-19

20-29

30-39

40-49

50-59

60-69

Q011 BY Q001:Q002:Q003

Rows.....: How much have info needs changed  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

| Company Name |   | Organisational Tasks                |          |                            |     |                |                   | Department        |                                 |                |
|--------------|---|-------------------------------------|----------|----------------------------|-----|----------------|-------------------|-------------------|---------------------------------|----------------|
|              |   | Uni-<br>versity College<br>of Luton |          | Mene<br>College<br>of H.E. |     | Exe-<br>cutive | Senior<br>Manager | Middle<br>Manager | Adminis-<br>tration/<br>Finance | Mar-<br>keting |
| Base         | ACE Busi-<br>ness Co-<br>mputers<br>Ltd | Datatel                             | of Luton | of H.E.                    |     |                |                   |                   |                                 |                |
| 91           | 13                                      | 38                                  | 6        | 34                         | 5   | 7              | 15                | 52                | 11                              | 9              |
| 9%           | 8%                                      | 11%                                 | 17%      | 6%                         | 0%  | 0%             | 7%                | 12%               | 0%                              | 0%             |
| 5            | 3                                       | 1                                   | 1        | 0                          | 3   | 1              | 0                 | 1                 | 0                               | 1              |
| 5%           | 23%                                     | 3%                                  | 17%      | 0%                         | 60% | 14%            | 0%                | 2%                | 0%                              | 11%            |
| 5            | 0                                       | 2                                   | 1        | 2                          | 0   | 0              | 4                 | 1                 | 1                               | 0              |
| 5%           | 0%                                      | 5%                                  | 17%      | 6%                         | 0%  | 0%             | 27%               | 2%                | 0%                              | 0%             |

The Development and Usage of Information Systems

| Q012 BY Q001:Q002:Q003                           |              |                              |                      |                      |                      |                |                |                 |           |             |                         |            |          |
|--|--------------|------------------------------|----------------------|----------------------|----------------------|----------------|----------------|-----------------|-----------|-------------|-------------------------|------------|----------|
| Rows.....: Fit of IS with changed info need      |              |                              |                      |                      |                      |                |                |                 |           |             |                         |            |          |
| Columns.....: Q001:Q002:Q003                     |              |                              |                      |                      |                      |                |                |                 |           |             |                         |            |          |
| Cells.....: Absolute, Column %, Zeros suppressed |              |                              |                      |                      |                      |                |                |                 |           |             |                         |            |          |
|  | Company Name |                              |                      |                      | Organisational Tasks |                |                |                 |           |             | Department              |            |          |
|  | Base         | ACE Busi-ness Co-mputers Ltd | Uni-versity of Luton | Nene College of H.E. | Exe-cutive           | Senior Manager | Middle Manager | Admini-stration | Other     | Pro-duction | Adminis-tration/Finance | Mar-keting |          |
| Base   | 91           | 13                           | 38                   | 6                    | 34                   | 5              | 7              | 15              | 52        | 11          | 15                      | 67         | 9        |
| MISSING  |              |                              |                      |                      |                      |                |                |                 |           |             |                         |            |          |
| No reply   | 16<br>18%    | 1<br>8%                      | 4<br>11%             | 2<br>33%             | 9<br>26%             | 0<br>0%        | 0<br>0%        | 2<br>13%        | 12<br>23% | 2<br>18%    | 0<br>0%                 | 15<br>22%  | 1<br>11% |
| FIT OF IS WITH CHANGED INFO NEED                 |              |                              |                      |                      |                      |                |                |                 |           |             |                         |            |          |
| Yes  | 57<br>63%    | 9<br>69%                     | 25<br>66%            | 4<br>67%             | 19<br>56%            | 3<br>60%       | 6<br>86%       | 12<br>80%       | 29<br>56% | 6<br>55%    | 14<br>93%               | 38<br>57%  | 5<br>56% |
| No   | 18<br>20%    | 3<br>23%                     | 9<br>24%             | 0<br>0%              | 6<br>18%             | 2<br>40%       | 1<br>14%       | 1<br>7%         | 11<br>21% | 3<br>27%    | 1<br>7%                 | 14<br>21%  | 3<br>33% |



| Q013 BY Q001:Q002:Q003  |              |   |          |           |                                    |                |                   |                   |                     |            |                 |                                 |                |
|---|--------------|---|----------|-----------|------------------------------------|----------------|-------------------|-------------------|---------------------|------------|-----------------|---------------------------------|----------------|
| Rows.....: How well IS fit changed info nee<br>Columns.....: Q001:Q002:Q003<br>Cells.....: Absolute, Column %, Zeros suppressed | Company Name |   |          |           | Organisational Tasks               |                |                   |                   |                     | Department |                 |                                 |                |
|   | Base         | ACE Busi-<br>ness Co-<br>mputers<br>Ltd | Date     | of Luton  | Uni-<br>versity College<br>of H.E. | Exe-<br>cutive | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other      | Pro-<br>duction | Adminis-<br>tration/<br>Finance | Mar-<br>keting |
| MISSING   | Base         | 91                                      | 13       | 38        | 6                                  | 34             | 5                 | 7                 | 15                  | 52         | 11              | 67                              | 9              |
| No reply  |              | 35<br>38%                               | 5<br>38% | 13<br>34% | 3<br>50%                           | 14<br>41%      | 2<br>40%          | 2<br>29%          | 3<br>20%            | 23<br>44%  | 5<br>45%        | 29<br>43%                       | 4<br>44%       |
| HOW WELL IS FIT<br>CHANGED INFO NEE<br>20-29  |              | 3<br>3%                                 | 0<br>0%  | 0<br>0%   | 0<br>0%                            | 3<br>9%        | 0<br>0%           | 0<br>0%           | 0<br>0%             | 3<br>6%    | 0<br>0%         | 3<br>4%                         | 0<br>0%        |
| 30-39   |              | 9<br>10%                                | 1<br>8%  | 4<br>11%  | 1<br>17%                           | 3<br>9%        | 0<br>0%           | 0<br>0%           | 4<br>27%            | 5<br>10%   | 0<br>0%         | 8<br>12%                        | 0<br>0%        |
| 40-49   |              | 11<br>12%                               | 1<br>8%  | 7<br>18%  | 0<br>0%                            | 3<br>9%        | 0<br>0%           | 2<br>29%          | 2<br>13%            | 6<br>12%   | 1<br>9%         | 8<br>12%                        | 1<br>11%       |
| 50-59   |              | 12<br>13%                               | 3<br>23% | 3<br>8%   | 0<br>0%                            | 6<br>18%       | 0<br>0%           | 0<br>0%           | 2<br>13%            | 8<br>15%   | 2<br>18%        | 8<br>12%                        | 1<br>11%       |
| 60-69   |              | 5<br>5%                                 | 0<br>0%  | 4<br>11%  | 0<br>0%                            | 1<br>3%        | 1<br>20%          | 1<br>14%          | 0<br>0%             | 2<br>4%    | 0<br>0%         | 3<br>4%                         | 1<br>11%       |
| 70-79   |              | 6<br>7%                                 | 0<br>0%  | 3<br>8%   | 0<br>0%                            | 3<br>9%        | 0<br>0%           | 1<br>14%          | 1<br>7%             | 3<br>6%    | 1<br>9%         | 3<br>4%                         | 1<br>11%       |
| 80-100  |              | 10                                      | 3        | 4         | 2                                  | 1              | 2                 | 1                 | 3                   | 2          | 2               | 5                               | 1              |

Q013 BY Q001:Q002:Q003

Rows.....: How well IS fit changed info nee  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

| Company Name |                            |                     | Organisational Tasks |           |                |                |                |       | Department |                        |           |     |
|--------------|----------------------------|---------------------|----------------------|-----------|----------------|----------------|----------------|-------|------------|------------------------|-----------|-----|
| Base         | ACE Business Computers Ltd | University of Luton | Nene College of H.E. | Executive | Senior Manager | Middle Manager | Administration | Other | Production | Administration/Finance | Marketing |     |
|              |                            |                     |                      |           |                |                |                |       |            |                        |           |     |
| 91           | 13                         | 38                  | 6                    | 34        | 5              | 7              | 15             | 52    | 11         | 15                     | 67        | 9   |
| 11%          | 23%                        | 11%                 | 33%                  | 3%        | 40%            | 14%            | 20%            | 4%    | 18%        | 27%                    | 7%        | 11% |

Q014 BY Q001:Q002:Q003

Rows.....: IS amendment due to changed info  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

| Company Name |   | Organisational Tasks     |           |                            |           |                |                   | Department        |                     |           |                 |                                 |                |
|--------------|---|--------------------------|-----------|----------------------------|-----------|----------------|-------------------|-------------------|---------------------|-----------|-----------------|---------------------------------|----------------|
| Base         | ACE Busi-<br>ness Co-<br>mputers<br>Ltd | Uni-<br>versity of Luton |           | Nene<br>College<br>of H.E. |           | Exe-<br>cutive | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other     | Pro-<br>duction | Adminis-<br>tration/<br>Finance | Mar-<br>keting |
|              |   | Datatel                  | of        |                            |           |                |                   |                   |                     |           |                 |                                 |                |
| Base         | 91                                      | 13                       | 38        | 6                          | 34        | 5              | 7                 | 15                | 52                  | 11        | 15              | 67                              | 9              |
| MISSING      |   |                          |           |                            |           |                |                   |                   |                     |           |                 |                                 |                |
|              | No reply                                | 3<br>3%                  | 1<br>8%   | 2<br>5%                    | 0<br>0%   | 1<br>20%       | 0<br>0%           | 0<br>0%           | 2<br>4%             | 0<br>0%   | 1<br>7%         | 1<br>1%                         | 1<br>11%       |
|              | IS AMENDMENT DUE TO<br>CHANGED INFO     |                          |           |                            |           |                |                   |                   |                     |           |                 |                                 |                |
|              | Yes                                     | 43<br>47%                | 5<br>38%  | 21<br>55%                  | 4<br>67%  | 13<br>38%      | 2<br>40%          | 6<br>86%          | 9<br>60%            | 22<br>42% | 4<br>36%        | 10<br>67%                       | 30<br>45%      |
| No           | 45<br>49%                               | 7<br>54%                 | 15<br>39% | 2<br>33%                   | 21<br>62% | 2<br>40%       | 1<br>14%          | 6<br>40%          | 28<br>54%           | 7<br>64%  | 4<br>27%        | 36<br>54%                       | 5<br>56%       |



The Development and Usage of Information Systems

Q015 BY Q001:Q002:Q003

Rows.....: Description of amendment  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

|                                      | Company Name |   |      | Organisational Tasks |                             |                            |                |                   | Department        |                     |       |                 |                                 |                |
|--------------------------------------|--------------|---|------|----------------------|-----------------------------|----------------------------|----------------|-------------------|-------------------|---------------------|-------|-----------------|---------------------------------|----------------|
|                                      | Base         | ACE Busi-<br>ness Co-<br>mputers<br>Ltd | Date | tel                  | Un-<br>iversity<br>of Luton | Nene<br>College<br>of H.E. | Exe-<br>cutive | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other | Pro-<br>duction | Adminis-<br>tration/<br>Finance | Mar-<br>keting |
| Base                                 | 91           | 13                                      | 38   | 6                    | 34                          | 5                          | 7              | 15                | 52                | 11                  | 15    | 67              | 9                               |                |
| MISSING                              | 48           | 8                                       | 17   | 2                    | 21                          | 2                          | 2              | 6                 | 30                | 7                   | 5     | 37              | 6                               |                |
|                                      | 53%          | 62%                                     | 45%  | 33%                  | 62%                         | 40%                        | 29%            | 40%               | 58%               | 64%                 | 33%   | 55%             | 67%                             |                |
|                                      | 21           | 2                                       | 14   | 3                    | 2                           | 1                          | 1              | 6                 | 10                | 3                   | 7     | 13              | 1                               |                |
|                                      | 23%          | 15%                                     | 37%  | 50%                  | 6%                          | 20%                        | 14%            | 40%               | 19%               | 27%                 | 47%   | 19%             | 11%                             |                |
|                                      | 9            | 2                                       | 3    | 0                    | 4                           | 2                          | 2              | 0                 | 5                 | 0                   | 2     | 6               | 1                               |                |
|                                      | 10%          | 15%                                     | 8%   | 0%                   | 12%                         | 40%                        | 29%            | 0%                | 10%               | 0%                  | 13%   | 9%              | 11%                             |                |
| Timely amendment-not<br>accur info   | 3            | 1                                       | 0    | 0                    | 2                           | 0                          | 2              | 0                 | 1                 | 0                   | 1     | 2               | 0                               |                |
|                                      | 3%           | 8%                                      | 0%   | 0%                   | 6%                          | 0%                         | 29%            | 0%                | 2%                | 0%                  | 7%    | 3%              | 0%                              |                |
| Delayed amendment-<br>not accur info | 2            | 0                                       | 0    | 0                    | 2                           | 0                          | 0              | 0                 | 2                 | 0                   | 0     | 2               | 0                               |                |
|                                      | 2%           | 0%                                      | 0%   | 0%                   | 6%                          | 0%                         | 0%             | 0%                | 4%                | 0%                  | 0%    | 3%              | 0%                              |                |
| Currently under<br>amendment         | 8            | 0                                       | 4    | 1                    | 3                           | 0                          | 0              | 3                 | 4                 | 1                   | 0     | 7               | 1                               |                |
|                                      | 9%           | 0%                                      | 11%  | 17%                  | 9%                          | 0%                         | 0%             | 20%               | 8%                | 9%                  | 0%    | 10%             | 11%                             |                |

| Q016 BY Q001:Q002:Q003                           |              |                              |         |          |                             |            |                |                |                 |       |             |                         |            |  |  |
|--|--------------|------------------------------|---------|----------|-----------------------------|------------|----------------|----------------|-----------------|-------|-------------|-------------------------|------------|--|--|
| Rows.....: Provision of info inhibits D-M        |              |                              |         |          |                             |            |                |                |                 |       |             |                         |            |  |  |
| Columns.....: Q001:Q002:Q003                     |              |                              |         |          |                             |            |                |                |                 |       |             |                         |            |  |  |
| Cells.....: Absolute, Column %, Zeros suppressed |              |                              |         |          |                             |            |                |                |                 |       |             |                         |            |  |  |
|  | Company Name |                              |         |          | Organisational Tasks        |            |                |                |                 |       |             | Department              |            |  |  |
|  | Base         | ACE Busi-ness Co-mputers Ltd | Datatel | of Luton | Uni-versity College of H.E. | Exe-cutive | Senior Manager | Middle Manager | Admini-stration | Other | Pro-duction | Adminis-tration/Finance | Mar-keting |  |  |
| Base   | 91           | 13                           | 38      | 6        | 34                          | 5          | 7              | 15             | 52              | 11    | 15          | 67                      | 9          |  |  |
| MISSING  |              |                              |         |          |                             |            |                |                |                 |       |             |                         |            |  |  |
| No reply   | 46           | 8                            | 21      | 4        | 13                          | 3          | 6              | 10             | 22              | 5     | 12          | 29                      | 5          |  |  |
|  | 51%          | 62%                          | 55%     | 67%      | 38%                         | 60%        | 86%            | 67%            | 42%             | 45%   | 80%         | 43%                     | 56%        |  |  |
| PROVISION OF INFO INHIBITS D-M                   |              |                              |         |          |                             |            |                |                |                 |       |             |                         |            |  |  |
| Yes  | 20           | 2                            | 7       | 1        | 10                          | 0          | 0              | 0              | 15              | 4     | 2           | 17                      | 1          |  |  |
|  | 22%          | 15%                          | 18%     | 17%      | 29%                         | 0%         | 0%             | 0%             | 29%             | 36%   | 13%         | 25%                     | 11%        |  |  |
| No   | 25           | 3                            | 10      | 1        | 11                          | 2          | 1              | 5              | 15              | 2     | 1           | 21                      | 3          |  |  |
|  | 27%          | 23%                          | 26%     | 17%      | 32%                         | 40%        | 14%            | 33%            | 29%             | 18%   | 7%          | 31%                     | 33%        |  |  |

The Development and Usage of Information Systems

| Q017 BY Q001:Q002:Q003   |              |   |                             |                            |                      |                   |                   |                     |           |                 |                                 |                |          |
|--|--------------|---|-----------------------------|----------------------------|----------------------|-------------------|-------------------|---------------------|-----------|-----------------|---------------------------------|----------------|----------|
| Rows.....: Request of info not available<br>Columns.....: Q001:Q002:Q003<br>Cells.....: Absolute, Column %, Zeros suppressed |              |   |                             |                            |                      |                   |                   |                     |           |                 |                                 |                |          |
|  | Company Name |   |                             |                            | Organisational Tasks |                   |                   |                     |           |                 | Department                      |                |          |
|  | Base         | ACE Busi-<br>ness Co-<br>mputers<br>Ltd | Uni-<br>versity<br>of Luton | Nene<br>College<br>of H.E. | Exe-<br>cutive       | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other     | Pro-<br>duction | Adminis-<br>tration/<br>Finance | Mar-<br>keting |          |
| Base   | 91           | 13                                      | 38                          | 6                          | 34                   | 5                 | 7                 | 15                  | 52        | 11              | 15                              | 67             | 9        |
| MISSING  |              |   |                             |                            |                      |                   |                   |                     |           |                 |                                 |                |          |
| No reply   | 8<br>9%      | 1<br>8%                                 | 1<br>3%                     | 2<br>33%                   | 4<br>12%             | 1<br>20%          | 0<br>0%           | 2<br>13%            | 5<br>10%  | 0<br>0%         | 8<br>12%                        | 0<br>0%        | 0<br>0%  |
| REQUEST OF INFO NOT<br>AVAILABLE<br>Seek info from IS<br>dept  | 33<br>36%    | 2<br>15%                                | 19<br>50%                   | 1<br>17%                   | 11<br>32%            | 2<br>40%          | 6<br>86%          | 7<br>47%            | 15<br>29% | 3<br>27%        | 8<br>53%                        | 20<br>30%      | 5<br>56% |
| Change the program   | 5<br>5%      | 0<br>0%                                 | 5<br>13%                    | 0<br>0%                    | 0<br>0%              | 0<br>0%           | 0<br>0%           | 2<br>13%            | 2<br>4%   | 0<br>0%         | 5<br>7%                         | 0<br>0%        | 0<br>0%  |
| Nothing  | 9<br>10%     | 3<br>23%                                | 3<br>8%                     | 0<br>0%                    | 3<br>9%              | 2<br>40%          | 1<br>14%          | 1<br>7%             | 4<br>8%   | 1<br>9%         | 4<br>27%                        | 5<br>7%        | 0<br>0%  |
| Refuse to undertake<br>the task  | 3<br>3%      | 0<br>0%                                 | 2<br>5%                     | 0<br>0%                    | 1<br>3%              | 0<br>0%           | 0<br>0%           | 0<br>0%             | 2<br>4%   | 1<br>9%         | 1<br>7%                         | 1<br>1%        | 1<br>11% |
| Ask my superior to<br>get info   | 33<br>36%    | 7<br>54%                                | 8<br>21%                    | 3<br>50%                   | 15<br>44%            | 0<br>0%           | 0<br>0%           | 3<br>20%            | 24<br>46% | 6<br>55%        | 2<br>13%                        | 28<br>42%      | 3<br>33% |



The Development and Usage of Information Systems

|  |                                 |  |  |                             |  |  |                            |  |                |  |                   |  |                     |  |                     |  |                |  |    |  |    |  |    |  |    |  |   |  |  |
|--|---------------------------------|--|--|-----------------------------|--|--|----------------------------|--|----------------|--|-------------------|--|---------------------|--|---------------------|--|----------------|--|----|--|----|--|----|--|----|--|---|--|--|
| Q018 BY Q001:Q002:Q003                           |                                 |  |  |                             |  |  |                            |  |                |  |                   |  |                     |  |                     |  |                |  |    |  |    |  |    |  |    |  |   |  |  |
| Rows.....: Control over functionality            |                                 |  |  |                             |  |  |                            |  |                |  |                   |  |                     |  |                     |  |                |  |    |  |    |  |    |  |    |  |   |  |  |
| Columns.....: Q001:Q002:Q003                     |                                 |  |  |                             |  |  |                            |  |                |  |                   |  |                     |  |                     |  |                |  |    |  |    |  |    |  |    |  |   |  |  |
| Cells.....: Absolute, Column %, Zeros suppressed |                                 |  |  |                             |  |  |                            |  |                |  |                   |  |                     |  |                     |  |                |  |    |  |    |  |    |  |    |  |   |  |  |
| Base   | Company Name                    |  |  | Organisational Tasks        |  |  |                            |  |                |  | Department        |  |                     |  |                     |  |                |  |    |  |    |  |    |  |    |  |   |  |  |
|  | ACE Busi<br>ness Co-<br>mputers |  |  | Uni-<br>versity<br>of Luton |  |  | Nene<br>College<br>of H.E. |  | Exe-<br>cutive |  | Senior<br>Manager |  | Middle<br>Manager   |  | Admini-<br>stration |  | Mar-<br>keting |  |    |  |    |  |    |  |    |  |   |  |  |
|  | Ltd                             |  |  | Datatel                     |  |  | of Luton                   |  | Manager        |  | Manager           |  | Admini-<br>stration |  | Pro-<br>duction     |  | Finance        |  |    |  |    |  |    |  |    |  |   |  |  |
|  | Base                            |  |  | 91                          |  |  | 13                         |  | 38             |  | 6                 |  | 34                  |  | 5                   |  | 7              |  | 15 |  | 52 |  | 11 |  | 67 |  | 9 |  |  |
|  |                                 |  |  |                             |  |  |                            |  |                |  |                   |  |                     |  |                     |  |                |  |    |  |    |  |    |  |    |  |   |  |  |
| MISSING  |                                 |  |  |                             |  |  |                            |  |                |  |                   |  |                     |  |                     |  |                |  |    |  |    |  |    |  |    |  |   |  |  |
| No reply   |                                 |  |  |                             |  |  |                            |  |                |  |                   |  |                     |  |                     |  |                |  |    |  |    |  |    |  |    |  |   |  |  |
| CONTROL OVER<br>FUNCTIONALITY<br>Own control     |                                 |  |  |                             |  |  |                            |  |                |  |                   |  |                     |  |                     |  |                |  |    |  |    |  |    |  |    |  |   |  |  |
| Request from IS dept                             |                                 |  |  |                             |  |  |                            |  |                |  |                   |  |                     |  |                     |  |                |  |    |  |    |  |    |  |    |  |   |  |  |

|  |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |  |  |
|--|------------------------------|----------------------|----------------------|----------------------|----------------|----------------|-----------------|-------|-------------|-------------------------|------------|-----|--|--|
| Q019 BY Q001:Q002:Q003                           |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |  |  |
| Rows.....: Description of the Interface          |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |  |  |
| Columns.....: Q001:Q002:Q003                     |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |  |  |
| Cells.....: Absolute, Column %, Zeros suppressed |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |  |  |
| Base   | Company Name                 |                      |                      | Organisational Tasks |                |                |                 |       |             |                         | Department |     |  |  |
|  | ACE Busi-ness Co-mputers Ltd | Uni-versity of Luton | Nene College of H.E. | Exe-cutive           | Senior Manager | Middle Manager | Admini-stration | Other | Pro-duction | Adminis-tration/Finance | Mar-keting |     |  |  |
| 91   | 13                           | 38                   | 6                    | 34                   | 5              | 7              | 15              | 52    | 11          | 15                      | 67         | 9   |  |  |
| MISSING  |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |  |  |
| 4  | 0                            | 1                    | 1                    | 2                    | 0              | 0              | 0               | 3     | 1           | 0                       | 3          | 1   |  |  |
| 4%   | 0%                           | 3%                   | 17%                  | 6%                   | 0%             | 0%             | 0%              | 6%    | 9%          | 0%                      | 4%         | 11% |  |  |
| DESCRIPTION OF THE INTERFACE                     |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |  |  |
| Very usable                                      |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |  |  |
| 24   | 5                            | 12                   | 2                    | 5                    | 3              | 4              | 3               | 10    | 4           | 8                       | 13         | 3   |  |  |
| 26%  | 38%                          | 32%                  | 33%                  | 15%                  | 60%            | 57%            | 20%             | 19%   | 36%         | 53%                     | 19%        | 33% |  |  |
| Usable   |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |  |  |
| 52   | 8                            | 22                   | 2                    | 20                   | 1              | 3              | 10              | 32    | 5           | 7                       | 41         | 4   |  |  |
| 57%  | 62%                          | 58%                  | 33%                  | 59%                  | 20%            | 43%            | 67%             | 62%   | 45%         | 47%                     | 61%        | 44% |  |  |
| Partly usable                                    |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |  |  |
| 10   | 0                            | 3                    | 1                    | 6                    | 1              | 0              | 2               | 6     | 1           | 0                       | 9          | 1   |  |  |
| 11%  | 0%                           | 8%                   | 17%                  | 18%                  | 20%            | 0%             | 13%             | 12%   | 9%          | 0%                      | 13%        | 11% |  |  |
| Non-usable                                       |                              |                      |                      |                      |                |                |                 |       |             |                         |            |     |  |  |
| 1  | 0                            | 0                    | 0                    | 1                    | 0              | 0              | 0               | 1     | 0           | 0                       | 1          | 0   |  |  |
| 1%   | 0%                           | 0%                   | 0%                   | 3%                   | 0%             | 0%             | 0%              | 2%    | 0%          | 0%                      | 1%         | 0%  |  |  |

| Q020 BY Q001:Q002:Q003                           |   |                             |                            |                      |                   |                   |                     |          |                 |                                 |                |           |          |  |
|--|---|-----------------------------|----------------------------|----------------------|-------------------|-------------------|---------------------|----------|-----------------|---------------------------------|----------------|-----------|----------|--|
| Rows.....: Interface enables manipulation        |   |                             |                            |                      |                   |                   |                     |          |                 |                                 |                |           |          |  |
| Columns.....: Q001:Q002:Q003                     |   |                             |                            |                      |                   |                   |                     |          |                 |                                 |                |           |          |  |
| Cells.....: Absolute, Column %, Zeros suppressed |   |                             |                            |                      |                   |                   |                     |          |                 |                                 |                |           |          |  |
|  | Company Name                            |                             |                            | Organisational Tasks |                   |                   |                     |          |                 |                                 | Department     |           |          |  |
|  | ACE Busi-<br>ness Co-<br>mputers<br>Ltd | Uni-<br>versity<br>of Luton | Nene<br>College<br>of H.E. | Exe-<br>cutive       | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other    | Pro-<br>duction | Adminis-<br>tration/<br>Finance | Mar-<br>keting |           |          |  |
| Base   | 91                                      | 13                          | 38                         | 6                    | 34                | 5                 | 7                   | 15       | 52              | 11                              | 15             | 67        | 9        |  |
| MISSING  |   |                             |                            |                      |                   |                   |                     |          |                 |                                 |                |           |          |  |
| No reply   | 6<br>7%                                 | 1<br>8%                     | 0<br>0%                    | 1<br>17%             | 4<br>12%          | 0<br>0%           | 0<br>0%             | 6<br>12% | 0<br>0%         | 0<br>0%                         | 6<br>9%        | 0<br>0%   | 0<br>0%  |  |
| INTERFACE ENABLES<br>MANIPULATION                |   |                             |                            |                      |                   |                   |                     |          |                 |                                 |                |           |          |  |
| Yes  | 52<br>57%                               | 7<br>54%                    | 27<br>71%                  | 1<br>17%             | 17<br>50%         | 1<br>20%          | 5<br>71%            | 9<br>60% | 30<br>58%       | 6<br>55%                        | 9<br>60%       | 38<br>57% | 5<br>56% |  |
| No   | 33<br>36%                               | 5<br>38%                    | 11<br>29%                  | 4<br>67%             | 13<br>38%         | 4<br>80%          | 2<br>29%            | 6<br>40% | 16<br>31%       | 5<br>45%                        | 6<br>40%       | 23<br>34% | 4<br>44% |  |



Q021 BY Q001:Q002:Q003

Rows.....: Interactive IS  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

|                | Company Name |   |           |                             | Organisational Tasks       |                |                   |                   |                     |          | Department      |                                 |                |
|----------------|--------------|---|-----------|-----------------------------|----------------------------|----------------|-------------------|-------------------|---------------------|----------|-----------------|---------------------------------|----------------|
|                | Base         | ACE Busi-<br>ness Co-<br>mputers<br>Ltd | Date      | Uni-<br>versity<br>of Luton | Nene<br>College<br>of H.E. | Exe-<br>cutive | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other    | Pro-<br>duction | Adminis-<br>tration/<br>Finance | Mar-<br>keting |
| Base           | 91           | 13                                      | 38        | 6                           | 34                         | 5              | 7                 | 15                | 52                  | 11       | 15              | 67                              | 9              |
| MISSING        |              |   |           |                             |                            |                |                   |                   |                     |          |                 |                                 |                |
| No reply       | 9<br>10%     | 1<br>8%                                 | 2<br>5%   | 1<br>17%                    | 5<br>15%                   | 0<br>0%        | 0<br>0%           | 1<br>7%           | 7<br>13%            | 1<br>9%  | 0<br>0%         | 8<br>12%                        | 1<br>11%       |
| INTERACTIVE IS |              |   |           |                             |                            |                |                   |                   |                     |          |                 |                                 |                |
| Yes            | 53<br>58%    | 6<br>46%                                | 28<br>74% | 3<br>50%                    | 16<br>47%                  | 1<br>20%       | 5<br>71%          | 11<br>73%         | 29<br>56%           | 6<br>55% | 8<br>53%        | 40<br>60%                       | 5<br>56%       |
| No             | 29<br>32%    | 6<br>46%                                | 8<br>21%  | 2<br>33%                    | 13<br>38%                  | 4<br>80%       | 2<br>29%          | 3<br>20%          | 16<br>31%           | 4<br>36% | 7<br>47%        | 19<br>28%                       | 3<br>33%       |

| Q022 BY Q001:Q002:Q003                           |                              |     |     |                      |     |     |      |     |                         |     |     |     |     |
|--|------------------------------|-----|-----|----------------------|-----|-----|------|-----|-------------------------|-----|-----|-----|-----|
| Rows.....: Format helps interaction              |                              |     |     |                      |     |     |      |     |                         |     |     |     |     |
| Columns.....: Q001:Q002:Q003                     |                              |     |     |                      |     |     |      |     |                         |     |     |     |     |
| Cells.....: Absolute, Column %, Zeros suppressed |                              |     |     |                      |     |     |      |     |                         |     |     |     |     |
| Base   | Company Name                 |     |     | Organisational Tasks |     |     |      |     | Department              |     |     |     |     |
|  | ACE Busi-ness Co-mputers Ltd |     |     | Uni-versity of Luton |     |     |      |     | Adminis-tration/Finance |     |     |     |     |
|  | Base                         |     |     | None College of H.E. |     |     |      |     | Marketing               |     |     |     |     |
|  | Base                         |     |     | DataTel              |     |     |      |     | Other                   |     |     |     |     |
|  | Base                         |     |     | Exe-cutive Manager   |     |     |      |     | Admini-stration         |     |     |     |     |
| MISSING  | 91                           | 13  | 38  | 6                    | 34  | 5   | 7    | 15  | 52                      | 11  | 15  | 67  | 9   |
|  | 9                            | 1   | 1   | 2                    | 5   | 0   | 0    | 0   | 8                       | 1   | 0   | 8   | 1   |
|  | 10%                          | 8%  | 3%  | 33%                  | 15% | 0%  | 0%   | 0%  | 15%                     | 9%  | 0%  | 12% | 11% |
|  |                              |     |     |                      |     |     |      |     |                         |     |     |     |     |
| FORMAT HELPS INTERACTION                         | 66                           | 12  | 28  | 4                    | 22  | 3   | 7    | 13  | 35                      | 7   | 10  | 52  | 4   |
|  | 73%                          | 92% | 74% | 67%                  | 65% | 60% | 100% | 87% | 67%                     | 64% | 67% | 78% | 44% |
| Yes  | 16                           | 0   | 9   | 0                    | 7   | 2   | 0    | 2   | 9                       | 3   | 5   | 7   | 4   |
|  | 18%                          | 0%  | 24% | 0%                   | 21% | 40% | 0%   | 13% | 17%                     | 27% | 33% | 10% | 44% |
| No   |                              |     |     |                      |     |     |      |     |                         |     |     |     |     |

The Development and Usage of Information Systems

Q023 BY Q001:Q002:Q003

Rows.....: Reasons behind good interaction  
Columns.....: Q001:Q002:Q003  
Cells.....: Absolute, Column %, Zeros suppressed

|                               | Company Name                            |                          |                            |          | Organisational Tasks |                   |                   |                     |           | Department      |                                 |                 |          |  |
|-------------------------------|---|--------------------------|----------------------------|----------|----------------------|-------------------|-------------------|---------------------|-----------|-----------------|---------------------------------|-----------------|----------|--|
|                               | ACE Busi-<br>ness Co-<br>mputers<br>Ltd | Univer-<br>sity of Luton | Nene<br>College<br>of H.E. | Base     | Exe-<br>cutive       | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other     | Pro-<br>duction | Adminis-<br>tration/<br>Finance | Mar-<br>ketting |          |  |
| Base                          | 91                                      | 13                       | 38                         | 6        | 34                   | 5                 | 7                 | 15                  | 52        | 11              | 15                              | 67              | 9        |  |
| MISSING                       | 26<br>29%                               | 1<br>8%                  | 10<br>26%                  | 2<br>33% | 13<br>38%            | 2<br>40%          | 0<br>0%           | 3<br>20%            | 18<br>35% | 3<br>27%        | 4<br>27%                        | 17<br>25%       | 5<br>56% |  |
|                               | 41<br>45%                               | 10<br>77%                | 17<br>45%                  | 4<br>67% | 10<br>29%            | 2<br>40%          | 5<br>71%          | 9<br>60%            | 21<br>40% | 4<br>36%        | 8<br>53%                        | 32<br>48%       | 1<br>11% |  |
|                               | 15<br>16%                               | 0<br>0%                  | 4<br>11%                   | 3<br>50% | 8<br>24%             | 1<br>20%          | 2<br>29%          | 1<br>7%             | 10<br>19% | 1<br>9%         | 2<br>13%                        | 12<br>18%       | 1<br>11% |  |
|                               | 23<br>25%                               | 10<br>77%                | 6<br>16%                   | 3<br>50% | 4<br>12%             | 3<br>60%          | 4<br>57%          | 5<br>33%            | 8<br>15%  | 3<br>27%        | 5<br>33%                        | 15<br>22%       | 3<br>33% |  |
|                               | 3<br>3%                                 | 0<br>0%                  | 2<br>5%                    | 0<br>0%  | 1<br>3%              | 0<br>0%           | 1<br>14%          | 0<br>0%             | 1<br>2%   | 1<br>9%         | 1<br>7%                         | 1<br>1%         | 1<br>11% |  |
|                               | 2<br>2%                                 | 0<br>0%                  | 1<br>3%                    | 0<br>0%  | 1<br>3%              | 0<br>0%           | 0<br>0%           | 0<br>0%             | 2<br>4%   | 0<br>0%         | 0<br>0%                         | 2<br>3%         | 0<br>0%  |  |
|                               | 12<br>13%                               | 1<br>8%                  | 8<br>21%                   | 0<br>0%  | 3<br>9%              | 1<br>20%          | 3<br>43%          | 2<br>13%            | 4<br>8%   | 1<br>9%         | 3<br>20%                        | 8<br>12%        | 1<br>11% |  |
|                               | 10                                      | 0                        | 6                          | 3        | 1                    | 0                 | 0                 | 4                   | 4         | 1               | 0                               | 9               | 1        |  |
|                               | No reply                                |                          |                            |          |                      |                   |                   |                     |           |                 |                                 |                 |          |  |
|                               | REASONS BEHIND GOOD INTERACTION         |                          |                            |          |                      |                   |                   |                     |           |                 |                                 |                 |          |  |
| Displays all info             |   |                          |                            |          |                      |                   |                   |                     |           |                 |                                 |                 |          |  |
| Uses appropriate wording      |   |                          |                            |          |                      |                   |                   |                     |           |                 |                                 |                 |          |  |
| Avoids unnecessary details    |   |                          |                            |          |                      |                   |                   |                     |           |                 |                                 |                 |          |  |
| Displays appropriate graphics |   |                          |                            |          |                      |                   |                   |                     |           |                 |                                 |                 |          |  |
| Uses appropriate colours      |   |                          |                            |          |                      |                   |                   |                     |           |                 |                                 |                 |          |  |
| Uses appropriate icons        |   |                          |                            |          |                      |                   |                   |                     |           |                 |                                 |                 |          |  |
| Uses upper/lower              |   |                          |                            |          |                      |                   |                   |                     |           |                 |                                 |                 |          |  |



| Q023 BY Q001:Q002:Q003                           |              |                             |                     |                      |                      |                |                |                |       |            |         |            |  |  |
|--|--------------|-----------------------------|---------------------|----------------------|----------------------|----------------|----------------|----------------|-------|------------|---------|------------|--|--|
| Rows.....: Reasons behind good interaction       |              |                             |                     |                      |                      |                |                |                |       |            |         |            |  |  |
| Columns.....: Q001:Q002:Q003                     |              |                             |                     |                      |                      |                |                |                |       |            |         |            |  |  |
| Cells.....: Absolute, Column %, Zeros suppressed |              |                             |                     |                      |                      |                |                |                |       |            |         |            |  |  |
|  | Company Name |                             |                     |                      | Organisational Tasks |                |                |                |       |            |         | Department |  |  |
|  | Base         | ACE Busi-ness Computers Ltd | University of Luton | Nene College of H.E. | Executive            | Senior Manager | Middle Manager | Administration | Other | Production | Finance | Marketing  |  |  |
| Base   | 91           | 13                          | 38                  | 6                    | 34                   | 5              | 7              | 15             | 52    | 11         | 67      | 9          |  |  |
| text   | 11%          | 0%                          | 16%                 | 50%                  | 3%                   | 0%             | 0%             | 27%            | 8%    | 9%         | 13%     | 11%        |  |  |
| Uses graphic borders                             | 4            | 0                           | 4                   | 0                    | 0                    | 0              | 2              | 1              | 0     | 0          | 2       | 1          |  |  |
|  | 4%           | 0%                          | 11%                 | 0%                   | 0%                   | 0%             | 29%            | 7%             | 0%    | 0%         | 7%      | 3%         |  |  |
| Displays important info                          | 14           | 1                           | 10                  | 0                    | 3                    | 0              | 1              | 4              | 6     | 2          | 12      | 1          |  |  |
|  | 15%          | 8%                          | 26%                 | 0%                   | 9%                   | 0%             | 14%            | 27%            | 12%   | 18%        | 18%     | 11%        |  |  |
| Uses helpful menus                               | 34           | 5                           | 13                  | 0                    | 16                   | 0              | 1              | 8              | 19    | 5          | 31      | 1          |  |  |
|  | 37%          | 38%                         | 34%                 | 0%                   | 47%                  | 0%             | 14%            | 53%            | 37%   | 45%        | 46%     | 11%        |  |  |
| Provides on-line support                         | 9            | 0                           | 8                   | 0                    | 1                    | 1              | 0              | 4              | 2     | 2          | 6       | 1          |  |  |
|  | 10%          | 0%                          | 21%                 | 0%                   | 3%                   | 20%            | 0%             | 27%            | 4%    | 13%        | 9%      | 11%        |  |  |

The Development and Usage of Information Systems

ALTERED DUTIES IN RELATION TO THE NUMBER OF YEARS ON THE JOB

Rows.....: Altered Duties & responsibility  
Columns.....: Number of years on the same job  
Cells.....: Absolute, Column %, Zeros suppressed

|                                 |      | Number of years on the same job |            |             |              |              |           |
|---------------------------------|------|---------------------------------|------------|-------------|--------------|--------------|-----------|
|                                 |      | Less than 3                     | 3 - less 5 | 5 - less 10 | 10 - less 20 | More than 20 |           |
| ALTERED DUTIES & RESPONSIBILITY | Base | 91                              | 42         | 21          | 16           | 9            | 3         |
|                                 | Yes  | 62<br>68%                       | 23<br>55%  | 14<br>67%   | 13<br>81%    | 9<br>100%    | 3<br>100% |
|                                 | No   | 29<br>32%                       | 19<br>45%  | 7<br>33%    | 3<br>19%     | 0<br>0%      | 0<br>0%   |
|                                 |      |                                 |            |             |              |              |           |

The Development and Usage of Information Systems

PROVISION OF INFORMATION LIMITS D-M IN RELATION TO ORG TASKS

Rows.....: Provision of info inhibits D-M  
Columns.....: Organisational Tasks  
Cells.....: Absolute, Column %, Zeros suppressed

|                                   |          | Missing <sup>1</sup> Organisational Tasks |           |                |                   |                   |                     |          |
|-----------------------------------|----------|---|-----------|----------------|-------------------|-------------------|---------------------|----------|
|                                   |          | Base                                      | No reply  | Exe-<br>cutive | Senior<br>Manager | Middle<br>Manager | Admini-<br>stration | Other    |
| MISSING                           | Base     | 91  | 1         | 5              | 7                 | 15                | 52                  | 11       |
|                                   | No reply | 46<br>51%                                 | 0<br>0%   | 3<br>60%       | 6<br>86%          | 10<br>67%         | 22<br>42%           | 5<br>45% |
| PROVISION OF INFO<br>INHIBITS D-M | Yes      | 20<br>22%                                 | 1<br>100% | 0<br>0%        | 0<br>0%           | 0<br>0%           | 15<br>29%           | 4<br>36% |
|                                   | No       | 25<br>27%                                 | 0<br>0%   | 2<br>40%       | 1<br>14%          | 5<br>33%          | 15<br>29%           | 2<br>18% |



The Development and Usage of Information Systems

INTERACTIVENESS OF IS IN RELATION TO THE COMPANY

Rows.....: Interactive IS

Columns.....: Company Name

Cells.....: Absolute, Column %, Zeros suppressed

|                | Company Name |         |          |     |     |
|----------------|--------------|---------|----------|-----|-----|
|                | ACE Busi     | Adam    |          |     |     |
|                | ness Co-     | Smith   |          |     |     |
|                | mputers      | Uni-    |          |     |     |
|                | Ltd          | Datatel | iversity |     |     |
| Base           | 91           | 13      | 38       | 6   | 34  |
| MISSING        |              |         |          |     |     |
| No reply       | 9            | 1       | 2        | 1   | 5   |
|                | 10%          | 8%      | 5%       | 17% | 15% |
| INTERACTIVE IS |              |         |          |     |     |
| Yes            | 53           | 6       | 28       | 3   | 16  |
|                | 58%          | 46%     | 74%      | 50% | 47% |
| No             | 29           | 6       | 8        | 2   | 13  |
|                | 32%          | 46%     | 21%      | 33% | 38% |

The Development and Usage of Information Systems

INTERFACES OF THE IS IN RELATION TO COMPANY

Rows.....: Interface enables manipulation

Columns.....: Company Name

Cells.....: Absolute, Column %, Zeros suppressed

|                                   | Company Name                            |   |           |           |
|-----------------------------------|---|---|-----------|-----------|
|                                   | ACE Busi-<br>ness Co-<br>mputers<br>Ltd | Adam<br>Smith<br>Uni-<br>versity<br>of H.E. |           |           |
| Base                              | 91                                      | 13  | 38        | 6         |
|                                   |   |   |           | 34        |
| MISSING                           |   |   |           |           |
| No reply                          | 6<br>7%                                 | 1<br>8%                                     | 0<br>0%   | 1<br>17%  |
|                                   |   |   |           | 4<br>12%  |
| INTERFACE ENABLES<br>MANIPULATION |   |   |           |           |
| Yes                               | 52<br>57%                               | 7<br>54%                                    | 27<br>71% | 1<br>17%  |
|                                   |   |   |           | 17<br>50% |
| No                                | 33<br>36%                               | 5<br>38%                                    | 11<br>29% | 4<br>67%  |
|                                   |   |   |           | 13<br>38% |

The Development and Usage of Information Systems

CHANGES IN ORGANISATIONAL TASKS

Rows.....: Have your tasks altered  
Columns.....: Number of years on the same job  
Cells.....: Absolute, Column %, Zeros suppressed

|                         |                         | Number of years on the same job |           |           |              |              |           |
|-------------------------|-------------------------|---------------------------------|-----------|-----------|--------------|--------------|-----------|
|                         |                         | Less than 3                     | 3 - 5     | 5 - 10    | 10 - less 20 | More than 20 |           |
| HAVE YOUR TASKS ALTERED | Base                    | 91                              | 42        | 21        | 16           | 9            | 3         |
|                         | Increased significantly | 35<br>38%                       | 11<br>26% | 4<br>19%  | 11<br>69%    | 6<br>67%     | 3<br>100% |
|                         | Small increase          | 35<br>38%                       | 18<br>43% | 10<br>48% | 4<br>25%     | 3<br>33%     | 0<br>0%   |
|                         | Same                    | 21<br>23%                       | 13<br>31% | 7<br>33%  | 1<br>6%      | 0<br>0%      | 0<br>0%   |
|                         |                         |                                 |           |           |              |              |           |



# **Appendix E:**

## **List of Semi-structured Interview Questions**

## **List of Semi-structured Interview Questions**

As the interviews were semi-structured, the same questions were not asked to all the participants in the investigation in the four case organisations. The variation in questioning occurred where the interviewees wanted to emphasise certain issues, and where the researcher pursued these issues or others that rose in the particular context of the interview. All the questions asked in all the interviews are given in Table E1 below. Certain questions, the structured aspects of the interviews, were asked of all the participants. Some questions were repeated in different ways to check the answers given against previous questions on the same topic. These questions concerned the development approach used, users' role in the development and subsequent usage of the systems, how systems cope with business change, whether users have control over systems, brief descriptions of systems used, and the usability of the interfaces to the systems and help given.

**Table E1: List of Semi-structured Interview Questions**

Question 1 to 26 were put to a systems support programmer at the Datatel Corporation case organisation.

- 1     Could you briefly detail the systems architecture?
- 2     What applications are in use?
- 3     Do you develop systems in-house or do you buy them?
- 4     What systems development approaches or methodology do you use for your in-house developed systems?
- 5     How do the systems in operation cope with business change?
- 6     Can users change systems themselves?
- 7     Is it company policy to go through the MIS Department or is it because they don't have the experience or expertise to make the changes themselves?
- 8     On average how long do user requested systems changes take to do?
- 9     Do you have any contact with systems analysts and what role do they have in the systems changes?
- 10    What systems do you use here at Datatel?
- 11    So, although you have the basis of a structured technique you don't follow it to the

letter?

- 12 Can users change systems themselves?
- 13 Would you say that users have control over the systems they use?
- 14 So they can control the layout and format of the reports?
- 15 So going back to the previous point about control, would you say users don't really have any control?
- 16 But they have no control over the functionality of systems?
- 17 So, the control they have is none at all. That's an interesting point?
- 18 How is unpredictable change in the business which affects systems usage dealt with?
- 19 How would you assess the usability of the systems provided to users and the interfaces to systems that they are given?
- 20 What kind of on-line help is given to users?
- 21 What kind of help is given on the field engineering system?
- 22 That's interesting, what do you mean by flexible?
- 23 How do you introduce the flexibility into the systems, for example in the field engineering system?
- 24 What about documentation?
- 25 You need to weigh how much control you give to the users?
- 26 Isn't that because of the different tasks that the departments have to complete?

Question 27 to 32 were put to a Project Manager at the Datatel Corporation case organisation.

- 27 Could you talk freely about how your systems are developed?
- 28 Please tell me more about how you develop the in-house systems?
- 29 How do you do that (*build flexibility*) and how do you manage change in the system?
- 30 How are the changes to the systems managed?
- 31 How long do such changes take to do?
- 32 Could you briefly detail the systems architecture?

Questions 33 to 47 were put to the Finance Director at the Ace Business Computers case organisation.

- 33 Could you describe the systems architecture of the company?
- 34 Would it be correct to say that your developed information systems are basically off-the-self packages?
- 35 Could you elaborate on what you mean by configuring the system?
- 36 So would it right to say that you tailored the system to your needs?



- 37 Could you describe how the system is used?
- 38 When you talk about creating sales analysis codes, is this accessible to all users of the system?
- 39 How are changes to the system managed?
- 40 So would it be correct to say that changes to the system are restricted by the management?
- 41 Would you say that users have control over the system?
- 42 What determines what changes are made to the system?
- 43 So on what basis do you make changes of the kind concerning customer care?
- 44 What is the actual mechanism for the changes you implement?
- 45 Returning to the issue of users controlling the system What training do you provide to users who are allowed to change sales analysis codes
- 46 How satisfied are you with the system's suitability to the company's needs?
- 47 Would you classify your Pegasus based accounting information system as a data processing system or an information system?

Questions 48 to 51 were put to a Field Manager of the Modular Credit Scheme at the University of Luton.

- 48 What systems development approaches or methodology do you use for your in-house developed systems?
- 49 Can users like yourself change HEMIS?
- 50 Could you give me an example of some change like that?
- 51 How does HEMIS cope with business change?

Question 52 to 63 were put to the Manager of the Management Services Department at the University of Luton.

- 52 Can users change aspects of HEMIS?
- 53 How does HEMIS cope with business change?
- 54 And this is done through maintenance programming?  
What systems development do you do here in relation to HEMIS?
- 55 Which will change the menu?
- 56 Are users allowed to design there own interfaces?
- 57 Is the reason for this that you want to keep control of the system or that users don't have the expertise or for security reasons?
- 58 Do you think people within this institution are satisfied with the information provision that HEMIS provides?
- 59 What systems development approaches or methodology do you use for systems

development?

- 60 Are you familiar with Nene College's use of spreadsheets?
- 61 How are changes to the systems managed?
- 62 Where does information from systems provided by Management Services go?
- 63 What about personnel?

Question 64 to 75 were put to the Chief Administrator of the Modular Credit Scheme at the University of Luton?

- 64 Could you describe the information system you use here?
- 65 In what ways do you use HEMIS to manage the modular scheme?
- 66 How useful is HEMIS to you?
- 67 How does HEMIS react to changes in your work or the work of other people in the Office?
- 68 You say the system is nothing like it used to be Who does the changes to the system?
- 69 So if John gave you permission to make the changes, you could do them?
- 70 Have you got any expertise in computing?
- 71 Are reports from HEMIS the only interaction with it?
- 72 How long do changes take to be done?
- 73 Do you most of the time get what you want?
- 74 So John provides you with a very good service?
- 75 How do you know something requires changing in HEMIS?

Question 76 to 89 were put to the Academic Registrar at Nene College of Higher Education

- 76 Could you tell me how you perceive HEMIS here?
- 77 What is discussed in the meetings?
- 78 Who were the members of the development team?
- 79 Did EMIS do all the programming for the system?
- 80 I see from other documentation that a Faculty Manager has asked for information on progression rates. Would you be able to do this change yourself as an institution or do you have to go through EMIS?
- 81 Have you got your own development team here?
- 82 Are users allowed to change aspects of the system?
- 83 How long do changes take to be done?
- 84 Is HEMIS a usable system?
- 85 How easy or difficult is it to learn to use HEMIS?

- 86     So the control you give to users is to input data. They don't have any other control over the functionality of the system?
- 87     What kind of change have you experienced in the institution over the past two or three years?
- 88     How does HEMIS cope with increased demand?
- 89     The only way of getting this information out for the time being is through reports?



# **Appendix F:**

## **Notes on Interviews**

## Notes on Interviews

The questions asked in the semi-structured interviews arose from three sources. First, the questionnaire survey provided quantitative data that could be further explored in the interviews. The purpose of the quantitative research questionnaire survey was to gather an initial understanding of systems development and usage in the case organisations, and then to use that understanding to inform the semi-structured interviews. Secondly, data from the interviews in one case organisation prompted questions in the researcher's mind which were explored in other case organisations. This type of cross organisation stimulus provided a validity check on the experiences of the different case organisations. Thirdly, the interviewer's own experiences at the University of Luton prompted some questions of interest which were explored with interviewees.

All the interviews were preceded with the same introduction of the research for the benefit of the interviewees, and to gain their confidence and to relax them. The participants were informed that the research was purely for academic purposes and that the results would remain in academic circulation only. It was emphasised to the participants that the research was not commissioned by management. The interviews presented in Appendix G have been corrected for language, abbreviations and everyday use of language, being replaced with proper usage as far as possible to allow ease of reading.

## Interviewees

The interviewees were selected because of their roles as developers or users of information systems in the four case organisations. Their personal experiences in these roles constitute qualitative aspects of the research data. The Systems Support Programmer at the Datatel Corporation case organisation has been with the company some ten years. He was initially employed as a trainee programmer. Part of his duties involve maintaining systems, which brings him in contact with users and their requests for systems changes.

The Systems Operations Manager at the Datatel Corporation case organisation was initially employed as a trainee computer operator. She has been with the company for over

fifteen years and is known to many of the other employees. She is quite knowledgeable about the company's systems.

The Project Manager at the Datatel Corporation case organisation has been with the company for over twenty years. He was originally employed in board repairs (electronic boards). He moved into systems and is now a project manager.

The Sales Manager at the Datatel Corporation case organisation is a relatively recent recruit. He is not fully aware of all the systems and is primarily concerned with using the Field Engineering Management Information System. He is a typical hard-driving sales person and is only interested in securing contracts for himself and the company.

The Finance Director at the Ace Business Computers case organisation is a founding partner of the company. He is keen to see profits grow. His background in math's and computing qualify him to be the systems manager in the company.

The Modular Credit Scheme Field Manager at the University of Luton case organisation is quite knowledgeable about information systems development. He is an academic member of staff. He may be regarded as a user of the HEMIS information system. He has an interest in information systems as part of his teaching duties and research interest.

The Management Services Manager at the University of Luton case organisation is qualified in computing. He operates a small systems team whose main responsibility is maintaining and operating the Higher Education Management Information System (HEMIS). He has no direct contact with users of HEMIS.

The Chief Administrator in the Modular Credit Scheme Office at the University of Luton case organisation is answerable to the Modular Credit Scheme Manager. The Chief Administrator is in direct contact with faculty departments who are users of HEMIS and with the Management Services Department. She has direct contact with the Management Services Manager to whom she reports users' requests and opinions on HEMIS.

The Module Coordinator at the University of Luton case organisation is the present researcher. He has been coordinating modules up to masters level, and he is on the HEMIS reports distribution list. He comes into contact with the HEMIS system as a module coordinator and at examination board meetings.

The Academic Registrar at the Nene College of Higher Education case organisation is responsible for the administration of HEMIS. She is in direct contact with the IT Services



Department, who maintain HEMIS, and with academic and administrative staff who use HEMIS.

The Module Coordinator at the Nene College of Higher Education case organisation is responsible for level three and master’s modules. He was not involved in the development of HEMIS.

The interviewees are detailed by case organisation in Table A1 below and those provided in Appendix G as samples are marked with an asterisk.

**Table A1: The Sources of Interview Data**

| Interviewee   | Organisation                     |
|---|----------------------------------|
| Systems Support Programmer*                             | Datatel                          |
| Systems Operations Manager*                             |                                  |
| Project Manager   |                                  |
| Sales Manager   |                                  |
| Finance Director*                                       | Ace Business Computers           |
| Modular Credit Scheme Field Manager*                    | University of Luton              |
| Management Services Department Manager*                 |                                  |
| Chief Administrator in the Modular Credit Scheme Office |                                  |
| Module Co-ordinator (Participatory Observer notes*      |                                  |
| Academic Registrar*                                     | Nene College of Higher Education |
| Module Co-ordinator                                     |                                  |

# **Appendix G:**

## **Sample Interview Data Transcripts**

Table of Content for Appendix G

| Interview                                 | Company                          | Page |
|---|----------------------------------|------|
| Systems Support Programmer                | Datatel Corporation              | 275  |
| Systems Operations Manager                | Datatel Corporation              | 277  |
| Project Manager                           | Datatel Corporation              | 282  |
| Finance Director                          | Ace Business Computers           | 285  |
| Modular Credit Scheme Field Manager       | University of Luton              | 292  |
| Management Services Department Manager    | University of Luton              | 296  |
| Chief Administrator Modular Scheme Office | University of Luton              | 300  |
| Academic Registrar                        | Nene College of Higher Education | 303  |
| Module Co-ordinator                       | Nene College of Higher Education | 308  |
| Sales Manager                             | Datatel Corporation              | 309  |
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**Datatel Corporation****Interview with a Systems Support Programmer**

Q. Could you briefly detail the systems architecture?

A. Our systems consist of various applications and a wide area network. Our network software is called Pollnet 3.11. That is our main network system. We do are about to install Novel but we haven't the time at the moment. We're trying to find out if it is compatible with the software we're using here. I can let you look at the Pollnet systems documents if you want.

Q. What applications are in use?

A. We use Microsoft Office, Word, Excel, PowerPoint and Caspion which is used by the sales people for recording their contacts. It's like a diary for them to keep a record of who contacts them and what action needs to be taken. Our management information systems are our internal software which is used for keeping records of stock-check, audit of personal computers and ordering parts, repairs. When we send repairs out they're recorded in our FEMIS system (*Field Engineering Management Information System*). Caspion is the system that is mostly used at the moment.

Q. Do you develop systems in-house or do you buy them?

A. We have bought Caspion from Datatel Direct, but the company is a part of Datatel. We have tried to develop it further so our people could use it, we've modified it. We got the basic software from them but we've modified it to suit users. I don't use the package myself but Anita's the main person, she knows everything about it. I've only worked on it recently. We develop our own systems, but packages are more convenient for less difficult problems like some office applications. We have developed major applications unique to our company, for instance the FEMIS.

Q. What systems development approaches or methodology do you use for your in-house developed systems?

- A. We have SSADM which we follow loosely. We don't have time to go through all its phases. Most of our early systems were developed in the USA and we have been shown how that was done by the developers there. For me they lead to feasibility study paralysis. Using a method doesn't tell me if the system is possible to develop. When a system is proposed to me, I'd like to know whether its possible to develop.
- Q How do the systems in operation cope with business change?
- A. As you know we have the MIS Department. They look into the actual software to see where they can modify it, and they tell us what has been changed. We can then use that to support the systems better.
- Q. Can users change systems themselves?
- A. I mean, it depends how big the change is to the software. How much you want to change it. If it concerns design, they can't do it. They'd have to ask MIS to write a program for it. That's how it works.
- Q. Is it company policy to go through the MIS Department or is it because they don't have the experience or expertise to make the changes themselves?
- A. They do have the expertise, but if its a major change, you don't know the software, you'd have to go to MIS who would help out with design. But we do have support in the support department. MIS is in-house. But the customers are dealt with by Customer Support.
- Q. On average how long do user requested systems changes take?
- A. We have a very good support team, but the actual time depends on how big the problem is really. Depends, how much research is required to make the change. We can do the small changes fairly quickly, say a week or so. The bigger changes may take a couple of months.
- Q. Do you have any contact with systems analysts and what role do they have in the systems changes?
- A. Yes, the analysts tell us what needs to be done. They do the research first, to check the feasibility of the required change. Some software is not possible to change.
- Q. Thank-you.

**Datatel Corporation****Interview with the Systems Operations Manager**

Q What systems do you use here at Datatel?

A. Datatel used make their own chips, their own computers. One of our main systems is the Resource Management System. It's our in-house system. We use other systems like the spare parts system, sales ledger, field-call system, because most of our business these days is dealing with spare parts and maintenance. To support our sales we have the quotes systems and the sales system. For our European subsidiary we operate the data management system as well.

Q What systems development approaches or methodology do you use for your in-house developed systems?

A. It's really ad-hoc basis, in theory we should go through all the phases of SSADM, but really, if you do structured programming you tend to spend so much time on that. You don't have the manpower to go through all the stages. We've developed all our systems, except for the standard office applications.

Q. So, although you have the basis of a structured technique you don't follow it to the letter?

A. No. Most us have been with the company a long time, and we are familiar with the way we do things. We use the method as a reference really. We get on well with our users and we develop systems in co-operation with them. We write new systems from scratch which work quite well. For that we go through the feasibility study, the problem definition etc. But at one stage development were dealing with nine to ten developments. Now we've only got two going. We're not writing new systems at the moment. We spend all our time enhancing and fixing old ones. A previous operating system called Datatel DOS was developed like this. The core programs have been here for about ten years.

Q. Can users change systems themselves?

A. Yes, if they're able to use 4GLs. We still use flat-files in many of our



applications, which require programming knowledge. We don't allow unrestricted actions on our systems, we've got built in security which means they can't write their own programs. If you write a program and it doesn't recognise it, straight away it'll throw you out. It needs to know certain codes, it needs to be called from certain programs. We need this kind of security because we're a technical company.

Q. Would you say that users have control over the systems they use.

A. They might, I mean. They really wouldn't want to change any of the parts of the program which deal in data entry. Most of the things they want to change are the reports they get out of systems. And that's where 4GL comes in; they select from particular tables giving the information they want. And they can change that as much as they like. But, I doubt whether they'll be able to go in and change actual code. You know if you look at the Oracle SQL form, you still want programs to change that. The only difference is the information that comes up is what they control.

Q. So they can control the layout and format of the reports?

A. Coming out, yes.

Q. So going back to the previous point about control, would you say users don't really have any control?

A. None at all. They've got control over the operation of the system. They operate their own systems, if they've got the right training.

Q. But they have no control over the functionality of systems?

A. Well, they have. Basically, if they want anything changed they come to MIS. They would need the support of systems programmers and analysts.

Q. So, the control they have is none at all. That's an interesting point.

A. I mean, if they used 4GLs yes, you're going to have something aren't you. And even then, even if you're using something like Oracle, they can't change the tables, all they can change are the uses of the tables.

Q. How is unpredictable change in the business which affects systems usage dealt with?

A. We try to plan for all changes, we need to get the systems requirements right. But those that slip by are of course dealt with when they arise. We sometimes

have to change program code, and much of the systems development work at present is maintaining systems. We have some very old systems.

Q. How would you assess the usability of the systems provided to users and the interfaces to systems that they are given?

A. That's a very odd question. They use devices like the mouse, and they like to have nice colours. Users like all the Windows interfaces, they want everything to be Windows compatible. Their interfaces are not windows compatible, but they work using scroll keys not the mouse. Frequent users prefer to have the mouse and windows, others just complain and think nothing about it afterwards. The mouse takes longer. If you use the keyboard its much faster. So anyone using a system over a long period of time would prefer the keyboard.

Q. What kind of on-line help is given to users?

A. Our systems were not user-friendly. That's because some of them were developed before all that happened. We have been adding help wherever we can, but it takes time.

Q. What kind of help is given on the field engineering system?

A. That system is very important to us because its the major income earner at the moment, we're not selling much. We have had to provide extensive help facilities on the field engineering system, our customers depend on the reports we provide them. So we have general help on the system and context sensitive help. Our engineers need to know how to provide the detailed reports that customers want, so the context sensitive help is useful to them for doing that.

Q. On average how long do user requested systems changes take to do?

A. It depends on how urgent it is really. These things are dealt with by the systems managers. Basically, it depends on how urgent it is. If it is absolutely urgent, the change will be made immediately. But our systems are so flexible really, I can't remember the last time that happened.

Q. That's interesting. What do you mean by flexible?

A. We design our systems with foresight, and we build space to allow changes. But that doesn't work over a long period of time. Some of our older systems

just cannot be changed, its too costly.

Q. How do you introduce the flexibility into the systems, for example in the field engineering system?

A. This happens when the programs are written. You take into account all the things that can happen. In most cases, most of us have been here a long time. I've been here the most number of years, others have been here at least ten years. We build flexibility into the program code. Only because we know how the company works. If someone says we want this done, we don't just do it. We know how the system works and only do those things that are possible.

A free flowing discussion followed this interview, as presented below. The interviewee is identified as "I" and the researcher as "Q".

I Most things are in peoples heads. Not everything is written down as required by SSADM. Most changes are given to the person who wrote the original program. There are so many little things that, which aren't necessarily written down somewhere. It's in somebody's head.

Q What about documentation?

I. Sorry, it might be documented, but the question is when doing the enhancement your not going to read all the documentation necessarily. If you've written the program, its simpler to just make the change than to read all the documents, it'll take hours to do it that way. You just do it. Users cannot control systems because they would read all the documentation. They'll just make a change and won't realise the consequence of it.

Q. Yes. You need to judge that. You need to weigh how much control you give to the users.

I. Depends on what the business is really. Computing is a bit technical and I don't think general users really understand it. The business is all vested

interests. Different departments have different vested interests. So you need, I mean some of the meetings we're at, you have two departments who on an issue they want to see it two different ways. Totally different ways.

Q. Isn't that because of the different tasks that the departments have to complete?

I. Yes. Some of their tasks are, they rather have it done in a certain way to make their life easier.

Q. What you need to do is to find a consensus.

I. Oh yes. But the thing is, if you don't have someone sitting on the outside, they're never going to agree. I'll give you an example, when we did our purchase order system. Very simple. We've now got two supplier's files. We've got one supplier file on the sort of, like the purchasing system, we've got one on the nominal ledger system, purchase ledger system. What was happening is this. We have a customer called Amtrax who was bought out and the name changed to Zyatech. In the purchase ledger department, suppliers are split alphabetically for staff to handle. The supplier is not worried, but we need to create a new debtor code called Zyatech to make it easier for the purchase ledger people.

But it really makes life difficult for them. There are now two people dealing with the same supplier. When they look at the history it becomes difficult to identify the two suppliers as one and the same. The two files will not be reconciled. What they really want to know is whether the supplier was paid, how much etc. What should have happened when the system was designed is that suppliers should have been identified with a unique number, but we use their actual names.

Giving control to users in situations like this can cause problems. Departments with vested interests would make the changes they want without reference to others. The MIS Department provides the overall control so that systems integrity is not compromised.

Q. Thank-you for your time.



**Datatel Corporation****Interview with Project Manager**

Q Could you talk freely about how your systems are developed?

A We are moving from proprietary systems to industry standard systems, for example Windows NT. We have been using our proprietary languages and operating systems. These were taught to us as 'best practices' from the horses mouth as it were, by the people who developed them in San Antonio. We use SSADM as model, but don't rigorously follow it, it's too time consuming. Our systems development manager has a long history of development and he prefers to get straight to the point, and he's been with the company since 1989.

SSADM is used as a standard, an approximate tool, for project control. We use this methodology in Datatel Direct for developing software for our clients. Our in-house systems are not done the same way, we only use the methodology for consulting work not in-house systems. You could say we have double standards!

Q Please tell me more about how you develop the in-house systems?

A. Our practice is significantly different from the standard methodologies. We're working at a local level and closely with people. We cater for local needs of people who've been with the company for a long time. I myself have moved from business to systems, so I know the business and the people. We don't use rigid standards in this kind of local level.

SSADM is not used like applied to an accountant, where each activity has to be accounted for. Users are involved throughout the development, not just for the prescribed stage. Our software is developed as open systems to be flexible. We build flexibility into the systems.

Q. How do you do that and how do you manage change in the system?

A. For example we create extra fields in database records to allow for growth. We have to be flexible in our approach because specifications change. We have a great deal of change the way people want information which effects our systems. For example, in our purchase order system some items become

consumables, a change in how items are used. Another example is the field engineering system. That is a very competitive area, and we're concentrating on that now as a company. In this area speed of reaction to customer needs is important. Some customers may want different information on repair tracking from what we normally provide. We have to meet this kind of change fast. So we've developed a customisable reporting front-end to the system.

Q. How are the changes to the systems managed?

A. We receive change requests as request enhancements by electronic mail. These need to be justified and is done then appropriate time is allocated and the work is done. For significant re-writes we have to involve senior management, for example the Field Engineering Manager. These requests also come to us by electronic mail. Someone in the department then owns the change, confirms it will be done and the change is affected. We then electronically communicate that the change has been done.

Q. How long do such changes take to do?

A. Changes to customer reports don't take more than a day or two. Other changes may take more than a week. It really depends on how much manpower is allocated to the job.

Q. Could you briefly detail the systems architecture?

A. We have developed systems that are core to the business, these are stock, repairs and invoicing. They have to be justified. So any systems development must have a significant impact on the quality of the business we do. There must be significant cost reductions and work should be made easier for a system to be justified. Monitoring of spare parts stock levels is important, as repairs is a major source of income for us. Purchase orders is all done electronically, which is an improvement as it's killed four jobs, or more than halved the department. Now orders are dealt with in one and a half days which is a bad case compared to the eight days it used to take. Our financial system is of course critical. It provides sophisticated management reporting, and we have noticed that users do a lot of re-keying of these reports onto their PCs. So now we enable the data from these systems to be

downloaded to spreadsheets like Excel.

Q. Thank-you.

**Ace Business Computers****Interview with the Finance Director**

Q. Could you describe the systems architecture of the company?

A. The company revolves around the accounts system, where from the minute somebody calls an order is placed. It automatically goes to the sales ledger. An order form is kept on the computer which we make into a hard copy as required. That hard copy goes down to engineering and gets built. That hard copy comes back with the built machine, goes back to the logging bay and then that hard copy is then picked up, checked and goes back to the Pegasus system where it is turned into an invoice. So basically its some sort of an accounting and trackability of where the work is for which we use the Pegasus environment.

Now, as a company we're running a Novell 3.11 as a network system in-house. For software we run Pegasus, we run Word 6 for our word-processing facilitates, some secretaries run WordPerfect. As regards returns and technical back-up we're currently in the process of writing our own database using QM.

Q. Would it be correct to say that your developed information systems are basically off-the-self packages?

A. That's right. We assessed our needs and found it more convenient to purchase a shall as it were and develop our systems around it. Our accounting information system on Pegasus is one example. Although its not a system specifically written for the company, we picked it up and configured it to meet our specific needs.

Q. Could you elaborate on what do you mean by configuring the system?

A. In this world any product you buy off the self is a generalised product. Its not one which you load onto the machine and away you go. We bought the Pegasus system and loaded it onto our network system. When I first used it a long time ago, I remember it was a command line type system. So it ran from menus. It's more sophisticated now, and better than SAGE. It's more powerful and more expensive. It's ideal for processing multi-currency



accounting or multi-company accounting or, as in our case, for doing lots of sales analysis. We structured our own sales analysis codes, our own sales invoice code, stock control codes. So we fed in all the data that we want to see on that system and we configured it to work as we want it to and produce the information we want. Our sales department is now information-rich and we can draw on more information.

Q. So would it right to say that you tailored the system to your needs?

A. That's right. You can say that we've bought the skeleton and configured it to suit our needs.

Q. Could you describe how the system is used?

A. The product was very generalised, when I say generalised, it'll do any sort of configuration you like. We've actually built in analysis codes that will help us to analyse our different areas. I'll give you an example. If for example we're selling a computer then we make the program support that. Here is an order for a computer, the sales analysis on that computer is SA1 for example (*the interviewee draws figures on a whiteboard*). If we sell a part, like for example a hard disk, then we pick up the sales order and we configure the analysis codes, for example HA1 and so on. So each different department gets what they want. So at the end of the day when we produce our reports okay, we can actually analyse how much sales we've done in each area, right. This is something which is an in-depth configuration of the system. We could have easily left it as we got it and just do not use any sales analysis codes whatsoever. Then you get all your information in one bundle, and you don't know what you sold, how many machines you sold, how many parts you sold, how many maintenance contracts you got, you just don't know. You have it as one lump sum.

Q. When you talk about creating sales analysis codes, is this accessible to all users of the system?

A. No, well we, we're fortunate in that we're a computer company and we know a lot about software programming. We have the expertise to actually configure software products. For example, my speciality in my math's degree days was software engineering. Okay, I was writing software. No

body is actually allowed to change these analysis codes. Its only strictly sales management and one or two management who are new. The immediate lower levels have got the expertise and they can change the system. But for example the company is structured in one way, the specific structures management wants to look at. We found that its best for sales management to actually make decisions on what sort of reports and analysis codes we want to get out of the system.

A manager will have different interests, hence he'll build up different analysis codes. A few managers doing this is manageable, we don't allow too many people to change them. We are careful about the systems use by the managers too, as in the past costing errors have occurred, leading to under-costed quotations.

Q. How are changes to the system managed?

A. Major changes are dealt with at the board level, with an input from the rest of the managers. If they have problem with something, they have to ask before they go loose and change anything major on the system. Any such changes are first discussed, we have a meeting about it. On the outcome of the meeting, then the relevant changes are made.

Q. So would it be correct to say that changes to the system are restricted by the management?

A. Yes, by the management. The system can be changed by knowledgeable people, but the system is password protected.

Q. Would you say that users have control over the system?

A. If they have the authority, yes. If they have the authority they can change things on the system, as is the case for sales managers. For minor changes they don't need to ask for permission. But whatever the change, it has to be logged down on the form and then made. Because a minor change, without a register, could actually led to a disaster. One day its one small minor change, the next day its another small minor change. At the end of the day it can be many, many minor changes, which transform the whole system as a whole. So a register is needed to keep a check.

O'right, I'll give you another example. Sales peoples' duty is to actually do

the invoice of their particular client or their own client. Because they're the people who actually speak with the clients, they are the people who raise the sales order, the sales purchase, and they're the people who actually see the teams of recruitment through for the client. The client has got one person who he deals with, okay.

And that person knows the client's character, knows what he wants to hear, knows what he likes to hear, can actually pamper him until he buys the system and continues from thereon to support the system. We strongly believe in that.

So the sales people are allowed to do the invoicing. At the same time, the system that we use can allow people to do credit notes. Now if we have no control, if management have no control of who is doing credit notes and why, then sales people can actually invoice a system and get paid in cash. An hour later if there is no control they can actually go and credit that system and keep the cash. So there is money lost in the system. There is money which is locked in the software package, but this is money that went out of the stock-room without my authorisation, without any control whatsoever. That's why there is a limitation of who can actually do certain things on the system. When it comes to counting the money there is strict control.

Q. What determines what changes are made to the system?

A. Basically we track the system continuously. If we find the situation where it does not conform to the actual operations of the company then that specific and unique case is looked at on its own ground individually.

We have recently configured our system to make sure our customers are satisfied with the service we provide. We found that to do that we have to allow sales managers to deal directly with the customers and to have control over the system.

If we believe that its a conformity that very rarely happens or doesn't happen at all, its just a special case, then it goes into a manual handling of that operation. If we find that conformity though is not a rare occurrence but its repeating then the system is altered to take care of that non-



conformity. Our concentration of customer case is one example.

Q. So on what basis do you make changes of the kind concerning customer care?

A. Its not a case of we're thinking of doing that or this change, because that's a wrong thing to do. Okay. Before you make any change you've got to have your statistical data correct. I'd actually look at the managers responsible for this section, who actually get paid more money (*drawing on the whiteboard*) than the last person on the line. These managers are the people with overall information about what customers want. After extracting information from them, then the second phase is entered, dealing with upper level management, and that information is fed through the upper level management and we make the change accordingly. But still tracking of the system is essential at whatever stage, whether you have five employees, 300 employees or two thousand employees.

You cannot actually dictate and say this is the way I want it done. And because you believe that the way you want it done, its not necessarily the way the company acts. No. Its not up to an individual to make a system, its up to a team to design a good system. Its up to your client that actually dictate some of the non-standard situations that the system will have to cope. Because each client will have a different type of attitude.

Q. What is the actual mechanism for the changes you implement.

A. We borrow from the life cycle, but don't actually follow it to the letter. After a request for a major change, like the need to support customer care, we do a feasibility study, and then we change the systems configuration. But our feasibility study is not a major thing, it looks at the knock on effects of the change, particularly form the accounting point, because we have to ensure that changes to sales analysis codes do not disturb historical data, for tax purposes for example. If we don't follow a structure, not necessarily to the letter, then there will be no systems control. Because there are a lot of solutions to a problem. Its just a matter of which solution you're going to



implement. And you've got to follow some rules under that solution, not necessarily the best solution or the worst solution.

Q. Returning to the issue of users controlling the system. What training do you provide to users who are allowed to change sales analysis codes?

A. That's a very good question. Even though most of our people are technically competent, we provide training on the use of the system. I would be concerned if anybody who did not know the system tried to change it. To keep things orderly we also insist that users make regular back-ups of the system. We want to be able to retrieve data and make the system working if something should go wrong. We have a contract with Pegasus to train our users, and they do a good job. We then feel confident that users are able to use the system, and then they'll be allowed to change it if required. Users who have not been on the training programme are not allowed to change the system.

Q. How satisfied are you with the system's suitability to the company's needs?

A. We are very satisfied. We have made some major changes to it to suit the new direction of providing customer satisfaction, and the system has borne up well. If I set-up the company anew, I would go back and say yes, the system still suits us, the system is still very, very good for our company with one drawback.

And that drawback is back-up. Okay. Although we know that Pegasus as a whole is a multi-user system, its fragile and very sensitive to crashes in terms of network failure, if that happens you lose your data and your work. Management in here has made sure that we have back-ups every night, back-ups every lunch-time, so that if we do lose any work its only one hours work. We can put things right within 45 minutes, and that is for the worst disaster. Network goes down, data is lost from the system, basically the whole company crashed and everything was on files. Within 45 minutes we can recover the system and we can start trading again.

Q. Would you classify your Pegasus based accounting information system as a data processing system or an information system?

A. Difficult question. Fundamentally its a transaction processing system, and that's what its built to do, its actually batch processing, not interactive. But we can generate sales analysis and reports, that would be an information system in a sense. It allows us to pick and mix fields and records from different files to actually create new fields. So its good when we want to do customer sales analysis because we can generate different reports. So for instance, when we want to know the average selling price of each of our products, because we negotiate different prices with customers, we can use the system's report generation facility to do that easily. That sort of facility is like a MIS. Any decent accounting system should provide management information, as Pegasus now does.

Q. Thank-you for the interview.

**University of Luton****Interview with a Modular Credit Scheme Field Manager**

Q. What systems development approaches or methodology do you use for systems development?

A. The problem is that because we used EMIS (*Educational Management Information Systems*) the vendors, remember that ours is a modular scheme, we decided that EMIS could do the job. There is a view from some areas that HEMIS would not cope. HEMIS certainly wasn't designed to work with the modular scheme. But there were people who in Management Services area who felt that HEMIS could be amended as a stop-gap and particularly I found that I had a chat with a chap called Peter Smith, he's still here, but he doesn't work on HEMIS anymore, he was a developer for HEMIS for this place, and he felt that we had probably been better to have used HEMIS for a while. 'Cause all the problem with HEMIS was really, it all came from a number of areas with mostly to do with resourcing time. I forgotten the exact timing of it, but it was something like, they had 6 to 12 months from first saying that they'd go with the idea to actually being live on the modular scheme. It was that short.

Originally there were ten institutions built into this and they put in £5,000 each. So there wasn't much money put in to develop it initially. The idea was that when there were the ten institutions using it they'd carry on contributing to the pot to get the amendments made. But as of certainly last year there were only two institutions that were using it. So the actual development was, I'd argue, probably under-funded.

It was a development that came from the combined views of ten institutions. So it was a bit like the old story of you know what happens if you design a horse by committee, you probably end up with a camel. The same thing happened with HEMIS really. All these ten people together and the system that was built was not a system which was for Luton or for Nene. Its a system that supposedly gave you most of what you wanted.

There are recognised shortcomings with it because of that. So they wrote to

HEMIS and said here your £50,000 to develop it. Now I know because I was here at the time of development was going on that certain people who managed courses were not involved in that.

We manage courses here, we weren't involved in the development. So the development seems to have been between, it seems to have come out of discussions between EMIS and Management Services here. So you're talking about Peter Smith and John Updike or his predecessor in fact, I've forgotten his name. And the people from EMIS were the ones who were trying to decide what it was that was needed.

So fundamentally what you've got is a structured approach, because you've got a problem solving approach. So whether you see that, I would go so far as to say that it was SDLC based, because I don't think it was that sophisticated. I not telling tales by saying that. I've asked the same question of people like Peter. He said no, he said to me. I'd like to use CASE tools, and I'd like to plan things and I'd like to have structure. So Peter and people in Management Services are very structured, computing people. So if they did do things, if they had time and money to do things the way they wanted to do it, they'll take a more structured approach. So you will end-up with a SDLC approach.

But they didn't really. What they ended up with was a fire-fighting approach. But however you look at it, I think its fair to say that they did take problem means solutions as the approach to what they were doing. And they didn't perceive anything outside that. They perceived that if they got the right thing in place, everything would work properly.

Of course the problem with HEMIS from my perspective, which I identify, which I'm still following up, is that HEMIS is just a piece of computing and software to enable the modular system to work. Now if you define the modular system, you've got something much broader than just HEMIS. So really what you're trying to do is trying to define what the needs are of the system that your trying to operate. And I don't think that's ever been done.

Q. Can users like yourself change HEMIS?

A. No they can't. Management Services can't change it either. There's a big



problem with changing anything in HEMIS, because its all been written by EMIS. Its written in Oracle. When they first started writing it, nobody knew Oracle and because the system has to satisfy a number of institutions, because there is still the idea that some of the others would be buying-in. If you want to support HEMIS, EMIS have to make the changes.

You got several things. You've got the cost and problem of involving EMIS in that. But you also got the fact that because the structure wasn't clearly thought out in the beginning, there are some things that are seen as pretty well impossible to do because they'd be so expensive to re-write.

Q. Could you give me an example of some change like that?

A. If you've got a student who wants to study computer science with business there are certain modules which they should not be allowed to study together, because effectively they're the same work. So certain combinations of modules are prohibited. HEMIS can't prohibit students from taking those modules. You can't build it into the system. So that if someone tries to put in two modules that are prohibited it throws them out and says "sorry" you can't do this. You have to do it manually.

Now to me that clearly is something that that sort of system ought to just be able to, ought to do it very easily I think. But we can't even amend it to do it because it would be too complex, it effects too many areas. There are lots of things like that. We really can't change it, we've got lots of problems. I actually use Excel before exam boards to provide profiles of each module to externals. That's ridiculous. HEMIS should be doing that for me.

Q. How does HEMIS cope with business change?

A. In theory they could build in sort of user-access. But I've no doubt as to how well that'll work. Simply because the system's been designed as a system to generate paper. It hasn't been designed as a decision support system, for instance. And because the idea of a decision support system to help with changes in business wasn't thought of at the time the system was built, I've a feeling you'd have difficulty if you try and tack anything on.

I think it would literally be a matter of building a design, if you want a system to move with the business, it would be a matter of building that a

different way, and getting that information to come across to HEMIS for individuals to use. And they do that at Nene. Here we put all our student assessment onto HEMIS, but Nene don't. They don't use it for assessment at all. They do all their student assessment in an assessment unit, and they hire people to do it and they use Excel for that. And when the results are ready, they then feed the data from Excel into HEMIS. So I think that's the sort of model that might work better because it allows for the possibility of change. But in a sense you could almost say that they haven't given thought about things like changes to the system when they built it. And it proved difficult to get the development team to agree on what they wanted. This became even more difficult because we were expanding fast and our needs changed and sometimes were different from the other partners.

I know its very difficult to do, its ever so easy for me to sit here and criticise, and I'm not really criticising. I think the people, with the resources we have and with the time-scale that we had, I think they've done a superb job with it. But the question is who dictates the resources and the time-scale. You know, are these things fixed, are they cast in stone, should we have waited longer. Could we have done it better a different way. Interesting.

Q. Thank-you.

**University of Luton****Interview with the Management Services Department Manager**

- Q. Can users change aspects of HEMIS?
- A. No. Not users. What would you define as users?
- Q. User would be all the people outside your Department who use HEMIS to help them complete their objectives or tasks.
- A. No one at all in that case. Only certain people within my Department can make changes to the system. And in fact we do not change any of the code of the product that's given to us by EMIS. We add things, we do additional things, we write code for reporting, and for calculations for reporting. Sometimes we write a different user-interface to get data into the system, but we never ever change any of the code that's given to us by EMIS.
- Q. How does HEMIS cope with business change?
- A. The code as far as we are concerned is fixed and rigid. Its enough to use SQL to write additional things and the database structure is flexible enough for us to use it in several different ways from the way we set the system up. It deals with most things we're likely to deal with. But if something fundamental changed totally, then we'd probably have to go back to EMIS and say look can you do the changes. Although as far as students records themselves are concerned I've not had to do that.
- In terms of calculations of fees, the financial side, that's a different matter. We've had to do something different there. But additional external requirements for example like the Department of Education now requires us to provide information to the Higher Education Statistics Agency for all students in detail, that's new. And some of the information they ask from us, information we didn't capture or the system did not cater for it.
- In cases like that EMIS have to respond because all higher education institutions have to do that. So they gave us new versions of the software. Things like that they know about and are external, apply across, we expect EMIS to deal with.
- Q. And this is done through maintenance programming?

- A. Yes.
- Q. What systems development do you do here in relation to HEMIS?
- A. We can write some of our own user-interfaces for data capture. We're now writing a different screen, which will mean we won't replace any of the HEMIS code, but we'll add an additional function that users want.
- Q. Which will change the menu?
- A. No. We'll have a different menu. Other users will use a different data entry mechanism to that provided by EMIS. The database will still be the same. We often have to provide new data entry screens when users want to capture new data.
- Q. Are users allowed to design there own interfaces?
- A. It has to come through us.
- Q. Is the reason for this that you want to keep control of the system or that users don't have the expertise or for security reasons?
- A. Yes, they don't have the expertise, and we wouldn't allow it anyhow. Its for control and access purposes, we want to maintain control of the system. What we might allow for the longer term is changing reporting codes, to create reporting codes, there's no problem with that. In principle we'd be quite happy with that. But for anything which is inputting data onto the database or changing data there, no.
- Q. Do you think people within this institution are satisfied with the information provision that HEMIS provides?
- A. Not yet. We hope to continue to improve. The Faculties now have access to produce their own reports in their own area. The statistics reports that we're producing for admission and for senior management are becoming more defined and clear, so we are getting more useful information out of HEMIS. But we, particularly the Faculties, they're still not happy.
- Q. What systems development approaches or methodology do you use for systems development?
- A. The HEMIS system is Oracle based, the development methodology was Oracle CASE. It was done strictly to that methodology and the company EMIS who developed HEMIS have tried to adhere to it. So we need them,



we can get entity diagrams and flow charts. We called for the logical data model at one time and other diagrams in the past, because we wanted to know the exact data flows between entities.

Q. Are you familiar with Nene College's use of spreadsheets?

A. I know that we use a gatepiece to enter results and produce examination board reports etc. and produce results which define new students to count awards etc. I know that at Nene they can't do that. They enter results on spreadsheets to do that total reporting. Also, as Nene they do the finance totally separately. They don't use the results to generate fees. So they use HEMIS differently from us.

Q. How are the changes to the systems managed?

A. From the 5<sup>th</sup> July we will have a set procedure. In the past we've more or less responded to users' requests and changed things, not to any clearly agreed priority, probably in the students records system. Mostly dictated by the Modular Credit Scheme. Therefore they know what was priority things for that area.

From the 5<sup>th</sup> of July in general within Management Services, I intend to introduce a formal request mechanism for changes. I certainly intend that every one will use that. Essentially, they submit the request, say what it is, we estimate the time and say this is how long it will take, and do you want to go ahead, and if you do sign it. And then when we reach the end of the process, do you accept the change, sign-off that its okay.

Q. Where does information from systems provided by Management Services go?

A. Its a mixture. To the Faculties, to the modular office and some to management and admissions. But gradually information should be available to them in reports that they can run off themselves, in their offices. We do expect these capabilities.

Q. What about personnel?

A. The personnel payroll system is separate. We do not have anything to do with that. But there are plans to have a central management information systems department in two years time, a long way to go.

Q.      Thank-you.

**University of Luton****Interview with the Chief Administrator in the Modular Credit Scheme Office**

- Q Could you describe the information system you use here?
- A. We use HEMIS. Its a new system which we use to manage the modular scheme.
- Q. In what ways do you use HEMIS to manage the modular scheme?
- A We use it to enter student details, like their programmes, modules they are taking, assessment. We provide information to the Field Managers who pass some of it on to module co-ordinators. We ourselves, I mean Scott Davis, uses information from HEMIS to manage the whole Credit Scheme.
- Q. How useful is HEMIS to you?
- A It has to be useful, otherwise we don't come to work each day. That's it, we have no alternative. They tell us that is the way it is, but sometimes I wonder why it has to be their way always. I don't know much about computers but we should be consulted about how we do things here.
- Q. How does HEMIS react to changes in your work or the work of other people in the Office?
- A. The majority of things we've done to it we've adapted it ourselves anyway. There's nothing like what we bought at this stage or what we expected to have delivered over a couple of years. Its not a problem to me because its all written for me. Its improving, its the most you can ask for. Every time you get a new experience, we've gone through massive changes of some of the way it operates, which should help us in report writing. I accept that, you know, things like non-returning student records are complicated.
- Q. You say the system is nothing like it used to be. Who does the changes to the system?
- A. John and Peter (*Both work in Management Services*). No other people are allowed, who've got the experience. But I don't have any staff to do that for me.
- Q. So if John gave you permission to make the changes, you could do them?

- A. I could have done it.
- Q. You could?
- A. I would like to make the changes as my work requires. But I have to work with John. We work together.
- Q. Have you got any expertise in computing?
- A. I can see what's wrong. I can't change it. I'd just look and find out what's wrong and then report that back. I can't change the programs, I don't know how they work. The more I do it, you know, the more I get. Its really not my job. But I just do it as part of the job anyway.
- Q. Are reports from HEMIS the only interaction with it?
- A. Yes. Module leaders can't view reports on screens. But they can look at individual sets of data on screen to get student information. But they couldn't view reports, it doesn't work like that in production.
- Q. How long do changes take to be done?
- A. Usually within twenty-four hours. I get a very good service.
- Q. Do you most of the time get what you want?
- A. If its scheduled. We've got to the point that the majority of our reports are written. Then you just fill it in, random check that you still need them. John might have made modifications to the rest of the system that has altered the reports slightly. But that's not a problem. We get them all out. He knows my schedule and he works accordingly.
- Q. So John provides you with a very good service?
- A. Excellent. The good thing about John is that he's very experienced in what he does, he's not like your normal analyst. He just writes programs. He understands the Modular Scheme, he understands the complete set of regulations. So the more he works with me, the less explanation is needed. And he knows what to predict. He knows, also knows all the results are starting, quite useful. Its very rare that an analyst would take any interest in that, the details of what you're providing.
- Q. How do you know something requires changing in HEMIS?
- A. Its from my own experience. Also from feedback from academics. There might be academic board meetings or lecturers say they'd like something



done differently, and that's been okayed by the directorate. Which means we then go and change the reports. So its a progressive thing, depending on what needs to be done.

Q. Thank-you.

**Nene College of Higher Education****Interview with the Academic Registrar**

Q Could you tell me how you perceive HEMIS here?

A. It was perceived as a different concept from FEMIS (*Further Education Management Information System*). FEMIS was something that had come out of further education, and it didn't fit higher education requirements. EMIS decided that about the same time a lot of institutions were saying that, you know, need something perhaps modularised. So we sort of started to put together, they asked us to join a development group of which ourselves were members from the beginning. And we went to a lot of meetings to actually help with the specifications for a new system. And that is how it was really built and we were consulted all the way through on how it was built.

In my view, I feel that it works extremely well. If its used the way, you know, that it was intended. Now I think that problems have been, where there haven't been, speaking personally, we work in a way which it gets best out of it I feel. We have got a team here in Registry working with a team in IT Services to support us. We have regular meetings, that's apart from day to day contact. And that means we can work on priorities.

Q. What is discussed in the meetings?

A. How we are going to do things and the way forward. We've done it on a working basis, we didn't go for using the lot, for everything, to start with because we knew it wouldn't be possible, its not feasible. We've worked largely, what we don't do, I mean because you're a different institution it probably works different. We don't use the assessment quite as it was intended. What we do, personally I felt and still feel that if we'd actually try to record every piece of course work on HEMIS, then the database would have become much too cluttered. So what've done, we have a central assignment handling office which is part of Registry, we download to their disks, well for spreadsheet use. So they build spreadsheets to record all the coursework, basis for the marksheet, so that question paper one is marked and the mark is put in and then at the end of the day, we've just been doing it now. We have that information back and we load it back into HEMIS, but

only we load the real assessment for each element. I think otherwise the database just becomes too enormous too comprehend almost really. And that's where you get a lot of problems. So I feel that we're trying to get the best out of it. I'd say relatively happy with it.

Q. Who were the members of the development team?

A. The ten institutions were originally part of it.

Q. Did EMIS do all the programming for the system?

A. Well, they do the majority of the programming. But, where, I mean we write all of our own reports. Very few were actually supplied with the system. Now some people have complained about that. But because of the format and the way that you can organise the study block into whichever structure that we want, I don't believe that they could have written reports that would suit everybody. So I feel, you know, that you can't really blame them because they've done a loose structure type thing, that can be fitted together in a way that is just specific to each institution. Then you can't have it both ways and have all the reports to go with it, because they'd end up writing reports for each institution.

Q. How does HEMIS react to changes in your work or the work of other people in the Office?

A. The development work with HEMIS has finished here. There's development currently with admissions. But what has taken its place is the Higher Education User Group. We have meetings of these regularly, about two or three no three or four times a year probably. Broadway and Nene College are chairing that at the moment. There was a meeting, was it last week in Bristol, and people who make suggestions will perhaps write to EMIS, or else make suggestions at those meetings. And the feeling of the group is then set to what the priorities might be to change something.

And if it was just one person, then they might say well, if I mean your talking about the Higher Education Statistical Information Agency return, then they have to do the requirements for that, everybody would feed into that any changes we need to do. But if it's a specific thing that one institution just wanted, then they might say we'll do it for you but it will be on a

consulting basis just for that one institution.

Q. I see from other documentation that a Faculty Manager has asked for information on progression rates. Would you be able to do this change yourself as an institution or do you have to go through EMIS?

A. Well, I mean it depends what sort of change it involves your talking about. I mean if it was in the way that we structured it. No, we just do it ourselves. If it involves core structure change, only EMIS will be able to do it.

Q. Have you got your own development team here?

A. Yes. We have three people in Registry and three people in IT Services.

Q. Are users allowed to change aspects of the system?

A. No. We don't permit faculty administration, I mean although we're on a network which is throughout the institution, we won't permit faculty staff to change anything to do with study block, or things like that. So you know they can get access to certain areas obviously, about students and things like that. Its like some of the assessment reports. We don't allow anybody at the moment, we're just working out strategy for the future, for them to actually access assessment at the moment.

Q. How long do changes take to be done?

A. It would depend upon what it was. It could very well be done that day if it was something that's really desperate, you know. I mean, for instance, something to do with the reports we're producing at the moment. It'll be done there and then.

Q. Is HEMIS a usable system?

A. Yes, yes. We've built in, you know, the reports we've written. We've built our own on-line help as well. So that you know, if I go into there and look at that (*pointing to HEMIS interface*), so if I do that that'll tell me what to do. So a user can find out themselves. I mean, it takes time, we've obviously put a lot of time and effort into it. But I think we're sort of building it, something that's really worthwhile. I think it would be difficult for us to manage the modular scheme without HEMIS, even with all its deficiencies.

Q. How easy or difficult is it to learn to use HEMIS?

A. Yes. I think obviously the more you use it, its like anything, the better you



are at it. The problems are that this use of it. It's when say I can use it once a year, say for enrolment, by the time its next year I've forgotten how. The way we try and get through that is we do some refresher training each year during the summer to sort of bring them back up to speed as it were.

Q. So the control you give to users is to input data. They don't have any other control over the functionality of the system?

A. No. No. No. I mean that's not quite true. We have as part of registry meeting with faculty staff, they're called Liaison Groups and one's about student records and one's about admissions, and representatives talk to us and say what they think they would like. And we take them into the whole thing and say, you know, we'll see what we can do. And if the time-scale might be that. We also report to our senior executive team on a termley basis, what is actually happening, what we're doing, what we're working on. In case they need to influence the direction we're going in. So that it goes to a high level in the institution on what we're doing.

Users' view are taken. Yes. We are thinking about having perhaps some training for advanced users, and those might be perhaps one or two in each faculty. I anticipate in fact having people who can actually access the Oracle database, as part of that.

Q. What kind of change have you experienced in the institution over the past two or three years?

A. Huge expansion. We've lost most of our FE, (*further education*) so that has made it a lost easier, you know, in setting it up. We haven't got much FE now. There's greater demand all the time for more information.

Q. How does HEMIS cope with increased demand?

A. Quite well, you know, providing we've got the man-hours to put in to do it. You know, that's a crucial thing. If we had more staff, then we could do things a lot easier. I mean the basis is there and the information is there, its just getting it out all the time.

Q. The only way of getting this information out for the time being if through reports, isn't it?

A. Yes. What we're actually about to order is fairly new product that EMIS

have got called EPLORER, which was available on FEMIS, but is now available for HEMIS. And you use that for writing your own reports on a local basis, and what we're probably going to do is set up workbooks for people, so they can actually manipulate some data into their own format, you know. But that's really a bit of sop to keep people happy in a way.

**Nene College of Higher Education****Interview with a Module Co-ordinator**

Q. How do you use HEMIS?

A. In honesty I'd have to say I have no confidence in HEMIS. We were told it would make our work efficient, and give us more time to spend on research and scholarly activity. I still do much of the module administration manually, or using spreadsheets, particularly where information on students is concerned. I don't remember any of the module co-ordinators being consulted when the system was being developed. How can you have confidence in something you've had no say in. It our way of doing things. We don't really plan things out. We have all the committees, but how many times have they had to react to situation. It happens constantly. We just don't make plans and we should.

Q. What effect has HEMIS had on your management of modules?

A. Well, logging students onto the systems has been poor. I get students attending my module who do not appear on the system reports. HEMIS reports are mostly produced during the beginning of the semester and the end, but they're not useful because the actual programmes the students are taking and modules they're attending is different. The system has not supported this kind of programme and module administration. Most staff don't welcome the system.

**Datatel Corporation****Interview with a Sales Manager**

Q What computer based information systems do you use?

A. We use the field call system. I need customer information to retain engineering contracts. The information I use varies according to the customers I'm dealing with. Each customer is different and I've got to look after them all. Besides I get commission for all the contract I get. If I don't look after them then I loose my contracts, and bang there goes my commission. I've become responsible for determining discounts. Sometimes my customers change their minds and I need information on their past contracts. We want to give them the best discounts we can.

Q. Do you mean the Field Engineering Management Information System?

A Yes.

Q. How useful is FEMIS to you?

A. The systems doesn't quite do what I need it to do. I think that partly because the systems people don't know what we need. They seem to think they know what we want. I certainly don't know what they do, so how do they know what I do, I can't understand. I need my clients' information at the touch of a button, but the systems don't give me that. Still, I've got to use the system, there's no alternative. Except my portable. I keep a lot of information on the spreadsheets on it. I get the data from the system and load it onto my portable.

I find that the systems people do not know what I actually have to do. They seem to think I work differently form what I actually do.



**University of Luton****Participatory Observer Notes**

I'm not allowed any direct contact with HEMIS. The module reports I get are generated by someone else. The decision to deliver a particular report is taken by people higher than me in the organisation.

I "use" the HEMIS system. By that I mean that all discussion on student and module matters are based on reports from HEMIS.

I cannot determine how HEMIS works or what its functionality is, but I can influence it by asking for particular reports. Usually, the need for such reports becomes evident during the course of my work. For example, at examination board meetings particular information may be needed to make decisions on students. If the information is not provided, we as a board ask for it from HEMIS. The certain delivery of this information is not guaranteed though.

I find HEMIS of little relevance to the work I do as a module leader in the Modular Credit Scheme. The student register report it provides for each module I teach is inaccurate. It does not match the actual students who take my module. The register information is of no use. I compile my own register, which the data entry clerks use to input onto HEMIS as actual attendance on my module. Information I should have got from HEMIS in the first place. The idea is that the Modular Credit Scheme, with the use of HEMIS, should provide me with this information at the start of semester.

I cannot use HEMIS to obtain data on students. I would like to know whether students have taken my modules in the past or are any taking any of my current modules. I would like to know the result profile of students taking my module. All this kind of information is not available to me.

There are many things that HEMIS should do but doesn't. I have to input module marks onto Excel to provide an analysis for boards of examiners. I should not have to do that, HEMIS should be capable of taking the data from its database and do it for me. Its quite frustrating to have to do it myself, it takes up too much time.

The HEMIS reports themselves are not well formatted. The reports do not reflect the actual Modular Credit Scheme, and sometimes much deciphering is needed to know what each report means.

The reports produced for examination board meetings are often inaccurate. Boards have to spend much time agreeing how to interpret the results on the reports before proceeding with the actual work of the board. In the past actual results have been inaccurate.

HEMIS seems to be distinct from the way the actual MCS works. The MCS and HEMIS appear to be two different entities.

**Appendix H:**

**List of Documents and Interfaces Examined**

## List of Documents and Interfaces Examined

This list of documents and interfaces by case organisation were used for three purposes. One, shown in bold type are the documents used to cross-check some of the questionnaire responses. Two, shown in normal type are the documents that were examined to understand the process of information systems development and usage. Thirdly, given in its own heading “interfaces” are the screens examined to get an appreciation of users contact with the systems within each case organisation. This is a list of input and output screens examined.

### Datatel Corporation

Datatel Education Services

MISA Network Configuration

MISB Network Configuration

MISC Network Configuration

Systems Amendments Logs

**MISA Terms of Reference (MIS financial system)**

**MISB Terms of Reference (MIS logistics system)**

**Project Management Report**

User Distribution Lists

Datatel Corporation Company Reports, 1995, 1996

MIS Department Structure Chart

Product Brochure

Datatel Customer Base Chart

Nominal Ledger

Sales Ledger

Purchase Ledger

EDGE Report

### Interfaces

FEMIS Customer Quotation

Customer Fault Report Diagnostics



## **ACE Business Computers**

Company organisation chart

Accounts Systems Reconfiguration Report

Systems Amendments logs

Sales Ledger

Order Forms

Financial Analysis Codes

## **Interfaces**

Customer Sales Analysis

Customer Order Entry

Sales Analysis Codes Set-up

## **The University of Luton**

HEMIS Amendments Log

HEMIS Dataflow diagram

Field Summary Report

Module Performance Reports (a Field Manager Creates this on a spreadsheet)

Business Systems Module Assessment Results

University Prospectus

## **Interfaces**

Assignments and Examination Results Entry Screen

Student Module Registration Details

## **Nene College of Higher Education**

HEMIS Dataflow diagram

Cognate Area Summary Report

HEMIS User Requested Amendments Log

Module Progression Report

Nene College of Higher Education Prospectus

**Interfaces**

Assignments and Examination Results Entry Screen  
Student Module Registration Details

**Appendix I:**

**Hyper-Tmodeller**

# Hyper-Tmodeller

## 1. Introduction

This appendix tentatively sets out the initial form of Hyper-Tmodeller. The discussion of the practical implications in Section 6.5 provides the basis for proposing a practical computer tool called Hyper-Tmodeller which is discussed in this appendix. The spiral of change model discussed in Chapter 6 gives rise to the notion of dynamic modelling of information systems to account for organisational variability or change. In this appendix, a computer tool is proposed to model dynamic aspects of information systems and thereby suggests an appropriate tailoring tool to enable users to tailor information systems. As well as proposing a computer tool, in this appendix the notion of tailorable modelling is discussed.

Approaches to information systems development that separate systems specification from implementation, like the life cycle model discussed in Section 2.2, are unrealistic in changing organisations (see Swartout and Balzer, 1982 for details on the intertwining of specification and implementation in program code). The pace of organisational change makes the separation of systems specification and implementation largely unworkable. The spiral of change model regards specification and implementation as one process, or as specification and implementation as being non-distinct, as discussed in Section 6.4.1. This is a valid view of systems development and usage, as the case organisations studied failed to draw a clear cut distinction, in temporal and task terms, between systems specification and implementation.

The Hyper Tailorable Modeller, abbreviated to Hyper-Tmodeller, is a proposed computer tool which seeks to regard systems specification and implementation as a continuous process. The purpose of Hyper-Tmodeller is to treat systems specification and implementation as non-distinct or as a single process in changing organisations. By allowing users to make use of the tool they become involved in the specification, design, and development of information systems. Allowing users to participate in the development process is not itself a new idea (for example see the work on participatory design by Mumford, 1993). However, whereas other participatory approaches have continued to regard users as non-developers, the aim of Hyper-Tmodeller is to treat users as developers as discussed in Sections 6.4.1 and 6.5. This type of



user involvement is considered to be a significant aspect of ontological computer systems design.

## 2. Hyper-Tmodeller CASE Tool

Hyper-Tmodeller explicitly recognises diversity and dynamism in the information systems environment, as its philosophy is that of the spiral of change model, which accepts that the organisational environment in which systems have to be developed and used is changeable. The various modelling tools in Hyper-Tmodeller enable modelling of dynamic aspects of the work environment, such as changing objectives, policies, and procedures. These are the kind of organisational changes observed in the case organisations (see Section 5.4.2).

One aim of Hyper-Tmodeller is to facilitate learning in organisations. The conception of living information systems should not only enable user tailoring, but should also be regarded as learning aids which facilitate understanding and making sense for users (and developers) of organisational change. The notion of living information systems facilitating learning should be considered in addition to Trigg's other triggers for user-tailoring activity namely "diversity", "fluidity" and "ambiguity" (quoted in Kjær and Madsen 1995). These triggers are a feature of the spiral of change model, in as much as their efficient cause is organisational change. In effect, the spiral of change model is a conception of information systems design as an extension and augmentation of the organisational thinking ability of users; for this reason it is necessary to provide models which consider users in their organisational settings.

To integrate theoreticians' and practitioners' views, Bellotti (1992), proposes that an appropriate design rationale be explored, and Paul (1993) asserts that users cannot fully specify their information requirements. So an interactive tool is required to enable users and developers to configure, and re-configure, information environments until they are "satisfied". This basic information structure is determinable through tailorable modelling.

Tailorable modelling is conceived to be a process of abstraction from the relevant business domain: abstracting generic features which identify links among organisational tasks, employees and associated information. The purpose of tailorable information models is to *re-present* business in a general form in information systems, one that can be continuously tailored by users for varying and changing information needs, and clarification (learning) of business situations.

The logic of tailorable information modelling is explained as follows: living information systems designers need to build models of complex and changing business reality which is not fully knowable, and since change is centrally pervasive in that reality, the models should contain important variables in users' information environments. Tailorable modelling treats users of information systems as organisational task performers, and not as quasi-systems analysts who need to understand technical data models, as required in methodologico-project frameworks. Tailorable modelling seeks to provide common communicative processes between potential systems users and initial systems developers. At any given time, potential users face many organisational uncertainties which prevent them from fully knowing all their information needs. Tailorable modelling may be thought of as a learning aid which allows users to tailor models of information systems to explore, and therefore learn, what action needs to be taken with respect to information needs in such uncertain situations. Thus making users into active designers of their own systems.

Tailorable modelling would require users (or systems analysts) to begin by graphically mapping organisational situations. Change in tailorable information models to match changing organisations can be represented by generic structures which themselves can be tailored, in this way features of systems tailorability become designed into tailorable information models. Tailorable models are conceived to be direct maps of changing organisations for living information systems designs, consequently, systems tailorability would be provided in actual living information systems through tailorable information models.

Tailorable models can be of individuals, groups, or functions in organisations. The aim is to discover structural links between organisational tasks and associated information and the variations in information needs that occur in these units. These links are distinct from notions of data becoming information. A structural link in tailorable information modelling may be thought of as an organisational task, or other aspect of organisational work, which connects an organisational employee with necessary information to complete that task successfully, efficiently, and effectively. In this sense, tailorable information modelling is re-establishing the primacy of organisational task analysis which, as Friedman and Cornford (1989) observe was displaced by structured methodologies emphasising stages of systems development. The next section uses these ideas on tailorable information modelling to propose a computer tool for tailorable information modelling.



### 3. The Proposed Prototypical Hyper-Tmodeller

This sub-section details the initial thinking supporting the concept of a dynamic computer tool, Hyper-Tmodeller, which is able to capture changing and tailorable information. Hyper-Tmodeller is proposed as a tailorable information systems analysis tool.

Business policies are actually programmed into traditional information systems, and when policies change, as they do quite frequently, traditional information systems are unable to cope with the changes. In Hyper-Tmodeller, such policies would be identified and made tailorable. Users' work environments are made complex by the fact that they have to communicate with colleagues. The development of systems tailorability has to consider this vital human aspect of information systems, which was termed ontological exchanges of information in Section 6.4.2. Hyper-Tmodeller enables interactive modelling by allowing various potential users (various managers, work groups, other employees) to individually model their perspective of their work environment. These disparate models are amalgamated by Hyper-Tmodeller to provide an organisational view of the proposed tailorable information system.

The kind of modelling supported by Hyper-Tmodeller may be described as end-user modelling (see Section 4 below for details). The aim is to create models or representations of organisational variability and to use these to understand and design tailorable systems architectures. Hyper-Tmodeller allows modelling by the eventual users of proposed information systems, who can decide what areas of information systems can benefit from incorporation of deferred systems designing. The spiral of change model depicts that humans, information technology, and organisations continuously change and that in such an environment information needs change too. Hyper-Tmodeller is conceived to facilitate systems development in such a changing development environment. The aim is to enable both potential users and developers to model a potential application area flexibly. By allowing users to make systems design decisions, Hyper-Tmodeller improves the process of learning and understanding regarding the information system to be developed.

Hyper-Tmodeller may be used in several ways. One, the actual modelling may be done by potential users of information systems. Two, the modelling may be done by systems analysts who make models of users in their organisational environment, where all things are dynamic or likely to change in the longer term, and give these models to users to validate. Users may

validate systems analysts' models by adding, deleting, or changing them. Three, both users and systems analysts could do the modelling together, either starting from scratch or working from an initial model provided by systems analysts or users.

In all case, a systems development dialogue is initiated between potential users of information systems and developers, but the difference being that potential users become active designers. The use of Hyper-Tmodeller results in visible information systems models which can be discussed. The use of visual reasoning and thinking in Hyper-Tmodeller means that graphical representations of dynamic information environments can be enabled which increase understanding. The use of Hyper-Tmodeller provides systems information, in terms of drawings, graphs, comments, and documentation to systems analysts, to investigate further an application area. Potential users of information systems may be unfamiliar with information technology, so Hyper-Tmodeller provides a transparent medium for them to explore proposed information systems. This type of visual exploration uses simple structures, diagrams, icons, and other things familiar to users or easy to learn. The modelling results in an objectification of living information systems by depicting actual organisational objects, in terms of humans, activities, information, flows of information, relationships and so on.

The purpose of Hyper-Tmodeller is to inform the design and validation of systems tailorability in information systems, and to use these to understand and conceptualise tailorable information architectures. The aim is to enable user of information systems to make graphical and textual representations of the organisational structure of their business activity. The reason being that users may have better cognitive models and better understanding of their roles in changing organisations and a better understanding of the information they require to complete their organisational roles. By allowing users to model their information environment on Hyper-Tmodeller, to draw or describe their organisational individual or group activities, Hyper-Tmodeller becomes a repository of information for the tailorable systems being designed. This information may be used by systems analysts to generate discussions. The discussions may lead to users or systems analysts re-modelling aspects of the original model, all of which could be captured by a background program (see Section 5 for an outline of Hyper-Tmodeller's modules).

The use of Hyper-Tmodeller has several benefits for users and information systems developers. One, the use of Hyper-Tmodeller enables users themselves to learn what they are required to do in organisations and what tailorable information they require. This type of



tailoring tool is necessary because, as Paul (1993) asserts users cannot know at the outset of systems development what to specify for design purposes. Two, the use of Hyper-Tmodeller by users leads to an understanding of what information they would like to tailor in systems. Three, Hyper-Tmodeller enables developers to understand better what is required from proposed systems and to cope with changing requirements.

Users learn about their own work environments while modelling, understanding relevant organisational processes and issues. In this sense, Hyper-Tmodeller provides a learning environment, and allows users to explore their working environment, through graphical interfaces. Modelling through the highly graphical interface of Hyper-Tmodeller enables users to externalise and objectify their work environment and gain a deeper understanding of their information needs and business practice in terms of systems development. Through this understanding users of information systems should be better able to communicate what is involved in their work, what information they use, how they get that information, and who their work colleagues are. By using Hyper-Tmodeller users become part of the development and actual designers of living information system, which brings about greater understanding of systems tailorability needs for both systems analysts and users of information systems (see Section 4 for a discussion on regarding users as systems modellers).

The use of Hyper-Tmodeller would result in drawings, graphs, text comments, and documentation, supplied by user-modellers to systems analysts to investigate further an application area (see Section 5 for details of Hyper-Tmodeller's modules). The result would be a visible and subsequently tailorable information model, which may be used to base discussions around and exchange ideas of required systems tailorability. In effect tailorable information modelling is a simulation of potential living information systems (see for example, Gardner et al., 1996). The use of Hyper-Tmodeller may be regarded as a simulation of the information system to be developed. The aim of the simulation being to provide a common and shared understanding to the stakeholders in their multiple roles in the system development. The purpose of the simulation being to provide a platform for everyone involved in the modelling process, in their multiple roles, to discuss the information issues involved, while simultaneously working towards an actual information system development.

## 4. End-User Modelling

The discussion on the spiral of change model and Hyper-Tmodeller engenders the view that potential users can be regarded as systems modellers. This type of systems modelling by users of information systems is here termed end-user modelling, and is discussed in this section.

Paul's (1993) assertion that users cannot know what their present information requirements are or what they will be in the future, requires living information systems developers to aid users to learn of their organisational environment, but in particular to learn of their organisational roles and associated information required to complete those tasks. The purpose of Hyper-Tmodeller is to enable users to explore their information needs. The spiral of change model depicts that user's work environments are continuously changing, therefore there is a need to understand the use of tailorable information in systems. Modelling information systems on the basis of Hyper-Tmodeller does not assume that users know what they require in terms of information, rather such modelling enables them to play with iconic representations of aspects of their work and its informational environment and so produce a picture of what is currently happening in the organisation both in terms of actual work and its associated information. Any change in the work itself or its environment may be easily remodelled because of the dynamic feature of Hyper-Tmodeller. In this sense, Hyper-Tmodeller provides a living design medium to enable users to explore their information environment. Such a medium needs to be flexible and so hypermedia technology is considered suitable because of its ability to form links dynamically (see Appendix I for an outline on implementing Hyper-Tmodeller).

The aim of this kind of end-user modelling is to improve communications between users and systems analysts, which is poor in existing systems development using the life cycle model discussed in Section 2.2. Users and systems analysts learn about changing organisational work and its environment by understanding organisational policies, processes, and procedures. This communication is facilitated by visual reasoning through the visual representations of the organisational information environment provided in Hyper-Tmodeller. The end-user models themselves may then be used as strategies for proceeding with systems development.



The use of Hyper-Tmodeller by users is not supposed to produce an *agreed* tailorable information system model. It is envisaged that its use by multiple users would actually produce disparate views or multiple (personally tailored) information systems, and that these views would be accommodated in a tailorable systems architecture of the kind proposed by Stamoulis et al., (1996).

Some essential features of an information systems model derived with the use of Hyper-Tmodeller need to be stated. Such models are true in the sense that they resemble the form of tailorable information systems but not the content. The content aspects, like exact system specifications in systems development methodologies, would be deferred and be designed to be tailorable by users. In a sense, the designed tailorable information systems would have the same structure as the organisation, but no pre-specified, fixed procedures. These would be determined by users in actual organisational situations using deferred systems designing.

## 5. Hyper-Tmodeller's Modules

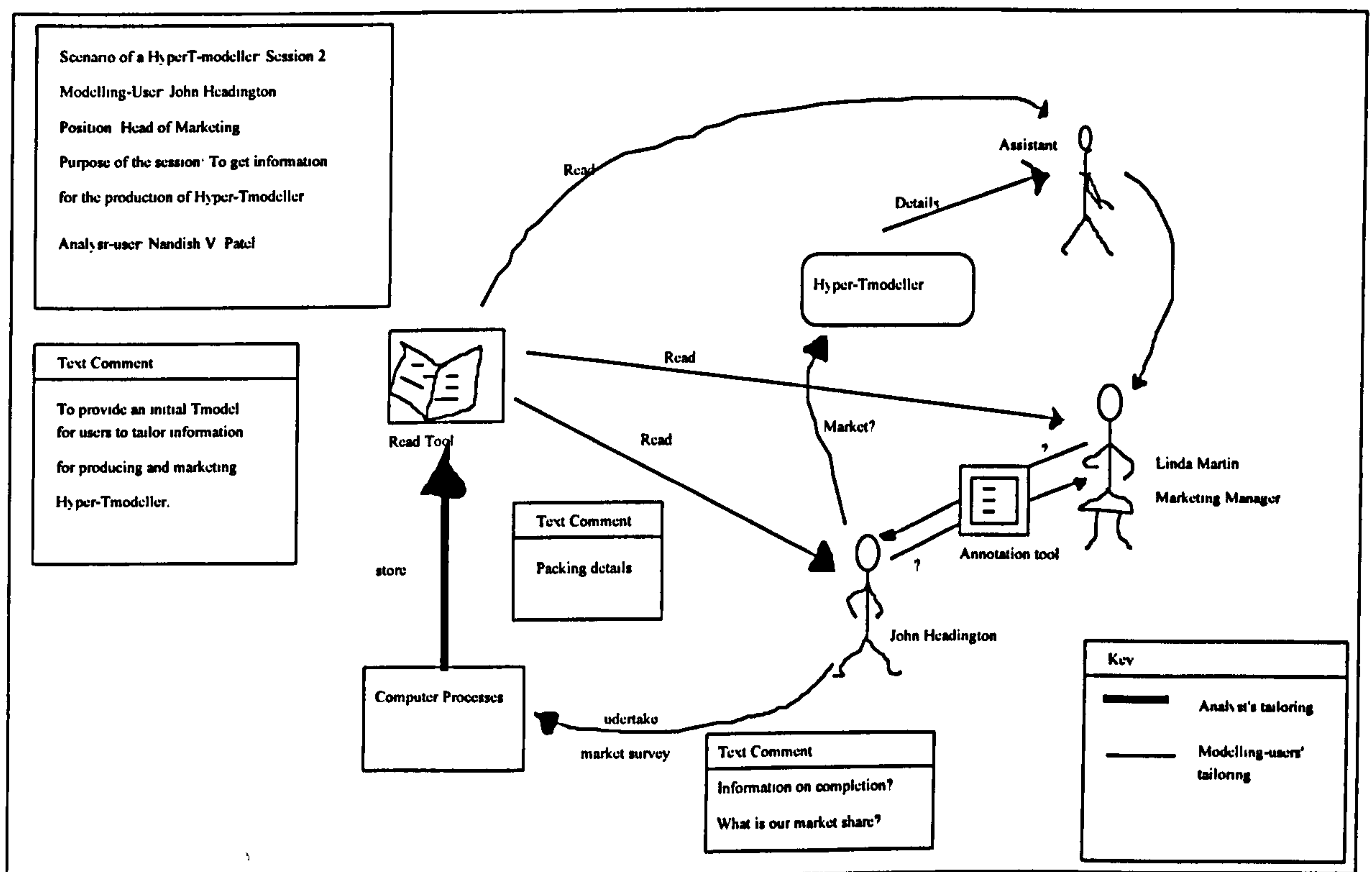
In this subsection a tentative structure for Hyper-Tmodeller is detailed. This structure incorporates aspects of the case data which led to the generalisation of systems tailorability through deferred systems designing. In determining a structure of the modules for Hyper-Tmodeller the kind of organisational change observed in the case organisations during systems development and usage has been considered, and the aim of thinking of Hyper-Tmodeller is to allow information systems to be modelled in such dynamic environments. The proposed prototypical Hyper-Tmodeller may be used simultaneously by users and systems analysts, and within each user type many such users can simultaneously use it. Each user produces a particular view of their working environment, and all these different views of tailorable information would be amalgamated to provide an overall view. A modular design for Hyper-Tmodeller was thought efficient to ensure its development, and each module functions to perform a separate aspect of tailorable information modelling. These modules are now briefly described.

There are four modules envisaged in Hyper-Tmodeller. These are: Originator-Creator, Discoverer-Designer, Logographer, and Tailorable Information Systems Analyser modules. Together these modules permit potential users to represent their organisational work in informational terms and as they themselves perceive it. In this sense, Hyper-Tmodeller facilitates ontological systems design, as discussed in Section 1.2. As Hyper-Tmodeller is

based on the spiral of change model it also facilitates modelling information systems in changing organisational environments.

## Originator-Creator

The originator-creator module functions to create an initial tailorable information model. The creation is done through discovery and learning and is akin to drawing ideas onto blank electronic paper, an example is shown in Figure I:1. The initial tailorable information model may be put together by systems analysts or users. If the initial model is provided by systems analysts than users may amend it, by adding or deleting or changing aspects, to reflect their perceptions of what they think is happening in their organisational tasks and the need for information. Alternatively, users could generate initial tailorable information models and systems analysts could use these to understand better users' needs.



**Figure I:1 Modelling-Users and Analyst-Users Joint Usage of Hyper-Tmodeller**



Discoverer-Designer

The discover-designer module is where actual tailoring is done, so all the required tailoring tools (Ttools) are provided here, as shown in Figure I:2. Once an initial tailorable information model has been created in the originator-creator module it is amended and refined in this discoverer-designer module. If a tailorable information model has been provided by systems analysts, users may add other observations to it or they may delete some aspects of it, by using various types of tailoring tools made available in the module or they could create their own tools and link-types, as shown in the bullet points below. If an initial tailorable information model is provided, users could be asked their opinions or comments regarding it, which they could add in text boxes using the text tool. The amendments to a tailorable information model by systems analysts or users are done according to their perceptions of the organisational situation being modelled, which facilitates the notion of ontological systems design.

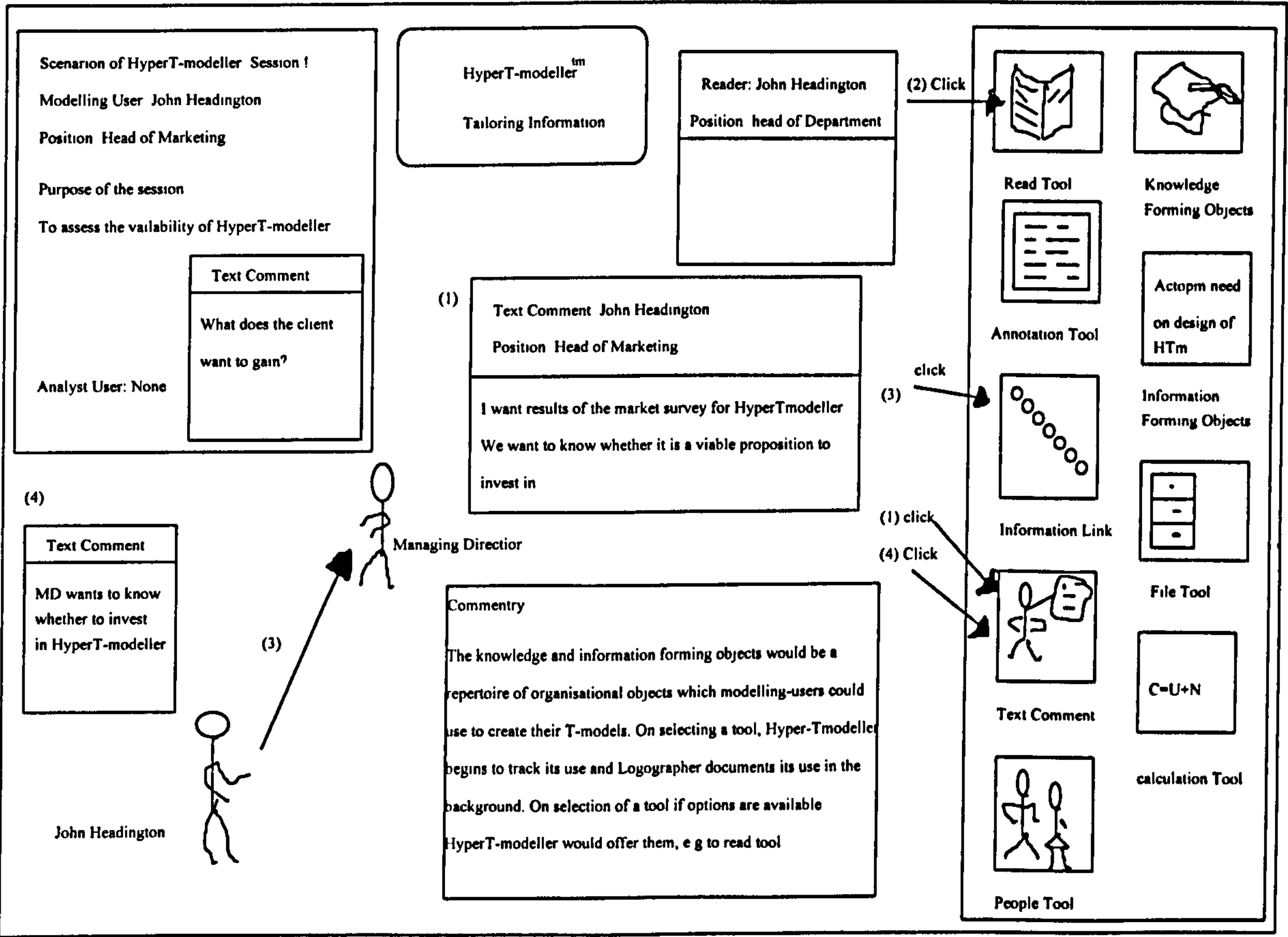


Figure I:2 A Tailoring Session in Hyper-Tmodeller

To enable modelling of changing organisations, Hyper-Tmodeller should contain appropriate functionality. Some feature might be:

- appropriate icons of business activity
- moving of icons (as in desktop interfaces)
- each tailoring activity connecting to a amalgamating program
- talk-links (I talk to X for such and such reason)
- need-links (I need X or Y information from him or her)
- browse links (I browse through this or that document for information)
- information links (I need this or that information, now and then, regularly)
- file-links (I file this or that, here or there)
- text comment facility
- diagramming facility (drawing palettes, either fixed or floating )
- graphing facility

Diagrams allow modelling-users to view, modify, and create pictures of the organisational settings they work in. Visual thinking is a useful provision in Hyper-Tmodeller, because modelling-users would be able to see pictorially their tailorable information system. Visual images also enable sharing ideas publicly to minimise misunderstanding.

Given the spiral of change model of tailorable information systems, Hyper-Tmodeller contains functionality to model organisational settings dynamically, thereby catering for organisational change during systems development and usage. Amongst Hyper-Tmodeller's features are appropriate icons for creating and tailoring information-links; for instance, "I-need" link-types for information that users need. Associated with this link-type is a "frequency-link" for stipulating the temporal occurrence of the need.

Another feature is the "talk" link-type. As living information systems are considered to be quintessentially human processes or ontological exchanges, and because talk is an important communicative aspect of these human processes, the talk link-type is essential to modelling living information systems. The human variable of the general spiral of change model is undoubtedly complex, and aspects like talk are features of that multifarious complexity. Talk and other living aspects, such as business meetings, have to be facilitated in any modelling of living information systems.



The link-types in Hyper-Tmodeller are the structural business links referred to in Section 6.3 on the spiral of change model. At present four types of structural links are envisaged which modelling-users can use to create tailorable information models, covering business policies and issues. Based on the case data presented in Table 5:2 in Section 5.4.2, four types of structural business links which recognise the need for tailorable information can be modelled in Hyper-Tmodeller.

- **Procedural links.** Often the need for information is subject to the types of business procedures that users of information systems are involved in. As organisational procedures change the need for associated information is likely to change too. Modelling-users can use procedural links which model users' organisation procedures associated with their organisational tasks and responsibilities.
  - **Process links.** Various processes are involved in organisational work, and as these change the associated information is likely to change too. The process involved in performing organisational tasks are modelled by using "process links".
  - **Causal links.** Organisational events and associated information are connected in causal relationships. As one event changes its effect on another means that the need for information changes. Causal links are used to model events that are causally related.
- Policy links.** Policies are a very important defining feature of business organisations, and these are linked to organisational procedures and tasks. (Business Policies are actually programmed as fixed algorithms in traditional information systems). As organisational policies change, their associated information changes too. Policy links are used to model policy invoked to do particular organisational tasks.

Other functionality in the discoverer-designer module covers text comments, diagramming and graphing. Text in Hyper-Tmodeller is used in various ways. It is used to provide a comment facility to capture users' thoughts while they are designing, or users could make text comments to an initial tailorable information model created by systems analysts. Systems analysts themselves could provide text comments in initial tailorable information models. When modelling users may model something that is not technically feasible, with the use of intelligent agents, text comments would ask the modelling user or systems analysts to reconsider their designs or suggest alternatives. This facility is used in Hyper-Tmodeller to let modellers know the technical limitations or capabilities of information technology.

## **Logographer**

The logographer is the documentor module, documenting all the modelling actions in the Originator-Creator and Discoverer-Designer modules. The logographer also collects all the tailoring; all the links, moves, all the text comments, and drawings done by modelling-users. Documentation in living information systems development has to be dynamic (see for example Paul and Gardner, 1994). Given that there is organisational change any mechanism for creating systems documentation would have to be dynamic. This documentation is made available dynamically to systems analysts and users through hypertext, and to technical systems designers and programmers to translate users' ideas of the tailorable information they want.

## **Tailorable Information Systems Analyser**

The Tailorable Information Systems Analyser (TISA) module collects all designed material, configurations, junctures of tailoring, diagrams, and configures them into an amalgamated version which could be treated as a model of a tailorable systems architecture. TISA produces an amalgamation by providing documentation of all the tailoring done by modelling-users. It is possible to do the amalgamation around an object-oriented database structure to preserve the flexibility and required tailoring modelled.

The TISA amalgamation is a concurrent procedure, and available to modelling-users through tailorable windows. Alternatively, when many modelling-users are simultaneously using Hyper-Tmodeller, their individual views are made available to each other through shared windows or captured snap-shots in real-time of the modelling process. That way modelling-users can learn what other members of the organisation think they do in relation to each other, allowing modellers to base their tailorable information models around each others' perceptions of their organisational work.

## **6. Some Technical Details**

Hyper-Tmodeller requires a platform capable of manipulating various communicative digital media. This includes text, graphics, sound, and pictures or images. The software configuration should allow the creation, mixing and linking of text, creation of graphics and sound. The implemented Hyper-Tmodeller should be portable across most machines.



To facilitate the use of flexible text, graphics, sound and images hypermedia is a suitable software for designing Hyper-Tmodeller. Hypermedia is itself a very flexible software medium. The main reason for considering Hypermedia is its ability to create connections dynamically among objects. To facilitate the capture of changing user requirements it is necessary to enable dynamic linking of objects.

There are various hardware platforms that may be used to run Hyper-Tmodeller. Both micro-computer platforms such as Apple Macintosh and workstation platforms such as SUN's SPARC-stations using X-windows and OPEN WINDOWS window manager. However, to make Hyper-Tmodeller accessible to a wider user group the micro-computer platform is preferable because of the prevalence of micro-computers. The arrival of new micro-processors from Intel, such as the MMX technology, capable of manipulating various media on micro-computers make the proposition of Hyper-Tmodeller more feasible.

To capture actual living aspects of business activity, it may be necessary to raise Hyper-Tmodeller to multimedia level. To store actual pictures of work processes certain additional hardware would be needed. A video digitiser, a video camera, a tape player and an audio digitizer would be needed to capture pictures and sound. In addition appropriate software to capture audio and video would be needed.

## **7. Conclusions**

The proposed HyperT-modeller is based on the idea that a dynamic form of understanding information requirements is needed for changing organisations. There is a need to understand information requirements in terms of tailoring information to suit varying organisational situations. Hyper-Tmodeller is itself based on the spiral of change model which is a recognition of the changing environment in which information technology is used in organisations. The type of dynamic modelling of tailorable information envisaged in Hyper-Tmodeller is a recognition of the intertwining of changing information needs with systems development and usage.

# Appendix J:

## Glossary

## Glossary

This glossary explains some major concepts and terms in systems tailorability and living information systems used in the dissertation.

**Adaptation:** The notion that computer-based information systems should be designed to change along with the requirements of users.

**Deferred system's design decisions:** The principle of designing systems functionality which can be tailored in real-time by users. The notion that information systems should be *continuously* developed by users.

**Deferred Systems Design:** The notion that by deferring systems design to users of information systems, such systems can be kept relevant to users' needs for changing information arising from changing organisational conditions.

**End-User Modelling:** A form of living information systems investigation to inform systems tailorability design.

**Fixed Point Theorem of Information Systems Development:** A critique of methodologico-project frameworks, which states that they assume "There exists a point in time when everyone involved in the system knows what they want and agrees with everyone else."

**Hypermedia:** Computer software enabling the manipulation of graphics and text in nodal format.

**Hyper-Tmodeller:** A proposed software tool for further research based on the principles of deferred system's design decisions to enable end-user modelling of tailorable information needs.



**Informational Environment:** It is postulated that organisational employees have sources of information to enable them to make sense of their organisational roles. These sources and the actual information from them is termed users' informational environment.

**Interpretivism:** "Interpretive methods of research start from the position that our knowledge of reality, including the domain of human action, is a social construction by human actors and that this applies equally to researchers." (Walsham, 1993, p.5).

**Living Information Systems Thinking (LIST):** An emerging body of thinking which challenges "established concepts regarding information systems and their development - thus, as a primary aim, ... seek to develop new ways of thinking rather than offering 'solutions'." (LIST on the Internet: <http://www.brunel.ac.uk:8080/research/clsit/> )

**Living Information Systems:** The notion that computer-based information systems should be tailorable by users and developers alike.

**Methodologico-Project Frameworks:** The notion that computer-based information systems can only be developed using structured methods which are bound in business projects. Such methodologico-project frameworks are primarily based on the life cycle model for information systems development.

**Organisational Change:** This term encompasses the notion that organised human behaviour is subject to many factors of business change. In particular, organised tasks and responsibilities are affected by alterations in the organisation.

**Organisational Learning:** Assumes users cannot know what their organisational information needs from information systems are or will be, and therefore mechanisms need to be researched to aid them to learn what those needs might be.

**Organisational Variability:** The notion that, in the long term, all aspects of an organisation are dynamic and subject to change.



**Projects:** A business device which binds the use of a systems development methodology for information system development into a time frame requiring the use of project management techniques.

**Spiral of Change Model of Tailorable Information Systems:** The generalisation of the human, organisations, and information technology variables centred around change in organisations concerning information systems development and change.

**Stakeholders:** Organisational employees who have an interest in a computer-based information system.

**Systems Development Methodology:** A set of pre-defined systems analysis, systems design, and systems programming and testing activities leading to the development of computer-based information systems.

**Systems Functionality:** The expandable set of functional possibilities of a computer-based information system.

**Systems Tailorability:** The ability of users to change or expand information systems functionality to meet changing organisational conditions.

**Systems Usability:** The ability of users to use information systems to complete organisational responsibilities.

**Tailorable Information Modelling:** A tailorable form of living information systems investigation resulting in a model of systems tailorability.

**Tailorable Systems:** Computer systems that provide end-users with tailoring mechanisms to alter systems functioning.

**Tailoring Tools (Ttools):** Software mechanisms based on the principle of deferred system's design decisions for users to change systems functionality in real-time. Tailorable tools enable systems tailorability.

**Tailorisation:** The ability of users to tailor information systems in response to changes in the organisation.

**User Control:** The ability of users to direct the behaviour of information systems in accordance with organisational needs.

**User Interface:** The mechanism which allows users to implement systems tailorability in information systems

**Users:** Anyone who is not a systems professional and who makes use of computer-based information systems to do organisational work.