Applying Information Technology to Minimise Risks in Satisfying Organisational Needs

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Abstract

The profound effect of Information Technology (IT) is changing the way managers of most organisations carry out their activities. In organisational management IT has the potential to offer accurate and timely data/information to support decision making. But research reveals that there are various types of risk associated with the development and successful integration of IT-based Information Systems (ISs) at organisational level. In attempting to meet business needs or organisational goals the situation often leads to a plethora of problems. The failure of some organisational IT-based information systems are reviewed and possible types of risk associated with the application of IT in meeting organisational requirements are discussed. Based on the experience gained in an ongoing project for developing an IT-based IS for manufacturing management, an anti-positivist methodology (Action Research) is proposed, which articulates a 'learning' process for both the business 'owners' and the IT analyst/developer, as a suitable means for eliciting the required knowledge. It is anticipated that the discussion presented may help to generate and increase an awareness of risks of failure when combining IT with organisational needs, so that such risks can be minimised or avoided through the suggested approach.

Keywords

Information Technology; Information Systems; Risks; Anti-positivism; Action research; Knowledge elicitation.

1 BACKGROUND

The creation of an efficient and effective manufacturing industry may be a means of assisting the improvement of people's standard of living. Equally, the commercial life of an organisation depends upon the customers buying its products and services. Various new

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information and communication technologies are helping to create new opportunities and secure a competitive edge for most organisations. In manufacturing management Information Technology (IT) has the potential to help in creating useful information infrastructure systems to support managers in decision making, in order to minimise (or entirely avoid) business risks in manufacturing operations. But research findings reveal that all projects which involve the development of IT-based information systems (ISs) exhibit some form of risks to the organisation. The point could equally be substantiated by the remark of Willcocks and Margetts (1994, p.128) that *Risk is involved in all IS projects.* Inadequate assessment and management of risks in the development of a computer-based IS in an organisation may lead to failures in the successful performance of the information system, which in turn may lead to other business problems. To drive home the point about failures of organisational ISs, examples could be cited of major instances in the UK such as: *(a)* in 1991 a commercial bank (National Westminster) abandoned a £20 million IBM DB2 Share registration system that was to link the bank with the London Stock Exchange's Transfer Automated Registration of Uncertified Stock (Taurus). The abandonment of the Share registration system was said to be due to lack of adequate specifications for the trading system Taurus (Computing, 16 May 1991, p.1); *(b)* Taurus itself was one of the greatest failures of bespoke information system developments, costing a total of £400 million which was aimed at being a paperless Stock Exchange system but ended up generating more paper than was ever dreamed of and was eventually abandoned (Computing, 25 March 1993, p.52). The implication of the two examples is that while the failures of major information system projects (such as the NatWest IBM DB2 Share registration system and Taurus itself) may be loudly reported in the news media, *there could be many others* that fail in less noticeable or less publicised ways.

A distinction could be drawn between IT and IS, in that: *(a)* IT represents the competence presented by computer hardware, software applications and telecommunication technologies; *(b)* IS represents a wider notion which encompasses various intelligence gathering devices put together to meet the defined information requirements of an individual (or an organisation) in attempt to properly control the surrounding. IS may or may not be IT-based (cf. Davenport and Short, 1990, p.11; Stowell, 1991, p.174; Willcocks and Margetts, 1994, p.128). In what follows the term IS will be assumed to include the potential offered by IT. Details presented are based on findings from an ongoing project at the University of Paisley, into IT-based risk assessment decision support for the *tendering process* in manufacturing management, in collaboration with Renfrewshire Enterprise, and Compaq Computer Manufacturing Limited, Bishopton, Scotland.

2 TYPES OF RISK IN ISs AND BUSINESS RISK FACTORS

Risk could be broadly characterised as the possibility of a negative outcome and the consequences of that possibility (cf. Hertz and Thomas, 1983, p.3; Brauers, 1986, p.139). Risk management constitutes a practice of reacting to perceived risk by some form of assessment or observations in order to reduce (or entirely avoid) the unfavourable consequences that may ensue should the risk occur. In the development and implementation of ISs for organisations, types of risk that could be encountered may include: (i) extended budgetary cost, due to over-stepping the amount initially allotted for completing the

project; (ii) longer time for implementation; (iii) inadequate systems specifications, which may be due to lack of proper understanding of the business needs by the IS analyst(s)/developer(s); (iv) poor performance of technical systems, which may be due to choosing unsuitable hardware/software for the business system; (v) inadequate data model, which may due to the systems analyst/developer not obtaining sufficient (or appropriate) business data to model and modify the knowledge-base of a required Knowledge Based System (KBS) for the IS; (vi) incompatibility of the system with other information systems of the organisation; (vii) failure to achieve some (or all) of the expected benefits due to users' ill-understanding of operational techniques or other implementation obstacles. Furthermore, these types of risk in IS may have an adverse impact on an organisation's effectiveness and efficiency to profitably satisfy its customers.

Based on theoretical and empirical investigations in the current research project of developing a prototype IS for the tendering process in manufacturing management, the possible types of risk associated with the development and implementation of ISs as listed above could further have an impact on and compound an organisation's business risk factors. In manufacturing management, results obtained from organisational investigation indicate that the risk factors which are often considered in practice are both quantitative and qualitative, encompassing the areas of: (i) total cost/benefit assessment in monetary terms; (ii) quality in terms of fitness for purpose; (iii) technology advantage; (iv) price and profitability; (v) timely delivery of products/services; (vi) image attainment and its sustainability; (vii) long term partnership relations and its proper management (with suppliers and customers) in terms of shared business risks and shared rewards; (viii) safety. These risk factors may also be applicable to the service industry. The types of risk and business risk factors aforementioned are not exhaustive but they serve to illustrate the potential risks in ISs. The exposure of an organisation to risks in ISs may increasingly become prominent when such risks further affect parameters of its 'business deliverables' to customers and other stakeholders. In extreme cases the commercial viability of the company may be seriously jeopardised.

Proponents and exponents of risk assessment/analysis of IS projects in organisations have evolved some models to help in evaluating various possible types of risk at the feasibility stage in order to avoid pitfalls. For instance, Corder (1989, pp.242-4) discusses the *strategic weighting of risk factors in estimating computer projects*, and presents a table for the calculation of strategic risks associated with such projects. The method identifies risk factors in organisational ISs and classifies them into three groups specified as: (1) high-risk factors, encompassing the five components (a) project size, (b) project definition, (c) user commitment and stability, (d) elapsed time and (e) number of systems interfaces; (2) medium-risk factors, which includes the seven elements (a) functional complexity, (b) number of user department, (c) newness of technology/vendor, (d) user experience of computers (e) the project team's experience of the user area, (f) newness of technology to the organisation, (g) number of vendor/contractors; (3) low-risk factors, covering the three elements (a) number of sites, (b) functional newness (c) number of project phases. Some other models include that of Parker *et al* (1988) and that of Cash *et al* (1992; also see Willcocks and Margetts, 1994, p.128). While these approaches may be useful they are likely to fall short of offering a 'complete solution' to risks reduction (or avoidance) in the development and successful implementation of organisational ISs; they tend to lay emphasis

on the feasibility (or initial) stage. But the initial stage which represents only a part of a coherent 'whole' in an IS project may be largely based on financial and statistical evaluation techniques that do not fully consider the human and business implications. Therefore, a problem-solving methodology which articulates an iterative learning process for both the organisational participants and the ISs analyst(s)/developer(s), then considers the various stages of the project may have a better potential in helping to reduce (or entirely avoid) the risks associated with all the stages (e.g. feasibility, design, development, implementation, training and use). The methodology suggested here and adopted in the project is the anti-positivist paradigm of social (or organisational) inquiry and analysis which is further discussed in the sections below.

3 POSITIVIST AND ANTI-POSITIVIST APPROACHES TO ISs

The philosophies of positivism and anti-positivism in organisational inquiry draw upon the assumptions of conceptualising the nature of science by *subjective - objective* dimensions for social inquiry; while the assumptions about the nature of society can be thought of as *regulation - radical change* dimensions (Burrell and Morgan, 1994, pp.21-23). The positivist (or 'functionalist') perspective involves the application of models based on natural science (such as in physics, engineering or biological methods) to the study of human socio-cultural affairs and organisational analysis (*ibid* pp.25-28). In terms of the development and implementation of an IS the implication is that the systems analyst/developer plays the explicit role of an observer of actions. Soft Systems Methodology (SSM) clearly points out a breakdown in the application of the natural science approach to a situation of problem-solving in social (or organisational) inquiry and analysis. SSM suggests an implicit participation and articulates a learning approach to organisational inquiry and analysis (Checkland, 1981; Checkland and Scholes, 1990).

In the anti-positivist (or 'interpretive') approach to organisational investigation the researcher (or analyst/designer) is an active participant in the process with the relevant group in the organisation. This contrasts with the natural science approach in which the researcher (or analyst/designer) is an observer, external to the process. The concept (based on the philosophy of SSM) seeks individual consciousness and human participation in a problem situation as opposed to that of an observer of action. The idea could be said to be of basic meaning that underlies social life (cf. Burrell and Morgan, 1994, p.31). With regard to information systems design, development and implementation the approach implies an understanding of the subjectively created world in the form of an ongoing process. Both the general form of *phenomenology*, i.e. 'philosophical examination of the foundation of experience and action' and *hermeneutics*, i.e. 'interpretation and understanding of the context of our social environment in a manner akin to our interpretation and understanding of text' (Winograd and Flores, 1990, pp.9 and 27-8 respectively) have philosophical commitment to anti-positivism. Equally, they all operate within the 'interpretive' paradigm for social inquiry (or organisational investigation) and analysis. In attempt to minimise risks in the development and implementation of ISs in an organisation *Action Research* (AR) strategy is suggested here as a means to enable the ISs researcher (or analyst/developer) to be implicitly and actively involved with the relevant group in the subject of investigation. Comprehensive details about AR are available elsewhere (see: Rapoport 1970; Foster, 1972; Susman and

Evered, 1978; Hult and Lennung, 1980; Checkland, 1981; Checkland and Scholes, 1990). The original concept of AR is credited to Lewin (1946), who expresses concern that the traditional science approach to social inquiry was not helping to resolve critical social problems (Susman and Evered 1978, p.587).

4 POSSIBLE USE OF ACTION RESEARCH FOR MINIMISING RISKS IN ISs

Figure 1 represents an AR framework which may be employed in the process of minimising risks in ISs. The various stages (1 - 6) represent the life-cycle of an IS. The model recognises that: (a) organisations are not homogeneous but they are different and unique in many ways; (b) clients (or managers) of an organisation may not fully know what they want (in terms of ISs) for their businesses; (c) the assumption should not be made that all managers in organisations are capable of articulating their expertise. Therefore, the AR model is based on an iterative learning process and implicit participation in problem identification/solving sessions between the organisation participants and the IS analyst/developer in order to have a better understanding of the domain, effect change and reduce (or avoid) risks in an IS project. As shown in Figure 1, the *AR stage (No. 2)* has an iterative link with the stage above it (No. 1) and the majority of the stages below it (Nos. 3,4 and 5). With stage 6 inclusive the model is a single coherent 'whole' aimed at reducing (or entirely avoiding) perceived risks in the various stages of an IS development project. In most cases the effective involvement of the organisational participants from the initial stage to the final stage may result in little or no further serious training programme. If the approach is properly employed a minimum level of risks coupled with satisfactory performance may be expected in an IS project. Potential benefits of the application of AR are now discussed in the sections hereafter.

5 POSSIBLE BENEFITS OF ACTION RESEARCH STRATEGY

In most situations of organisational management data required from managers (or business 'owners') which are associated with types of risk in ISs and business risk factors are often a mixture of quantitative and qualitative parameters (see section 2). The assumption that the business 'owners' (or clients) fully know what they want and can clearly articulate their needs or expertise may be an over ambitious expectation. The benefits derived from using AR may help to obtain suitable data as well as minimise risks in an IS development and implementation processes. Some of the possible benefits of AR are enumerated below, substantiated with the work of other professionals and commentators.

5.1 Bringing about change

Experience in using AR shows that it has the potential to assist in identifying key elements of risks, business needs and data considered suitable for the development of an information system in an attempt to improve and simplify business decision making and operations. This involves investigation into *what* the managers may consider to be the main components of

risks associated with profitably satisfying their customers' requirements as well as *how* to carry out such risk assessment/analysis in practice. The action methodology of research as a framework for inquiry in human activities has been suggested by various authors and practitioners (e.g. Lewin, 1946; Rapoport, 1970; Foster, 1972; Susman and Evered, 1978; Checkland, 1981; Checkland and Scholes, 1990). This knowledge about AR and personal experience of using it in the current IS project indicate that AR might be a suitable approach that may help to bring about change and minimise risks in organisational ISs, if properly employed. Fundamentally, AR does not view human actors as objects of inquiry but as initiators of actions in their own right that can bring about changes (Checkland, 1989, pp.38-9).

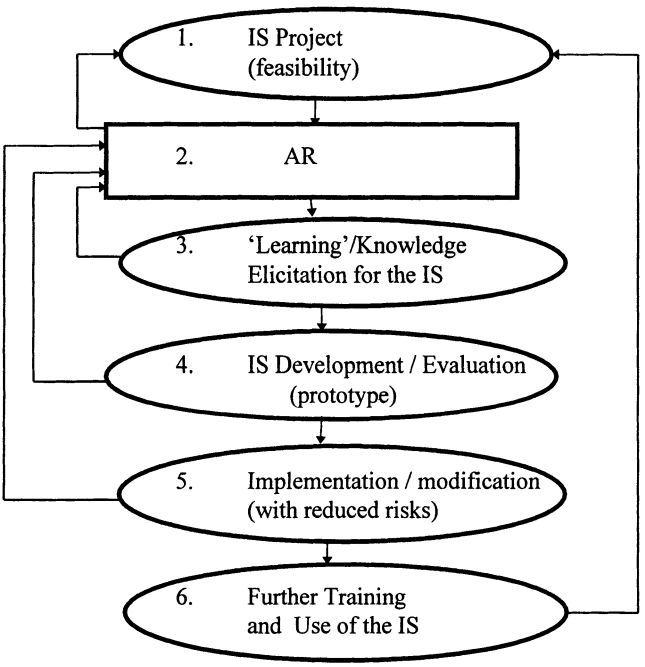

Figure 1 Possible Model for Applying AR to Minimise Risks in ISs Life Cycle.

5.2 Collaborative Learning in Risk Assessment

Action research philosophy proposes an iterative process of investigation and involves participative learning between the researcher (or analyst) and client (see: Lewin, 1946; Rapoport, 1970; Foster, 1972; Susman and Evered, 1978; Stowell, 1991). The concept is in concord with the notion of Soft Systems Methodology which articulates a process of inquiry that leads to action (Checkland, 1981; 1989; Checkland and Scholes, 1990). The integrative problem solving approach is considered a suitable means of reducing risks in IS projects

such that: (a) the 'owner' of the problem situation and the information systems researcher (or analyst/developer) can collaboratively work out the nature of the problem(s) in a project of an IS development, its implementation, and the process of resolving the entire problem situation; (b) the organisational participants and the researcher can be involved in the process of learning and improving the system under investigation at *an early stage* of the project, thereby creating a feeling of ownership and satisfaction for the clients and analyst(s). The process of iterative learning through understanding, interpretation and experience of the problem situation by both the analyst and the organisational participants is comparable to the idea of hermeneutics, phenomenology (Winograd and Flores, 1990; Burrell and Morgan, 1994) and Vickers' concept of appreciation (Vickers, 1965).

5.3 Integrating Theory and Practice

The main concept of AR is that of combining theory with practice as the researcher acts on the social system. This has been shown to involve a cyclic process having five major stages: *diagnosis, action planning, action taking, evaluating and specifying learning* (see: Susman and Evered, 1978, pp.586-9; Stowell and West, 1994, p.128). The merging of theory and practice then subsequent reflection leads to an increased understanding of the problem situation, which may lead to appropriate action. The AR approach falls into the 'interpretive paradigm' as opposed to the 'functionalist' (positivist) paradigm of resolving organisational problem situations and is capable of assisting in reducing (or entirely avoiding) risks in the development and implementation stages of organisational ISs.

5.4 Creating a More Desirable Information Systems

In discussing the corrective measures offered by AR Susman and Evered (1978) note that *'the consequences of selected actions cannot be fully known ahead of time'* (*ibid* p.590). This implies that in the development of an information system for an organisation, the researcher (or analyst/developer) should recognise that what the suitable system should be and how it should be developed to meet the client's needs must be deduced from the AR process itself and not assumed. An *assumed 'what'* and *'how'* in the development of an information system is likely to lead to the creation of an unsatisfactory system which could even assault the very situation it is meant to improve or save.

6 THE APPLICATION OF AR AND RESULTS OBTAINED

Due to the complex nature of most management risk assessment activities, the AR-based method adopted in providing a framework for the organisational investigation and for Knowledge Elicitation (KE) is the *Appreciative Inquiry Method* (AIM). The process of KE is a difficult but crucial aspect in the development of KBSs due to the inherent problems of KE. Feigenbaum (1984) specifies the process as a *critical bottleneck problem* stage. Irrespective of the sophistication and suitability of the *inference mechanism* employed at the construction stage of the computer-based model of the risk assessment, the resulting *Risk Assessment Decision Support System* (RADSS) may introduce business risks; for example, if

the integration of the IT is not appropriately matched with the requirements of the organisation. Due to confidentiality, data considered sensitive to the organisation are excluded, but this does not diminish the value of the technique or the example presented below.

6.1 Eliciting Knowledge to Model the Risk Assessment Process

AIM provides a method of inquiry that enables both the information systems analyst (or researcher) and the domain expert(s) or client(s) to 'learn', identify and define their problem domain. The method enables the participants to pay particular attention to the use of data/information within the domain before attempting to transfer the data based on the expert's knowledge to a computer-based model. It is not the intention here to discuss the mechanics of AIM as they have been fully covered elsewhere (see: Stowell, West and Fluck, 1991; West, 1995) but to: (i) show how its efficiency, flexibility and practical tools may complement or replace the traditional interview approach in KE; (ii) show its application in the current project and the results obtained. The method draws its epistemology and practical tools from SSM through Checkland and Vickers' notion of 'appreciation' coupled with the process of 'appreciative' system (see West, 1995, p.140). The method is made up of *three major phases* that correspond to three main activities involved, from which a meeting at each of these phases, is arranged between the information system analyst/developer and the domain expert.

Applying Phase 1 to Investigate the Risk Assessment Domain

At the first session, the researcher (or analyst/developer) showed an example of a 'systems map' to a respondent as a possible procedure to present his/her view on paper. Based on a concise statement *Risk Assessment* within a 'central bubble' (such as in Figure 2) as a starting point, the client was asked to represent his/her view of the domain of investigation pictorially in the form of a 'systems map'. The main risk factors were represented by each respondent as 'primary bubbles' and their environmental influences were added as associated bubbles similar to those shown in Figure 2. The method helped the domain experts to express their own views of the domain of risk assessment without interference from the analyst or knowledge elicitor. At the same time it enabled the analyst to *facilitate* the inquiry process and support the client with a framework which allows the client freedom to express and represent his/her view within the boundary constraint of the 'systems map' itself. The elements of the 'map' drawn by the expert form the basis of a discussion. The results obtained from this phase was a map that gives a full but relatively low level insight into the expert's thoughts about the defined situation of focus in the original central element (or bubble). Away from the inquiry session, the analyst carried out a careful examination of the various maps produced by the different respondents in a particular department (or section) and developed a *composite systems map* (CSM) of the domain. An example based on a resulting CSM from investigation in one of the departments of the organisation is shown as Figure 2. The CSM encapsulates the elements from the clients' individual systems maps, given as: *price, reliability, service and support, performance, technology.*

Applying Phase 2 to Investigate the Risk Assessment Domain

The aim of the second phase of the organisational inquiry was to further explore the data/information given in Phase 1. The individual elements of the domain expert's map were grouped or looked upon as single entities and each was redefined as a *purposeful human activity* (or entity). A detailed activity description was carried out based on the SSM mnemonic *CATWOE* as a guide for further inquiry (see detail in: Checkland 1981, Checkland and Scholes, 1990). Away from the venue of the inquiry and through the process of applying the technique of SSM, each of the purposeful human activities was then explicitly described by the elicitor, a description usually referred to as *Root Definition* (RD). Such a RD was produced for all the primary elements. The next step in this phase, which was also carried out away from the domain of inquiry was to convert each RD into an activity diagram, referred to as *conceptual model* (CM), using the conventions in SSM for the creation of the conceptual models. The CM was represented in a format suitable for return to the expert for the purpose of validation, deeper exploration of the domain and further discussion on the elements so far identified. A conceptual model built from the RD of the purposeful human activity (of risk assessment) to determine a product *price* through management practice as identified from the composite 'systems map' of Figure 2 is given as Figure 3. In the project, such a CM was developed for the other primary activities (or entities) of the Figure 2. Each CM serves as an agenda and a means for further exploration of the domain of investigation at the third stage.

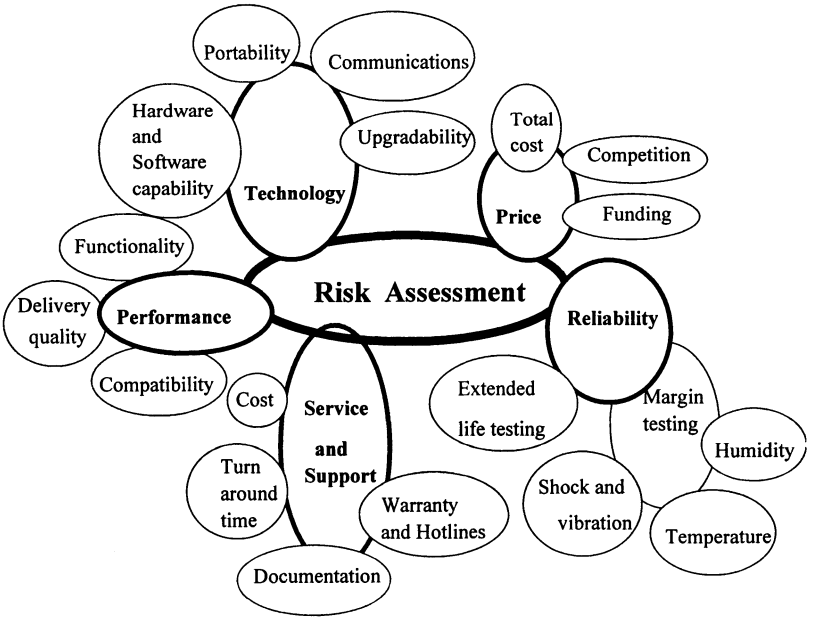

Figure 2 Example of a Composite Systems Map Based on the Results Obtained.

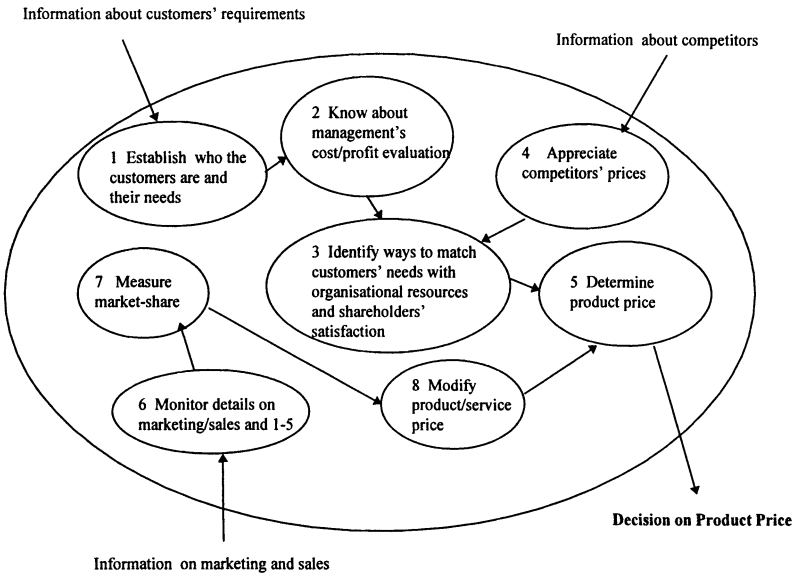

Figure 3 A Conceptual Model Developed from the RD on the 'Price Activity'.

Applying Phase 3 to Investigate the Risk Assessment Domain

At the third stage the analyst took the conceptual model(s) back to the domain expert(s) for *evaluation*. The CMs helped the analyst to structure relevant questions about the situation under investigation and to form an agenda for further discussion. For an example of how to derive questions for discussion see (Stowell *et al,* 1991, p.162; West, 1995, p.155). A combination of the CMs, further discussions and explorations between the analyst and domain expert(s) helped to provide a better understanding of the domain of investigation and a platform for further data extraction. The CM has the advantage of providing a forum for the client to reflect on his/her view, opinion and data/information already given about the domain. Equally it was possible to correct any imperfect understanding of the risk assessment domain on the part of the elicitor/analyst through the discussions.

6.2 Further Work

Data/information obtained through the method have so far proved encouraging in their suitability for developing a knowledge-base for a customised model of an IT-based RADSS. The resulting prototype will be made available to the organisation for evaluation and necessary feedback. There has been a debate about difficulties and loss of data in linking CMs to Data Flow Diagrams (DFDs) among various authors (e.g. Doyle and Wood, 1991; Prior, 1991). The technique of DFDs was employed as a means to further cross check the possible linking of the data obtained and CMs to technological design and development. Details about DFDs are available elsewhere (e.g. Sawyer, 1991; Mingers, 1995; Gane and Sarson, 1979).

7 CONCLUSION

The findings of the investigation presented in the paper indicate that risks associated with organisational ISs can in turn affect other business activities in both product and service companies. Apart from the frustration this may cause to managers and other staff of the organisation there could be potential economic pitfalls in both the short and long terms. In some cases the commercial stability of the organisation may slide on a downward slope due to performance failures of the ISs which may in turn lead to inadequate customer satisfaction, hence the company's poor competitive edge in the market-place. The point has been made that due to human 'cultural differences' organisations are not homogeneous, but are different and unique in their own respect including the way that business activities are carried out. The major issues advanced in this work are: (a) that IT has the capability to improve ISs if IT competencies and IS methodologies are appropriately combined; but a risk assessment/analysis model focused mainly on the feasibility stage of an IS project rather than on the 'coherent whole' may not adequately minimise overall risks for an organisation; (b) that AR strategy which considers a problem situation and articulates a learning process for both ISs analysts/developers and clients has the potential to reduce risks associated with ISs for an organisation. It is worth noting that while computers may be good at processing data, only human beings make things 'happen' in an organisational environment and suitably merging human capability and IT potential may help to reduce risks in IS projects. The approach presented is capable of coping with both the 'soft' (or sociological) area of human activities and the 'hard' (or technological) aspect of an information infrastructure system project, in order to minimise (or avoid) organisational risks.

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