KNOWLEDGE MANAGEMENT: USING A KNOWLEDGE REQUIREMENTS FRAMEWORK TO ENHANCE UK HEALTH SECTOR SUPPLY CHAINS

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Abstract
The gaps of mismatch both knowledge and understanding of beneficiaries and solution providers at the initial stage of developing projects have led to the failures of many projects including supply chains (SC) and related information technology systems (ITS) projects (Lyytinen and Hirschheim, 1987) . The aims of this paper are first, to address theoretical framework by bridging the gaps of different types of knowledge. Second, to establishing business requirements and the flow of information in supply chains between beneficiaries and solution providers in the long and complicated supply chains of the UK's Health Sector. On the basis of brief introduction to knowledge, knowledge management and supply chain, the paper presents a practical framework that has been developed through critical and relevant literatures in the above three subject areas. Techniques and Tools stem from both management science and information systems were used to provide a possible solution for the problem in bridging the gaps of mismatch knowledge and understanding at the initial stage of identifying requirements in projects through knowledge sharing and transfer.

Keywords *Bridging the Gaps, Knowledge Requirements Framework, Knowledge Management, Knowledge Sharing, Effective communications, Supply Chain, Sociotechnical, Failures, Healthcare Sector.*

1 WHAT IS IT ABOUT?
There is a growing need to better understand the broad issues of "medical" procurement and management of the supply chains and their relationship to the user and procurement process. The aim of this paper is to explore issues surrounding medical procurement including information technology systems (ITS) and component-based development, as well as gaining insights into the theory and practice of supply chains management (SCM).

This paper seeks to establish the reasons for what can best be described as a disappointing track record with the development of new projects in the public and assessing the field research (Marble, 2003); and identifying the problem domain in the areas of knowledge management (KM), knowledge sharing (KS) and supply chains (SC) in the Health sector in the UK (Bali and Dawived, 2006). This paper addresses the issue of knowledge sharing process, and not in depth discussion on knowledge management's structure (Liebowitz, 2001; Liebowitz, 1999; Liebowitz, 1998; Liebowitz and Beckman, 1998). Therefore, from published literature and observing the project failure situation (Al-Karaghouli, 2006; Al-Karaghouli et al., 2005, 2004, 2003; Bocij et al., 2003; Burke 2003; Castka et al., 2001; Irani, 2002), a hypothesis put forward to establish the existing of gaps of knowledge and understanding during the crucial initial requirements stage of the system developments (Kotonya and Sommerville, 1998; Lin and Shao, 2000), an idea developed to research deeper this topic, and the causes behind it. The topics of project failures and initial requirements (Gubbins, 2001) are of interest to the researchers for many years. These topics were observed and are part of teaching and research areas of the authors. Also, our interest shared by other academics and practitioners within the BCS, Requirements Engineering Specialist Group (RESG) and the Sociotechnical Group.

2 LOOKING OUT AND OBJECTIVES

This practical paper provides a contribution on how to gather requirements from, first identifying medical business needs through to structuring the beneficiaries' requirements (user requirements document and the user acceptance "Test-drive" of the medical equipments). Participants (beneficiaries and providers) have to play the parts of stakeholders and requirements engineers in a system development project to work out what they want in terms of practical operational scenarios. In the UK National Health Service (NHS), the only way to ensure a quality medical product is to make sure it meets beneficiaries' original requirements (Lewis, 2000); consequently, there is increasing interest in the use of practical techniques for successfully translating business process and objectives into systems. The use of requirements and test plans is well understood, but the use of scenarios or use cases to obtain these is less familiar. There is a parallel need for a way of capturing requirements that is compatible with an "object view of the world".

Requirements and KM hold the key to this dilemma in the healthcare environment. KM especially places value on the tacit knowledge (sticky) that individuals (the diversity of KM applications in the healthcare sector, e.g. Doctors, Nurses, Paramedics and IT/IS personnel) hold within an institution and often makes use of IT to free up the collective wisdom of individuals (Intellectual Capitals -IC) within a health organisation. This paper will explore the nature of KM within contemporary healthcare institutions and associated organisations. It will provide academics and practitioners with an understanding of approaches to the critical nature and use of knowledge by investigating healthcare-based KM systems (Leonard and Sensiper, 1998; Lee, 2001). Designed to demystify the KS process and

demonstrate its applicability in healthcare, this paper offers contemporary and clinically-relevant lessons for future organisational implementations. While many KM literatures suffer from pitching theoretical issues at too technical a level, our approaches the topic from the more versatile 'twin' perspectives of both academia and practitioners.

Based on the researchers observations a hypothesis has been established in the view that the problem of project failures (especially information technology systems - ITS) might be caused by defect or non-functional requirements (Lakshminarayanan, 2007). The project features could be improved by the capture of functional requirements (smart requirements) is valid area of research. The basic hypothesis that Business Requirements are different from Technical Specifications (Kelly, 1999), i.e. they are not the same, is true. This relationship is shown in Figure 2, that the technical expertise by itself is not the answer. The human-machine relation is still not the answer especially when it comes to establishing the smart requirements of the proposed future system to a retail organisation. It is the sociotechnical approach that counts and not the technical approach by itself! To understand the contribution of system failures, requirements and diversity of knowledge in the NHS to the efficiency of future ITS, efforts were made to establish primary sources and find secondary sources that would help. Contacts were made via e-mail with appropriate well known authors and 'gurus' in these areas, and questionnaires followed up by phone calls were used to fill gaps in some of these. Secondary sources such as textbooks, journals and articles of professional publications such as Computing, Computer Weekly, IT Week, press releases and the Financial Times-IT surveys have also been searched and consulted.

The e-UK University system is another spectacular example of system failure in the public sector (Green, 2005), most of the failures in the public ITS projects can be avoided if more thinking and planning put in it (Oates, 2005; Spiegel, 2005). Those public failures coincided with well publicised private glitch at the HSBC bank that for several hours effected its Switch and Maestro debit cards and online banking (Computing, 2005).

The same is true in the private sector, for example, the Channel tunnel was budget at $7 billion (£4.6 billion), but it entered service in the second half of 1994 with nearly double the above figure ($13 billion-£6.7 billion). In 2003 it was still heavily burdened by $9.3 billion (£6.2 billion) on debt, supported by a mere $3.7 billion (£2.5 billion) equity (Levinson, 2001).

Rigby (2004a & 2004b) reported that Sainsbury has to write-off £140m against unsuccessful IT system and £120m with regard to ineffective supply chain equipment (Gattorna and Walters, 1996; Macalister, 2005). The main reason given to the £140 write-off supply chain system was "purely a financial matter" according to Sainsbury's IT director Maggie Miller (Knights, 2005d & 2005f; Knowledge Management, 2004; Fernie, 1995). This is despite the dominant market position enjoyed by the retail organisations and the vast investment they devoted to technological advancement over a long period of time (Foremski, 2004a & 2004b; Slack et al., 2004). Such reticence also offers significant opportunity

for new market entrants to challenge the traditional retail structure in the UK. Some cases of IS failures unheard off in the private sector due to many reasons including lose of face (Fielding, 2003), the private sector including the retail industry can learn so much from the ITS projects of the public sector (Parker, 2000; Timmins, 2004). Other factors, according to Glick (2004) the European business organisations alone wasted £4.05bn (€6bn) on poorly outsourcing contracts in 2003. The research study carried out by Gartner of which 80 per cent of the outsourcing deals are unsuccessful including in some cases catastrophic failures due to the cancellation of the service. Customer satisfaction with outsourcing fell from 81 per cent in 2001 to 50 per cent in 2003.

3 SETTING OUT: THE PROPOSED THEORETICAL FRAMEWORK TO BRIDGING THE KNOWLEDGE GAP

The main part of the research study focused upon the development of information systems in the NHS organisations and the significant issues of requirements elicitation and specifications. The implementation of such system in a NHS organisation is very complex, that led the authors to propose easy but effective and relevant pictorial techniques and tools.

For the purpose of this paper, we will refer to both the "solution providers" and the commercial broker as "supplier". The emphasis on the beneficiary's business knowledge and acquired the knowledge is very important. On the other hand, the supplier's technical knowledge is also important, but the knowledge the two groups posses are different. This will lead to mismatch of their understanding and interests, which in most cases contributes to the failure of projects. Glass (1998 & 2001) highlights the importance of learning from failures, and of the vital need of the suppliers to clearly understand the beneficiary's requirements. We take a slightly broader view in that we see the problem not only being that the suppliers often fail to understand the beneficiary's business and needs, but that the beneficiaries in turn often do not sufficiently appreciate the realities of project development's process, or what the project people are offering.

The following is based on understanding developed from the study and discussions with two of the participating organisations. One was well known high street retailer and the other was the retail arm of a larger financial institution both based in London. The theoretical framework to be used for the purposes of this research has been developed based on an extensive review of the literature. The proposed theoretical framework presented in figure 1 comprises three main people (actors, i.e. beneficiary, solution provider and broker) and attempts to relate them to various implementation stages as those identified in Figure2. The extended and proposed theoretical framework (figure 2) is represented by two main sets of environments, namely frameworks of knowledge management (KM) and supply chains (SC) implementations. Related issues are, knowledge gap, understanding gap, effective communication, share and transfer knowledge (gathering and implementing requirements – people issues). It is

suggested that there are explicit knowledge linkages between the main three people in the initial requirements stage.

Figure 1 clearly illustrates that within the Requirements Common Knowledge Environment (RCKE), there are different gaps, which needs bridging. There has been much talk of a 'gap' or 'gaps' between beneficiaries and suppliers and commercial brokers in procurements including ITS development, but no attempts have been made in the academic literature to critically address the gaps, the authors identified two elements to these gaps. It is suggested that there is a potential for a knowledge gap (KG) and an understanding gap (UG) to exist between the beneficiary and the supplier. The beneficiary's knowledge is mainly "business" knowledge with limited or non-techie knowledge, on the other hand the supplier's knowledge is "technical" knowledge with limited business knowledge. The gap between the beneficiary and the supplier developer can be bridged if we have more specific information about the customer. The KG is essentially the mismatch of knowledge that the customers typically has concerning IT capabilities and limitation. The hypothesis is illustrated in the diagram.

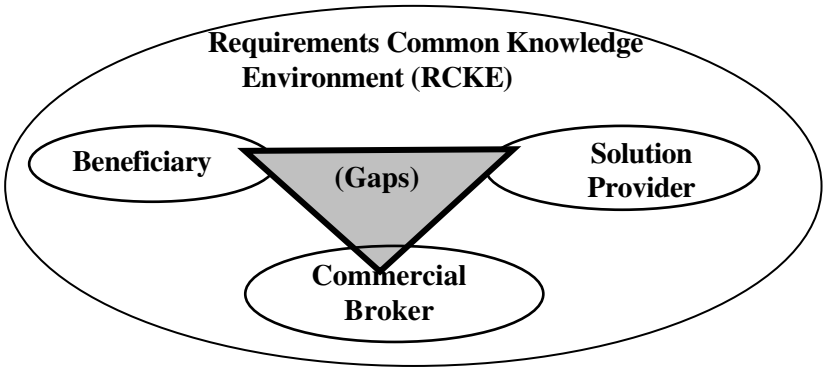

Figure 1. Bridging the Knowledge Gap (RCKE)

4 FINDING OUT: METHODOLOGY

The paper addresses two main themes, Business Requirements Engineering (BRE) including knowledge management (KM) and the Supply Chains (SC) in the NHS sector. The paper uses a realistic example project, to work through the required operational scenarios. The participants (beneficiaries and providers) worked as a group of stakeholders and involved in the project. From the scenarios, they have to write down the main requirements in a way that makes acceptance testing clear from the start (Collis and Hussy, 2003). The workshop uses and teach simple techniques based on "pictorial techniques and tools from both the management science and IT/IS areas" to identify exceptions and other scenarios, and structure these in a way that users can immediately understand.

• A top-level Scenario describing the overall approach to the problem (see Figure 2)

• Detailed Scenarios to solve each sub problem, including handling exceptions (see Figures 2, 3, 4, 5, & 6)

• The outline of the beneficiary's requirements and the user acceptance test Documents

Participants have learned how to:

• Identify the types of beneficiary for the system

• Find out from each type of beneficiary what scenarios they are involved in

• Make an effective document structure from the scenarios

• Locate misunderstanding, errors, exceptions, and missing scenarios

• Build beneficiary requirements from scenarios

• Construct and trace test cases from scenarios

An integral part of the paper will be a discussion on the key research issues from a beneficiary (user) perspective, drawn from the practical experience and theoretical underpinning shared by the researchers.

Business Requirements Engineering (BRE) is the branch of systems engineering concerned with the goals, desired properties and constraints of complex systems, ranging from embedded software systems and software-based products to large enterprise and socio-technical systems that involve software systems, organisations and people.

5 MAKING OUT: SUMMARY OF PRELIMINARY RESEARCH

The concepts and techniques suggested in this paper are based on a research study of business organisations in the United Kingdom and their use of ITS, undertaken by the authors. The research study was undertaken in the NHS sector that depends on large procurement and ITS projects, which typically suffers from the legacy of different developments of hardware and software being added to existing systems. The human influences and involvement in the development of ITS are difficult to measure in the conventional sense of productivity improvements, but the issue could be addressed by both quantitative and qualitative study of cases that interpret productivity in a boarder sense than is conventionally found. The main objective was identifying particular features that either inhibit or facilitate the success of the requirement identification process. The empirical data collected for this research comes from one case study conducted in a UK. Qualitative data collection methods (mainly semi-structured interviews) were utilised along with observations and collection of supporting documentation. The interviewees were beneficiaries (senior managers, middle managers) and suppliers (devices & ITS senior managers and middle managers) from the different departments within the organisations under study. The empirical data confirmed the validity of the proposed framework and enabled insight to be gained into other issues of particular importance to the initial requirements stage.

It is not the purpose of this paper to discuss the full findings from this study and how they relate to the overall performance of project development. However, we will summarise the findings that relate directly to the requirement identification process, which is the subject of this paper. It can be stated that in general, the replies received from the business (beneficiaries) side and the techie (suppliers &

commercial brokers) side were significantly different, with the beneficiaries and the suppliers in many procurement organisations (70% of cases) having very different views concerning requirements and the requirements determination process. Of the rest, 27% generally showed varying degrees of disagreement. Only 3% of the cases revealed a situation of general agreement. What makes these results significant is the fact that at the time of the survey, 60% of these organisations were either undertaking or about to get involved in some kind of project development. Analysis of the gathered data (particularly from the interviews) revealed wide gaps in the customers (beneficiaries) side knowledge, both in the technology and the process, concerning how their requirements could be realized into finished products. 50% of the interviewed managers were categorised as generally having very poor or poor knowledge, 45% as fair, and only 5% as good or very good. On the provider side, the findings were even more dramatic when it came to knowledge of specific (and even general) retail business operations. 65% were categorized as having very poor or poor knowledge, 30% as fair and only 5% as good. No one was categorized as very good. Further, there were clear instances of 'accusations' made between the parties indicating the degree of misunderstanding between customers and developer, and vice versa. Clearly, there were significant indications in the findings supporting the hypothesis that there is a knowledge gap (KG) and an understanding gap (UG) between the two parties.

5.1 Using Scenarios to Organise Requirements Effectively

Figure 2, represents a powerful conceptual module, using the conceptual model of the knowledge management and supply chain in UK Health sector (Figure 2), which is based on the research study that gaps in knowledge and understanding will lead to certain types of project failures (Al-Karaghouli, 2006; Holden, 2002). The discussions and dialogues between the different stakeholders represented in figure 2 are not standard. The dialogues are action research which are the outcome of active participants (different people, i.e. beneficiaries and providers) to establishing smart requirements. These people are not affected by market forces (Levitt, 1983), but by the needs of local individuals and their individual (personal) needs.

In such discussions and dialogues there are "Business Sphere and Technology Sphere" due to the different stockholders and to bring up new knowledge (explicit). This new knowledge is not designed or an outcome of standard methodologies and theories, but it evolves through the dialogue that takes place between the two spheres, business and technology (Nielson and Svensson, 2006). Action research has changed from experimental (classic) to dialogical innovation (Ernst, 2002; Gollan, 2005). Action research is a process which includes resistance and a change of perspective of both business and technology individuals who are involve in determining smart requirements. It can be seen that there are common identified areas which contribute to some supply chains projects to achieve and that it is people who are the main factor, so it is necessary that the working environment is right and that people are managed in a way that '*brings out their best*' (Mintzberg, 2004, p12), thus improving morale and

commitment, while encouraging them to manage the organisation's processes in a way that will increase the level of performance and achievement.

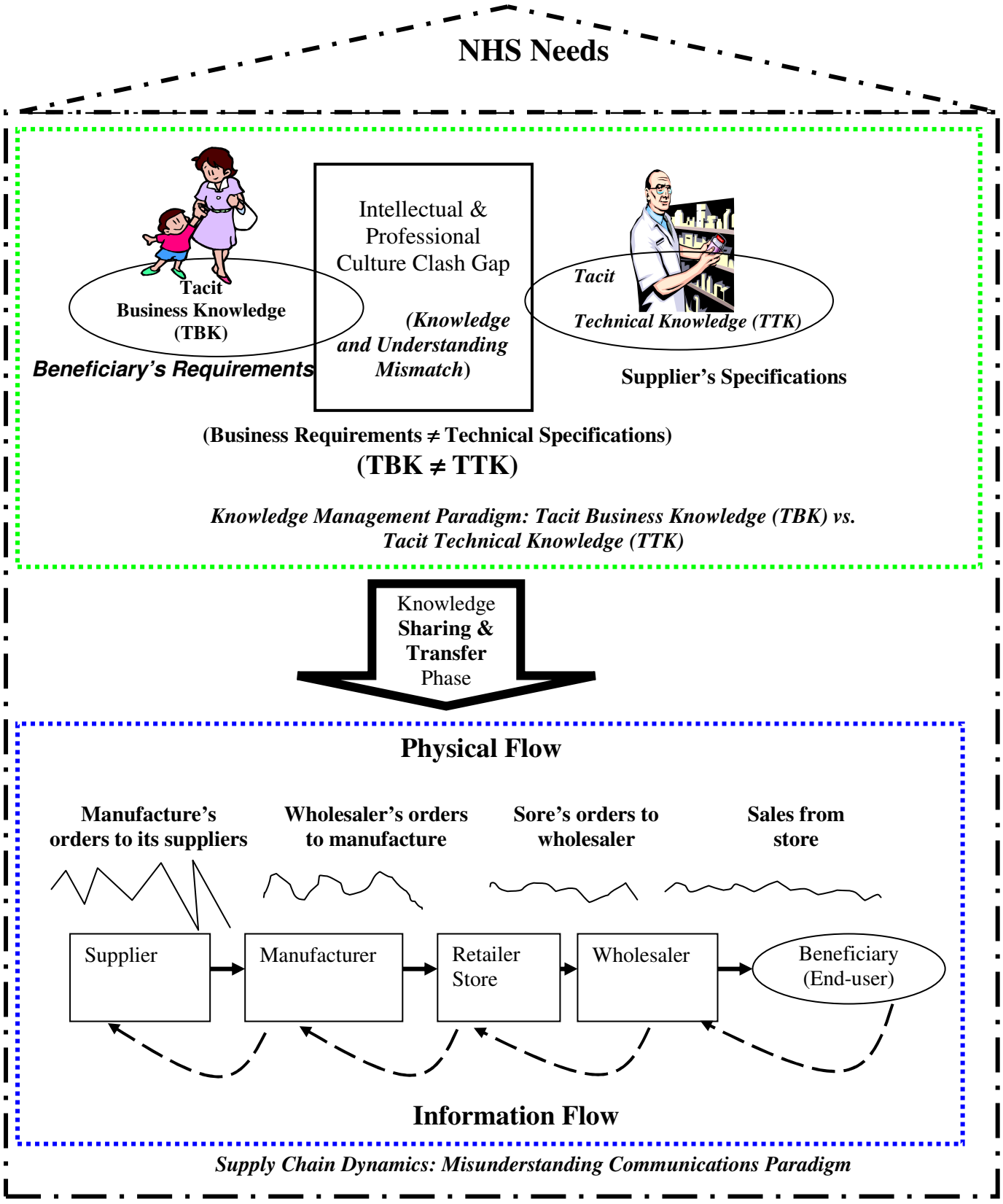

Figure 2. Conceptual Module of the Relationship between Knowledge Management and Supply Chains in the NHS

5.2 The Culture Gap: Communications Is the Key

The view of two cultures, that of providers and the beneficiaries, is in evidence in many organisations. The culture of suppliers is typically technically oriented and is based on an understanding of technical issues (Kavanagh, 1998; Price Waterhouse, 1991, 1992). In project development this is reflected in a focus on issues such as the functionality of the device/system, its performance, the response rate, the type of programming language that should be used, etc. (Sturt, 2000; Flood, 2000). On the other hand, the business culture and focus is rather different and is more concerned with business issues and the system as support for business and management processes. These two cultures have been identified by many, for example Nuseibeh (1996), Sommerville (1992), Cavell (1999), Griffin (1998), and Sabbagh (1999). However, we go beyond this and identify two elements to the gap.

We suggest that there is frequently a *knowledge gap (KG)* and an *understanding gap (UG)* that exists between the beneficiary and the supplier. We believe that this gap is a result of the different backgrounds, experiences and working environments of the groups with both sides talking a "somewhat different language". Further we identify an understanding gap, which is to some extent a result of the knowledge gap, but is a whole set of differing understandings, meanings, assumptions and values, see Figures 2 and 3.

In terms of ITS suppliers, the business culture typically views the ITS department as a cost centre rather than an investment and contributor to the success of the organisation. As a result beneficiaries and providers have different expectations of each other and particularly of any system to be developed which is not just about following rules and procedures but must take into account these differing cultures (Howard, 1999).

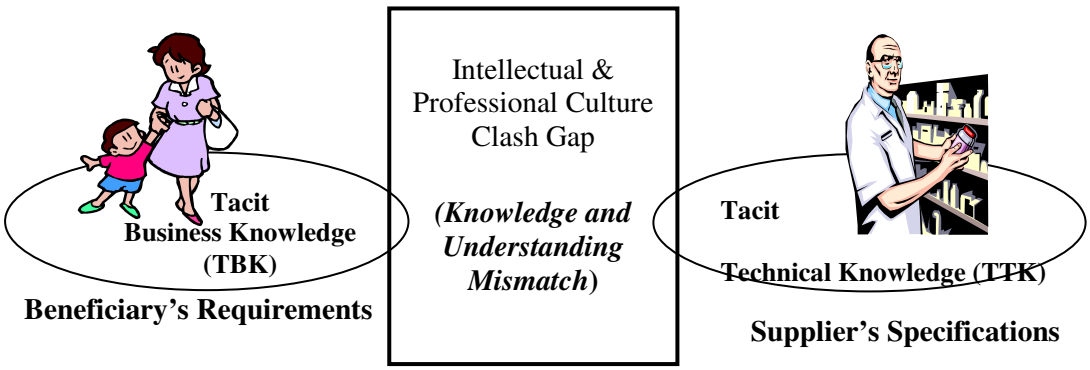

Figure 3. A Culture Clash: Tacit Business Knowledge (TBK) vs. Tacit Technical Knowledge (TTK)

It is argued that the view of two cultures is in evidence in most organisations although it is true that some organisations have made efforts to overcome these different and conflicting cultures, usually by trying to mix the participants in 'seamless' teams and by co-location of the two groups when developing projects (Figure 3). However, although this can help the differences are still deep-seated and not easily resolved. For the purposes of this paper we shall assume that there are two separate groups of people involved. We believe that the determination of clear and adequate understanding of the requirements is a socio-technical process and that human communications and interaction are important ingredients in determining effective requirements. Intensive and sustained communications between the beneficiary and the solution provider lead to a clearer understanding of the requirements and are likely to result in a better and more useable system for the beneficiary (Lipnack, 1997). It is also likely to improve the situation if the requirements are more right first time, i.e. before any development is undertaken (Lee et al., 1995; Lee et al., 2000). This is not to say that we believe that requirements are always 'out there' waiting to be discovered. Often the notion of a full set of requirements existing in the minds of the customers is just not true. Frequently the customer has to learn and evolve their understanding of the requirements as part of the elicitation process, particularly in complex and new application areas.

High and unrealistic expectations of a project prior to development are well known problems and can contribute to disenchantment with the system when it is implemented. Beneficiaries can get too enthusiastic about technology and hopelessly over-estimate the technology's capacity to change their world (Mirl, 1998). If both groups initially agreed practical requirements and understood what the system is going to do when it is built, then their expectation will match the system performance. On the other hand, if both groups fail to discuss and evolve the requirements then this kind of mismatch of expectations is a possibility.

6 OUTCOMES: FINDINGS

6.1 The Sociotechnical Factor

Other researchers believe that professional culture issues (social and human factors) contribute majority in the big proportion of failures. Walsham (1992) argues that the high degree of failures in organisations is due to an over-reliance on management science techniques, which are inadequate on their own. This lead to the mix techniques used in this research study. Walsham also asserts that these techniques emphasise content at the expense of culture and politics. His opinion has been seconded by Lorsch (1986) who suggested that culture affects many aspects of the organisation. It influences the decision to be made regarding the organisation's relationship with its environment and its strategy and

the way mangers believe within the organisation. Likewise, organisational culture dictates the formal and informal channels of communication (Marchand and Stanford, 1995).

We argue that a sociotechnical approach, wherein a match between human (social) and technical factors is sought, is fundamental to the design and implementation of organisational change. This research study agrees with Mackenzie and Wajcman's (1985) study of the social influences upon ITS, the authors claimed that a new technology is created in the context of existing projects, and only appears radical with benefit of a historical perspective which filters out less successful alternatives. They criticised the idea that an ITS can be "invented" as a single inspiration in isolation of the influence of existing practices by noting that historical analysis allows the benefit of hindsight to trace a particular invention back to a single inspirational source. In reality, competing projects may have overlapped and been developed concurrently, but only the story of the "winner" survived the passage of time. In support of this claim, the authors cited Ogburn and Thomas (1922), who argued that technological developments were an inevitable result of the synergy created as innovators merged technological capability and contemporary artefacts within new context. They concluded that the major constituent of new ITS was the existing process, often applied in new situations and modified in an incremental fashion over time by many ITS developers working independently. A number of authors have supported this theory, notably Hughes' (1979) analysis of the development of electricity. By regarding both technological capability and human influence as central to innovation process, this viewpoint discredits more deterministic account of the impact of technology which was reviewed above.

6.2 Knowledge Gap Identification: Use of Set Diagrams

The technique that we shall illustrate is the use of the Set Diagram (or Venn diagram) and how it can be applied to the understanding of customer requirements and the minimisation of the gap Set diagrams have been used successfully for some time in management science (Anderson et al. 1995), as well as, of course, in their traditional areas of logic and maths. It may seem strange that a mathematical technique is being used in requirements gathering, but they are used mainly for their graphical representation to drive the requirements understanding process. They have been found to be highly effective as a graphical or pictorial technique for illustrating gaps in understanding that exist at the requirements stage. The diagrams essentially illustrate the degree of overlap between the two parties in their understanding of requirements. They are extremely easy to understand and can be manipulated by both sides to make particular points. For example, by re-negotiating the overlaps it is easy to indicate how good or bad current agreements are on particular matters. Although the set diagram has quantitative antecedents it is used here in the context of a socio-technical approach and applied as a driver of a socio-technical process.

6.3 The Use of Set Diagrams

The example used below is a representative sample taken from real life testing of the technique that was undertaken in two of the participating organisations. One was well known business organisations (NHS beneficiary) and the other was the retail arm of supplier, both based in London. The example relates to the perceived need to 'enter the internet world' and to have a web based information and sales channel for the companies existing products. Beyond this the case is simplified and does not reflect the detail of the organisations nor their actual requirements. It is a purely illustrative example of the situation and the processes.

The two circles of the Set diagram in Figure 4 represent different areas of knowledge and understanding; one represents the understanding of the suppliers, and the other the beneficiary. The matching or common understanding of the requirement is where the two circles overlap (BRSS).

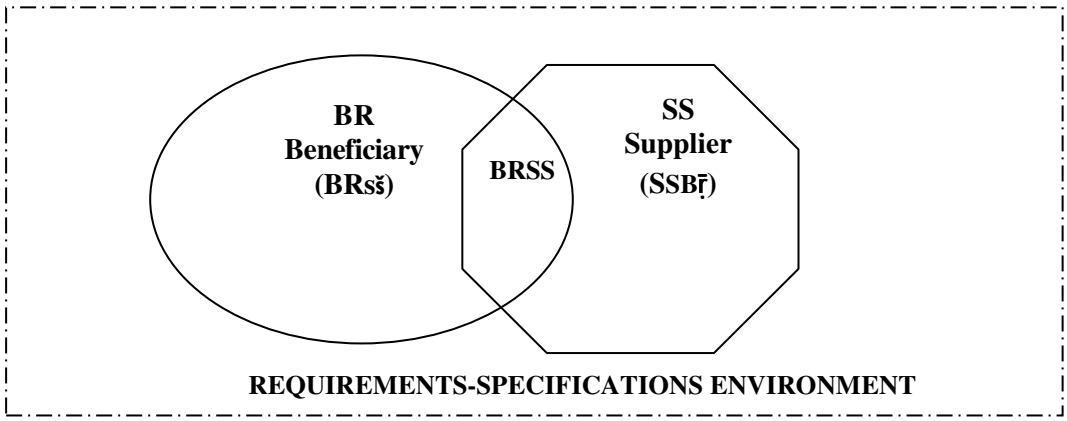

Figure 4. Initial Overlapping of Beneficiary Requirements and Supplier Specifications

The above diagram clearly illustrates that in this case the customer and the developer have different perceptions and understandings of what the system is to deliver and what it will be like as the area of overlap is very small.

6.3.1 Beneficiary Requirements Set

In the Set diagram of Figure 4 business requirements (BR) denotes the set of all possible beneficiary requirements space that contains the individual (fragments) business requirement as sub-sets viewed by the customer.

BR contains a set of individual requirements, e.g. we would like to offer an e-commerce facility for our external customers (BR1), the image required for this business is one of trust (BR2), the new system must be operational by the end of the year (BR3), the system must be easy for internal and external customers to use (BR4), the system must provide quick response for customers (BR5), the system must be totally secure (BR6), the system must provide enough information for beneficiaries so that they do not put an additional burden on the existing help line (BR7), a maximum of 8 people (from the business side) will be available to support the development of the new system (BR8), the new system needs to fit

very closely with the existing business processes (BR9), and the system should attract additional customers, not just be a tailored farcicalities for existing customers (BR10).

6.3.2 Supplier Specifications Set

Supplier specifications (SS) denotes the set of all possible supplier specifications space that contains the individual (fragments) suggested specification design as sub-sets viewed by the developer.

SS contains a set of individual specification elements, e.g. an electronic retail channel is required (SS1), the development of the project is a major new undertaking for the ITS department (SS2), the time scale is extremely tight (SS3), the skill required are in short supply(S4), the development environment will be Unix (SS5), a mirror environment will be required (S6), absolute security is impossible (SS7), the development scanning images (SS8), response times depend on factors outside of our control (SS9), and the system can utilise the existing processing systems for the underlying functions which will shortcut the development time (SS10).

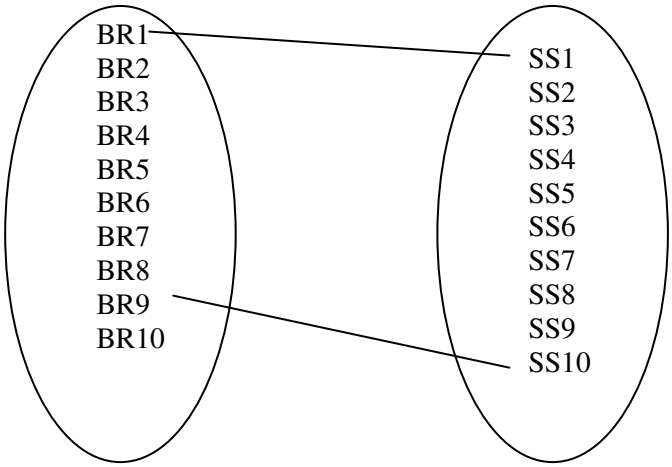

Figure 5. First Stage Mapping Diagram

In this case the common understanding (overlap) is relatively small. The common factors are that they are both talking about an internet channel and that the existing processes will be utilised which will obviously make them a close fit to the new system. The non-overlapping sector is represented by **BRSS**. For example, the customers want the system to be 'totally secure' whereas the developers are indicating that they believe that total security is difficult to achieve, and are talking about a mirror system. This clearly shows an area of mismatch or misunderstanding (possibly on both sides) and in Set Diagram terms there is no mapping between the two sets in terms of security. Another example of a mismatch is that the customers want the system to attract new customers but this does not seem to have been taken on board in any way by the developers. Maybe it is difficult for them to do but the fact that they have ignored this is likely to lead to unfulfilled expectations at the very least. Overall there is obviously a far greater degree of mismatch than match of requirements (or at this stage understanding and perceptions), between the two parties.

The diagram is obviously only illustrative but nevertheless powerful in its ability to convey the size of the gap. In real use, the diagrams would have the specific elements fully defined and possibly written on the diagram in the appropriate places. However this makes the diagrams rather messy and unwieldy so it has not been included here. When the elements of the gap are discussed in detail and agreements thrashed out, the participants can re-draw the diagrams with the overlap becoming larger as understanding develops. The point is that the diagram clearly represents the current level of agreed areas of understanding and misunderstanding between the two sides at any stage. Figure 5 shows the actual mapping between the two sets instances. There are some potential matches, for example, both parties have defined something relating to the implementation date. However, the Beneficiary has specified a date but this is not agreed by the Solution Providers, they simply state that the deadline is tight and this certainly does not indicate a meeting of minds as to the likely implementation date. In fact were this to remain the state of affairs the project would probably be of high risk of not meeting the deadline simply because the two sides have not really come to a serious agreement on the issue. Having this highlighted early on is obviously beneficial. Similarly, there is the issue of response rates, which both sides have mentioned, but at this stage there is little common ground with different assumptions being made. Clearly a mapping does not really exist and more dialogue and negotiation is required. On the other hand the Customer requirement concerning the image of trust is not really even on the agenda of the developers, as there is really no corresponding element in their set. Thus the developers do not seem to have taken any of the implications of these requirements on board. Equally certain specification statements do not reflect any immediately identifiable requirement of the customer, again indicating a need for further clarification and discussion.

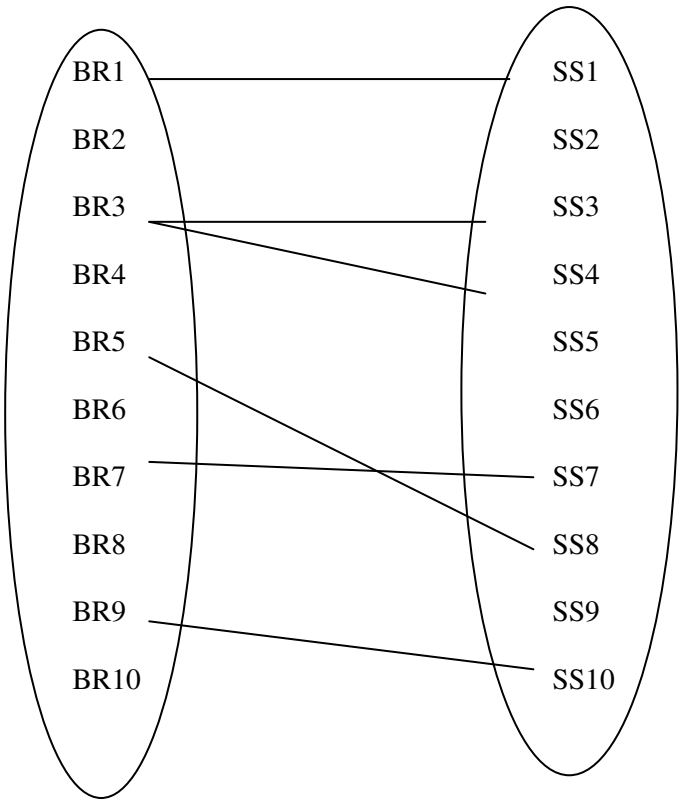

Figure 6: Later Stage Mapping Diagram

Further stages or iterations would now be entered and attempts to resolve the mismatches made. After several iterations (depending on complexity of situation) there should be a greater degree of overlap, and in the example case there was a greater convergence of the requirements and specification achieved. The issue of time scale has been resolved as a result of it having been highlighted in the first stage. The customer has understood some of the limitations and concerns of the developers and delayed the deadline by two months. Thus as a result of discussion, negotiation and improved understanding on both sides the content of the requirement changed. On the developer side the issue of resources had been addressed, project management addressed, and it was agreed to buy in new skills. The sides were now in general agreement over time scales and response rates were agreed. The customer agreed to match competitor systems and the developers agreed to identify and benchmark them. Similarly the assumptions concerning security were discussed and agreed. The customer was persuaded that total security was unrealistic but agreed to specific measures that reflected best practice in the sector and the channel.

The diagrams in figures 5 and 6 show the agreed mappings of a later stage in the cycle. The diagrams helped the parties to focus on those instances that were not mapped in each set. These are then reviewed, discussed and negotiated as to what they mean, why they are there, and the implications for either side. Ideally a third stage or iteration of discussions is undertaken with the objective of mapping all the elements in each set.

In the above case there are still a number of instances in both sets that have not been agreed and mapped. For example the issue of 'the image of trust' is still not resolved. It might be that there is nothing on the specification side that can be done to address this. If this is the case then this should be recorded and the requirement instance removed from the diagram. Everybody would now be clear that this is not something that the new system can directly deliver and there are no false expectations. Equally there are some specification instances that are not mapped, for example the one concerning development in Java and C++. If there is no requirement that maps directly to this then again it should be removed. This would make it clear that there is no requirement that leads to the use of Java and C++, that some other languages could alternately be used and that this is purely a technical decision. The customer should be made aware of the benefits and limitations of using these development languages. In other words dialogue and negotiation ensue. Of course it might be that the use of Java and C++ is in fact mapped directly to some requirement. Either way the developers have to be very specific about the reasons for doing things in a particular way and explain them to the customer so that they understand

the implications and vice versa. As part of the process the agreements are documented along with the reasoning behind the decisions that forms part of the knowledge management exercise.

Compromise and trade-offs are inherent in resolving and illuminating differing perceptions and although the technique proposed is the use of Set diagrams it is really the negotiation and dialogue that is key and the way that the diagrams drive the associated socio-technical process.

7 KNOWLEDGE DIVERSITY

Acquisition of tacit business and tacit technical knowledge is very important to any organisation. Equally likely, continuous communications (Sturt, 2000; Harrington, 2001) are also vital to the progress of any organisation, in most organisations there is a clear division between the providers and beneficiaries (both business users and end-users) of the proposed system and the solution providers of the system, i.e. different individual knowledge and perception of knowledge (see Figures 2 and 3). Usually the developer is the internal IT department although increasingly it is a third party organisation, such as an outsourcing vendor or consultancy company. This can exacerbate communication problems due to the physical separation of the organisations. Some organisations claim a more integrated environment where the customer and the developers are not seen as separate elements of the business but they work seamlessly together with shared objectives. Even in this environment there is usually a separation in the roles of customer and developer, it is just that they work in a coherent team or project (Tenkasi and Boland, 1996; Sieloff, 1999; Kuruppuarachchi et al., 2002; OGC, 2005; Maylor, 2004; Gray and Larson, 2008).

Stakeholder (business users and beneficiaries) of the system, which we will for shorthand purposes call the 'beneficiary' and secondly the solution providers of the system which will include supplier, business analysts, systems analysts, programmers, software engineers, network specialists, security specialists, etc., which we shall call 'solution providers'. For convenience we will talk about the two sides but this terminology should not indicate that there is only one of each or that they are not a diverse set of people and levels of seniority involved. Further the term beneficiary is usually taken to mean the person or people (internal beneficiaries) within an organisation who require the system to support their part of the business (or the business as a whole).

The current concept of a system requirement is ill suited to develop clear "smart" requirements for large projects. The received concept follows a technical rationality, which regards requirements as goals to be discovered and solutions as separate technical elements (Cavell, 1999; Regnell et al., 1995). In contrast, we advocate a view where a requirement specifies a set of mappings between problem and solution spaces, which both are socially constructed and negotiated (Figures 5 & 6).

8 UNDERSTANDING

A major contributor to the failure of information technology based systems is the problem of understanding the beneficiaries' requirements in the initial requirements and identification stage of development. This section identifies and describes an approach to help overcome some of these problems, particularly the mismatch or understanding gap between the beneficiary and the suppliers. The approach is intended to be used at the early stages of requirement determination and introduces techniques from operational research (OR) into the process. In particular Set Theory and Venn Diagrams are used as a way of graphically representing the relationships and gaps in understanding that may exist. The benefit obtained from the use of the technique is partly in the graphical representations themselves but mainly in the dialogue and negotiation that results from the construction of the diagrams (Al-Karaghouli et al., 2004). The technique has been developed in a research study of retail organisations use of IT in the United Kingdom and an example case study from the sector is used to illustrate and discuss the technique.

The requirements process is a **socio-technical process** which relates to human-human interaction in the forms of communication, knowledge sharing, knowledge transfer and understanding of the beneficiary needs and the supplier (Hislop, 2005; Jashapara, 2004), it is not a human-machine relationship. The view adopted in KRF is that requirements emerge from a process of learning (Senge, 1990; Schein, 1992) in which they are elicited, prioritised, negotiated, evaluated and documented. Requirements evolve over time and cannot be elicited as a snapshot. This necessitates managing requirements evolution and aligning requirements to organisational change. In any business, effective projects require detailed and specific requirements which need to be achieved through intensive and rich communications between the different stakeholders (Sanghera, 1999). Unfortunately the determination of requirements and the development of specifications are frequently not seen in this way but simply as something to be established and got out of the way as soon as possible. In many large and complex information technology projects, the need for a clear understanding of beneficiary requirements has long been underestimated (Al-Karaghouli et al., 2003 & 2004) and this has led to the failure of vital and expensive projects.

9 BRIDGING THE GAP THROUGH EFFECTIVE COMMUNICATIONS

An important part of getting the requirements right is effective communication and knowledge sharing, knowledge transfer between the various groups involved in systems development (Hislop, 2005). The process of providing a solution is conducted in various different ways in different organisations. Some adopt a very formal approach strictly adhering to a relevant methodology, such as SSADM, whilst others adopt a softer method, e.g. SSM or Multiview. Each approach usually has some recommendation concerning the people who should be involved in the process at each stage. Again it is not the purpose of this paper to comment on what arrangements should be made. Suffice it to say that the involvement of the widest range of stakeholders is advisable. It is often the case that too few people are involved and

that they do not have the necessary knowledge or seniority to make, and adhere to, decisions. In most organisations there is still a clear division between the customers and beneficiaries (both business users and end-users) of the proposed system and the solution providers of the system. For example, in the recent development of new technology in communications, e.g. mobile phones, the wireless applications are becoming important to provide additional services such as internet connection and e-mail. With such new and innovative applications nobody really knows what the requirements are and what the customer actually wants. In such situations the end or external customer is as important as the internal customer in the determination and negotiation of requirements. Thus, intensive, continuous and effective communications between all beneficiaries and suppliers are extremely important to help establish a clear understanding of the needs which the proposed project must support in order to get things correct, first time, as much as possible.

9.1 RCKE: Identifying the "Knowledge" Gap (KG) and the "Understanding" Gap (UG)

The beneficiary's business knowledge and acquired knowledge through experience is very important. On the other hand, the supplier's technical knowledge is also important, but the knowledge the two groups have is significantly different, which leads to misunderstandings. Also there is often a cultural gap with different backgrounds, experience, management styles and focus being evident. These 'gaps' have often contributed to the failure of projects [The reader is referred to Cavell (1999), List (1999) and Knights (2005d)] for recent work on systems in the retail sector and the problems encountered. We take a slightly broader view in that we see the problem not only being that the suppliers often fail to understand the beneficiary's business and needs, but that the beneficiaries in turn often do not sufficiently appreciate the realities of project development (especially ITS developments). On the one hand we are developing methods to help identify and make mutually apparent the gaps that exist between the understanding that each side in the project has, and on the other hand we have techniques aimed at facilitating and accelerating the generation of understanding to close these gaps, see Al-Karaghouli et al (2003 & 2004).

10 CONCLUDING REMARKS

Knowledge, knowledge management, effective communication and supply chains were identified as the most important factors in establishing smart and functional requirements in the business organisation with reference to the NHS in the UK. These factors supported the key elements of the theoretical framework, i.e. beneficiaries, solution providers and commercial brokers. The results show that the theoretical framework identifies the requirements as a sociotechnical issue. Clearly more investigations need to be carried out to ensure that the issues identified in this paper are through out KM and SC implementations in project developments. Some practitioners consider the main reason of business failure is the misuse of ITS and others argue that the failure is because of the deficient consideration to the culture and social issues (Buday, 1992; Brightman and Moran, 2001). Some organisations view ITS

as an obstacle to the success of their business, this could be attributed to many reasons such as to the poor performance of an IT Departments, the unclear role, and improper use of ITS.

To summarise the arguments made so far, historical evidence shows that exaggerated claims of the impact of technology including e-technologies have been made in the past fifteen years, and the recent events of glitches and failures of many ITS projects have revealed different outcome (Gonsalves, 2004; Samuels, 2004b; Watson, 2004a & 2004b). In another case, Saran (2004) reported that the termination of £90m of EDS contract to develop a national e-mail system for 1.2million NHS has hit the national and professional newspapers. This coincides with the Home Office -Prison Service system problems resulted in £7m salary error. Also, according to Arnott (2007), no other public sector technology programme, however controversial, has generated quite the same furore as the £12bn National Programme for NHS IT (NPfIT), which conceded with one of the directors, Mr Richard Granger, stepping down.

Finally, the NHS-ITS programme focuses on implementation rather than the identification, elicitation and managing requirements. Only one in ten UK-ITS projects are delivered on time. This is due to the lack of a global quality standard that focuses on "test drive" (Linger and Hausler, 1992), the track record of delivery and of outcomes of business requirements (Lakshminarayanan, 2007). It is worthwhile mentioning that procurements were unprecedented in government, they ran to a short timescale, and we had a techie person at the other end rather than a business/ procurement person. That impact has also been felt across the government ITS sector as a whole. Granger was one of the first of a spate of private-sector appointees to top Whitehall IT jobs, and his stringent contracts set new standards in an environment previously dominated by procurement fudge. There has been widespread adoption of more punitive penalties and rewards but there is little evidence of the same approachability across government ITS. That is the next stage of evolution.

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