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Validating the Four-Paradigm Theory of Information Systems Development

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**VALIDATING THE FOUR-PARADIGM THEORY
OF INFORMATION SYSTEMS DEVELOPMENT**

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ABSTRACT

The objective of this research is to evaluate, using field study methods, the four-paradigm theory of information systems development (Hirschheim, Klein & Lyytinen 1995). The theory broadly states that systems developers hold key assumptions that may be grouped together and classified into paradigms, and that these paradigms influence the information systems development process. The context for the research is a qualitative study of the process of constructing requirements and implementing information systems in two UK public hospitals. In contrast to previous, theoretical, research our work has involved a field study approach to theory validation, and the main results are, firstly that assumptions at the start of a project of the majority of developers fall under more than one paradigm, and that it cannot be said, in contrast to the theory's prediction, that one of these paradigms is dominant. Secondly, considering developer behaviour in the process of systems development, we found, as the theory predicts, that one paradigm, the functionalist paradigm, is dominant. Thirdly, we did not find evidence that the assumptions of the majority of developers influenced the development process.

1. INTRODUCTION

The four-paradigm 'theory' of information systems development (ISD), due to Hirschheim and Klein (1989) and Hirschheim, Klein and Lytinen (1995) (subsequently referred to as HK and HKL), has been of major importance in the field of information systems. They based this theory on the work of Burrell and Morgan (1979). The theory broadly states that systems developers hold certain key assumptions that may be grouped together and classified into paradigms, and that these paradigms influence the process whereby developers construct information systems. In highlighting the narrowness of the traditional functionalist approach to ISD, the paradigms have played a central role in asking our IS research community to reflect on the importance of social and organizational factors in the development and use of information systems.

However, we do not know whether there is an empirical basis to the theory, and the research described here concerns theory validation in two research situations, using a field study approach, in two public National Health Service (NHS) hospitals (appendix 1) in the north of England from 1998-2000, within the context of a

qualitative study focusing mainly on social factors affecting the process of requirements construction. Paper structure is: introduction, four-paradigm theory, research objectives; research methodology; results, results summary and conclusions.

2. THE FOUR-PARADIGM THEORY

In this subsection, the nature of HKL paradigms will be introduced by referring to the work of Burrell and Morgan. It will also discuss our three research propositions based on HKL's work.

2.1 Introduction to paradigm theory

The meaning of the term paradigm is stated as (B & M 1979:23) *a term which is intended to emphasise the commonality of perspective which binds the work of a group of theorists together in such a way that they can be usefully regarded as approaching social theory within the bounds of the same problematic.* They synthesize theories of organization based on (1) a philosophy of social science, using a subjective-objective dimension, and (2) a theory of society, using a regulation-radical change dimension. They present four paradigms for the analysis of social theory in organizations by combining these dimensions, as shown in figure 1.

FIGURE 1. FOUR PARADIGMS OF BURRELL AND MORGAN

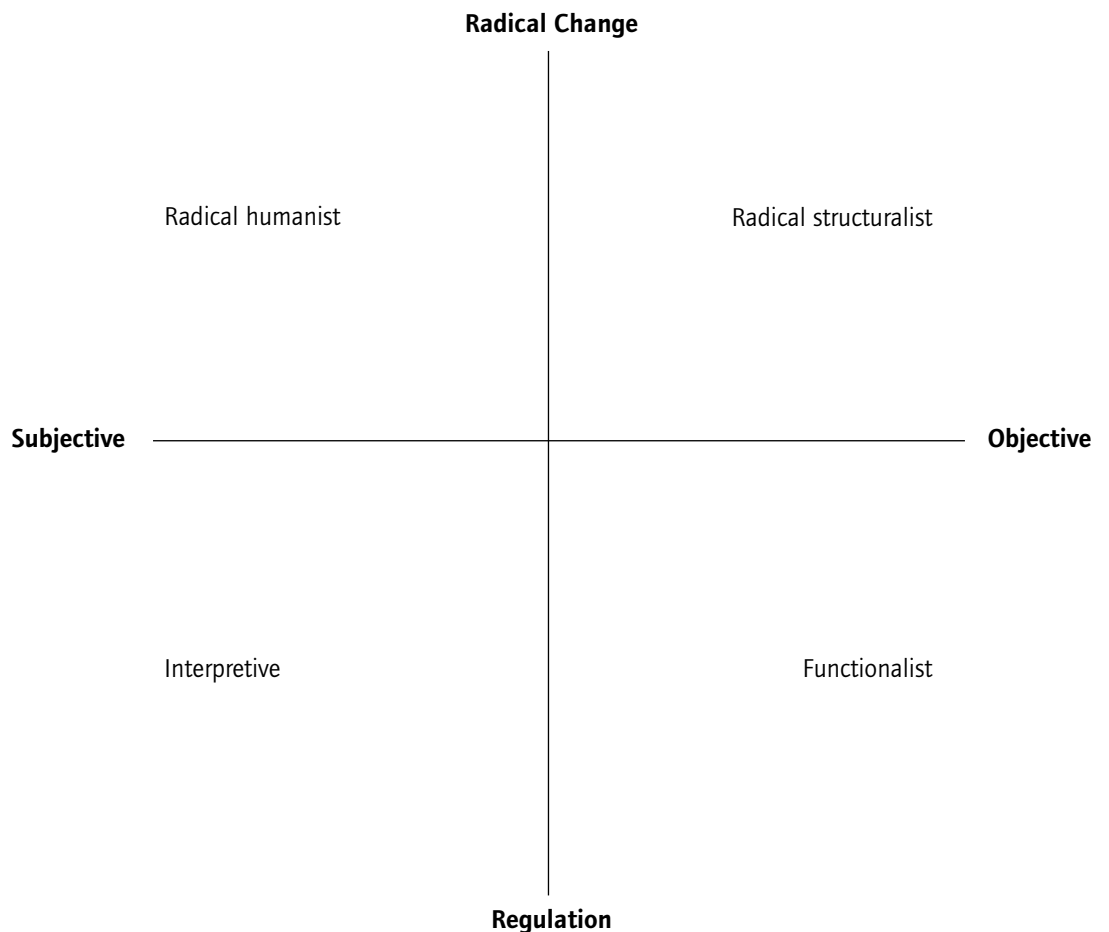


Figure 1 consists of four assumptions about the nature or philosophy of social science. The assumptions are:

Ontological Assumptions: These concern the existence of the social world. At one extreme, the social world is considered external to the individual: 'reality' is objective (realism). At the other extreme, the social world is considered the product of individual consciousness: 'reality' is subjective (nominalism).

Epistemological Assumptions: These concern the grounds of knowledge. At one extreme, knowledge is hard, real, tangible: it can be communicated tangibly (positivism). At other extreme, knowledge is soft, subjective, spiritual: it can only be personally experienced (anti-positivism).

Human Nature Assumptions: These concern human relationships with their social environment. At one extreme, humans are viewed as being conditioned or determined by their environment (determinism). At the other extreme, humans are viewed as the creators of their environment: they possess free will (voluntarism).

Methodology Assumptions: These concern the method used to investigate and obtain knowledge of the social world. At one extreme, method views social world as external, objective reality (nomothetic). At the other extreme, method views social world as created by the subjective experience of individuals (ideographic).

Regulation - Radical change dimension

This dimension consists of assumptions about the nature of society. *Regulation:* Assumptions from the regulation perspective are that the social world is stable, cohesive and integrated with underlying unity. There is an emphasis on consensus (voluntary) between humans and needs satisfaction and the stabilising effect of structure on interaction involved in societal regeneration. The status quo is continually maintained or changes only slowly - conflict and differences are largely absent. *Radical Change:* Assumptions from the radical change perspective are that the social world is unstable and divided, with deep-seated structural conflict, dissension and modes of domination. It emphasises the unstable nature of structure or interaction that produces new structure. The status quo changes rapidly and forces exist that tend to change society radically.

2.2 Characteristics of the paradigms used

2.2.1 Functionalist paradigm

The organization is a concrete entity rarely undergoing radical change, and it exerts influence on individuals to maintain the status quo.

The organization has a concrete existence - regularities exist:

- *high degree of planning (strategic and operational)*
- *day to day organizational production*
- *visible organizational hierarchy*
- *fixed job titles*
- *perception of physical structures and boundaries*
- *standardisation and rational decision-making*

Stability and the status quo are important. There is a focus on the organization as: an orderly, stable entity that only rarely undergo radical change, and, exerting influence on individuals' behaviour to maintain the status quo.

Functionalist paradigm applied to ISD requirements process

- needs and requirements already exist and will be discovered through systematic means
- requirements do not depend on stakeholders' perceptions - stakeholders are biased and irrational and, to eliminate subjective distortion, should not be consulted
- the systems developer is a neutral technical expert who builds requirements with management help.

2.2.2 Interpretive paradigm

The organization is a social construction created by the process of human interaction. Radical change is infrequent and consensus is important to maintain the status quo. The organization exists as a result of consensus - people agree it is there. For example:

- *consensus emerges from a social construction process of human interaction*
- *reality exists in human consciousness only as such a consensus*
- *intangible view of reality*
- *thinking is subjective*

Language, communication and interaction are important. There is a focus on the human interaction process whereby radical change is infrequent. The process whereby consensus is obtained to maintain the status quo is critically important.

Paradigm applied to ISD requirements process

- needs and requirements are socially constructed
- requirements emerge as stakeholders' perceptions change and as they learn - they do not exist at beginning of development
- stakeholders are best placed to build requirements as they are most familiar with their jobs and they should be consulted throughout ISD
- the systems developer assists as a facilitating *change agent*

2.2.3 Radical structuralist paradigm

Organizations are shaped by *social conflict* between production owners and labour, which is experienced as objective reality by the oppressed classes (labour). This conflict has the potential for radical change. The organization is experienced as concrete, objective reality by the oppressed classes:

- reality arises from the fundamental social conflict between the production owners and labour (the class struggle).
- structural economic and social differences, such as the class system, are due to the capitalist mode of production.

There is a focus on the ways in which power and domination perpetuate this reality, and there is also a focus on the tendency of society to create conflict and instability. The potential for radical change always exists and strong forces are pervasive in society. For example management control of labour and labour's need to escape such control

Paradigm applied to ISD requirements process

- workers should not build their requirements as they do not possess the necessary expertise and are not usually aware of their best interests
- requirements should be built by worker representatives with the systems developer as their *agent*

2.2.4 Radical humanist paradigm

Organizations are shaped by social constructions arising from the subjective views of their participants. Dissension creates radical change to status quo to potentially emancipate participants. The organization exists as a social construction - social constructions are a product of human consciousness:

- it is fragile and easily liable to change
- such change is healthy and should be encouraged.

There is a proliferation of subjective viewpoints and interests, which naturally differ and conflict. Fluidity, flexibility, ease of change and adaptability are important characteristics. There is a focus on the process of interaction characterised by dissension whereby radical change may occur to the status quo. Such change has the potential to emancipate individuals.

Paradigm applied to ISD requirements process

- requirements are constructed by a process of mutual agreement from organizational stakeholders, involving sense-making and discussion.
- the process provides opportunity for creative individuals to remove restraints by radically improving working conditions.

Finally, we present the theory as in the form of three main propositions, which we have inferred from the referenced publications.

2.3 Proposition 1: *Systems developers hold a wide range of assumptions relevant to the ISD process that may be grouped together and classified into paradigms*

All systems developers approach the development task with a number of explicit and implicit assumptions about, for example, the nature of human organizations, the nature of the design task, the value of technology, and what is expected of them.
HKL (1995: 46)

The most fundamental set of assumptions adopted by a professional community that allows its members to share similar perceptions and engage in commonly shared practices is called a 'paradigm'. Typically, a paradigm consists of assumptions about knowledge and how to acquire it, and about the physical and social world. HK (1989: 1201)

HKL classified similar types of assumptions together into four paradigms of ISD - *functionalism, social relativism, radical structuralism and neohumanism* (1995: 48) - based on the four paradigms of socio-organizational research of Burrell and Morgan (1979).

2.4 Proposition 2: Systems developers exhibit aspects of behaviour during the ISD process that may be grouped together and classified into paradigms

The assumptions can either be held by the systems developers or embedded in their preferred development approach.

HKL (1995: 46)

The theory provides *paradigm-specific definitions* (our term) that characterise key behavioural aspects of ISD for each of the four paradigms (1995: 49-56). The aspects broadly concern ISD-related activities or decisions and are:

... archetypical characterizations of how systems analysts might behave if they try to put the tenets of each paradigm into practice
HKL (1995: 49)

Altogether, definitions for 21 behavioural aspects for each of the four paradigms are provided, under four headings: (1) implications for ISD, (2) paradigm limitations and their implications for the definition of system goals, (3) implications for ISD functions, (4) differences in developed systems. We show definitions of three of these aspects for the functionalist paradigm in table 1.

2.5 Proposition 3: Assumptions influence the process of ISD as well as IS use

.. these assumptions play a central role in guiding the information systems development process. (HKL 1995: 46)

We are thus invited to view developer assumptions as being critical in influencing their ISD behaviour.

We validated the three components using different approaches. The first approach (proposition 1) involved operationalisation of the paradigms using a questionnaire, completed by developers. The second (proposition 2) involved observing developer behaviour over the duration of a project and matching it against the paradigm-specific definitions, which define key aspects of ISD. The first approach thus

ascertained *mental attitudes* while the second approach observed *manifest behaviour*. The third approach (proposition 3) analysed the results of the earlier approaches to investigate whether there was evidence that developer assumptions influenced their ISD behaviour.

3. RESEARCH OBJECTIVES

3.1 Approach 1 - paradigmatic assumptions of developers

Approach 1 involved operationalisation of the paradigms to investigate their applicability to the assumptions of developers. We designed a questionnaire to ascertain these *paradigmatic assumptions* (our term for the HKL types of assumptions), using a multiple-choice format and asking five questions based on ontological, epistemological, human nature, change and conflict assumptions (Burrell and Morgan 1979) from which the paradigms were originally derived. To determine what paradigm was indicated by a given response, we provided reference answers to each question for each of the four paradigms. Six respondents were interviewed in organization 1 and nine in organization 2, explaining questions and possible responses. Questioning was conducted early in requirements construction stage, in organization 1 at the organizational level, while in organization 2 it was at the IS requirements level (as shown in Appendix 2). This change in questioning was due to our judgement that the latter would provide more detailed insight. In organization 2, the operationalisation exercise was also conducted after system implementation, to investigate whether developer assumptions had changed as a result of project involvement. To validate the theory, we aimed to answer the following research questions:

RQ1 - Do developers find it easy to match their appropriate paradigmatic assumptions to the questionnaire choices?

We wanted to establish whether paradigmatic assumptions were easily identifiable by developers and whether they corresponded to their assumptions, hence whether the paradigms were generally applicable.

TABLE 1. FUNCTIONALIST PARADIGM: PARADIGM-SPECIFIC DEFINITIONS FOR IMPLICATIONS FOR ISD

Role of IS Designer	Nature of IS Application	Objectives for Design and Use of IS
The EXPERT, similar to an engineer who masters the means for achieving given ends	IS is built around deterministic laws of human behaviour and technology to gain optimal control of socio-economic environment	ISD is concerned with fitting technology, for instance, IS design is a means to better realise pre-defined objectives. IS use is aimed at overcoming computation limitations of man and improving productivity

RQ2 - Is the influence of one paradigm on a person dominant despite their acceptance of other paradigms?

By ascertaining a developer's most important paradigm, we wanted to investigate the theory prediction that the influence of one paradigm on a person is typically dominant.

3.2 Approach 2 - paradigm-specific definitions of behaviour

We applied the paradigm-specific definitions of behaviour to investigate their applicability to developers in describing the relevant behavioural aspects of ISD. Observations of developer behaviour and decision-making were made throughout the research period. For space reasons, the results will only be discussed for research situation 2. To validate the theory, we aimed to answer the following research questions:

RQ3 - Do the paradigm-specific definitions match developer ISD behaviour in the research situation?

We wanted to ascertain the extent to which a given definition fully or partially matched, or did not match, a given aspect of developer ISD behaviour in a research situation. We also used this research question to check the internal consistency of the definition.

RQ4 - Are some paradigm-specific definitions more dominant than others in describing developer ISD behaviour?

For a particular developer, we wanted to ascertain the extent to which one paradigm was dominant in describing aspects of their ISD behaviour, despite the existence of other paradigms. The theory states that the functionalist paradigm is dominant (HKL 1995: Introduction).

3.3 Approach 3 - influence of assumptions on process of ISD

In approach 3, we sought to investigate whether there was evidence that the assumptions made by developers influenced the behavioural aspects of ISD with which they were involved, to establish whether developer assumptions became manifest in practice (HK 1989: 1199).

RQ5 - Is there evidence that paradigmatic assumptions of developers influence the behavioural aspects of ISD with which they are involved?

4. RESEARCH METHODOLOGY

4.1 Research situations

The research was conducted at two organisations, the facts about these are provided in appendix 1. In organization 1, the project concerned the integration of seven separate day clinics into one clinic in a single location. This involved an integration of different subcultures and value systems, and the aim was to create a single clinic culture. IS development was an important part of this integration process, concerned with the need to support the administrative aspects of the new clinical procedures. The developers constituting the project team were chiefly involved in setting requirements and providing specifications to software vendors. This phase of the project took a year. A large proportion of the new requirements came from the users and the project teams. In organization 2, the project concerned the replacement of an existing pharmacy system with a year-2000 compliant system. The construction of requirements by the developers was in two phases. In phase one, the current system was examined and requirements were documented in a narrative form before being translated into a standard form by the Project Manager. In phase 2 the pharmacy process of dealing with a prescription from start to end was conceptualised with IS playing a role at many stages. It was compulsory to develop requirements for any NHS system in a very structured format termed POISE. For both organizations, after the software system was delivered by the vendor, the implementation and integration phases began.

4.2 Methods of eliciting attitudes

We have elicited the beliefs and attitudes of stakeholders through applying the key paradigmatic principles to research situations through operationalisation involving questionnaires and observations. Other writers who used similar techniques are:

Firstly, Davis et al (1989) focus on the resistance to system from the end user perspective. Their research aims to predict stakeholders' account of their own attitudes, norms, perceptions, perceived ease of use and related issues. The key aspects looked at are perceived usefulness, perceived ease of use, user attitudes, intention and computer adoption. They used two models - (1) Theory of Reasoned Action (TRA) model which originates from social psychology and is concerned with determining intended behaviour (Ajzen and Fishbein 1980). The TRA helps to capture the internal psychological and external variables. (2) Technology Acceptance Model (TAM) was used by

Davis (1986) as an alternative to TRA and it is capable of explaining user behaviour across a broad range of end user computing technologies and user population. Key purpose of TAM is to consider external factors (issues and instruments) as well as the internal beliefs, attitudes and intentions. Authors' empirical study involved 107 full time MBA students using a word processing package as a test application. The study looked at salient beliefs and behaviour using a questionnaire.

Secondly, Baroudi et al (1986) focus on whether user involvement is important for ensuring a success of the system. Typically, in IS literature the user involvement leads to greater system use and user satisfaction. Assumptions that user involvement leads to use or satisfaction is tested through survey of two hundred managers in this study. They conducted six studies on user involvement and satisfaction. They use Fishbein and Ajzen's (1980) Dissonance theory to investigate the behaviour and attitudes. Dissonance with a presently held attitude is created by performance of a contradictory behaviour. An individual may change the belief or attitude to review or reduce dissonance. As far as their study and research methodology was concerned the data regarding user involvement and satisfaction was gathered from two hundred large manufacturing firms in USA using mail survey. Data was gathered on a variety of systems and emphasis was placed on general user involvement and design. They used Bailey and Pearson's (1983) instrument scale that was made up of thirty-nine aspects of information satisfaction. Data generated in this study was also used for further validation and modification instrument. The resulting hypothesis was that user involvement is positively associated with both system usage and user satisfaction.

Finally, the research approach used by us for eliciting attitudes was also effective where we used multiple-choice questionnaires based on paradigmatic principles as devices to facilitate further discussion. The respondents were allowed to alter the responses as they wished, if they found that the given multiple-choices did not meet their preferences. They served as good tools as we were just concerned with eliciting the stakeholder attitudes.

We also triangulated research methods by using a variety of sources and by involving a variety of developers, attending discussions, seminars, conducting open-ended interviews, survey

questions, and studying minutes of meetings and project related documents. We initially studied the paradigm-specific definitions of behaviour, redefining those we felt to be inconsistent or contradictory, and then attempted to match them, one at a time, to the relevant aspects of a developer's ISD behaviour. Those that we found did not match were redefined and applied again. Those that did match an individual's behaviour were applied again to reconfirm, often from a different source. A longitudinal study such as this allowed us to study and confirm behaviour by repeated observation over a long period, rather than relying on a snapshot view. ZIH carried out the fieldwork and data collection, but data analysis was undertaken by the two authors. Both ZIH and DJF have practical experience of ISD in a variety of organizational settings. In both projects, the majority of the project team developers would also be the eventual users of the system. They worked only part-time on the project during requirements construction. Tables 2 and 3 below show the job roles of those on the teams. Although the idea that 'ordinary' organizational workers may be seen as developers may give one pause for thought, our results suggest that, by the end of the project, they were behaving as the theory predicts that developers would behave.

4.3 Research Strategy

We chose a qualitative research strategy, using a combination of case study and longitudinal designs, as we wished to gather rich data over a two-year period in the organizations, where we were also applying structuration theory to understand wider social factors influencing the ISD process. One of us (ZIH) gained access to the organizations on the understanding that relevant results suggesting improvements to organizational ISD processes would be communicated at the end of his study. He remained as an observer throughout the research period (1998-2000), and found that his knowledge of theory and practice of ISD helped the developers (the majority of whom did not have an IT background) to trust him. He visited each organization for an average of half a day a week. From time to time he was asked his advice on specific points concerning the requirements process. He responded positively to these requests, corroborating Geoff Walsham's suggestion (Walsham 2000) that there is an action research element to every fieldwork investigation in organizations. We gathered and analysed our research data (Kaplan and Maxwell 1994) as follows. Early interviews were held with senior developers to gain basic knowledge of the organizations and the relevant projects. Then,

(initial) questionnaire data were gathered in individual interviews. The correctness of the meanings of the 'quantitative' type of data resulting from our multiple-choice questionnaire was checked in interviews against developer comments and questions where they were assisted in choosing the most appropriate responses. Respondents were shown all the final results and asked to confirm their accuracy in reflecting their views and those of others.

4.4 Operationalisation of paradigms

We used five questions based on B&M's notion of: ontology, epistemology, human nature, methodology, regulation and radical change assumptions. We are aware that just five questions with a set of answers are not sufficient to reveal the complex 'reality' but they help as sensitising devices. As will become apparent from appendix-2 that the questions asked were at organizational level at organization 1 and they were at requirements level at organization 2. This change in questioning was due to our realisation that the organisational questions were resulting in broader responses and hindered the degree of respondent concentration. The latter types of choices helped the respondents to provide more focused responses. Due to the continual presence of the researcher (ZIH) in research situations, he was aware of IS requirements at organization 1, which he inferred through longitudinal observations. Finally, as far as the analysis of the questionnaire is concerned each of the multiple-choice options was linked to a paradigmatic assumption. This link served as a code for analysing the results. Hence the responses of each respondent were carefully assembled and analysed.

5. RESULTS - ORGANIZATION 1

The paradigmatic assumptions held by developers in organization 1 during the operationalisation exercise are shown in table 2. We answered the research questions in the following way:

RQ1 - Do developers find it easy to match their appropriate paradigmatic assumptions to the questionnaire choices?

During interviews, it was found that some developers did not find an easy match between their paradigmatic assumptions and the questionnaire choices; hence they ticked the ones closest to their assumptions. Some made more than one paradigmatic choice and prioritised (by numbering them in order of importance) or gave an equal rating to their choices.

RQ2 - Are some paradigmatic assumptions of developers more dominant than others?

Table 2 shows that only one, or possibly two, of the five developers (the Day Clinic Manager and the Day Clinic Executive) have a dominant paradigm (at least three out of the five choices).

The results show that paradigmatic assumptions of developers can differ from one question to the other, so they may change their paradigmatic stance depending on the scenario. They can also view one scenario using more than one paradigmatic assumption, as shown in brackets in table 2. It does not appear, for these individuals, that only one paradigm can be dominant at any one time.

TABLE 2. PARADIGMATIC ASSUMPTIONS FROM ORGANIZATION 1 DEVELOPERS

Name	Q 1	Q 2	Q 3	Q 4	Q 5
IT Executive	F	SR	SR	RS	SR
Project Manager	F (N)	F (N)	F	F (SR)	F (SR)
System Manager	F	F	N	SR	SR
Day Clinic Manager	F	F	F	F	F
Organizational Development Manager	SR (F)	F	F	SR	F
Day Clinic Executive	RS	N	F	F	F
Key: F = Functionalist, SR = Social Relativist, RS = Radical Structuralist, N = Neohumanist, X= Absent or not involved, (second choice), / = equal rating					

TABLE 3. PARADIGMATIC ASSUMPTIONS RESULTS FROM ORGANIZATION 2 (OPERATIONALISATION 1)

Name	Q 1	Q 2	Q 3	Q 4	Q 5
Pharmacy Manager	F/N	F	N	N	N
Ordering Clerk	SR	RS (N)	SR	N	RS
Clerical Officer	F	F	F	N	RS
IT Manager	F	F	F	N	N
Project Manager	RS	N	F	RS	SR
Chief Pharmacist	N /SR	N	N	N	SR
Pharmacy Technician	F/SR	F	SR	SR	RS
Pharmacist	F	F/N	SR	N	RS
Assistant Administration Officer	N	F (SR)	RS	RS	F

Key: F = Functionalist, SR = Social Relativist, RS = Radical Structuralist, N = Neohumanist, (second choice), / = equal rating

6. RESULTS - ORGANIZATION 2

6.1 Approach 1 - paradigmatic assumptions of developers

Developer paradigmatic assumptions are shown in table 3. They show a wide range of assumptions, as well as the fact that developers change their paradigmatic stance depending on the scenario and can view a scenario using more than one paradigmatic assumption.

RQ1 - Do developers find it easy to match their appropriate paradigmatic assumptions to the questionnaire choices?

Some prioritised between several paradigmatic choices, while some gave two choices equal ratings.

RQ2 - Are some paradigmatic assumptions of developers more dominant than others?

Table 3 reveals that dominance of one paradigm is indicated by four of the nine developers. Some developers hold three paradigms and several chose two in response to a particular question.

6.2 Approach 2 - paradigm-specific definitions of behaviour

6.2.1 Introduction

This section discusses the matching of the paradigm-specific definitions with the behavioural aspects of ISD. We investigated all 21 aspects except for two (physical design & technical implementation, logical design) with which our developers were not involved. Due to space limitations we show nine aspects only in table 5, which convey the essence of our results. Each row of table 5 shows one of the behavioural aspects of ISD of the research situation, together with the paradigm describing developer behaviour to

which we found that aspect corresponded.

Developer behaviour was sufficiently similar to allow us to aggregate behaviour over all developers and to summarise it in this table. The functionalist paradigm corresponds to the majority of the aspects we investigated, with the partial exception of *Role of IS Designer and Analysis*.

6.2.2 Role of IS Designer

The *neohumanist* and *radical structuralist* paradigmatic definitions were applicable at the beginning of the project. The Chief Pharmacist and Pharmacy Manager behaved like *emancipators* who aimed to achieve greater freedom from organizational ways of working by the design of new systems to minimise worker effort spent on laborious tasks. The Project Manager and the IT Manager behaved like *warriors* who attempted to force their ISD-related decisions upon others.

TABLE 4. PARADIGMATIC ASSUMPTION RESULTS FROM ORGANIZATION 2 (OPERATIONALISATION 2)

Name	Q 1	Q 2	Q 3	Q 4	Q 5
Pharmacy Manager	N	F	N	SR	SR
Ordering Clerk	SR	F	SR	F	F
Clerical Officer	F	F	N	RS	F
IT Manager	F	F	F	F	N
Project Manager	RS	RS	F	F	F
Chief Pharmacist	RS	F	F	F	F
Pharmacy Technician	F	F	F	F	F
Pharmacist	RS	F	F	F	SR
Assistant Administration Officer	X	X	X	X	X

Key: F = Functionalist, SR = Social Relativist, RS = Radical Structuralist, N = Neohumanist, X= Absent or not involved, (second choice), / = equal rating

TABLE 5. PARADIGMS APPLICABLE TO DEVELOPER ISD BEHAVIOURAL ASPECTS IN ORGANIZATION 2

Aspect of ISD	Corresponding paradigm
Role of IS Designer	Neohumanist/Radical Structuralist (at the start) and Neohumanist/Social relativist (at the end)
Nature of IS application	Functionalist
Objectives for design and use of IS	Functionalist
Legitimation of system objectives	Functionalist
Metaphor for framing IS	Functionalist
Problem finding & formulation	Functionalist
Analysis	Functionalist (at start) and Neohumanist (at end)
Organizational implementation	Functionalist
Maintenance	Functionalist

At the end of the project, the behaviour of the Pharmacy Manager conformed to the neohumanist and the social relativist paradigms. The behaviour of the Project Manager and the Chief Pharmacist conformed to the functionalist paradigm. But the behaviour of the IT Manager remained unchanged. As the Project Manager said: "... *the requirements have to be functionally sound*". They behaved like expert engineers who possessed a high degree of knowledge about the Pharmacy, IS and organizational rules through which they succeeded in keeping overall control over ISD.

6.2.3 Analysis

The *functionalist* definition was applicable at the beginning of the project, as there was emphasis on all the processes of the Pharmacy being examined to determine maximum efficiency of the

new system. However, at the end of the project, the *neohumanist* definition was applicable, as the workers were given less laborious work due to the automation of mundane tasks.

6.3 Research questions arising from approach 2

6.3.1 RQ3 - Do the paradigm-specific definitions match developer ISD behaviour in the research situation?

Internal check. On checking the definitions against their underlying assumptions we discovered that while most definitions were complete and accurate, some were problematic. Two forms of problems were encountered: (1) inconsistencies - inconsistent definitions against their basic assumptions, (2) contradictions - different interpretations of the same paradigm for different definitions. The functionalist and radical structuralist definitions for the *Preferred metaphor for framing ISD* aspect were inconsistent,

as the functionalist definition placed emphasis on productivity and control, while the radical structuralist definition placed emphasis on productivity only; it would be more consistent for the reverse to be the case. Most of the wording of the radical structuralist and functionalist definitions for the *Physical design and technical implementation*, *Organizational implementation* and *Maintenance* aspects was very similar and appeared to be inconsistent with the underlying assumptions. A number of radical structuralist definitions were contradictory, some focusing on interests of workers others on those of management.

External check. The majority of paradigm-specific definitions did match the relevant ISD behavioural aspects of the research situation. However, *Organizational implementation* needed redefinition, as none of its definitions matched, due to a specific focus on compliance-seeking strategies, which also, in our view, did not totally capture the spirit of the base assumptions.

6.3.2 RQ4 - Are some paradigm-specific definitions more dominant than others in describing developer ISD behaviour?

The behaviour of all developers was largely functionalist, as shown in table 5.

6.4. Approach 3 - influence of assumptions on process of ISD

The results from approaches 1 and 2 show that, although the functionalist paradigm is overwhelmingly present in developer behaviour (table 5), it is dominant for only a minority of developers in their assumptions (table 3). An example concerns the IT Manager at organization 2, with dominant functionalist assumptions but exhibiting behaviour that mostly conformed to the radical structuralist paradigm. He was highly autocratic in his attitude. In his view the system was acquired to improve the productivity of the Pharmacy Department as well as overcoming the Y2K problem. He was intolerant about the possibility of user involvement and during interviews he said: *"Users would always have something to complain about. In fact they don't know what's good or bad for them"*.

RQ5 - Is there evidence that paradigmatic assumptions of developers influence the behavioural aspects of ISD with which they are involved?

For most of these developers there is not a close link between the paradigms indicated by their assumptions and those revealed by their observed behaviour, as the functionalist paradigm is

dominant for behaviour but not for assumptions. We conclude that, for the majority of our developers, there is no evidence that paradigmatic assumptions influence developer behaviour.

7. RESULTS SUMMARY

7.1 Proposition 1: *Systems developers hold a wide range of assumptions relevant to the ISD process that may be grouped together and classified into paradigms*

RQ1 - Do developers find it easy to match their appropriate paradigmatic assumptions to the questionnaire choices? With researcher assistance, developers were able to match their assumptions to questionnaire choices fairly easily. A spread of paradigms for a given developer was common, with some selecting equal choices or prioritising over two paradigms for one question.

7.2 Proposition 2: *Systems developers exhibit aspects of behaviour during the ISD process that may be grouped together and classified into paradigms*

RQ3 - Do the paradigm-specific definitions match developer ISD behaviour in the research situation? Although most paradigm-specific definitions were consistent with their underlying paradigms and with each other, a few were inconsistent or contradictory, particularly concerning the radical structuralist paradigm. Most definitions matched the relevant ISD aspects in the research situation, with the exception of the organizational implementation definition. Thus Proposition 2 is mostly met.

RQ2 - Is the influence of one paradigm on a person dominant despite their acceptance of other paradigms? Only a minority of developers' assumptions (tables 2 & 3) conformed to a dominant paradigm. However, table 4 shows that, after system implementation, a majority had a dominant (functionalist) paradigm. We were surprised by this result, as we had expectations that the non-IT developers in our two hospitals would exhibit a wider range of paradigmatic behaviour.

RQ4 - Are some paradigm-specific definitions more dominant than others in describing developer ISD behaviour? We found that the dominant definition of behaviour was functionalist (table 5), supporting the theory that only one paradigm is dominant, not only for one but for the majority of developers.

7.3 Proposition 3: Assumptions influence the process of ISD as well as IS use
RQ5 - Is there evidence that paradigmatic assumptions of developers influence the behavioural aspects of ISD with which they are involved? As the functionalist paradigm is dominant for behaviour but not for assumptions this indicates the reverse, for instance, that the ISD process has, over the course of the project, influenced developer paradigms. This might explain the results in table 4. Our results indicate that, broadly, developer behaviour is 'simpler' than their assumptions at project start as it is largely based on one paradigm, whereas, as the results above show, their assumptions may involve several paradigms. Proposition 3 is thus not met, based on assumptions at project start.

7.4 Research Validity

The results of applying the research validity criteria of Lincoln and Guba (1985) are provided below:

Dependability (reliability and replicability): In this research most of the data was documented on paper and tapes, such as interviews, observations, explanations and discussions. This data was filed manually and more routine records of meetings were kept on a database. However, despite keeping a systematic record of research data a lot of research related information resides in the mind of the researchers, due to the interpretivist nature of this research.

Confirmability (objectivity): Attempts were made by the researchers to minimise his personal bias when communicating with the research subjects and interpreting the research results. This involved us checking and piloting the survey and interview questions. However, as this research involved visiting the research organisations to collect data and to gather inferences of the research subjects it is likely that the researchers may have influenced some of the subjects. We are aware that our bias could have affected his data collection and data analysis. Our bias in data collection may have resulted from our:

- 1) theoretical knowledge that may have restricted us to only collect the data that was applicable in the theoretical scope. So the researchers were critical about the use of their chosen theoretical approaches.
- 2) understanding of the research situation from the information that we may have obtained from our close contacts in the organisations.

The researchers had a number of close links with several stakeholders in each organisation, they could have used their perspective in looking at the research situation, for example, if their contacts thought a particular individual is political and against IS development they could have believed them. But the researchers collected 'first hand' inferences and data about the relevant stakeholders.

- 3) understanding of the organisation based on secondary account of the organisation or its departments, such as organisational reports and newsletters. The organisational literature from both research organisations was obtained, and in all cases the organisations were presented as highly bureaucratic, regulated and caring attitude towards the patient. But in reality there were different forms of hierarchical workings, different forms of interpretations of regulations and the culture of care did not exist in some of the departments in these organisations.

On the other hand, the researcher bias at data analysis stage could have happened, if his analysis were solely based on his objective of approving or disapproving a particular theoretical dimension. For example, the researchers could have only analysed those results that would help him to justify the applicability of some parts of the theory. For instance only presenting the data conformed to one paradigm only, but the researchers presented all the data that indicated the presence of paradigmatic assumptions. The objective in this research was to show the effectiveness of the theoretical approaches as sensitising devices.

The researchers took necessary measures to appear neutral throughout the research and tried to avoid Hawthorne, placebo and doctor effects (Sadler and Kitchenham 1996). On the other hand, the researchers developed an informal relationship with a number of subjects, where they felt 'conformable' in talking to the researchers, without taking too much care in what they were saying. The researchers discussed participant interviews, behaviour and context with supervisor and sometimes with his work colleagues.

Credibility (internal validity): The results extracted and analysed from the data collected are logical and consistent. There is a good match between the theoretical concepts and the data collected, for example, through the

operationalisation of paradigms involved in extracting the theoretical principles and then applying them. The researchers provide multiple perspectives of subjects on a number of ISD-related issues in order to provide a more complete view of the situation. The data collected came in many forms and was collected from many sources, hence was very rich in nature. The researchers used the theoretical approaches to overcome confusions and puzzles. Although some confusions led the researchers to carry out a more thorough investigation and explanation leading to a better understanding of the issues or situations (Kaplan and Maxwell, 1994).

The researchers also used respondent validation that involved asking the respondents whether they understood the meaning of the questions and if they wanted to clarify any questions. In cases where the respondents were not sure of a question or a part of the question they asked the researcher (ZIH). In addition before launching any major surveys questionnaires were tested on several respondents, who were close to the researcher (ZIH).

Credibility (ecological validity): The researchers made attempts to undertake research within the 'natural' work settings of the subjects. He observed their work being present in their setting and on occasions helping them. The researchers succeeded in settling into the research organisations and developing an informal relationship with most of the subjects. Hence they felt more 'comfortable' and less disturbed in the presence of the researchers.

Transferability (external validity): The elements of the theoretical approaches used and the way of applying them can be generalised to other organisations. Some of the insights resulting from this research could be generalised to other situations, such as the creation and use of legitimisation structures, the importance of legitimisation in achieving domination, unintended consequences of ISD-related actions of stakeholders, non-conformance of stakeholders to organisational ways of working, applicability of multiple paradigms to some ISD-related activities and conformance of stakeholder assumptions to multiple paradigms can be seen as applicable to other types of organisations during ISD. The way of investigation could also be generalised to other situations. The generalisation of the application of theoretical approaches and rich insights has also been highlighted by Walsham (1995).

8. CONCLUSIONS AND FUTURE RESEARCH

In terms of the three propositions of the theory as we have formulated them, Proposition 1 is met but Proposition 3 is not met, Proposition 2 is not met under certain conditions while Our results thus indicate that a refinement to the four-paradigm theory is required, as for the two cases we studied, not all the propositions of the theory hold.

By validating the theory using field study methods we are continuing a recent trend to the wider acceptance in our IS community of the usefulness of qualitative approaches to understanding the theory and practice of ISD. We have shown that initial developer assumptions, at the start of a project, are spread widely over the paradigms, and that one paradigm is not dominant. However, as the project proceeds, assumptions change. In the organization we studied, assumptions changed radically resulting in the dominance of the functionalist paradigm. We also noted that behaviour throughout the project was largely functionalist. Initial assumptions thus appear to have little effect on ISD behaviour, but the reverse may be true - ISD behaviour influences developer paradigms.

We concluded that where developers behaved differently from their assumptions it was due to: (1) pressures to conform to expectations of others, mostly immediate or strategic management, (2) a lack of knowledge or experience to take IS-related actions; hence they followed decisions made by those who they thought possessed greater knowledge. This last point may merit further investigation, as it is widely accepted (for example Walsham 1993) that management pressure to produce systems focused on efficiency goals is a key factor in influencing developer behaviour in a functionalist direction. But is this always the case? There was evidence that many of our developers became functionalists by being guided by more 'knowledgeable' developers to use narrow, methodical techniques to develop requirements in the accepted NHS POISE format. Although it has been asserted that there is 'social within the technical' (Bloomfield 1992) the emphasis is generally on the effect on the developed system, rather than on the developers. We shall investigate this point in future research.

The use of HKL's four paradigms was a good sensitising device despite having certain limitations. The limitations were: (1) too rigid classification of four sets of assumptions as it may not be possible for someone to fall under two paradigms. (2) Some of the wording used in

explaining paradigms is loose, and could have multiple interpretation, and (3) applicability of a different paradigm to stakeholder behaviour at different times.

For future research we will investigate changing paradigms over several projects, and test developers to see if, by the time of a subsequent project, their paradigms have remained the same or if they have reverted to those, perhaps more idealistic, they held at the beginning of a previous project. That is, are paradigmatic assumptions changed temporarily or more permanently by experience?

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APPENDIX 1 – COMPARISON OF THREE RESEARCH SITUATIONS

	Organisation 1	Organisation 2
Research particulars		
Type of access, length of research and number of visits	<ul style="list-style-type: none"> • Unlimited access to all aspects of the organisation, apart from the Trust Board. Access negotiated with Assistant Personnel Director. • 60 visits on 37 occasions. • September 1997 - September 1998 (12 months). 	<ul style="list-style-type: none"> • Unlimited access to all departments. Access negotiated with the Chief Pharmacist. • 44 visits on 32 occasions. • September 1998 - September 1999 (12 months).
Context		
Type of hospital	Acute Trust (Secondary/tertiary service)	Acute Trust (Secondary service)
Number of employees	7,000 before the merger with another major trust of similar size	5,000
Number of patients to be affected by the system	30,000 for all 7 day clinics at the time of integration. But this figure will increase to 50,000 in line with new NHS proposals within two years from project completion.	All patients affected directly or indirectly.
Main stakeholders	<ul style="list-style-type: none"> • OD Manager • Clinic Director (Registrar) • Clinic Manager • IT Executive 	<ul style="list-style-type: none"> • Chief Pharmacist • Pharmacy Manager • Project Manager • IT Manager
Project owners	<ul style="list-style-type: none"> • Clinic Director (registrar) • Clinic Manager • IT Executive 	<ul style="list-style-type: none"> • Chief Pharmacist • Project Manager
Nature of IS	An integrated day clinic system to support a large day clinic.	Pharmacy system to support all aspects of the Pharmacy including prescription handling and drug manufacturing.
Purpose of IS	To support the new day clinic's workflow to increase efficiency and effectiveness and reduce patient dissatisfaction.	A Y2K compliant IS to run the Pharmacy work processes and achieve efficiency and effectiveness in prescription handling.
Sources of requirements	<ul style="list-style-type: none"> • 5 project teams • Old requirements • Other hospitals • Interview with chosen stakeholders 	<ul style="list-style-type: none"> • Pharmacy Management • Visiting other hospitals • Vendor specified and project manager's choice
Change in the job of primary stakeholders	<ul style="list-style-type: none"> • Theatre Manager > System Manager. • Clinic Director > Registrar • Urology clinic manager > Clinic Manager 	<ul style="list-style-type: none"> • Senior sister (TM) > Assistant Clinic Manager • Pharmacy manager > System Manager (while retaining his existing role)
Project Budget	£157,000	£87, 000

APPENDIX 2 – QUESTIONNAIRE FOR ORGANISATION 1

*Ontological***1) Do you see your organisation as having a relatively objective existence or as a collection of beliefs and values of the individuals who control the organisation?**

On one end of the continuum the reality only exists in a physical form, where as on the other end it is seen as reification based on beliefs or as a network of individual beliefs, some of which are shared.

*Epistemological***2) Do you view the nature of knowledge in your organisation as tangible or intangible?**

On one end of the continuum there is hard/tangible knowledge about the organisation or society, which exists as 'hard data' and can be acquired through 'scientific' means. An alternative belief is much knowledge is intangible and is made up of common beliefs, where it can be learnt through subjective experience and continual interaction.

*Change***3) Do you see your organisation as one where fundamental changes occur frequently or only rarely?**

On one end of the continuum the change is a frequent and natural phenomenon and on the other hand, it is too problematic and not really worth it.

*Conflict***4) What role does conflict play within your organisation?**

On one end of the continuum conflict is positive and has the potential to make improvements, whereas it is negative on the other side. For example, conflicting views on the usability aspects of an information system may be seen as positive by those who want to improve the usability and vice versa.

*Choice***5) How important is it for workers to determine some or all aspects of their work at your organisation?**

On one end of the continuum the behaviour is seen as voluntary and self determined whereas on the other side of the continuum its determined by others or rules and ways of working

The multiple-choices given with each of the above questions. These multiple-choices are linked to the four paradigms of HKL in the following order: functionalist, radical structuralist, social relativist and neohumanist.

OPERATIONALISATION QUESTIONS**AT ORGANISATION 1****1) Do you see your organisation as having a relatively objective existence or as a collection of beliefs and values of the individuals who control it?**

My organisation is:

- a concrete entity and has a clearly defined structural set-up on functional logic.
- a concrete entity that aims to maximise its output through full use of the human and non-human resources.
- made up of individual beliefs and meanings.
- made up of collective beliefs that are mutually agreed.

2) Do you view the nature of knowledge in your organisation as tangible or intangible?

The nature of knowledge in the organisation is:

- tangible and there are precise ways of running the organisation/department.
- tangible but very few key individuals in the organisation have access to it.
- intangible and can only be learnt and taught through interaction with other organisational workers.
- intangible and has to be upgraded/refurbished constantly in-line with changing beliefs and values of workers.

3) Do you see your organisation as one where fundamental changes occur frequently or only rarely?

Change:

- is only necessary to increase the organisational efficiency.
- does not needed generally happen, but when it does, it has to be a radical one.
- should not occur too often as it threatens human security or even needs.
- is good for organisation and helps to bring about greater improvements for organisational workers.

4) What role does conflict play within your organisation?

Conflict:

- is unnecessary due to harmonious nature of organisations.
- leads to change and helps to achieve worker equality.
- creates differences that need to be reconciled.
- encourages resolution of differences.

5) How important is it for workers to determine some or all aspects of their work at your organisation?

As far as worker’s self-determination is concerned:

- there is no need for worker determination since everything is pre-planned.
- workers can not determine their own ways of working, as they are generally incapable of making work related decisions.
- workers are capable of making their own decisions.
- only workers can make best decisions for themselves, thus make decisions to protect their rights.

OPERATIONALISATION QUESTIONS

AT ORGANISATION 2

Ontology (The nature of requirements)

Question. Are requirements *objective or subjective*?

Comment. Requirements may be objective, consisting of general rules and regular patterns external to individuals; they are related either to organisational aims based on a common view of organisational reality, or to the material conditions resulting from the opposition between the economic interests of management and workers.

Alternatively, they may be subjective, consisting of social constructs, where they are based on the views of different stakeholders and where it is recognised that there are different perceptions of reality and that requirements are the products of the human mind; requirements may be either consensus views or sets of individual beliefs and values.

Tick your choice(s): (should you tick more than one choice then please number your choices in priority order)

Should be:	Currently is:	
		Requirements are objective, related to organisational aims based on a common view of organisational reality.
		Requirements are objective, related to the material conditions resulting from the opposition between the economic interests of management and workers.
		Requirements are subjective, based on the consensus views of stakeholders.
		Requirements are subjective, based on sets of individual beliefs and values.

Epistemology (The process of obtaining requirements)

Question. What kind of knowledge constitutes the requirements and what kind of process is required to learn or gather this knowledge?

Comment. Knowledge constituting requirements pre-exists the requirements process and can be gathered through a form of scientific investigation that focuses on rational organisational operation, cause-effect relationships, organisational functions and information. It may be based on organisational aims as set by management, or on the interests of the workers.

Alternatively, a process of discussion and sense-making involving stakeholders, typically looking at organisational culture, myths, stories, image and general organisational values, results in the knowledge being constructed, through mutual agreement, either with no assumptions regarding the outcome, or by taking into account principles, such as better mutual understanding and emancipation from constraints, to improve the working life of stakeholders.

Tick your choice(s): (should you tick more than one choice then please number your choices in priority order)

Should be:	Currently is:	
		Knowledge pre-exists, is gathered through a form of scientific investigation and is based on organisational aims as set by management.
		Knowledge pre-exists, is gathered through a form of scientific investigation and is based on the interests of workers.
		Knowledge is constructed through mutual agreement by a process of sense-making and discussion involving stakeholders, with no assumptions regarding the outcome.
		Knowledge is constructed through mutual agreement by a process of sense-making and discussion involving stakeholders, taking into account principles such as better mutual understanding and emancipation from constraints, to improve the working life of stakeholders.

Change (Fundamental Change in the organisation)

Question. Should requirements lead to a system that will bring about fundamental change in the organisation?

Comment. In many organisations, fundamental change is unlikely to result from a new system. This may be because management seek to preserve organisational stability, proposing change only where it will improve existing organisational operations, or because stakeholder consensus is difficult to obtain if the human need for social order is threatened.

However, in other organisations, fundamental change is likely, due either to the opposing interests of management and workers leading to a redress of power between the two groups, or to stakeholder belief that organisational life is constraining and that there should be freedom to openly debate organisational problems and objectives using rational discourse.

Tick your choice(s): (should you tick more than one choice then please number your choices in priority order)

Should be:	Currently is:	
		Fundamental change is unlikely, as management seek to preserve organisational stability.
		Fundamental change is unlikely, as stakeholder consensus is difficult to obtain if the human need for social order is threatened.
		Fundamental change is likely, due to the opposing interests of management and workers leading to a redress of power between the two groups.
		Fundamental change is likely, due to stakeholder belief that organisational life is constraining and that organisational problems and objectives should be openly debated using rational discourse.

Conflict (Conflict in the requirements process)

Question. What role should conflict play in the requirements process?

Comment. Conflict may be regarded as negative and is either avoided and repressed by management as it is dysfunctional (particularly if it concerns ends rather than means), or it is anticipated and resolved by conflict-handling procedures so as to preserve the status quo.

Alternatively, it may be regarded as positive, either because it is a natural consequence of the opposing interests of management and workers, leading to inevitable change, or because it allows stakeholder viewpoints on necessary change to be aired, in which case it is actively encouraged.

Tick your choice(s): (should you tick more than one choice then please number your choices in priority order)

Should be:	Currently is:	
		Conflict over requirements is negative, and is avoided and repressed by management as it is dysfunctional.
		Conflict over requirements is positive, as it is a natural consequence of the opposing interests of management and workers, leading to inevitable change.
		Conflict over requirements is negative, and is anticipated and resolved by conflict-handling procedures so as to preserve the status quo.
		Conflict over requirements is positive, and is actively encouraged, as it allows stakeholder viewpoints on necessary change to be aired.

Determinism (Determinism in the requirements process)

Question. Should workers build their requirements?

Comment. Workers should not build their requirements as they are biased or irrational, with different objectives to management, or they do not possess the necessary expertise.

An alternative view is that they are best placed to build their requirements because, as eventual users, they are most familiar with their jobs, or because the requirements process provides an opportunity for creative individuals to radically improve their working conditions.

Tick your choice(s): (should you tick more than one choice then please number your choices in priority order)

Should be:	Currently is:	
		Workers should not build their requirements as they are irrational, biased and have different objectives to management. Requirements should be built by management with the aid of the systems developer as neutral technical expert.
		Workers should not build their requirements as they do not possess the necessary expertise. Requirements should be built by worker representatives with the systems developer as their agent.
		Workers are best placed to build their requirements because, as eventual users, they are most familiar with their jobs. Assistance is provided by the systems developer as change agent.
		The requirements process provides an opportunity for creative individuals to radically improve their working conditions, assisted by the systems developer as emancipator.

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