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Navigating the Gap Between Action and a Serving Information System

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Abstract. *Creating, or adapting, information systems to support people undertaking purposeful action in organizational settings involves moving from: exploring the problem situation and thinking about what action to take, to thinking about how to support that action. In business settings this support will inevitably entail technology-based information systems. Most information system design approaches neglect the importance of the initial exploration and sense making phase and move directly to specifying the business process to be operationalised through the application of some software. The ideas described here have been developed with the intention of supporting a group of people navigating an inquiry through the shift in focus from: thinking about action, to thinking about support in a manner that promotes Client-led information system design. The ideas have been applied in practice through an Action Research field study in a UK banking organization and here we describe our* navigational *approach to IS design.*

Key Words. *interpretive, Client-led, information systems design, conversation modelling*

Introduction

In this paper, we describe a practical, coherent approach to Client Led information system development underpinned by interpretive assumptions, that has been applied in practice in the Debt Management Operations section of a UK bank. The work described in this paper has been carried out as part of the SEBPC (1996) managed research program for the project "A Unified Mechanism for Information System Definition" (UMISD, 1998). The aim of the research was to find means of supporting those involved in the situation of focus, the clients, in leading the information system (IS) design process. One of the fundamental challenges of undertaking IS design is the need to find some means of moving from methods of inquiry suited to sense making in social situations, to methods suited to organizing knowledge into a suitable format for the construction of a logical specification for any supporting technology. Many authors have discussed the suitability of using Soft Systems Methodology (SSM) (Checkland, 1981; Checkland and Scholes, 1990, 1999) to support initial sense making in a problem of concern, but problems have been encountered in linking up with methods for constructing technological specifications (Doyle, Wood, and Wood-Harper, 1993; Lai, 2000; Liang, West, and Stowell, 1998; Mathiassen and Nielsen, 2000; Miles, 1988; Prior, 1992; Savage and Mingers, 1996; Stowell and West, 1994). Most approaches to creating such a link have attempted to create some sort of bridge between the first phase of inquiry, exploration and sense making and the second phase, constructing a logical specification. We argue that attempts to create a bridge between methods of sense making in social situations and methods for creating technological specifications are somewhat ambitious. The ideas described here, offer some intellectual devices to support those involved in a process of information system design in navigating through the gap between creating ideas for action and creating a logical specification for support, in a logically sound and coherent manner. First we briefly set out the assumptions and foundations of Client Led information system design.

Foundations

The ideas in this paper are underpinned by interpretive assumptions. Adopting such a stance, means acting according to the idea that reality is continuously socially constructed with each human actor creating his, or her, own individual meanings and possessing his, or her, own viewpoint (Burrell and Morgan, 1979). Crucially, regarding social reality as being continuously constructed by the actors involved, means that when undertaking information systems design, the 'users needs' are not assumed to have some pre-existence waiting only to be discovered by the developers (Boland, 1985). Any requirements for a technology-based information system will be created during the design process through the interactions of those involved (Boland, 1985; Winograd and Flores, 1987). Approaches to information system design underpinned by these assumptions can be regarded as being exploration-oriented, as the concern is to make sense of the situation from the point of view of actors involved in the situation of concern. This contrasts sharply with an attempt being made to describe reality and define an optimal technical solution to any perceived difficulties, as is the aim during information system design based on methods from engineering and underpinned by a scientific approach to inquiry (Stowell and Champion, 2000).

For the work described in this paper, an information system is assumed to be *a system to serve purposeful action*; this definition was first provided by Checkland and Scholes (1990, p. 54) and is also discussed in Winter, Brown, and Checkland (1995). Using this definition, a process of information system design can be described as a process of inquiry that involves first creating some ideas for some desired purposeful action (or willed action by a group of human beings) and moving toward some ideas for a system to serve that action (or purposive action). Checkland (1981, p. 119) explains the difference between purposeful and purposive with the example of a clock: "the escapement is a purposive system of a clock; telling the time by reading the dial of a clock is a purposeful action by a human being". Information systems are purposive systems serving some purposeful action undertaken by human beings.

Currently, one of the inherent difficulties in undertaking information system design is the need to move from a method suited to undertaking sense making (Checkland and Scholes, 1990) in human organizational settings to the sort of methods and techniques that have been created to facilitate the construction of logical specifications for software. Most approaches to information system design place the emphasis on constructing some sort of description of the business process to be supported and then move on to constructing a description of the required functionality for a technology-based information system to support that process (Checkland, 1995; Stowell and Champion, 2000). One of the fundamental obstacles to moving from an approach to sense making within social settings to designing software-driven technology-based information systems seems to be the manner in which different groups of people involved in the inquiry process *use* any models created. Models constructed by software developers are usually attempts to represent some real world activity and so the models created are "used as *surrogates for the real world*" (Checkland, 1995, p. 49, Checkland's italics). The danger in this approach is that using models *as if* they are capable of representing real world human action results in a perilous oversimplification and inevitably any designs created using such approaches, once implemented, fail to match the complexity of the human social situation (Vickers, 1965).

Lewis (1993) offered the view that data-focussed approaches to information systems design employ data models that are used in practice as epistemological devices that offer "... a coherent means of investigating the problem domain rather than being a description of the real world". In discussing the use of data-models for the purpose of constructing technology-based information systems, Lewis argues that:

> ... however well researched and rigourous are the techniques for manipulation and refinement of the conceptual data model, they ultimately rely upon a subjective and interpretive identification of entities or objects (Lewis, 1993, p. 180).

Lewis (1993) suggests that: data analysis and data modelling can be regarded as "a process of reality creation". Stowell and West (1994) also place emphasis on the importance of facilitating a cycle of learning and the use of intellectual devices to facilitate those involved in creating a shared appreciation of the situation of focus. The difficulty seems to arise from the use of the models as "*surrogates*" (Checkland, 1995), which can lead to the models being given more status than is due. Indeed, Vickers (1981) refers to this tendency to place undue confidence in any models constructed as "hypnosis by models".

The data models and object models created as a precursor to software construction are devices to facilitate the marshalling of knowledge into a suitable format for the task at hand, in other words these devices *are* used for the purpose of sense making. These intellectual devices are simply applied to a different phase of the design process, a phase where those involved decide what to build. What is needed in a process of information systems design is some means to facilitate the necessary shifts in thinking, from a focus on what purposeful action to take, through to a focus on how might that action unfold, before thinking about what support might be required. These shifts in focus must be obvious to all those involved; so open discussion can occur. The notion of *navigating* the gap by using various intellectual devices (referred to as navigational devices) provides those undertaking IS design with a means of creating a route, or learning a way through, from any ideas for action, to the requirements for a technology-based information system to serve the action. The so-called navigational devices are intended to facilitate the necessary discussion for this phase of debate and learning.

In addition, the intellectual devices employed within the navigational phase are intended to maintain the sense of coherence from the ideas for purposeful action through to the serving activities. One of the criticisms levelled at previous attempts to move from conceptual activity models created during SSM guided inquiry to a logical design for an information system using Data Flow Diagrams, was the abrupt change from conceptualising action to conceptualising data (Doyle and Wood, 1991; Mingers, 1995). It is important that the shift in the focus of the inquiry is obvious to those involved, whilst at the same time maintaining a sense of coherence throughout the inquiry process. To achieve coherence, it has been argued elsewhere that it is desirable for the navigational devices used to provide a similar view to that created during the sense making phase of inquiry (Champion and Stowell, 2001).

The ideas created throughout the progress of this research have been published in the academic literature and these papers form a chronicle of the learning, as it unfolded (Champion and Stowell, 1999a, 1999b, 2000; Stowell and Champion, 2000, 2002). The ideas were used to guide inquiry in an Action Research field study to enable the practical value to be evaluated. Those interested in a full account of the planning for the field study, are referred to Champion (2000). This paper describes the modelling method used in practice to navigate from some ideas for purposeful action, to some ideas for the technology-based support for that action.

Navigation

When employing SSM as a guide for inquiry, there are a number of established devices that can support reflection on the consequences of implementing the ideas for action. For example, conceptual activity models, and the elements of CATWOE (Smyth and Checkland, 1976). During information system design it is necessary to conceptualise how to support action in some detail, particularly when considering what functionality will be required from any technological provision. One of the central concerns when building a technology-supported information system is the necessity to check for consistency and completeness (Pressman, 1997; Sommerville and Sawyer, 1997) and so some formalisation of the ideas for action is useful in enabling the IT support to be tested for robustness. To facilitate the design of an adequate technical specification it would therefore be useful to develop means of creating more detailed models of the action to be taken (or some parts of that action) (Champion and Stowell, 1999b). It must be accepted that any such models will not be a full representation of what will actually occur. Due to the sheer unpredictability of the future, learning about the situation and possible action will never be complete. To maintain a Client-Led approach to information system design, it would be desirable though for any intellectual devices employed to be openly accessible to all those involved in the design process and not unduly technical in execution (Savage and Mingers, 1996).

The idea that conversations in a social setting can be regarded as enabling co-operative action has resulted in heightened interest in using Conversation Modelling in information system design and in computer-supported co-operative work (Ågerfalk, Goldkuhl, and Cronholm, 1999; Dietz et al., 1998; Flores and Ludlow, 1981; Reijswoud, van Mulder, and Dietz, 1999; Winograd and Flores, 1987). Some researchers have also developed methods for mapping conversations in organizational settings (Goldkuhl and Roslinger, 1999; Harris and Taylor, 1998; Schoop, 1998). The focus in such methods is on providing accurate descriptions of the conversations that occur within a situation, with the intention of enabling difficulties to be analysed and new processes to be designed. Conversation Modelling has been criticised for being difficult to undertake, overly detailed and as offering a very rigid view of a situation (Graham, 1998; Hirschheim, Klein, and Lyytinen, 1995). In Champion and Stowell (1999a, 1999b) we had argued that it may be possible to use some of the conceptual activity models produced during an inquiry guided by SSM to inform the construction of models of possible 'Conversations for Action' that might take place if the desired action was undertaken. In this instance the explicit and detailed nature of a Conversation Model seemed to be useful in order to provide a detailed view of how the action might operate in practice.

The purpose in creating such models was twofold. First, the implications of implementing the intended action in the real world situation could be considered in more detail, enabling those responsible for creating the technical specification to consider how to provide the technical functionality required. In particular, the models would help to 'contextualise' the action within the real world situation of focus. Second, a Conversation Model offers an activity-oriented view of the situation, and it was argued that this would provide a degree of continuity between the Conversation Models and the conceptual activity models employed in the initial phase of debate (Champion and Stowell, 2000). Any models created during this phase of debate ought to also be useful in moving toward the construction of a technical specification. SOMA (Graham, 1998) is an approach to designing the logical model for technology that uses a Conversation Model to describe the operation of the IT interacting with the 'user'. It was argued that it may be possible to use such an approach to designing technical specifications as one means of constructing the technical definition required (Stowell and Champion, 2000). By describing the ideas in this fashion, the reader may underestimate the iterative nature of inquiry we advocate. The learning continues in a cyclic manner, with the shared appreciation continually being enriched through the debate and exploration that occurs. At no stage is the learning considered 'complete', though at some point it will be necessary to assume there is sufficient knowledge to create an information system. These ideas for structuring debate were applied in an Action Research field study to enable the framework of ideas to be critically evaluated through practical use.

Learning from an Action Research Field Study

SSM was used as a guide for the initial phase of inquiry, to support those involved in deciding what purposeful action might bring improvement (Champion, 2000). Identifying the problem theme and developing ideas for purposeful action emerged through discussion and debate supported by rich pictures, root definitions and the associated conceptual activity models. Fig. 1 is one of the conceptual activity models, or holons, created that expressed a view of some potential purposeful action, that those involved in the situation agreed might bring some improvement. The reader is referred to Champion (2001) for a full account of this phase of inquiry.

The navigational devices were then employed to undertake a 'contextualisation' of the ideas for action. As a first step in contextualising the ideas for purposeful action in sufficient detail to consider the adaptations to the information system this change required, the Conditions of Satisfaction were drawn directly onto some of the conceptual activity models that had been found useful in the first phase of debate. Thinking about the commitments that would need to be entered into if the intended action was undertaken was found to be useful in making explicit some tasks and activities that had not been expressed in any of the conceptual models. This addresses a concern expressed by Mingers (1995), Savage and Mingers (1996), Ledington and Ledington (1999) and also by Mathiassen and Nielsen (2000) that the ideas expressed by holons created during SSM guided inquiry do not express all the activities required to implement the purposeful action. Fig. 2 is the contextualised holon from Fig. 1.

From this point it is necessary for those involved in the information system design process to move to conceptualising how these ideas for purposeful action *might* unfold in the situation of concern, before thinking about the technology-based support for the action (or the serving system, Winter, Brown, and Checkland, 1995). To support this phase of debate and learning, the contextualised ideas were expressed by using the device of a model of possible Conversations for Action that might occur if the purposeful action were to be undertaken in the real world situation. This model is provided in Fig. 3.

Again, the reader is referred to Champion (2001) for a full explanation of this phase of debate. This model provides some ideas on how the expressed ideas for

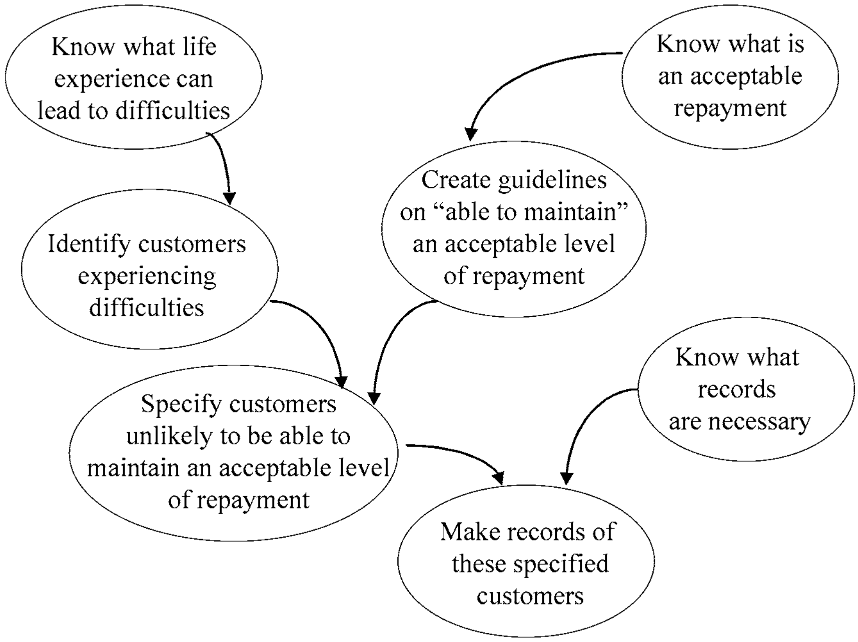

Fig. 1. *One of the holons created during the action research field study, expressing some ideas for action that might bring improvement to the situation of concern.*

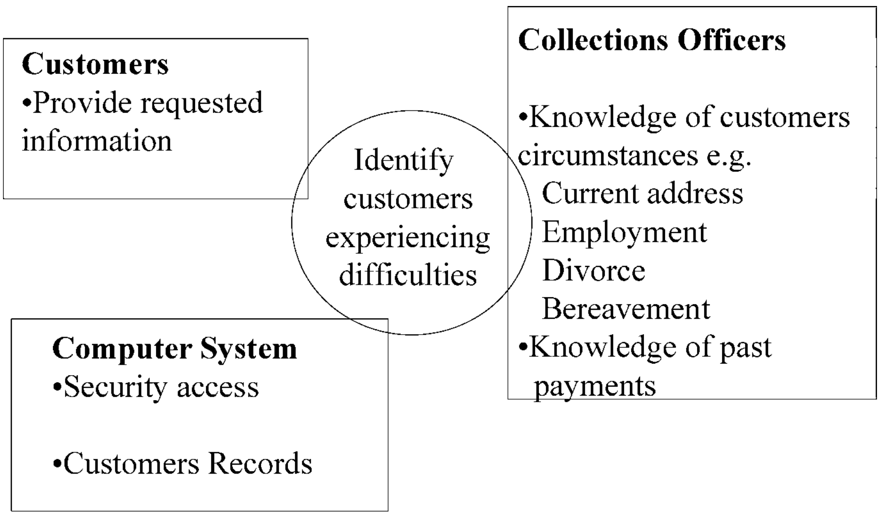

Fig. 2. *The contextualised sub-system 2, from the holon in Fig. 1.*

purposeful action might unfold in the situation of concern. An absolute and unambiguous description of the action that will occur is not possible. Essentially, these navigational models, created through discussion with those involved in the situation, express the commitments made by actors and ways that the intended purposeful action might unfold in the real world, as perceived by those within that situation. Vickers (1981, p. 24) suggested that "systemic thinking" can provide a means of "building complementary pictures of inexhaustible reality". Holons created during inquiry guided by SSM are examples of such "complementary pictures" in that holons are constructed to express ideas that may be relevant to the situation of focus;

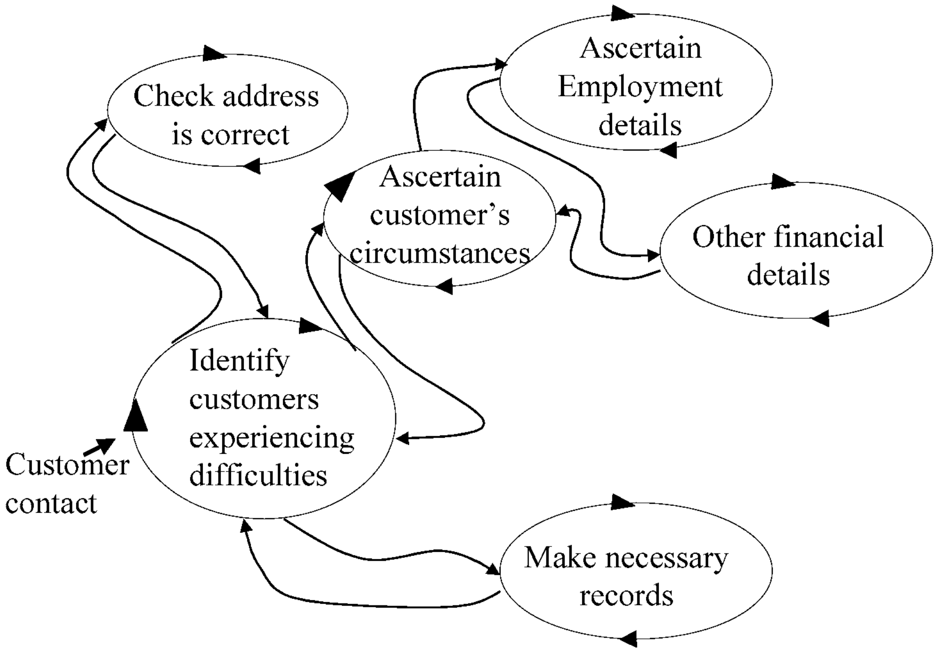

Fig. 3. *Model of possible conversations for action that* might *occur if the purposeful action expressed from activity 2 in Fig. 2, were implemented.*

these models are not descriptions of real world activity. To navigate the gap between ideas for purposeful action and a design for a serving information system in a logically sound manner, those involved in the design process must retain the idea that the models created during the navigational phase are also "complementary pictures" (Vickers, 1981). The value in creating such models is that they express possibilities that may be useful to those involved in the problem situation and the limitation in such models is the same, that they can only express possibilities, not certainties. There may be many possible ways of implementing the action and so some accommodation must be reached amongst those involved. Once some ideas on how the action might work in practice have been considered, it is then possible to create a design for a supporting technology-based information system, if so desired. There are no simple 'correct answers' to be found. Those involved in the situation must learn their way, or navigate their way, through the space between some ideas for purposeful action and any required information support. There is likely to be much iteration, with perhaps many cycles of learning being needed before some accommodation is reached. As the potential opportunities for technological support increase, this phase of debate increases in importance, as it is essential that clients and developers work at creating a shared appreciation before irreversible design decisions are made.

Using the arguments of Checkland and Scholes (1990) and Winter, Brown, and Checkland (1995), it has been argued that the fundamental shift that occurs during information system design is the movement from some ideas for purposeful action, to thinking about how to support that action. Moving from conceptualising purposeful action, to conceptualising support for action, will require those involved in the inquiry to think clearly and be certain which design problem they are addressing at any particular moment. SSM can be employed as a guide to support an exploration of the problem situation and to create ideas for purposeful action. This phase of the inquiry is then addressing the need to think about what problems are perceived by those involved and what purposeful action might bring improvement to the situation of concern. In other words, those involved are supported in creating ideas for a system to be served. The construction of a logical specification is addressing a different design problem, that is, the creation of a serving system. The intellectual devices of Conditions of Satisfaction and Conversations for Action, support those concerned in considering any issues associated with operationalising the ideas for purposeful action, so as to enable the movement from potentially relevant purposeful action to designing a serving system.

The value in navigating from ideas for purposeful action to ideas for support, is that the difference between the two is highlighted, and so those involved are supported in thinking clearly about, and coming to a shared appreciation concerning, the problem situation being considered at any point. In applying the research ideas, it was important to investigate if the navigational devices of Conditions of Satisfaction and Conversations for Action would be sufficiently detailed expressions of the possible real world action to inform the construction of a logical specification for a serving technology-based information system.

Using SOMA to Construct a Logical Specification

A developer using SOMA as a guide to constructing the logical specification for a technology-based information system first attempts to describe the real world business process using the device of an Agent Object Model. Graham (1998) distinguishes between "Business Objects" found in the "external context" (or business environment) and other "internal agents" who actually use the computer system being developed, these Agents are referred to as "Agent Objects". For example, a customer placing an order would be regarded as an external Business Object in a SOMA specification and the salesperson who takes the order and uses some technology to support this activity, would be an internal Agent Object. The emphasis when creating models using the ideas of Graham (1998) in SOMA, is to describe how the users will interact with the technology being developed. Graham argues that adopting this approach enables a developer to identify any rules associated with the activities under scrutiny. For example, when an order is placed with a salesperson as described above, Graham (1998) suggests a developer constructing a specification for a supporting information system would need to query who was responsible for setting the credit limit of the customer placing the order, the salesperson, or a more senior manager. In the approach suggested in here, such issues would be addressed when those involved in the inquiry consider the Conditions of Satisfaction associated with the action they wish to undertake. Providing support for such issues to be considered would seem a more reliable guide than assuming the design team would remember, or indeed know, to ask. Debating the Conditions of Satisfaction facilitates a consideration of the issues involved in the operationalisation, or implementation, of the ideas for purposeful action. Graham (1998) suggests using "design acumen" to cross these hurdles, but few clients in a business environment will be practitioners of some thirty years, as is Graham. The use of intellectual devices to support all the clients remaining involved in the inquiry process, regardless of their technical ability, also helps to promote the aims of *Client Led Design* (Stowell and West, 1994) as stated in the UMISD project proposal.

For the purposes of the UMISD research, the models expressing possible Conversations for Action constructed during the field study were used as an expression of how the intended real world action might unfold in practice. These Conversations for Action models were then used in the first instance, to inform the construction of a logical model of a potential serving technology-based information system using *SOMATiK*, the case tool built to support the application of the SOMA approach in a business environment.

To construct the Agent Object Model, it was first necessary to identify the "Business Objects" (Agents who were considered to be in the external context, or the business environment) and the Agents who were considered to be in the internal context (that is, using the computer system). The navigational devices of Conversations for Action with any agreed underpinning Conditions of Satisfaction had been used to facilitate the participants in considering how the action might unfold. In the example provided below, a customer experiencing difficulties maintaining repayment is regarded as existing in the business environment and is therefore an external Business Object and the Collections Officer who will use the computer system, is regarded as an internal Agent Object. As described earlier in this paper, Graham (1998) regards the occurrence of Conversations for Action as being equivalent to the passing of messages between interactants. To construct an Agent Object Model using SOMA, the first task is to identify the messages (in Graham's terminology) that an Agent will send and receive. For the work on the UMISD project, the Conversations for Action that the Collections Officer participated in were each regarded as a message for the purpose of creating the SOMA specification, as can be seen in Fig. 4.

The phrase 'change address' is used, partly due to the need to state that there would need to be some software facilitating the Collections Officer changing the

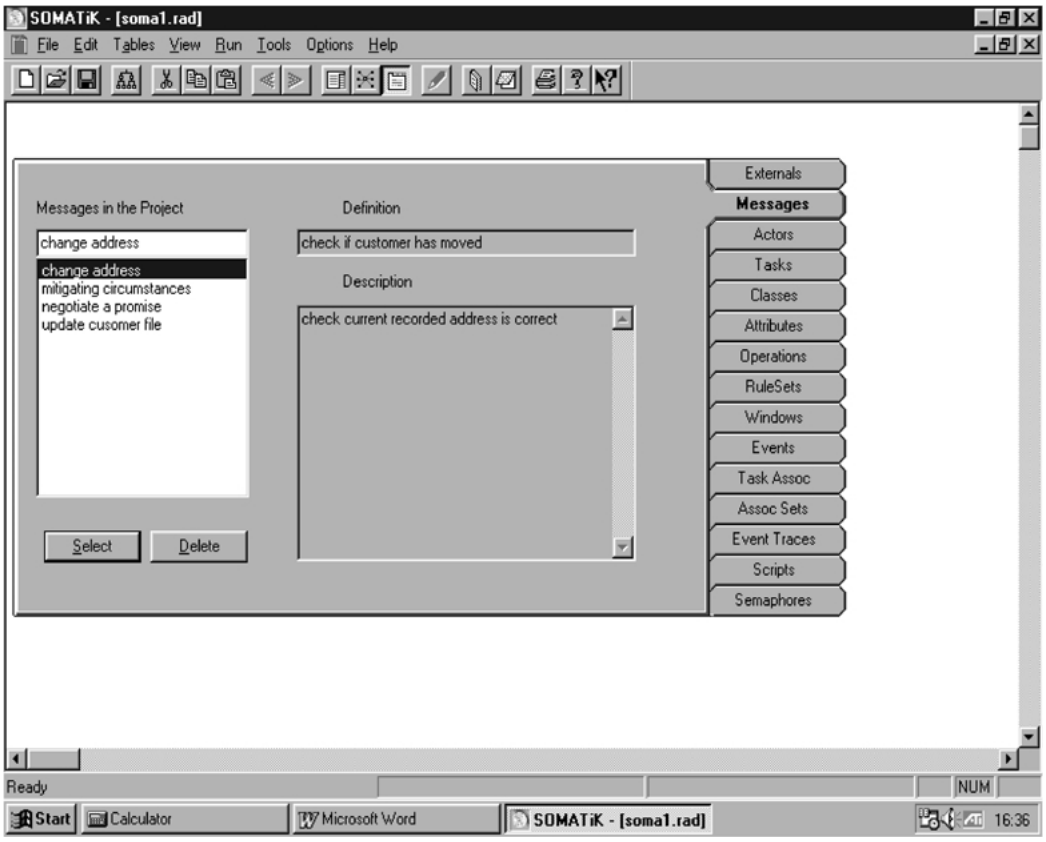

Fig. 4. *The messages identified in the initial specification using* SOMATiK.

address details if necessary and partly due to the limit on space in the *SOMATiK* case tool. The definition of this message in the Message Table used the same phrasing as that in the guidelines provided for the Collections Officers in their training manual and so 'check address is correct' became 'check if the customer has moved'. This is shown in Fig. 5.

Also, to create the SOMA specification a so-called "Trigger Event" was required. The accounts managed by Credit Card DMO all belonged to customers who were behind with repayment of Credit Card debt. It was possible that a Collections Officer might contact the customer, if that Collections Officer was working through the telephone lists. It was also possible that the customer might contact the bank to inform them of a change of address, or change of employment details, or even to ask advice if they were already aware that the next due payment would be missed, or would not be of the required amount. In any of these cases, as all the customers dealt with in this section were in debt, in essence, any of these contact situations could be regarded as notifying the bank of some type of default on a required payment. For this reason, the term 'default payment call' was considered an apt description of either the customer informing the bank of the situation, or the computer system flagging the account of that customer as being in debt and putting the customer onto one of the telephone lists. By choosing to regard the Conversations for Action as SOMA messages, and checking through the Conditions of Satisfaction an Agent Object Model was gradually constructed as shown in Fig. 6.

By constructing the above Agent Object Model the focus of the inquiry has *shifted*. The focus has moved from an emphasis on ways the action *might* unfold expressed by the Conversations for Action models to a focus on how the Collections Officer might interact with the technological support if undertaking the expressed action in the real world situation. The Agent Object Model is an expression of the basic functionality

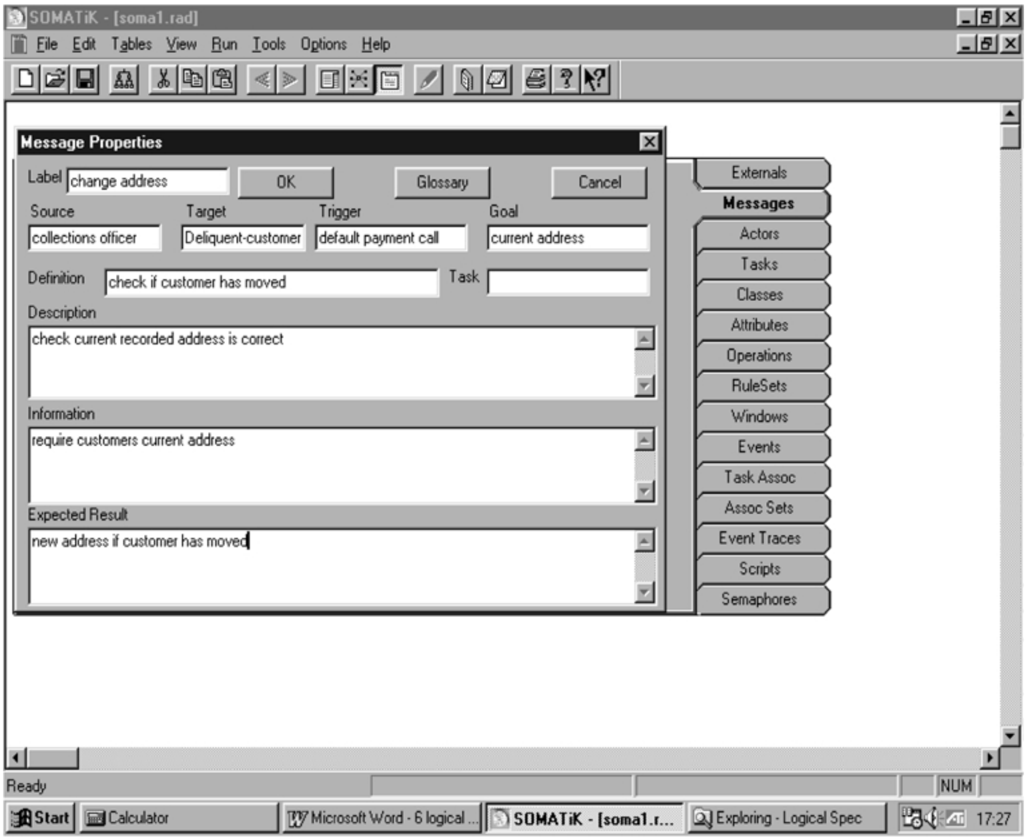

Fig. 5. *The table from* SOMATiK *describing the details of the message 'Change Address'.*

a potential serving technology-based information system would require. The move from conceptualising 'Conversations for Action' to conceptualising these conversations as messages between interactants is a somewhat easier move to make than the move from action to data, as occurs during *Client Led Design* (Stowell and West, 1994). The crucial point to note is that the Conversation for Action models and Agent Object Models are both used as epistemological devices throughout. Once those undertaking the inquiry have created a route from the focus on action to a focus on how to support that action, methods of constructing a technical specification for the supporting information system can appropriately be employed.

Future Development

There is a growing awareness amongst computer scientists (certainly amongst those involved in the SEBPC (1996) programme, see: Ramage, 2001), that the field of computer science does not offer any guidance in addressing the most difficult issues in information system design. The issues that cause concern are intimately related to the way in which information systems are actually created through the interactions of people undertaking purposeful action within social settings. Although, most computer scientists will argue that they have acknowledged the importance of the social, cultural and political issues involved, there is evidence that even the most recently developed engineering approaches are still underpinned by a rationalistic view of information and organisation. (See Ramage, 2001 for a useful summary of a discussion that took place at a workshop for the SEBPC programme at ICSM, Oxford, 1999). However, some members of the software engineering community are beginning to address these issues. For example, Edwards and Millea (2002) acknowledge that:

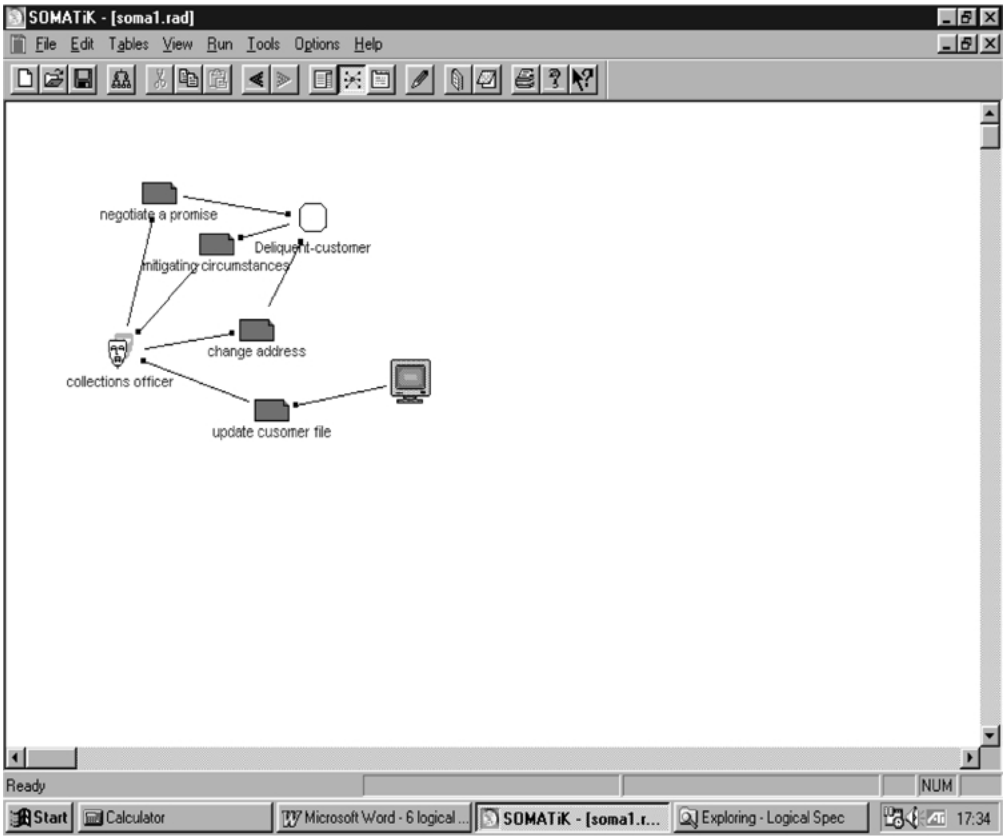

Fig. 6. *An Agent Object Model in* SOMATiK*, expressing how a collections officer undertaking the activity:* Identify customers experiencing difficulties*, might interact with the technology.*

> *Removing the black art of the software engineer in interpreting requirements from the application domain, or systems environment, would remove the weak link in the evolutionary feedback loop.*

They suggest one means of overcoming such difficulties might be to provide a method for formal mapping between the models of the business process and those of the technological implementation. Such a manoeuvre is immensely difficult and Edwards and Millea (2002) suggest that what is required are new, more natural programming languages empowering those using the technology "... to make their own changes". This suggestion seems to provide hope for the future of information system development, although the problem of supporting those involved in the situation of focus in deciding what changes to make, still remains.

Navigating through the Design Process

The need to move from a means of sense making in human social settings to constructing some software to operationalise a technology-based information system is the fundamental challenge currently facing the Information Systems community (Checkland and Scholes, 1999). Much effort has been directed at finding ways to cross the gap between action and the logical specification for a supporting technology-based information system, but, the previous work in this area has concentrated on devising ways to *bridge* the gap. The UMISD (1998) project has provided an opportunity to move a little closer to the possibility of a truly Client-Led approach to the creation of information systems with the notion of navigating through the space between ideas for action and a specification for a serving information system. To maintain a sense of coherence throughout the whole design process, the modelling methods, or navigational devices employed, all expressed an activity-based view of how the action might unfold in the real world situation of concern. To construct each set of models, further debate and interaction was required and those involved created a way through towards a view that expressed the shared appreciation that emerged through the debate. The Agent Object Model created as a first expression of a potential serving technology-based information system also provided an activity-based view. Crucially though, an underpinning cohesion was provided by employing the principles of inquiry underpinning Soft Systems Methodology Mode 2 (Checkland and Scholes, 1999) throughout the *entire* inquiry process. The emphasis throughout the UMISD (1998) project has been on developing practical methods of supporting Client-Led information system design and the ideas expressed here have been found useful within a dynamic business setting.

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