

# RESEARCH TECHNIQUES IN CONSTRUCTION INFORMATION TECHNOLOGY

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## ABSTRACT

*An important strategic issue in the use of IT by construction organisations is its use as an enabling technology for re-engineering the construction process. An examination of research reveals a tendency in IT research to adopt a mechanical systems view of an organisation's activities: the organisation is treated as a complex of 'black box' processes or sub-systems linked by information flows. It is suggested that although this may be necessary for the production of a computer model, a detailed study of the empirical world, which the model is intended to represent, is a prior requisite if the system designed is to meet its purposes.*

*We argue that the current assumptions made in construction IT research characterise a dominant 'rationalist' research paradigm. The main feature of this paradigm is belief in the objective reality of information or data: this has the effect of excluding from consideration the meaning or semantic content of information. A consequence is that the processes which are the interpretive context for information and data are ignored as matters for study. Information requirements within the system are treated as unproblematic, and do not seem to be adequately addressed by researchers within this paradigm.*

*We suggest that research where an insufficient examination of the empirical world is undertaken misrepresents the nature of the processes under study. It also highlights the limitations of a positivistic approach to research. We note the emergence of 'soft systems methodologies' as an attempt to address these issues, and a call within the construction IT research community to recognise their importance, albeit one which may as yet have gone unheeded.*

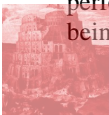
*In order to develop a more coherent research strategy for construction IT, we present an alternative, interpretive research paradigm which seeks to provide an appropriate footing on which to model socio-technical phenomena. We introduce the concept of participant observation-supported software development, which may help to remedy some of the problems identified.*

## KEYWORDS

*Information technology, Systems theory, Research paradigms, Methodology*

## INTRODUCTION

Though the construction industry uses IT widely, the degree to which construction organisations use IT for strategic management of their businesses is limited. O'Brien *et al* (1995), for example, suggest that '[firms ...] have been slow to adopt [...] those components of technology related to computer-integrated construction'. Thus, the strategic use of IT by construction organisations, through integration of data, information and processes, has, therefore, yet to be developed. Consequently, much research is currently being carried out intended to remedy this limitation and exploit the opportunities for strategic use of IT by construction organisations. In the UK, this research is being co-ordinated by the Construct IT Centre of Excellence, which 'has been set up to co-ordinate and promote research in IT in Construction in the UK to improve competitive performance of the UK construction industry' (Salford, 1996). The number, and variety of projects being undertaken in this field is, therefore, large (Reading, 1996).



One important aspect of strategic IT use is re-engineering the construction process. As an example of research being undertaken to this end, we will examine information available on some research into design management (Austin *et al*, 1994). This study is, we believe, representative of a particular research paradigm that is dominant in the field of construction IT. We suggest that this paradigm places severe limitations on the extent to which such studies can adequately represent the empirical. We present an alternative research paradigm which, we argue, allows a better representation of 'what is going on' in the real world under study. Thus, we see Austin *et al*'s study as representative of a more general problem in construction IT research, and, on a wider scale, as typical of the thinking that underlies much current management research. We pick this study not because it is in any way badly researched or badly presented, but rather for its typicality.

The aim of the researcher engaged in strategic IT management research is to model the organisation's business processes. The complexity of the interdependent processes in multi-disciplinary organisations and the consequent number of possible organisational permutations invite computer modelling. However, modellers have to bridge the gap between reality and model. How do they capture the real world? We suggest that while systems theory, properly applied, is, indeed, the bridge between an account of the world and the computer program or model, its role in such research is widely misunderstood.

## **THE RATIONALIST PARADIGM**

The dominant research paradigm in construction IT, elsewhere (Seymour and Rooke, 1995) referred to as the 'rationalist' paradigm, consists of several methodological assumptions and techniques.

"Chief among these is the attempt to import into management research the distinction which is drawn between subjective experience and objective reality. The use of this analytic device is intended to produce a neutral description of some field of human activity. Such a field is conceived of as a natural system. The aim is to identify the constituent elements of the system, show how they interact, and show how the system as a whole interacts with its environment. The attraction of this paradigm, applied at both the individual and organisational levels, is that it seems capable of providing specific and scientifically valid statements about the probability of organisational success and failure. It offers to show how key variables are related and how they can be managed to achieve successful outcomes" (*ibid* p.511).

In assuming the 'objective reality' of information or data and modelling the flow of information between processes, the methods of research adopted may, in fact, distort the reality of the design process. For instance, we show in the next section how the dichotomous treatment of information as 'informal' and 'formal' may lead to methodological problems in accurately representing the processes being modelled. Further, the standard way of modelling organisational activity within this paradigm seems to be systemic rather than systematic. In other words, the attempt is made to articulate in exact and comprehensive detail the intrinsic logic of the construction (or design) process; to construct a blueprint (or normative version) of how the process can be made to work most efficiently. In such research, as suggested below, little attention is paid to developing a methodological rigour with which to investigate the empirical world; its character is taken to be self-evident and, therefore, not needing any special study. In other words, it is unsystematic. This leads to parts of the organisational processes being classed as 'informal' or 'too confusing' (Austin *et al*, 1994; p.449). This is surprising since it has been realised both in the systems literature as a whole (Checkland & Scholes, 1990), and more specifically in the context of IT in construction that 'technology barriers are becoming less significant, and are in turn exposing structural and cultural

issues' (BT & DOE, 1995; p.22). Thus, it is these very 'structural and cultural issues' that are marginalised by the rationalist paradigm. The issue of understanding complex human activity demands both a systemic (by which we understand, holistic) *and* a systematic approach to research. Only in this way can methodological rigour be achieved. Whereas research under the current paradigm may be able to model very simple organisational processes in isolation, we believe it has limitations when investigating the issues that Checkland & Scholes identify, and that now demand attention.

The point needs to be stressed that researchers in IT are not in the same situation as natural scientists. In researching complex socio-technical phenomena, for the purposes of computer modelling, the theory, in the form of a model, must reflect the empirical reality. In natural science, the concepts which natural scientists use are 'first order constructs' (Schutz, 1971). They constitute the imposition of meaning on a natural order which, in itself, is meaning free. The objects of study in natural science neither know nor care about the fact that they are the subject of research, nor about the presence of the researcher. The researcher in natural science is free to impose his/her meanings and his/her causal explanations on the phenomena s/he observes. In the example examined below, this occurs in the conceptualisation of Functional Primitive Tasks, the blocks on which the model is built. In order to make this methodological step, only the formal provisions of the process are addressed while the so-called 'informal' are claimed to be ignored. However, in fact they are not ignored but selectively and tacitly employed in constructing a version of the 'formal'. In other words, all the taken-for-granted conventions of everyday life which make the design process possible (Durkheim, 1933) are unsystematically recruited to the purpose of modelling the 'formal'. As a result a model of the design process is produced in which little reference is made to those who carry out the process (i.e. designers) apart, perhaps from how they have to be controlled in order to fit it. The model purports to tell those who use it about the design process, and about how to optimise this process, without anywhere discussing how the model's creators will find out about what designers do.

We suggest then that researchers in IT must address the fact that as part of an integrated research method, they will have to carry out social research. As such, they (the researchers) will use their socially-gained ability to make sense of the world around them and understand what people tell them. In this respect they are no different from the people they research, and the models they produce are no more valid than those employed by their subjects. Further, their 'objects of study' (designers in the case cited) will attribute significance to both the presence of the researcher and to the questions s/he asks. The researcher will come upon a world which is already described; their own descriptions are in competition with those of the people whose activities they research.

We will discuss how, in order to discover what the systems modeller needs to know to make his/her system work, s/he needs a systematic, rigorous approach when looking at the empirical world of the designers. We suggest that ethnography in the naturalistic tradition provides that approach. In respecting the nature of the empirical world, and taking as objects of study the multiple viewpoints of people involved in the process, naturalistic research does not seek to preimpose a theoretical framework onto the design process. It does not start with the presumption that design is a system, but seeks to give an account of design that will serve the purpose of constructing the computer model that is the ultimate aim of the IT researcher. The researcher, adopting naturalistic methods can produce an ethnography, from which s/he (or others) could develop the system, and from which the programme could be written.

Systems theory may then be put to its proper use, providing a bridge between the ethnography and the program(mer). Thus, research into IT may be both systematic and systemic. The rationalist paradigm, with its appeal to natural science method, cannot provide the systematic, rigorous approach to researching social processes not because the method is in any way deficient in its rigour, or because it is unsystematic, but because the concepts of 'systematic' and 'rigour' embodied in the 'scientific' approach are inapplicable to the methods of investigation needed for social research. We show below how the attempt to apply natural science methods to a problem for which they were never designed results in methodological problems.

We support the view of Austin *et al* that the design process would benefit from more proactive management, and believe that IT has a large part to play in that. However, the level of technology available, and the applications for which it is now being adopted demand the adoption of radically different concepts of process modelling to those that the construction world currently seems to hold. These models must be firmly grounded in the empirical world. As such researchers will require a deep-seated knowledge of the design process, in order to first produce a systems model of it, and then to carry out computer manipulations of this model. It would seem important when looking at the design process with a view to modelling it *as* a system to first investigate and produce an account of the process 'as is', through the eyes of the designers. We would point out, along with Morgan (1986) that this conceptualisation of design is simply a 'way of seeing' the empirical world introduced by researchers. As such they are no more valid than the 'ways of seeing' of members of the organisation.

## THE STUDY

The study examined in this paper (Austin *et al*, 1994) is concerned with developing an approach to modelling the design process with a view to optimising the order in which design tasks are performed. They suggest that traditionally the design process has been subject to somewhat *ad hoc* management; the 'traditional ordering [of design tasks] is based on experience but modern complex projects require a more rigorous approach' (*ibid* p. 445). Further 'a properly managed, systematic approach to the whole building design process is essential to ensure smooth and harmonious progress in construction' (p.445). They suggest that an important feature of the design process is that it takes place in an iterative manner, with design tasks being interdependent. They argue that this feature of the process makes traditional network analysis methods of planning unsuitable: network analysis and bar charts are 'ideally suited to deterministic processes such as construction [...] but are unsuitable when handling a process that involves iterations or the choice of alternatives' (p.446). With traditional planning methods, in order to represent these iterations, they suggest 'a loop would have to be introduced into the network, which is logically impossible' (p.447).

As part of the development of their model of design, what they term a Design Process Model (DPM), Austin *et al* suggest 'information is seen as the fuel of design. The principal design activity of any project is evaluating and processing information and communicating that information between various parties' (p.446). Thus, the authors conceptualise design as 'a system consisting of processes and tasks, linked by interfaces', later, explaining that here they will model only the interfaces (*op cit* p.447). The technique they use for modelling the design process, called Data Flow Diagrams (DFD), are 'hierarchical in nature', 'not concerned with how processes are performed' and 'view systems from an information point of view' (p.447). They suggest, 'every design task shown in the DFDs is treated as a 'black box' (Addis 1990). How each task is performed is of no concern in the model [...] The DFDs map the information flowing into and out of each task. The design process model concentrates on the information processed by various design tasks and not how the information is processed or manipulated' (p.448).

As a further dimension to the model, they suggest that the design process 'can be considered as two separate functions: design work and management work' (p.449). They 'define management functions as activities that try to ensure that design work proceeds smoothly'. As such, 'DFDs do not impose or record any managerial control on the timing of the flow of information and, subsequently, do not dictate an order in which the tasks should be performed'. Austin *et al* ignore the management functions in their model, suggesting, 'these functions tend to be specific to individual projects and organisations and will not be modelled' (p.449).

By understanding the design process in terms of the DPM, further analysis can be performed to enable the most appropriate sequence of design activities to be produced. They, again, point out the limitations of traditional network analysis in attempting to do this, suggesting it is 'unable to cope with the level of abstraction and detail needed to plan the design phase of a project with any measure of success' (p.449). As a method for dealing with the interdependent tasks, the authors introduce the concept of the 'Design Structure Matrix' (DSM) where tasks are represented along the axes of a matrix, and the dependency between two tasks is indicated in the appropriate row/column intersection of the two tasks. They suggest that the DSM technique requires 'the design planner to have a detailed understanding of the information requirements of tasks likely to be performed', but acknowledge that 'for a large [...] process such as building design a detailed appreciation of the information transfers may not be possible' (p.450).

In order to overcome this problem they introduce the concept of a Functional Primitive Task (FPT) which is one of 'the tasks which are not divided into subtasks [and thus] are most interesting from a planning or scheduling point of view' (p.450). After all the FPTs are represented on the DSM, inspection of the matrix allows those tasks which are 'coupled' or interdependent to be identified as a block. The block of coupled tasks can then be manipulated to identify what information is required to 'uncouple' them, and which of that information it would be most expedient to estimate. This latter process is performed using 'engineering judgement', with the information needed being further subdivided into 'sensitive' and 'insensitive' information. By estimating the insensitive information, the model allows tasks to be uncoupled, and rescheduled in the most effective order according to information flows. The results of this would then be fed back into a critical path network, where the time each task takes to complete, and the number of design iterations can be estimated. The final result is what they claim is an 'accurate and workable design programme' which will be 'a major asset in planning and managing the design phase' (p.453).

## **THE PRACTITIONERS' POINT OF VIEW**

In the wider context of their study, the authors (*ibid*) suggested, following Bennett *et al* (1988), that 'multidisciplinary practices [...] have the disadvantage that the communication is often informal and not documented' (p.446). Informal communication is presumably seen to be a disadvantage because it presents difficulties to the researcher attempting to model the design process. As part of their model, Austin *et al*, distinguish between 'formal' and 'informal' information, and choose to model simply the 'formal' information transfers because, 'it was deemed too time-consuming and confusing to try and model informal or formal oral communication' (p.449). It is unclear how Austin *et al* will apply the definition of 'formal' information transfer (i.e. 'a transfer [...] via the medium of paper or computer [...] [that] can be documented and recorded (p.449)), when carrying out the empirical work necessary for the model's success. However, there is an ambiguity about the phrasing here which is symptomatic of the rationalist paradigm. It may be read as saying that the presence of informal communication is actually a disadvantage in the design process. Such ambiguity arises because no reference is made to the points of view of those who are being researched. As is typical of research carried out within this paradigm, the subject's point of view is

first taken for granted and then overridden. Thus, the solution that is offered is to exclude the troublesome informal communication from the finished model. Our alternative approach, which takes the point of view of the subject as paramount, suggests that informal communication in the design process occurs for good reasons. It is the role of the researcher to discover what the reasons are, a necessary prelude to deciding whether or not they can be dispensed with.

As it is, Austin *et al* seem to present us with two possible scenarios. First, the informal information transfer may simply not be taken into account. This will mean simply documenting every transfer of paper the designer makes and ignoring everything else s/he does. The system designers may choose to ignore all transfers which are not in the form they conceptualise as representing a 'formal' information transfer. We would suggest that this approach is potentially problematic, with two possible consequences: the information obtained for use in the model may be incomplete for the purposes of ordering the tasks; and worse the information obtained may simply be wrong. This approach may either wrongly or incompletely represent the reality of the design process. For example, the 'informal' parts of the design process, the questions, queries, formal and informal requests for information, and the formal and informal verbal communication (a 'chat in the corridor', a 'quick fax explaining that steelwork detail', the assertion 'Oh, that bit's the same as on the other job we did') may be the major part of what 'design' consists of. If they are ignored, a large part of the process may be 'lost'.

Second, the (existing) informal transfers may be modelled as formal transfers. This will require changes in the way people work, for example, writing down the information that would have been transferred orally to create a 'formal' document. As such, from a methodological point of view, the introduction and creation of new parts of the process, in what may be a specious manner seems to create large problems. On a more practical level, it is not clear whether these new formalised transfers will make the process more efficient: they may involve more paperwork and more time and inconvenience for designers. It may be problematic for researchers to formalise parts of a process that seem to have functioned efficiently as 'informal' (possibly leading to lower efficiency), simply to provide input for a model that will make the process efficient in a different manner.

It is frequently observed that design takes place *despite* the 'formal' system: as such, the 'formal system', no matter how it is defined, can never be *the* system. A representation of the 'formal' system (in terms of a design process model) contains any number of what Garfinkel (1967) calls "'etc" assumptions'. These are the taken-for-granted 'ways of doing things around here', the 'design culture' that everyone makes use of. The model presented here ignores all the "etc" assumptions, all the taken-for-granted assumptions of the members and how they contribute to realising a design. While its creators are perfectly entitled to pursue this agenda, we would suggest that due to the limitations of the methodological assumptions upon which the model is based, to some extent the agenda is predefined, and is limited. We will show below that further methodological problems with the model arise as a result of the same necessity to interface the model's abstraction to the reality of designers.

That this problem is indeed symptomatic of the dominant approach in construction management is illustrated by a recent discussion of construction management theory (Betts and Lansley 1993). Betts and Lansley classify the contribution of various types of work in a hierarchical manner: at the lowest level are '*Insights* [...] [whose] contribution lies largely in the data. [...] [They] do not generate new models or theories'. At the highest level, there is '*Theory building/modifying*. [...] [D]evelopments of [...] [mainstream management] theory to fit construction would fall here' (*op cit* p.245). In other words, the practical thinking done by managers lies at the lower end of the scale,

whereas the theoretical thinking done by researchers lies at the top. In a later paper, this same theory building is seen as necessary to produce 'global visions and understanding of the construction industry' (Betts and Wood-Harper, 1994 p.552). We suggest the categories being presented here follow a similar logic to the ones that are drawn when informal communication is described as a 'disadvantage'. In construction management, researchers adopting the standard methodological conventions set out to transcend, correct or discard the 'practical theorising' of managers, issues we explore in Seymour *et al* (1996). In so doing, we would suggest that the research community is doing the organisations it studies a disservice, and treating their members and the way they operate with less respect than they deserve.

Austin *et al* set out to model information flows, but information does not exist in a vacuum. Information means something to someone in a particular context. Communication in the design process is a matter of establishing shared meaning concerning, for example, 'what that drawing represents'. We acknowledge that as a result of the culture that exists (in this respect we embrace Eglin's (1980) understanding of 'Culture as method'), there are many taken-for-granted meanings among and between the groups involved: to be a designer, you will know what a drawing represents without needing to negotiate its significance with other designers. Nonetheless, much of the meaning is situated: it is negotiated and renegotiated through an iterative intersubjective process, in a highly contextualised manner. This is recognised by Checkland and Scholes (1990), when they suggest 'An 'information system', in the true sense, entails data manipulation and meaning attribution' (p.55). They suggest that action takes place under a *Weltanschauung* or worldview whereby participants attribute meaning to the perceived world.

In this respect, people establish the significance of a piece of information and use that as a resource for design. Others in the design process (especially if it is multi-disciplinary) may not attach the same significance to that information. Thus, significance is not objectively 'in' the information. To exclude from consideration the meaning and to ignore the semantic content of information in the design process may misrepresent the work involved and the information flowing in the process under study. A further consequence is that the complex processes by which the significance is established and which are the interpretive context for information and data are ignored as matters for study.

## **THE DANGERS OF ABSTRACTION**

We discussed above how, at the beginning of the modelling process, the authors rejected conventional planning techniques as they were deemed unsuitable for modelling interdependent tasks. Network analysis techniques were rejected as an interdependent set of tasks would involve 'a loop [...] [in] the network, which is logically impossible' (p.447). This is because some pairs of design tasks can exist where neither task can start until the other ends. This is clearly a paradox. But why should interdependent tasks be modelled in this way to begin with? It would seem expedient and perfectly logical to model them as parallel activities which must begin and end at the same time. It would be relatively easy to build such a device into conventional network analysis.

We suggest that the generation of this paradox is due to Austin *et al*'s own commitment to systems thinking and their lack of a deep understanding of critical path analysis. Their own DFD model excludes any consideration of time; it is only by excluding time that they conceive of interdependent tasks in the paradoxical manner they do. Having developed this paradoxical conception, they then try to import it into the network analysis. Finally they criticise the network analysis for showing up the paradoxical nature of their concept. We suggest that it is not network analysis which is lacking, but the way Austin *et al* think about interdependent tasks.

We derive two lessons from this. First, when building abstract models, it is inevitable that we leave out much of what makes the world what it is. This, as we have seen, can lead to error. We recognise that this abstraction is necessary in developing computer software, but insist that it must be balanced by a deep and comprehensive appreciation of practice. Such an appreciation is not easily or quickly achieved. We suggest that only through intensive qualitative study can it be guaranteed.

Second, while abstractions are inevitable, the abstractions made by practitioners situated in real working processes are likely to be more realistic than those made by outsiders. Practitioners' abstractions are continually applied, tested and adjusted against the constraints of day-to-day practice. The qualitative approach which we propose is focused not simply upon what practitioners do, but more precisely on what they think they do. We regard practitioners' abstractions as part of our data, not as competing theories to be criticised.

### **THE NEED FOR EMPIRICALLY-GROUNDED STUDY**

Although they are subsequently ignored in Austin *et al's* model, ('The design process model concentrates on the information processed by various design tasks and not how the information is processed or manipulated' (p.449)), the identification of the 'black box' tasks is crucial to the model. The account shows how the tasks are defined as 'Functional Primitive Tasks' (FPT), but how the FPTs are identified is unclear. This is an empirical question and, as such, it is something that can only be answered by research. In other words, it must be answered by talking to designers to obtain an account *in their own words* concerning what they are doing, and crucially what *they* think they are doing. Thus, in order to identify the FPTs for a project, there is a need to look at both what the designers do, and the context in which they do it. In order to define the FPTs, a deep and detailed knowledge of the design process is needed, one which sees design through the eyes of the designers.

How this deep and detailed knowledge will be gained is not addressed in the account, nor in any others we have read concerned with process modelling. In not dealing with this issue, we must assume that the architects of these systems believe the knowledge will be easy to obtain, that acquisition of the deep and detailed situated knowledge will be unproblematic. As an example of this paradigm, Checkland and Scholes point to 'the poverty-stricken stages of systems analysis and design methodologies in which information requirements analysis is assumed to be straightforward, or organisations are documented as a set of unproblematic entities and functions' (1990, p.57). We describe this as the belief in an objective reality of information. We use the term 'objective' to suggest that the information is seen as similar to a 'physical object': it can be 'picked up'. The information is 'there for the taking' and obtaining it will present neither methodological nor practical problems. However, we would suggest that different people will have different ideas of what the FPTs consist of, even assuming that designers think in terms of FPTs at all (a not unproblematic assumption).

### **THE ALTERNATIVE APPROACH**

We have identified a number of methodological problems inherent in the current approach to research into construction IT. We will use the rest of the paper to outline an alternative research paradigm which we believe holds the answers to many of these criticisms.

One strand of this approach originates in the work of Weber and his conception of *Vestehende*. This German word translates into English as 'understanding'. It refers however to the understanding of another's point of view, rather than to the kind of causal understanding which is the aim of the rationalist approach. It amounts to a recognition that to fully understand people's attitudes and



beliefs, is to understand how they perceive the world (Weber, 1933). A second strand originates with the work of the American social psychologist, G.H. Mead. Even more than Weber, Mead places interaction between individuals at the centre of his analysis. As some guiding principles for developing this alternative approach, we are informed by Blumer (1967), himself influenced by Mead. Blumer suggests that an empirical science, 'designed to yield verifiable knowledge of human group life and human conduct' must meet a fundamental criterion. This is well expressed by Blumer:

'an empirical science presupposes the existence of an empirical world. Such an empirical world exists as something available for observation, study, and analysis. It *stands over against* the scientific observer, with a character that has to be dug out through observation, study and analysis. This empirical world must forever be the central point of concern. It is the point of departure and the point of return in the case of empirical science. It is the testing ground for any assertions made about the empirical world. "Reality" for empirical science only exists in the empirical world, can be sought only there, and can be verified only there [...]' (*op cit* p.21, italics in original)

As such:

'Methodology refers to, or covers, the principles that underlie and guide the process of studying the obdurate character of the empirical world. There are three highly important points implied by this conception of methodology:

1. methodology embraces the entire scientific quest and not merely some selected portion or aspect of that quest;
2. each part of the scientific quest as well as the complete scientific act, itself, has to fit the obdurate character of the empirical world under study; therefore methods of study are subservient to that world and should be subject to test by it;  
and
3. the empirical world under study and not some model of scientific inquiry provides the ultimate and decisive answer to the test.' (*ibid* p.23)

In other words, the nature of the actual design process, *all* parts of it, both formal and informal, what the design process 'is', what it means to 'do' design, must be the starting point, the focus, the culmination and the measure of all models and theoretical activity. As such, in order to 'build a model' of the design process, the first thing that will be required is an understanding of this process. This understanding is not simply a causal understanding that 'in order to do task F, tasks A, C, and P must be completed'. The understanding that is required is a *Verstehen* understanding of the whole process, from the point of view of those involved in it. In short, the researcher cannot build a meaningful model if s/he does not understand 'what goes on' in design, through the eyes of the people who 'do' design. An account of design, produced as a result of rigorous research will allow the researcher to find out what design 'is'. It is only then that any kind of informed decision can be made on which parts of the empirical world to ignore in the model. In the rationalist approach we have described, the form of the model is decided on beforehand: the researcher decides on what the design process consists of. S/he then decides which parts of it to investigate and which not to.

We have called this new approach 'participant observation-supported software development'; it is informed by the work of Hughes *et al* (1994). In it, the researcher's role is to give a fine-grained empirical account of the organisational reality. The researcher aims to empathise with his/her informants, to see the organisation through their eyes. As such the researcher is part of the research

process, and cannot claim to be giving an objective account in the conventional sense of the word. The researcher is concerned with what people think they are doing, not what they may be said to be doing from any, claimed neutral standpoint (Vaill, 1975). The researcher is there to report how and why people 'do design' as they do. It is recognised and acknowledged that the report will not represent a 'single truth', as there is no single truth to be had. The researcher aims to report the multiple perspectives of his/her informants, in the particular settings in which they occur. It is recognised that these accounts are highly situated, and given for a particular purpose. Instead of attempting to amalgamate these accounts into one 'meta-version' (Seymour *et al.*, 1993), the interpretive researcher treats the context of the various reports as part of the data. The final account is presented as a situated one, and by being invited to examine the context of the data, the reader of the account is able to reflexively engage with it. This is in direct contrast to an account produced under the rationalist paradigm, where a decontextualised, 'objective' account is given, as if it were reporting a 'scientific law'. The account is highly descriptive: the researcher is not there to make prescriptions about what should be, especially under the guise of describing what 'is' because s/he is the 'expert'. Thus, the relationship between the researcher and the informant is analogous to that between teacher and pupil. The researcher is there to learn 'what the world means to the other fellow'. In an account given under a research paradigm which recognises only one 'true', 'objective' account, prescription often happens when the researcher *qua* expert presumes to select from a complex, integrated culture only that which s/he understands and to see the rest as mumbo-jumbo. Thus the key to such an approach is that the researcher take seriously the worldviews of the people concerned. This involves resisting the temptation to dismiss these views in favour of some 'real' version of the facts, however self-evidently correct this version may appear. This principle was stated many years ago by W.I. Thomas: 'If men define situations as real, they are real in their consequences' (Thomas, 1964).

From this detailed account, the systems modeller can then make informed decisions concerning what features of the empirical world to include in the model (and more importantly which parts to reject). The rigour in this process is that the nature of these decisions can be traced back to the empirical world, and as such they are neither arbitrary nor uninformed. This is not to say the decisions will somehow be 'self-evident' in the data. The decisions made by the modeller will be 'policy decisions'. Thus, it is also possible for a future researcher to re-examine the data and to make his/her own policy decisions on what to model and what not to. As such, it is not the intention of the interpretive researcher to make these policy decisions, merely to provide an account to inform the policy makers. The researcher *may* wish to suggest to the modeller which parts of the empirical world to include in his/her model, but in this respect the researcher's opinion is no more valid than that of any other competent member of society. The scientific myth that gives 'expert status' to the researcher is dispelled under this approach.

## CONCLUSIONS

We have identified three problems with the dominant research approach in construction IT:-

1. the treatment of the informal communication that is a part of all organisational processes - the rationalist approach overrides the actor's point of view;
2. the creation of paradoxes through abstraction; and
3. the failure to realise the difficulties involved in identifying the FPTs.

All these problems are related, and all lead to methodological difficulties. The problems spring from a failure to engage with the nature of the empirical world - a nature that consists in the ideas of those who make it up.

We have presented an alternative research paradigm that we believe better 'fit[s] the obdurate character of the empirical world under study' (Blumer, 1967; p.24). This approach takes the view that what is essential about business processes is the ideas held by those who participate in them. The paradigm suggests that people act on the basis of what things mean to them in particular contexts; that the meaning of things arises out of the social interaction that occurs in such contexts; that 'meanings are handled in, and modified through, an [iterative, intersubjective] interpretive process used by the person in dealing with the things s/he encounters.' (*ibid* p.2). Thus, this paradigm takes as *prima facie* 'objects of study' the processes used by actors to establish, negotiate and renegotiate meaning in a highly situated manner. By taking seriously the worldview of the actors in the process, and by considering what the process means to them, the approach allows a fine-grained, rigorous account of, for example, the design process to be produced. In so doing, this approach allows identification of *all* parts of the process to be made visible, not simply what is deemed important by the application of an arbitrary theoretical model. The account allows those who wish to produce such a model to make informed non-arbitrary decisions about which parts of the empirical world to include in the model.

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