DEFINING SYSTEM REQUIREMENTS: A CRITICAL ASSESSMENT OF THE NIAM CONCEPTUAL DESIGN PROCEDURE

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ABSTRACT

Requirements definition is a fundamental activity within information systems development. Social and organisational issues are at the centre of many of the problems experienced during the development and implementation of information systems, and these need to be explored during requirements definition. The NIAM Conceptual Schema Design Procedure (CSDP) is a method for identifying and describing information requirements using fact types. This paper discusses some limitations of the information requirements definition step of the CSDP which result from its lack of focus on the socio-organisational dimension of information systems development. Four different approaches to exploring the socio-organisational contexts of systems are discussed. It is proposed that one of these, viewpoint development, be incorporated into the NIAM CSDP to provide a means of exploring and understanding a system's socio-organisational context and to ensure that contextual information is a major input to the requirements definition process. This results in an enhanced design procedure. Future and current research areas are identified.

INTRODUCTION

Requirements definition is a fundamental activity within information systems development. Inadequate and incorrect requirements definitions are known to be a major source of difficulties for large systems projects (Boehm 1981). It has been suggested that the so-called "hard" or "engineering" type approaches to systems development emphasise the technical aspects of information systems and the systems development process, ignoring the socio-organisational dimension of information systems as human activity systems (Backhouse et al. 1991, Doyle et al. 1993). Thus technical-oriented approaches cannot adequately address the social and organisational issues which are at the centre of many of the difficulties experienced both during systems development itself and with the implementation of computer-based information systems. It is essential that such issues are explored and understood during the requirements definition phase (Goguen 1992, Lewis 1993a, Doyle et al. 1993).

Requirements definition within the "hard" approaches concentrates on modelling users' requirements in terms of the data, process and behaviour perspectives (Olle et al. 1991). Data analysis and the design of conceptual data models can be viewed as requirements definition in terms of the data perspective. Nijssen's Information Analysis Method (NIAM) is an approach to information systems development which focuses on the data perspective (Nijssen

and Halpin 1989). The major component of NIAM is a fact-oriented modelling technique which forms the basis of the method's data analysis activities and which results in the specification of a conceptual schema (ISO 1982). The modelling technique, known as the Conceptual Schema Design Procedure (CSDP), consists of a sequence of nine steps. The NIAM method has been used successfully for the development of many large systems (Halpin and Orlowska 1992).

This paper identifies some limitations of the requirements definition step of the CSDP which result from its technical-oriented perspective of the requirements definition process. These limitations could be addressed by including techniques within the CSDP which focus on exploring and understanding a system's socio-organisational context. Four different approaches to exploring the socio-organisational contexts of information systems are discussed: the Soft Systems Methodology (Checkland and Scholes 1990), the use of concepts from semiotics as in the MEASUR approach (Stamper 1992), the use of concepts and techniques from anthropology, sociology and sociolinguistics (Goguen 1992), and the use of viewpoint development to identify, understand and represent different views and perceptions of a problem domain (Darke and Shanks 1995). It is proposed that viewpoint development be incorporated into the first step of the CSDP to facilitate exploration and understanding of a system's socio-organisational context and to ensure that contextual information is a major input to the information requirements definition process. The paper consists of five sections. The next section describes the NIAM method and the limitations of the requirements definition step of the CSDP. The third section discusses the four approaches identified above, and the fourth section outlines how viewpoint development can be incorporated into the CSDP. The conclusion describes current research and future research directions.

REQUIREMENTS DEFINITION WITHIN THE NIAM CSDP

The NIAM Conceptual Schema Design Procedure (CSDP)

NIAM is a data-focused information systems development approach which includes a graphical notation to represent a conceptual schema and a design process to guide the modelling of the conceptual schema. The NIAM notation is based on the fact construct and is described as a fact-oriented approach (Halpin and Orlowska 1992). The current NIAM approach has evolved from earlier work by Falkenberg (1976), Verheijen and Van Bekkum (1982) and Nijssen (1989) and is described in detail in Nijssen and Halpin (1989) and updated in Halpin and Orlowska (1992). The NIAM graphical notation provides a rich set of constructs to represent object types and the roles they play in fact types. Fact types "connect" object types and form the basic building blocks of a NIAM conceptual schema design. A number of notations are available to specify constraints on and between fact types, including uniqueness, cardinality, equality, exclusion, and subset. Information flow diagrams provide limited support for modelling the process perspective. NIAM does not currently provide adequate support for either the process or behaviour modelling perspectives, although research efforts in this area are in progress (Halpin and Orlowska 1992). An algorithm for transforming NIAM conceptual schema diagrams into optimum normal form relational database tables allows for ready implementation of NIAM designed schemas using relational database technology.

The CSDP provides a method for the development of a NIAM conceptual schema and consists of nine steps (see Fig 1). Steps 1 and 2 of the CSDP lead to the drawing of a first draft conceptual schema diagram. Subsequent steps refine the model and add constraints. A number of steps are oriented towards quality checking of the model and particular emphasis is placed on checking the model against example fact types.

1. Transform familiar information examples into elementary facts, and apply quality checks.
2. Draw a first draft of the conceptual schema diagram, and apply a population check.
3. Eliminate surplus entity types and common roles, and check for derived fact types.
4. Add uniqueness constraints for each fact type.
5. Check arity and logical derivation of fact types.
6. Add object type, mandatory role, subtype and occurrence frequency constraints.
7. Check that each entity can be identified.
8. Add equality, exclusion, subset and other constraints.
9. Check that the conceptual schema is consistent with the original examples, has no redundancy, and is complete.

Figure 1 The NIAM Conceptual Schema Design Procedure (CSDP)
(from Halpin and Orlowska 1992, p 99)

Step 1 of the CSDP is critical to the whole process: it is "the foundation of NIAM's design procedure" (Halpin and Orlowska 1992, p 97). In this step, familiar information examples are translated into elementary facts which define the information requirements of the system being developed. Step 1 is therefore the requirements definition process in terms of the system's data perspective. Step 1 is carried out by "natural verbalisation of examples in terms of elementary facts" (Halpin and Orlowska 1992, p 97). Examples of the kinds of information required by the system are collected from input and output documents and reports used in the existing system. Where these sources are not available, eg. in the case of a new system, then the "analyst should begin by getting the user to write down some examples and then work from these" (Nijssen and Halpin 1989, p 35). The "natural verbalisation" is carried out by the analyst, with the assistance of a user who is familiar with the application area, reading off information from output reports in the form of simple sentences or elementary facts, where an elementary fact "asserts that a particular object has a property, or that one or more objects participate in a relationship" and "a fact is elementary if it cannot be expressed as a conjunction of simpler facts" (Halpin and Orlowska 1992, p 99). It is suggested that the "telephone heuristic" be used to assist with verbalisation. This requires the analyst or user to "imagine you are on the phone and have to convey the information, in simple sentences, to the person at the other end of the line" (Nijssen and Halpin 1989, p 33).

The information examples selected are required to be "familiar" either to the analyst or the UoD expert, so that during the verbalisation process their background familiarity with the situation can be used to resolve any doubts concerning the information on the reports. However the issue of interpretation of data is considered only in terms of whether or not the examples collected are significant, in the sense of covering all possible types of information and all possible constraints on combinations of information required for the application area. Two "quality checks" are then applied: check that the objects in the elementary facts are well-defined, and check that the elementary facts are unable to be split further. The remaining steps of the procedure are then carried out.

Limitations of Requirements Definition within the NIAM CSDP

The ability of Step 1 of the CSDP to adequately support the identification and description of a system's information requirements is significantly reduced by its simplistic view of requirements definition which ignores the socio-organisational dimension of information systems. The limitations of Step 1 are caused in particular by its underlying assumptions about three key aspects of requirements definition: the nature of the requirements definition process, the nature of system requirements, and the nature of representations of system requirements. The limitations of Step 1 in terms of these three aspects are discussed in this section.

The nature of the requirements definition process. Requirements elicitation and definition is to a large extent a social process. The human interaction between user groups and between analysts and users contributes to the evolution of an understanding of the nature of the problems and issues which any new or amended system must address. Interaction between users and analysts is necessary to combine knowledge about the business area, which the users have, and knowledge about technical possibilities, which the analysts have (Goguen and Linde 1993). The "natural verbalisation" process of Step 1 precludes this type of interaction.

There are no activities within Step 1 which support exploration of alternative viewpoints or solutions. It is assumed that there is complete agreement as to the nature of the present situation, what problems exist, and what the information requirements of the new system are. The possibility of conflicting views is not considered, so no conflict resolution processes are included.

Emphasis on socio-organisational issues has increased as the role of data analysis has changed. Originally, data analysis was seen as part of the data storage design activity, and occurred later in the development lifecycle. Now data analysis is being used much earlier, in the planning and requirements definition stages, as one of the techniques for defining the problem domain itself. This means that technical issues are of less importance, and questions concerning the nature of organisations, how they can best be investigated, and how their user groups make sense of their organisational "world" become important (Lewis 1993a). There are no activities within Step 1 which support investigation of these issues.

There are two quality checks applied as part of Step 1, but these concentrate on the technical correctness of the elementary facts. There are no techniques for ensuring the completeness and validity of the elementary facts as a representation of the various user groups' perceptions and understanding of the application domain.

The nature of system requirements. System requirements have been described as "emergent"; they do not exist already, rather they emerge from the interaction between user groups and analysts (Goguen 1992). Step 1 of the CSDP assumes that information requirements are predefined, and can be obtained from the input and output documents of the existing system. These documents are also the major source of information about system requirements within Step 1 of the CSDP. They are examples of what Goguen (1992) describes as "dry" information: the formal, context insensitive information associated with formal information systems. He argues that, in order to capture a more complete view of requirements, the informal, context sensitive information which occurs in human interaction, described as

"wet" information, must also be considered. This type of information is typical of the informal information system which surrounds any formal information system. It is essential to also incorporate "wet" information into the definition of requirements to ensure that they reflect the system's socio-organisational context. The informal information system determines the context of the formal system, and shapes its organisational reality (Benyon-Davies 1992).

Step 1 assumes that defining information requirements is about modelling an objective reality that exists independently of our perceptions of it. The set of elementary facts defined as the basis for the conceptual schema is considered to represent a neutral, objectively true description of a problem domain, expressed as a set of true propositions about reality. The analyst's role is primarily that of providing the technical expertise required to convert an objective reality into a data model. This represents an objectivist approach in terms of Klein and Hirschheim's (1987) data modelling paradigms. Problems with the objectivist paradigm have been described (Klein and Hirschheim 1987, Lyytinen 1987, Lewis 1993a). A subjectivist approach considers that reality is subjectively constructed via our particular framework of social values and beliefs. Thus a data model is an *interpretation* of a socially-constructed reality, reflecting the socio-organisational values of those involved in developing the model. There is no one "correct" model to be discovered and described. Different viewpoints can exist, and these need to be explored and understood if the resulting system is to meet the needs of all involved user groups.

The nature of representations of system requirements. Much of the interaction between user groups and between analysts and user groups takes place using natural language, i.e. without the use of formal techniques and specification languages. Natural language is considered in many ways to be inadequate for representing requirements because of its informality and ambiguity. However, these features can in fact be useful. They help to facilitate the gradual evolution of requirements by requiring clarification and interpretation of user statements and viewpoints, thus preventing "too early a resolution of conflicts and ambiguities" (Goguen 1992, p 8). The representation of requirements within Step 1 moves directly from the existing system's input and output documents to verbalisation of their contents in the form of fact types. This does not support an evolutionary requirements definition process. The use of informal representations of requirements as a precursor to their representation as fact types could facilitate exploration of different user groups' perceptions of the application domain and result in the definition of system requirements which are better able to meet the information needs of all involved user groups.

APPROACHES TO EXPLORING SOCIO-ORGANISATIONAL CONTEXTS

The previous section has identified limitations of requirements definition within the NIAM CSDP which are caused by a lack of focus on the embedding of a system in its socio-organisational environment: there are no activities to support development of an understanding of a system's context, and definitions of requirements and their representations do not draw on the socio-organisational dimension of systems as human activity systems. Four approaches which emphasise understanding of a system's socio-organisational context during requirements definition are described in this section. Each could provide a means of enriching Step 1 of the CSDP to facilitate exploration and representation of contextual information.

The Soft Systems Approach

The Soft Systems Methodology (SSM) (Checkland and Scholes 1990) recognises that in many system development projects there may be complex problem situations where there is not a high level of agreement as to what the present situation is and what any new information system should do. SSM attempts to explore, understand and integrate different perceptions of problem situations and their socio-organisational contexts. However SSM does not yet have specific techniques for data analysis and modelling as part of its problem exploration activities. Lewis (1993a) argues that embedding conventional, objectivist data modelling techniques within SSM is not desirable because the objectivist paradigm is fundamentally opposed to the soft systems approach. Objectivist approaches view data modelling as revealing an objectively existing structure of data within a problem domain, whereas the soft systems view is that there is no neutral, objectively true description of a problem. According to SSM's "appreciative" model of human sense-making "no organisation or individual can ever 'know' the 'real' situation directly but can only *interpret* the situation through a particular set of standards, norms and values" (Lewis 1993a, p 181). Lewis (1993b) proposes an "interpretative", subjectivist data analysis approach based on the definition of "cognitive categories" to build "system data models". He suggests that this could be incorporated into SSM to complement its conceptual models. The possibility also exists, though, of incorporating interpretative data analysis using the concept of cognitive categories, which reflects a subjectivist approach, into Step 1 of the NIAM CSDP which is an objectivist data modelling approach. This could provide a means of supporting exploration of different perceptions and contexts as part of information requirements definition within the CSDP. However the usefulness of this approach cannot yet be determined as Lewis' technique of interpretative data modelling based on cognitive categories is not yet sufficiently developed. It is not clear exactly how cognitive categories differ from the entity types or objects of objectivist data modelling techniques such as the CSDP, except that they are derived from within the framework of SSM's root definitions.

The Application of Concepts from Semiotics

Semiotics (the theory of signs) is concerned with language, communication, signs and codes. Information can be defined in terms of properties of signs at various semiotic levels: the syntactic (dealing with the structure of signs), the semantic (dealing with the meanings of signs), and the pragmatic (dealing with the usage of signs) (Stamper 1992). Semiotics has relevance for conceptual data modelling and database design because it is the various socio-organisational groups within an organisation which give meaning to the signs which exist within an information system (Benyon-Davies 1992). Information systems are considered to be social systems and "only by correctly embedding the computer-based system in the social system can the data it contains have any meaning, express knowledge or support intelligent behaviour" (Stamper 1992, p 32). Semantics has, of course, been recognised as an important aspect of conceptual data modelling, but most attention has focused on representation notations (for example, see discussion of semantic data models in Peckham and Maryanski 1988 and Hull and King 1987) and on prescriptive methods for developing a conceptual schema, such as NIAM's CSDP. Little has been done in the area of human interpretation of data models and the "social and psychological processes by which meaning is produced" (Benyon-Davies 1992, p 215).

Stamper (1992) describes a methodology for information systems development, MEASUR, which is based on the principles of semiotics because it "concentrates on the meanings of signs, the purposes for which they are used and the social consequences they produce" (Stamper 1992, p 32). MEASUR leads to the creation of a "normbase" rather than a conventional database. A normbase is a collection of "norms": specific patterns of organised behaviour which should be displayed by user groups within an organisation in specific situations. Norms embody the users' business knowledge and their interpretation and perceptions of their organisational situation. The normbase is intended to contain not only business data, as in a typical database, but also knowledge of business policy which is usually retained within various application programs. Definition of norms is an attempt to express more than just a system's technical data and function requirements, as norms reflect a system's socio-organisational context, including the users' expected behaviour patterns.

The first three phases of MEASUR focus on exploring and understanding a system's socio-organisational context. Problem articulation (a "soft systems analysis") produces a set of problem statements defining the business problem in the users' own terminology. Semantic analysis clarifies the meaning of each problem statement, producing a semantic schema for the normbase. Norm analysis involves creating the normbase by populating the schema with particular instances. The use of problem articulation and semantic analysis techniques could be investigated as a means of enriching the CSDP. The feasibility of this depends on whether the techniques can be applied outside the context of the MEASUR methodology.

The Application of Sociological and Ethnomethodological Concepts and Techniques

Recent research in this area has identified two basic types of information: "dry" or formal, context insensitive information, and "wet" or informal, situated information (Goguen 1992, Goguen and Linde 1993). Both are relevant to defining system requirements. Formal or "dry " information is exemplified by the syntactic representations found in computer systems, and by much of the formal documentation associated with information systems. Informal or "wet" information typically occurs in the social interaction between people, eg. between user groups and between users and analysts. They are complementary aspects of information and therefore an understanding of both is important. Both are relevant as sources of information about system requirements because requirements definition is not just about solving technical problems; the socio-organisational context of information systems is of major importance in this phase (Goguen and Linde 1993). Requirements are often not pre-existing and clearly defined, but rather emerge from the interaction between the user groups and systems analysts. Research is being conducted into the use of concepts and methods from the social sciences (sociology, anthropology and sociolinguistics in particular) to gain a better understanding of this interaction (Goguen 1992, Sommerville et al. 1993). Discourse analysis and other interaction analysis techniques can be used to analyse written texts in their social context and to analyse spoken language and other interaction structures. These techniques are useful in situations where social interaction is significant, and can be used to explore the value systems of organisations. Discourse analysis of user explanations of activities can also be used for situated task analysis (Goguen and Linde 1993). These techniques can assist in understanding the structure of the communication and interaction between people, and the ways in which these are determined by the social context in which they occur, and the ways in which they at the same time define and construct the social context (descriptions of these techniques and further references can be found in Goguen 1992, Goguen and Linde 1993, and Sommerville et al. 1993).

Ethnomethodology and ethnographic studies are used to study the structure, organisation and practices of social groups. Ethnographic studies require spending an extended period in an actual working environment, noting work practices and social processes. This aids in understanding the socially-constructed informal information system in which any formal, procedural information system is embedded (Sommerville et al. 1993). The success of any formal information system is considered to be dependent upon how well it aligns with the informal information system. Sommerville et al. (1993) describe a system development project in which ethnomethodological techniques are being used to explore and document the users' views of their socio-organisational situation. This can help to ensure that it is their views, rather than those of systems analysts, which are applied to the problem situation.

These sociological and ethnomethodological techniques could also be used within Step 1 of the CSDP in problem situations where social and organisational issues appear to be critical. Goguen and Linde (1993) discuss the general suitability of these techniques for requirements elicitation. They suggest that as these techniques are very labour intensive they should be used in conjunction with traditional methods such as interviews, questionnaires and JAD sessions, in situations where significant problems have been revealed which cannot be adequately understood using traditional methods.

Viewpoint Development for Requirements Definition

Viewpoint development provides a means of understanding a system's socio-organisational context by identifying and exploring the different perceptions and viewpoints of the various stakeholder groups involved (Darke and Shanks 1995). Representations of viewpoints can then become an important and useful input to requirements definition. The feature which distinguishes viewpoint development from other requirements definition activities is that multiple viewpoints are developed as separate, independent "objects", i.e. in no way are the viewpoints just distinct views of a common underlying representation. A conceptual framework for understanding viewpoint development has been proposed (Darke and Shanks 1995). This is depicted in Figure 2.

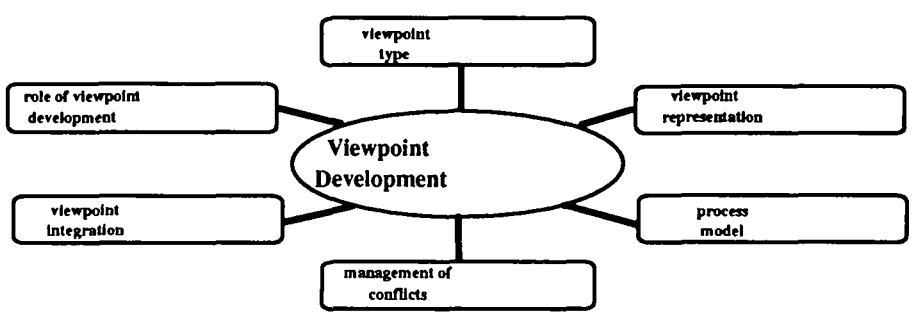

Figure 2 Conceptual Framework for Viewpoint Development
(from Darke and Shanks 1995)

The conceptual framework identifies six core elements as central to an understanding of viewpoint development. These are: the role of viewpoint development, the viewpoint type, the representation of viewpoints, the viewpoint development process model, management of

viewpoint conflicts and inconsistencies, and integration of viewpoints. A number of key features of each of the framework elements have also been defined and described. The framework elements are briefly outlined here (see Darke and Shanks 1995 for full details).

The Role of Viewpoint Development. Viewpoint development may focus on either or both the requirements acquisition and requirements modelling phases of requirements definition. During requirements acquisition it supports the elicitation and understanding of system requirements. During requirements modelling it supports the representation and management of multiple perspectives and components of system requirements models and specifications.

Viewpoint Types. Either user or developer viewpoints may be identified. A user viewpoint captures the perceptions and domain knowledge of a particular user group. A user group may have several organisational roles, so it is possible to associate more than one viewpoint with a specific user group. A developer viewpoint captures the perceptions, domain knowledge and modelling perspective relevant to a systems analyst or other developer responsible for producing some component of a requirements specification.

Representation of Viewpoints. Viewpoints can be represented using informal, formal or semi-formal representation techniques. The suitability of a particular technique for viewpoint representation depends on both the role of viewpoint development and the viewpoint type. No single representation technique is adequate for representing all types of viewpoints or for supporting viewpoint development during both requirements acquisition and requirements modelling, so a combination of techniques is necessary (Darke and Shanks 1995). It is also essential to ensure that viewpoint representation focuses on the semantics of the viewpoints and not just the syntax of the representations.

The Viewpoint Development Process Model. Viewpoint development is an exploratory and evolutionary process. The process model defined within the conceptual framework identifies six core activities: viewpoint identification (identify the relevant viewpoints and acquire their content), viewpoint representation (represent each viewpoint using appropriate representation techniques), viewpoint analysis (identify intra-viewpoint inconsistencies and determine the completeness of each viewpoint), viewpoint comparison (compare all viewpoints to identify inter-viewpoint inconsistencies and conflicts), management of conflicts and inconsistencies (use inconsistency handling techniques and conflict resolution strategies), viewpoint integration (negotiate a common viewpoint if it is considered desirable and feasible to do so).

Management of Conflicts and Inconsistencies. Techniques to identify conflicts and inconsistencies between viewpoints are needed so that relationships and differences between viewpoints can be understood. Easterbrook (1991) defines conflict as "any interference in one party's activities, needs, or goals, caused by the activities of another party", whereas inconsistency is indicated by apparent contradictions between the stated requirements of involved parties. This distinction is useful, but in practice it is not always easy to recognise whether differences between viewpoints are the result of conflicts or inconsistencies. It is important also to ensure that the emphasis is on identification of semantic differences between viewpoints rather than just on syntactic differences between viewpoint representations, otherwise viewpoint comparison and integration activities will be compromised and important differences in understanding of the problem domain may be suppressed (Darke and Shanks 1995).

Viewpoint Integration. One of three viewpoint integration methods may be used: one representation scheme (one representation scheme is used for the viewpoints and for the integrated viewpoint), pre-integration translation (viewpoints are developed in various representation schemes which are translated into a different common representation scheme for comparison and integration), post-integration translation (one representation scheme is used for viewpoints, a common viewpoint is negotiated and then translated into a different representation scheme).

INCORPORATING VIEWPOINT DEVELOPMENT INTO THE NIAM CSDP

Viewpoint development is "method independent", i.e. it can be used within the context of any approach or methodology. The viewpoint development process model which is an element of the conceptual framework developed by Darke and Shanks (1995) is depicted in Figure 3.

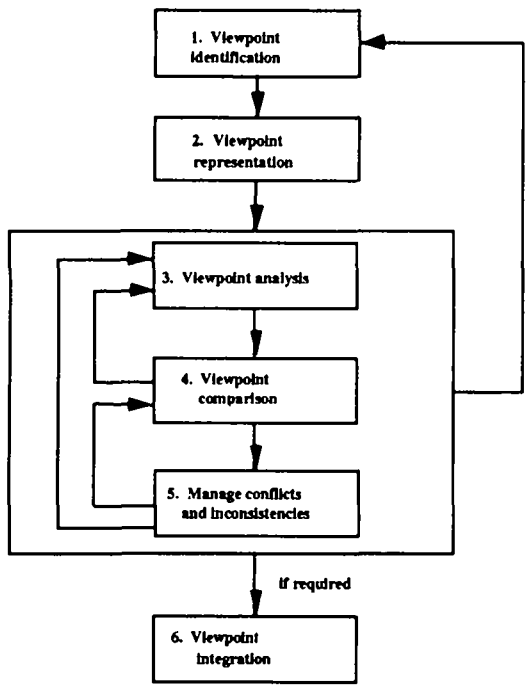

Figure 3 Viewpoint Development Process Model
(from Darke and Shanks 1995)

The incorporation of viewpoint development into the NIAM CSDP would provide a mechanism for exploring, understanding and representing a system's socio-organisational context in terms of user viewpoints, as an integral part of the requirements definition process. This can be achieved by adding the viewpoint development process model to the front of the CSDP as "Step 0", thus including viewpoint development as a specific activity to be carried out. The resulting enhanced design procedure would address the limitations of Step 1 identified earlier in this paper. Viewpoint development would help to ensure that requirements definition within the CSDP is an evolutionary and exploratory process which focuses on social interaction between users and analysts, that requirements themselves are

seen to be emergent and not always predefined, and that representations of requirements are not formalised too early in the requirements definition process.

CONCLUSION AND FUTURE RESEARCH

This paper has identified limitations of the requirements definition step of the NIAM Conceptual Schema Design Procedure (CSDP) which result from its lack of focus on the socio-organisational dimension of information systems development. The limitations relate specifically to the CSDP's underlying assumptions about the nature of the requirements definition process, the nature of system requirements, and the nature of system requirements representations. Four different approaches to exploring the socio-organisational contexts of information systems were described: the Soft Systems Methodology, the use of concepts from semiotics (as in the MEASUR methodology), the use of concepts and techniques from the social sciences, and the use of viewpoint development. It was proposed that viewpoint development, which is a methodology independent approach, be incorporated into the CSDP to provide a means of exploring and understanding a system's socio-organisational context and to ensure that contextual information is a major input to the information requirements definition process. Viewpoint development can be integrated into the CSDP by including the viewpoint development process model at the front of the CSDP as "Step 0", to create an enhanced design procedure.

Further research is underway to investigate more fully the proposed approach to integration of viewpoint development within the CSDP, including techniques for converting representations of user viewpoints into NIAM fact types. Empirical studies will be conducted to test the usefulness of the enhanced design procedure. General strategies for incorporating viewpoint development within system development approaches and methodologies other than NIAM are being explored as well.

Research is also in progress to investigate specific techniques for integrating viewpoint development activities with other requirements definition activities. The focus of this research is on development of user viewpoints. It involves investigation of the types of contextual information which need to be identified and represented in order to ensure that the "local" socio-organisational perspectives of relevant user groups are captured as part of requirements acquisition and modelling activities. The development of techniques for the representation and structuring of user viewpoints to support this process is an important component of this research. A notation for representing user viewpoints is being developed which will incorporate the use of multiple and diverse representation techniques to allow a broad range of types of contextual information to be identified and captured.

Integrating viewpoint development activities within requirements definition should ensure that local perspectives of problem situations are not ignored or suppressed. In this way alternative viewpoints and perspectives can be explored. This should facilitate the development of systems which are better able to meet the needs of all involved stakeholder groups.

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