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Co-operative Information System Design

**How Multi-Domain Information System Design Takes Place
In UK Organisations**

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Abstract

The thesis focussed on the need to understand the nature of design processes in innovative, multi-domain, organisational information systems design. A cross-disciplinary, interpretive investigation of organisational IS design was based upon multiple literatures: information system development and methodologies, human-computer interaction, situated action, social psychology, psychology of programming, computer-supported co-operative work, computer science, design 'rationale' and organisational behaviour. Three studies were performed:

1. A case study of a user-centred design project, employing grounded theory analysis.
2. A postal survey of IS development approaches in large UK companies.
3. A longitudinal field study, involving participant observation over a period of 18 months in a cross-domain design team, employing ethnography, discourse analysis and hermeneutics.

The main contributions of this research were to provide rich insights into the interior nature of IS design activity, situated in the context of the organisation (a perspective which is largely missing from the literature); to provide conceptual models to explain the management of meaning in design, and design framing activity; to produce a social action model of organisational information system development which may form the basis for communicating the situated nature of design in teaching; and to suggest elements of a process model of design activity in multi-domain, organisational information system development. The implications of the research findings for IS managers and developers are also considered a significant contribution to practice.

Detailed findings from these studies relate to:

1. Disparities between the technology-centred view of organisational IS development found in the literature and the business and organisation-based approaches reported in the survey.
2. The role of pre-existing 'investment in form' in shaping the *meaning* of design processes and outcomes for other team members and its implications for the management of expertise and for achieving double-loop learning.
3. The detailed processes by which design is framed at individual and group levels of analysis. These findings indicated a mismatch between "top down" models of organisational IS design and observed design "abstraction" processes, which were grounded in concrete analogies and local exemplars; this finding has significant implications for organisational design approaches, such as Business Process Redesign.
4. The distributed nature of group design, which has implications for achieving a 'common vision' of the design and for the division of labour in design groups. Intersubjectivity with respect to process objectives may be more critical to design success than intersubjectivity with respect to the products of design.
5. The political nature of design activity: it was concluded that an effective design process must manage conflict between the exploration of organisational possibilities and influential, external stakeholders' expectations of efficiency benefits.
6. Design suffers from legitimacy problems related to the investigation of a "grey area" between explicit system design goals and boundary and emergent definitions of design goals and target system boundaries; this issue needs to be managed both internally to the design-team and externally, in respect of stakeholders and influential decision-makers.

It is argued that the situated nature of design requires the teaching of design skills to be achieved through simulated design contexts, rather than the communication of abstract models. It is also suggested that the findings of this thesis have implications for knowledge management and organisational innovation. If organisational problem-investigation processes are seen as involving distributed knowledge, then the focus of organisational learning and innovation shifts from *sharing* organisational knowledge to *accessing* distributed organisational knowledge which is emergent and incomplete.

Contents

<i>Abstract</i>	<i>Front</i>
<i>List of Figures</i>	v
<i>List of Tables</i>	vii
<i>Acknowledgements</i>	viii
<i>Declaration</i>	ix
1. INTRODUCTION	1
1.1 Research Purpose And Objectives	1
1.2 Research Motivation	2
1.3 Scope Of Research	4
1.4 Research Approach And Summary Of Empirical Studies	4
1.5 The Thesis Structure	7
2. THE PROBLEM DOMAIN	10
2.1 Organisational Information System Development	10
2.2 The Design Of Organisational Information Systems	12
2.2.1 Organisational Information Systems As Interrelated Systems Of Human Activity And Information Technology	12
2.2.2 The Linear Staged Model Of Information System Development	13
2.3 Methods For Organisational IS Design	15
2.3.1 The Use Of Development Methodologies	15
2.3.2 User-Participation In IS Design	16
2.3.3 Methodological Support For The Processes Of Design	18
2.4 The Nature Of Information System Design	19
2.4.1 IS Design As The Solution of Ill-Structured Problems	19
2.4.2 Situated Information System Design	20
2.4.3 The Social Processes Of IS Design	22
2.5 Conclusions	24
3. LITERATURE REVIEW: ORGANISATIONAL IS DESIGN FROM THE PERSPECTIVE OF THE IS DEVELOPMENT LITERATURE	26
3.1 Introduction	26
3.2 Models Of Design	26
3.2.1 Individual Process Models Of Design	27
3.2.2 Models of Information Systems Development	29
3.2.3 Conclusions: Identifying Appropriate Models Of Design	31
3.3 The Impact Of IS Development Methodologies	31
3.3.1 The Role Of Methodologies In Information System Design.	31
3.3.2 What Methodological Approaches To IS Development Are In Use And To What Extent Are They Used?	33
3.3.3 The Influence Of Development Methodology Upon User-Involvement In Design	39
3.3.4 Conclusions: The Impact Of Development Methodologies Upon IS Design	43
3.4 A Framework For The Description Of IS Development Approaches	45
3.4.1 Validation Of The Framework And Using The Framework To Examine IS Development Methods	47
3.5 Conclusions And Research Questions Arising From Literature Review	48
4. RESEARCH METHODOLOGY	50
4.1 Introduction	50
4.1.1 Research Objectives And The Research Study Process Model	50
4.2 The Research Approach	51
4.2.1 The Interpretive Research Paradigm	51
4.2.2 The Use Of Multiple Research Approaches	53
4.3 Research Questions and Appropriate Research Methods	55
4.3.1 Implementation Of The Research Process Model	55
4.4 Research Iteration 1	56
4.4.1 Research Questions	56
4.4.2 The Case Study Method	57
4.4.3 Deriving Grounded Theory For Co-operative Information System Design	58
4.4.4 The Postal Survey Approach	60
4.5 Research Iteration 2	61
4.5.1 Research Questions	61

4.5.2	The Longitudinal, Participant Observation Method	63
4.5.3	The Ethnographic Research Approach	63
4.5.4	Soft Systems Theory.....	64
4.5.5	Actor-Network Theory	66
4.6	Applying Research To Practice.....	67
4.7	The Role Of The Researcher	67
4.8	Summary	69
5.	CONSTRAINTS UPON A USER-CENTRED SYSTEM DESIGN PROCESS	71
5.1	Introduction.....	71
5.2	The Context Of The User-Centred System Design Project.....	72
5.2.2	The Process Model Of User-Centred Design	74
5.3	Research Method.....	74
5.3.1	Execution Of The Case Study	74
5.3.2	Limitations Of The Study	75
5.3.3	Data Analysis Method	76
5.4	Critical Incidents During The Design Process	78
5.4.1	Commencement Of Project	78
5.4.2	Critical Incident 1: "Agreement" Of Project Plan	79
5.4.3	Critical Incident 2: Marginalisation Of Psychologist Evaluator 1	81
5.4.4	Critical Incident 3: Delivery And Evaluation Of First System Prototype	83
5.4.5	Critical Incident 4: Withdrawal Of Project Sponsor.....	88
5.4.6	Critical Incident 5: Delivery And Evaluation Of Second System Prototype.	89
5.5	Grounded Theory Model Derived From Analysis.....	94
5.6	Discussion Of Findings.....	98
5.6.1	What are the critical processes of design and can they be related in a process model of design activity, which may be used for the effective management of system development projects?	98
5.6.2	What type of design tools might be useful, in supporting design managed by 'traditional' approaches?	99
5.6.3	Under what conditions can the use of a user-centred methodology involve users effectively in the processes of design?	99
5.7	Conclusions & Implications For Further Research	99
6.	AN INVESTIGATION OF IS DEVELOPMENT APPROACHES IN UK ORGANISATIONS	102
6.1	Introduction.....	102
6.2	The Survey Design.....	103
6.2.1	The Survey Perspective	103
6.2.2	Questionnaire Design	104
6.2.3	Bias And Validity In Postal Surveys	106
6.2.4	Limitations Of The Survey	106
6.2.5	Representativeness Of Response Sample	107
6.2.6	Analysis Of Response Data	108
6.3	Survey Findings	109
6.3.1	Companies' Stage Of Growth With Respect To IT.....	109
6.3.2	Type Of Project And Use Of External Consultants In IS Development.....	110
6.3.3	Overall Management Emphasis Of Change.....	110
6.3.4	User-Involvement During System Development And Implementation.....	111
6.3.5	Approach To System Requirements Definition.....	111
6.3.6	Approach To System Design & Modelling	112
6.3.7	Control Of Development Project.....	113
6.3.8	Methods And Tools Used For Project Management.....	113
6.3.9	System Development Life-Cycle Model	114
6.3.10	Methods And Tools Used For Project Management and System Development.....	114
6.4	Mapping Results Onto The Conceptual Framework.....	115
6.5	Discussion Of Findings	116
6.5.1	To what extent are information system development methodologies used in organisations and are they used consistently and fully?	116
6.5.2	How is the development of information systems approached in organisations?	117
6.5.3	What is the extent, scope and quality of user-involvement in organisational information system design?.....	117
6.6	Summary	118
6.7	Implications Of Findings For The Second Research Iteration	119

7.	LITERATURE REVIEW FOR SECOND ITERATION: ORGANISATIONAL ‘PROBLEM-SOLVING’ AND THEORIES OF SOCIAL COGNITION	120
7.1	Introduction.....	120
7.2	Design As The Investigation And Solution Of Organisational ‘Problems’	120
7.2.1	The Nature Of IS Design Processes.....	120
7.2.2	Design As Functional Analysis	121
7.2.3	Design As Problem-Solving	123
7.2.4	Design As Problem-Setting	124
7.2.5	Design As Situated, Evolutionary Learning	129
7.2.6	Discussion Of The Critical Processes Of Design	133
7.3	Social Cognitive Aspects Of Design.....	136
7.3.1	Individual Cognition In Design	137
7.3.2	The Group Level.....	144
7.3.3	The Organisational Level: Interest Groups, Transitional Objects And Organisational Change	150
7.3.4	The Construction Of Communities Of Practice Through The Social Cognitive Processes Of Design.....	155
7.4	Synthesis And Summary Of Research Questions	156
8.	AN ETHNOGRAPHIC STUDY OF THE PROCESSES OF DESIGN	158
8.1	Introduction.....	158
8.1.1	The Context Of The Field Study	158
8.2	Research Method.....	159
8.2.1	Execution Of The Case Study	159
8.2.2	Limitations Of The Study	160
8.2.3	Use Of Soft Systems Methodology To Model Design Perspectives	161
8.2.4	The Analysis Of Data For This Study	161
8.2.5	Assumptions Of Analysis And Position Of Researcher	163
8.3	The Context Of The Design Project.....	163
8.3.1	Company History and Culture	163
8.3.2	Antecedents to the Design Project.....	164
8.3.3	The Design Project Organisation.....	166
8.4	The Design Process.....	168
8.4.1	The Intended Process Of Design	168
8.5	Episodes Of Design.....	171
8.5.1	Episode 1: Expanding The Design ‘Problem’	174
8.5.2	Episode 2: Process Decomposition.....	179
8.5.3	Episode 3: Managing Emergent System Process Interdependencies.....	185
8.5.4	Episode 4: Piloting And Operationalising Stage 1 Process	193
8.5.5	Episode 5: Detailed Information System Design.....	203
8.5.6	Episode 6: Pilot Of Stages 2-6 And Managing Organisational Perceptions.....	212
8.5.7	Episode 7: Change Management	215
8.5.8	The Final Phase: Company Restructuring and Reorganisation	218
8.6	Summary Of Findings	218
8.6.1	Issues At The Level Of The Individual	218
8.6.2	Issues At The Level Of The Group	219
8.6.3	Issues At The Level Of Organisation	219
9.	A SOCIAL COGNITIVE ANALYSIS OF THE DESIGN PROCESS	221
9.1	Introduction.....	221
9.2	Differences in Individual Mental Models	221
9.2.1	Method Of Analysis	221
9.2.2	Findings Of Analysis.....	222
9.2.3	Team Learning, Intersubjectivity And Distributed Cognition.....	228
9.3	Framing Processes In Design	231
9.3.1	Method Of Analysis	231
9.3.2	Issue 1: Design Occurs At Multiple Levels Of Decomposition.....	232
9.3.3	Issue 2: How A Design Model Is Abstracted	233
9.3.4	Issue 3: Managing Meaning Through Possession Of Knowledge Or Expertise	237
9.3.5	Issue 4: The Influence Of IT Design Practice.....	241
9.3.6	Issue 5: The Emergent Design Boundary	242
9.4	Summary	244
9.4.1	Differences In Perspective, Intersubjectivity And Distributed Cognition	244

9.4.2	The Framing Of Design.....	245
9.4.3	The Role Of Existing, Normative IS Design Practices.....	246
9.4.4	The Legitimacy Of Emergent Design Goals.....	246
10.	A GENEALOGICAL ANALYSIS OF THE DESIGN PROCESS	247
10.1	Introduction.....	247
10.1.1	Method Of Analysis	247
10.1.2	Limitations Of The Analysis	248
10.1.3	Perspectives Of Design.....	249
10.2	A Genealogical Analysis Of The Design Process	250
10.2.1	Antecedent Conditions To Project.....	250
10.2.2	Episode 1: Expanding The Design 'Problem'	251
10.2.3	Episode 2: Process Decomposition.....	255
10.2.4	Episode 3: Managing Emergent Process Interdependencies.....	257
10.2.5	Episode 4: Piloting Stage 1 Process	259
10.2.6	Episode 5: Detailed Design Of Stages 2-6	260
10.2.7	Episode 6: Pilot Of Stages 2-6 and Managing Organisational Perceptions	262
10.2.8	Episode 7: Change Management	263
10.2.9	End of project.....	265
10.3	Summary	265
11.	SYNTHESIS FROM ANALYSES OF THE LONGITUDINAL FIELD STUDY.....	268
11.1	Introduction.....	268
11.2	How do differing perspectives on the nature of problem-definition and analysis/investigation affect organisational actors' approaches to information system design processes?	268
11.3	How are individuals' different mental models manifested in design and are individuals aware that they hold different models from other individuals?	270
11.4	What are the processes by which designers frame design models and what tools or methods are appropriate in supporting the construction of mental models by designers?.....	271
11.5	How do members of a design group engage in a 'community of social practice'?.....	274
11.6	To what extent is design scope constrained by political considerations and what role do explicit models of the design play in extending and obtaining consensus on the scope of a design? ...	278
11.7	Summary: Managing The Design Process	281
12.	CONTRIBUTION OF THE THESIS	283
12.1	Introduction.....	283
12.2	The Interpretive Research Position And Its Implications For Generalisability	283
12.3	Implications For Researchers.....	286
12.3.1	The Impact Of Methodologies Upon Organisational Information System Development....	286
12.3.2	Managing Investment In Form In The Context Of Organisational Innovation.....	287
12.3.3	The Situated Nature of Design Activity	288
12.3.4	The Distributed Nature of Design Activity.....	290
12.3.5	The Political Nature of Design Activity	291
12.3.6	Towards A Process Model For Organisational Information System Design.....	291
12.4	Implications For Educators	293
12.5	Implications For Practitioners	296
12.5.1	The Emergent Nature of Design	296
12.5.2	Managing Design And Domain Expertise	297
12.5.3	The Nature Of The Design Process	298
12.6	Conclusion	301
	APPENDIX 1: ADDITIONAL INFORMATION FOR INITIAL CASE STUDY	A1-1
	APPENDIX 2: SURVEY QUESTIONNAIRE AND CODING SCHEME	A2-1
	APPENDIX 3: LONGITUDINAL STUDY AT FTEL: SCHEDULE OF DESIGN MEETINGS	A3-1
	APPENDIX 4: FTEL ACTION RESEARCH STUDY. SSM ANALYSIS OF TEAM MEMBERS' PERSPECTIVES OF DESIGN	A4-1
	APPENDIX 5: GRAPHS OF SAMPLE DESIGN CONTRIBUTIONS AT VARIOUS POINTS IN DESIGN.....	A5-1
	REFERENCES.....	R-1

List of Figures

Figure 1-1: Implementation Of The Research Process Model	7
Figure 1-2: Structure Of The Thesis, Relative To The Stages Of Research.....	9
Figure 2-1: The Concepts of Served And Serving System (Winter & Brown, 1994)	13
Figure 2-2: The 'Waterfall' Model Of System Development (Boehm, 1988)	14
Figure 2-3: The layered, behavioural model of software development (Curtis et al., 1988).....	21
Figure 2-4: Literatures Drawn Upon By This Research	25
Figure 3-1: A Conventional Model Of The Design Process (<i>Lawson, 1990</i>).....	27
Figure 3-2: Darke's (1978) Model Of The Design Process.....	28
Figure 3-3: Model Of Individual Cognition in IS Design (<i>Author's model, based upon findings of Malhotra et al., 1980</i>).....	28
Figure 3-4: Models of System Development (Friedman & Cornford, 1989)	29
Figure 3-5: The Spiral Model Of Software Development (Boehm, 1988)	30
Figure 3-6: Comparison of (a) traditional system development life-cycle and (b) user-centred system development life-cycle	41
Figure 3-7: Leavitt's (1972) 'Diamond' Model Of The Organisation	45
Figure 3-8: A Framework For The Classification of Approaches To IS Development.....	47
Figure 3-9: Using The Framework To Map Development Methods	48
Figure 4-1: The Research Process Model (<i>after Galliers, 1992</i>).....	50
Figure 4-2: Implementation Of The Research Process Model	56
Figure 4-3: The Grounded Theory Approach To Data Collection and Analysis (<i>Pigeon & Henwood, 1976</i>).....	59
Figure 5-1: The Intensely Supportive Learning Environment (ISLE) Concept	72
Figure 5-2: Involvement of Main Project Members Over Time.....	73
Figure 5-3: The Intended Process Model For The ISLE Development Approach	74
Figure 5-4: The Actual Process Model For The R&D Project	78
Figure 5-5: A Model Of Design Influences, Derived From Grounded Theory Analysis Of Data.....	96
Figure 6-1: Profile of Survey Respondents (Number Of Firms In Each Category In Brackets).....	107
Figure 6-2: Overall Management Emphasis Of Change.....	110
Figure 6-3: User Involvement At Different Stages Of System Development Life-Cycle	111
Figure 6-4: Approach To System Requirements Definition.....	112
Figure 6-5: Approach To System Design & Modelling	112
Figure 6-6: Project Management Tools/Methods Used For In-House Development	113
Figure 6-7: System Development Methods Reported By In-House Developers	114
Figure 6-8: Approaches To IS Development.....	115
Figure 7-1: An Information-Processing Model of Problem-Solving (Mayer, 1989).....	121
Figure 7-2: Object Systems In Systems Development (Lyytinen, 1987)	127
Figure 7-3: The Inter-related Nature Of Design and Problem Definition	130
Figure 7-4: The Implications Of Emergent Design	132
Figure 7-5: Uncertainty Vs. Complexity In Information System Design.....	134
Figure 7-6: Neisser's Perceptual Cycle (<i>Weick, 1979, after Neisser, 1976, page 112</i>).....	137
Figure 7-7: Conceptual Models in Design (Norman, 1988, page 16).....	141
Figure 7-8: Coupling Between A User's Conceptual Model Of A Technical Artefact And Their Task-Action-Mapping Model	142
Figure 7-9: The Concept Of Shared Cognition (adapted from Laukkanen, 1994)	146
Figure 7-10: Types of Power Exercised (Markus & Bjorn-Andersen, 1987).....	153
Figure 8-1: A Rich Picture Of The Tender Response Process (The Target System To Be Designed In The Research Study Project)	165
Figure 8-2: Fujitsu Telecommunications (Europe) Ltd. Company Organisation	166
Figure 8-3: An Organisational Network Representation Of The Core Design Team And Their Contacts	167
Figure 8-4: Involvement Of Core Design Team Members Over Time	168
Figure 8-5: The Proposed Process Of Design.....	169
Figure 8-6: Duration And Sequence of Episodes During the Design Process.....	171

Figure 8-7: Overview Of The Designed Tender Response Process	174
Figure 8-8: A Rich Picture Of The New (Intended) Tender Response Process	177
Figure 8-9: The Initial Stage 1 Process Design Flowchart Compared To A Later Design.....	187
Figure 8-10: IS Manager's Representation Of Relationship Between Target System Process And Wider Business Processes.....	191
Figure 8-11: A Later Representation Of The Relationship Between The Target System Process And Other Business Processes.....	199
Figure 8-12: IS Manager's Model Of Tasks Required To Complete Design	203
Figure 8-13: A Rich Picture Of The Explicit And Implicit System Boundaries	208
Figure 9-1: Duration And Sequence of Episodes During the Design Process.....	221
Figure 9-2: Design Framing At Individual And Group Levels Of Analysis	237
Figure 9-3: A Framework For The Management Of Meaning In Design.....	238
Figure 10-1: FTEL Design Process Mapped To Complexity/Uncertainty Dimensions	249
Figure 10-2: Political Trajectory Of The FTEL Design Project.....	250
Figure 10-3: The Design Network At The Start Of Project.....	251
Figure 10-4: Effect Of The Statement Of Design Objectives.....	252
Figure 10-5: The Team's Published Model Of The Design Objective.....	253
Figure 10-6: Direct And Indirect Actor-Networks Established By The Model Of The Design 'Problem'	254
Figure 10-7: Local and Global Actor-Networks Following Departure Of Marketing Representative	257
Figure 10-8: Explicit System Boundary (Solid Line) Vs. Implicit System Boundary (Dotted Line)	258
Figure 10-9: Direct And Indirect Actor-Networks In Technology Implementation.....	260
Figure 10-10: The Attempt To Attach The Global Network Through a Definition Of Design Benefits.....	263
Figure 11-1: Design Framing At Individual And Group Levels Of Analysis	273
Figure 11-2: A Framework For The Management Of Meaning In Design.....	275
Figure 11-3: The Concept Of Emergent Design.....	279
Figure 11-4: A Model Of The Organisational Information System Design Process.....	280
Figure 12-1: A Framework For The Management Of Meaning In Design.....	287
Figure 12-2: Design Framing At Individual And Group Levels Of Analysis	289
Figure 12-3: An "Ideal" Design Process.....	292
Figure 12-4: A Social Action Model Of The Organisational Information System Design Process	294
Figure 12-5: Multiple Dimensions Of Design Abstraction And Representation.....	299

List of Tables

Table 3-1: Studies Assuming Methodology Is A Sufficient Condition For Success.....	34
Table 3-2: Studies Of IS Methodology Use Which Take A Critical Perspective.....	35
Table 3-3: Operationalised Concepts For The IS Development Approach Framework.....	46
Table 4-1: Alternative Stances On Knowledge And Reality (Walsham, 1995 pg.76)	52
Table 7-1: Some contrasting features between well-structured and ill-structured problems (Guindon, 1990b).....	123
Table 7-2: The rational problem-solving paradigm and the reflection-in-action paradigm contrasted (Dorst and Dijkhuis, 1996).....	131
Table 7-3: Four Perspectives On The Resolution Of Organisational Problems	133
Table 7-4: Comparison Of Two Worldviews Underlying Organisational IS Design.....	156
Table 8-1: Episodes Of Design At FTEL: A Summary	172
Table 9-1: Perspectives At The Start Of The Project	222
Table 9-2: Perspectives In The Middle Of The Project (Start of Episode 5).....	225
Table 9-3: Perspectives Towards End Of Project (Start of Episode 7).....	227
Table 9-4: Summary of Meeting Analysis By Contribution Decomposition-Level.....	232
Table 9-5: Dominant Form Of Knowledge Vs. Design Approach, For Each Design Episode .	240
Table 10-1: Significant Translations Of The Design Process At FTEL	266

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Completing this dissertation was a process which required numerous demands on my time, especially in fitting the work around a full-time, academic position. I could not have completed this work without the help and support of my partner, Jim, who told me I could do it, continually questioned what my conclusions were and who did the washing-up!

Declaration

The following references are materials contained in this thesis which have been published or presented elsewhere:

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Gasson, S. (1995) 'User Involvement In Decision-Making In Information Systems Development' in *Proceedings of IRIS 18*, Göteborg, Sweden, August 1995

Extracts from this paper are also reproduced in Macaulay, L.A. (1996) *Requirements Engineering*, Springer-Verlag, London, UK, pages 84-91

Gasson, S. (1995) 'The Role Of Methodologies In IT-Related Organisational Change' in *Proceedings of the Conference of the BCS Information Systems Methods Specialist Group*, Heriot-Watt University, Edinburgh, September 1995

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1. INTRODUCTION

1.1 Research Purpose And Objectives

The core interest of this research is how multi-domain, information system (IS) design groups function: the processes of co-operative information system design. An organisational information system is seen as an integrated social system of organisational actors using information, which may or may not use computer-based technology (Hirschheim, 1986; Galliers, 1987; Land, 1987). Organisational information system design takes place primarily among members of design-groups and requires the participation of users and other organisational stakeholders for good fit between the information system and the work and business objectives of the organisation (Corbett et al., 1991; Curtis et al., 1988; Dahlbom & Matthiassen, 1993). The processes of information system design, and therefore the skills involved in design, are not well understood (Turner, 1987).

Optimal design, both in terms of system effectiveness and in terms of user job satisfaction, cannot be expected unless designers possess the skills necessary for good design. If there is little understanding of what these skills are, then they cannot be sought or practised, except by accident. The aim of the proposed research is therefore to investigate empirically the nature of the information system design process - to derive an understanding of the nature of the process, with respect to both the requirements for information technology and the social context of the system.

The overarching research objective addressed by this thesis is to investigate the design of information systems in an organisational context, with the aim of contributing a rich insight into co-operative information design in UK organisations. In particular:

1. To explore the impact of information system development methodologies upon the practice of organisational information system design.
2. To investigate the nature of the processes involved in the co-operative design of organisational information systems, involving participants from multiple organisational domains, such as potential system users and other stakeholders in the design.

Detailed research issues are identified in a more detailed discussion of the problem domain (Chapter 2). Research questions are developed in response to lacunae in the review of IS development literature (Chapter 3) and in the review of organisational problem-solving and social psychology literatures (Chapter 7).

1.2 Research Motivation

The original motivation for this research was an interest in emancipation, both of information system (IS) developers and of IS users. IS developers are liable to high levels of stress from mismatches between the theory-in-use and the espoused theory (*c.f.* Argyris & Schön, 1978) which pertain to their work. IS users are liable to high levels of stress from the products of information systems development through the cognitive dissonance which arises from mismatches between the way in which users believe their work could be performed most effectively and the way in which an information system may constrain their work. It is argued in Chapter 2 that much of the literature which describes the nature of IS design is lacking in any real description of the nature of the processes involved, in a social and organisational context, or how such processes might best be supported. This study takes a neohumanist position in its focus on emancipation (Hirschheim & Klein, 1989, 1994): user involvement is viewed as critical to the success of an information systems development exercise:

“Emancipation embraces two dimensions: psychological and organisational. The former calls for the realisation of the full creative and productive potential of individuals; the latter refers to the establishment of social conditions which encourage effectiveness through organisational democracy, specifically overcoming existing forms of authoritarianism and social control if they perpetuate inequities of the status quo in the work place.” (*Hirschheim & Klein, 1994, pg. 85*)

There is a wide body of literature on the development and application of human-centred technology. Some of the main ideas of this literature are:

1. The human-centred approach rejects the idea of the “one best way” of doing things (Taylor, 1947): that there is one culture or one way in which science and technology may be most effectively applied (Gill, 1991).
2. Technology is shaped by, and shapes in turn, social expectations: the form of technology is derived from the effect of these social expectations upon the design process (Berger and Luckman, 1966; MacKenzie and Wajcman, 1985). The social constructivist approach reveals the *social* interior of technological design: technology no longer stands as an independent variable, but an outcome which is the result of socially-constrained choices made by designers.
3. The human-centred approach is opposed to the traditional, technically-oriented approach, which prioritises machines and technically-mediated communications over humans and their communicative collaboration (Gill, 1991). While technically-oriented design traditions see humans as a source of error, the human-centred design approach sees humans as a source of error-correction (Rosenbrock, 1981).

4. Human-centred production should concern itself with the joint questions of “What can be produced?” and “What should be produced?” The first is about what is technically feasible, the second about what is socially desirable (Gill, 1991).
5. Objective and subjective knowledge cannot exist independently of each other: while technologists attempt to encode the explicit, rule-based knowledge needed to perform a task, this knowledge is useless without the “corona” of tacit and skill-based knowledge which surrounds the explicit core and through which explicit knowledge is filtered (Rosenbrock, 1988). Cooley (1987) suggests that modern technology is designed to separate “planning” tasks from “doing” tasks (for example, in modern Computer-Integrated Manufacturing); this results in deskilled human technology users (Braverman, 1974), who are less equipped for exception-handling as a result (Cooley, 1987), and in poorer work outcomes, as those who plan are uninformed by seeing the results of their plans and those who “do” are unable to affect the way in which work tasks are approached (Willcocks & Mason, 1987).

The human-centred perspective has formed the basis for a great deal of work with the ‘Scandinavian tradition’ in the information systems literature for example, Bjercknes et al. (1987), Bjorn-Andersen (1989), Briefs et al. (1983), Dahlbom and Mathiassen (1993). Worker-emancipation facilitated by user-participation in design has been widely practised in Scandinavia, aided by the collaborative trades union policies adopted by Scandinavian employers (for example, the UTOPIA project discussed by Bødker et al., 1987). In the UK, the socio-technical approach of Emery and Trist (1960) was extended to apply to organisational information systems development by Mumford (1983); our concept of an information system has changed from a technical system to a social system which is supported by technology (Land & Hirschheim, 1983) and from a formal, designed system to an informal system (Land, 1992), where information is communicated in a variety of ways, many of which are not part of, and may bypass, the designed information system. Another, missing element in information system design is the need for continually evolving organisational and business fit. Avison and Wood-Harper (1991), Galliers (1987), Scott-Morton (1991) and others have argued for a changed approach to the development of information systems which considers the information requirements of the people in organisations. In the turbulent competitive environments of the 1990s, information systems cannot be seen as static and prescriptive (Argyris, 1987), nor can they be seen as embedded in existing organisational structures (Baskerville et al., 1996; Davenport, 1993; Truex and Klein, 1991). Current approaches to IS design are embedded in structured, rule-based methods and models (*c.f.* Galliers & Swan, 1997). To align

information systems more closely with the needs of both system users and the business as a whole, design methods need to be more fluid, responsive and supportive of system design in an organisational, socially-mediated context.

1.3 Scope Of Research

For the purpose of this research, a definition of the term “information system design” will be used which distinguishes between:

1. The design of computer-based information technology (IT design)
2. The investigation, synthesis and management of change in a socio-technical system of human-activity, which is supported by information technology (IS design).

It is the second type of design that will be investigated here, taking as its starting point the wider nature of the systems boundary envisaged by Checkland (1981, Checkland & Scholes, 1990), Avison and Wood-Harper (1991), Dahlbom and Mathiassen (1993), Hirschheim and Klein (1989, 1994), Land (1992), Mumford (1983), Galliers (1993a, Galliers & Swan, 1997) and many others. Where the design of technology is considered, it is considered within the context of the organisational environment and the socio-cultural system of which both technology and the practice of design are a part (Latour, 1987, 1991, 1992; Lave 1988, 1991).

IS design activities occur at multiple, conceptual ‘levels’ (Curtis et al., 1988):

- at the level of individual cognition, where learning about and clarification of design requirements are paramount;
- at the level of group interaction, where maintenance of intersubjectivity, shared learning, communication and the division of labour are important;
- at the level of organisational behaviour, where stakeholder inclusion, cross-domain learning, political negotiation and environmental monitoring are critical for success.

Activities at the multiple levels of design interact and impact upon one another; this research will study design at all three levels, to obtain a rich perspective of the research problem. The organisation is seen as a body of interdependent domains:

“ A theory of social practice emphasises the relational interdependency of agent and world, activity, meaning, cognition, learning and knowing.” (Lave and Wenger, 1991, page 50).

1.4 Research Approach And Summary Of Empirical Studies

The purpose of this research is to establish the nature of co-operative, multi-domain, information system design and to investigate what types of support tools and management approaches might help to accomplish more human-centred processes and outcomes for information systems development. To achieve an investigation of the internal nature of the

design process, the main research paradigm used is interpretive (Burrell & Morgan, 1979; Orlikowski & Baroudi, 1991; Walsham, 1993a, 1995), although other research paradigms were employed as part of a multi-methodological approach, as recommended by Galliers (1992). This is discussed further in Chapter 4.

Jackson (1992) argues that information systems (IS) research has three aims:

1. To serve the practical interest, in promotion and expansion of mutual understanding among the individuals and groups participating in the social systems which underlie information systems;
2. To serve the technical interest, in improving the productive potential and steering capabilities of social systems; *and*
3. To serve the emancipatory interest, in protecting the domain of the practical interest from incursion by the technical interest and exposing situations where the exercise of power or other causes of distorted communication prevent the open and free discussion necessary for the success of interaction.

By using complementary methodologies and research perspectives, the objective is to achieve an holistic approach to the furtherance of all three interests, in order to achieve a rich insight into co-operative information system design through the investigation of IS design from different perspectives. A wide collection of data has been used - case study interviews, survey data, observations of design meetings, design documentation, stakeholders' elicited frames of reference, user-generated problem perspectives and conceptual models - to understand design activity in the context of organisational information systems development in the UK. Empirical investigations performed as part of this research, the approach employed and the main findings of each investigation are summarised below.

Stages Of The Research Study

<i>Initial Case Study</i>	Study of problems with user-centred design method
Method of investigation	Unstructured interviews with the members of a design-team investigating a design project which employed a user-centred development method.
<i>Summary of findings</i>	<ul style="list-style-type: none"> ☛ The ability of the design team to construct shared frames of meaning was constrained by power inequalities, leaving the system and work-roles to be defined by a technical elite. ☛ The design process lacked integrative mechanisms to ensure that intersubjectivity was maintained among the design team. ☛ The intended development method was subverted by a distortion of the process by technical actors.



Postal Survey

Method of investigation

Summary of findings**Study of IS development practice in the UK**

Postal survey of IS development approaches, responded to by the most senior IS manager in 49 large, UK companies.

- ☛ Information system development methodologies were not widely used and were not used in full
- ☛ User-participation in information system development was lowest during the formal design stage of the information system development life-cycle
- ☛ Companies which outsourced IS development had significantly lower user-participation than companies which performed information system development in-house.

**Longitudinal Study**

Method of investigation

Summary of findings**Study of multi-domain organisation-focussed IS design**

An ethnographic field study of design processes over a period of 18 months, including design meeting observation, interviews and SSM sessions. A social cognitive analysis of the design process and a genealogical analysis of the design product supplement the initial, ethnographic analysis.

- ☛ The *meaning* of design processes within a design-team was shaped by pre-existing "investment in form", represented by individual IT-design and application-domain expertise.
- ☛ There was a mismatch between "top-down" models of organisational IS design (based upon Business Process Redesign) and observed design abstraction processes.
- ☛ Mismatches between the structured, decompositional design approach and the intended flexible, autonomous work-system, constrained the resulting target-system task autonomy.
- ☛ Negotiated design outcomes were influenced by different types of knowledge at various stages. 'Complication' of the design by periodically changing the process focus is recommended.
- ☛ The distributed nature of group design has the effect that achieving a 'common vision' of the design process is more critical than achieving intersubjectivity with respect to product.
- ☛ Design is political: conflict between the exploration of organisational possibilities and influential stakeholders' expectations of efficiency benefits must be managed.
- ☛ Activity relating to the "grey area" between explicit system design goals and boundaries and emergent definitions of goals and boundaries needs to be legitimised for effective design.

1.5 The Thesis Structure

The research design, shown in Figure 1-1, was based on one of theory building, testing and extension, after Galliers (1992). This model is discussed in detail in Chapter 4.

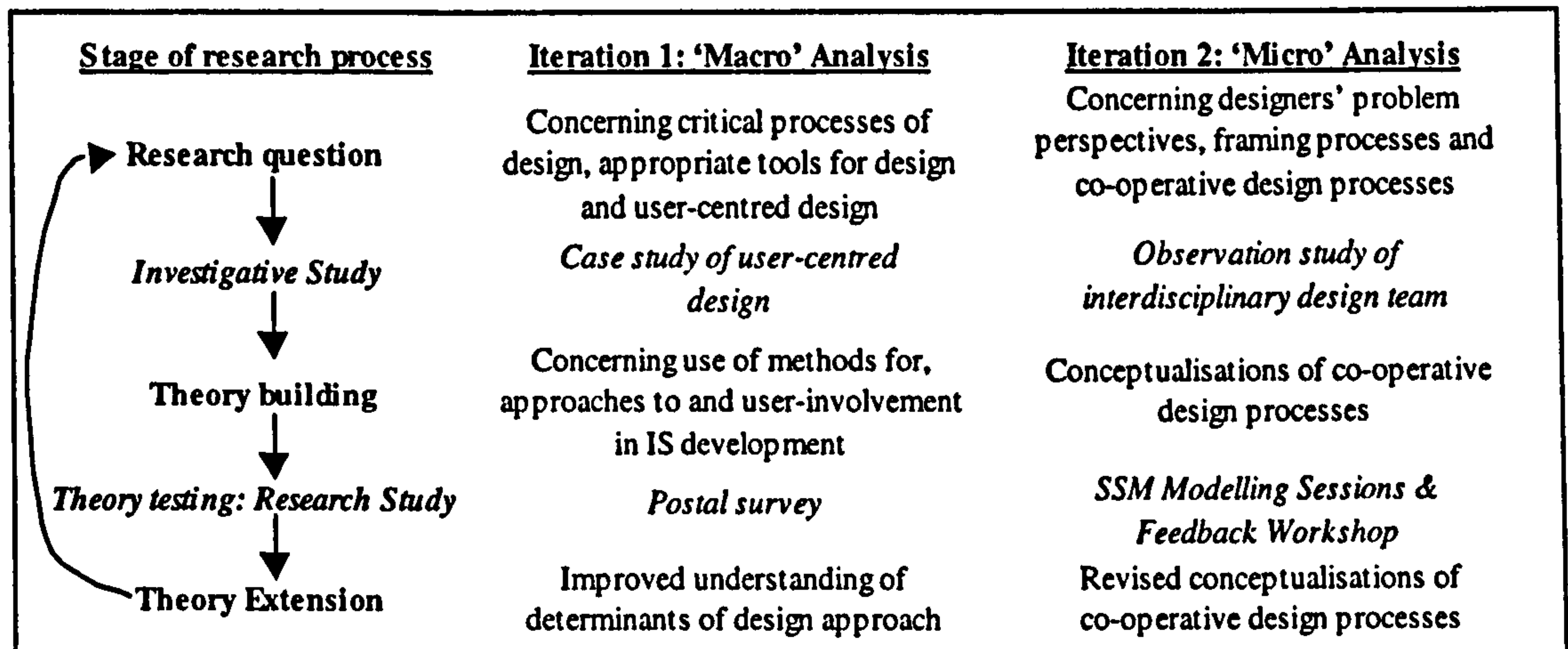


Figure 1-1: Implementation Of The Research Process Model

The structure of this thesis follows the design of the research, with a literature review for the first research iteration preceding the methodology chapter (which discusses research methodology for both iterations) and the two empirical studies of the first iteration, followed by a literature review for the second research iteration followed by the chapters which discuss the longitudinal field study which formed the basis of the second iteration. The association between this thesis structure and the research design is illustrated in Figure 1-2. A summary of each chapter in this thesis follows:

- Chapter 1 (This Chapter) Summarises research objectives, presents the thesis structure and summarises the overall research study design.
- Chapter 2 Introduces the problem domain. High-level research issues are identified and the research context is described.
- Chapter 3 Reviews areas of theory relevant to the problem domain and summarises empirical research in these areas, providing a synthesis of the current state of knowledge with respect to information system design, in the IS development literature. Lacunae in the literature are identified and detailed research questions for the first research iteration are generated.
- Chapter 4 Discusses the methodological approach to this study, presenting a critique of research approaches to this area, discussing the strengths and weaknesses of alternative approaches and justifying the methodological approach taken for this study. The research design and the deployment of research methods to accomplish the objectives of the thesis are discussed in this chapter.

- Chapter 5 Describes the initial case study investigation and discusses its findings, relating these to the research questions.
- Chapter 6 Describes the survey of approaches to information system design, relates this to the operationalisation of constructs in the conceptual framework and discusses the survey findings with respect to the research questions. The findings of the first research iteration are summarised here and issues are identified to be examined further in the second research iteration.
- Chapter 7 Reviews relevant literatures concerning the issues which arose from the findings of the first research iteration. Two main areas of theory are examined: the nature of organisational ‘problem-solving’ and theories of social psychology, as these relate to design. A synthesis of the current state of knowledge with respect to these research areas is provided and detailed research questions for the second research iteration are generated.
- Chapter 8 Describes the longitudinal field study which formed the basis of the second research iteration and presents an ethnographic analysis of the IS design context.
- Chapter 9 Presents a social cognitive analysis of design processes observed during the field study.
- Chapter 10 Presents a genealogical analysis of field study data, tracing the emergence of the design outcome.
- Chapter 11 Discusses the research findings from the three analyses of the field study with respect to the research questions posed for the second research iteration.
- Chapter 12 Summarises the overall research findings, from both iterations, and discusses their implications for future research. Implications for information system development practitioners and managers are also explored.

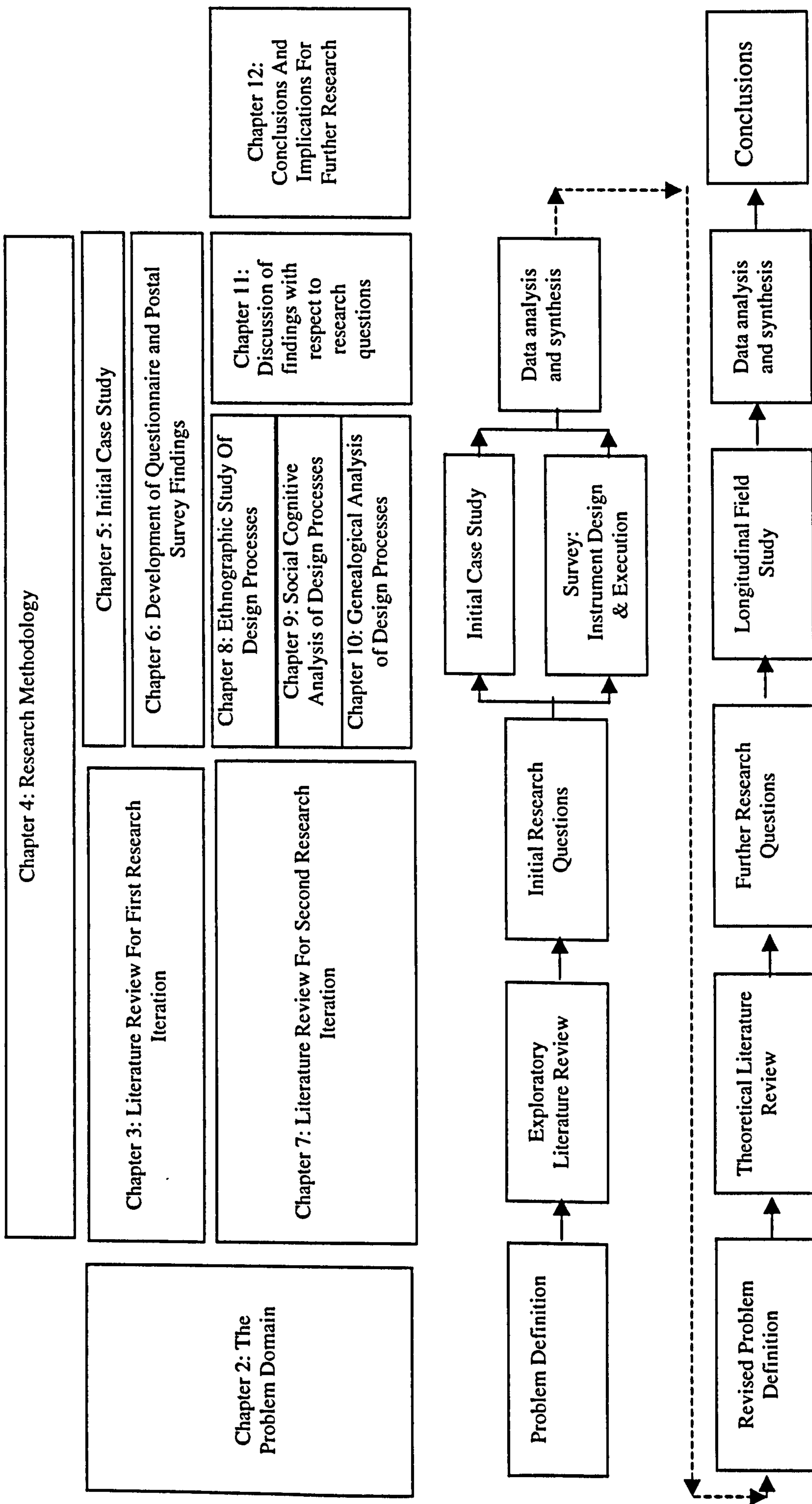


Figure 1-2: Structure Of The Thesis, Relative To The Stages Of Research

2. THE PROBLEM DOMAIN

This chapter discusses issues of the problem domain of organisational information system design and development, identifying critical research issues, the literatures for which are explored in more detail in the next chapter.

2.1 Organisational Information System Development

During the 1980s and 1990s, research evidence emerged of organisational information system failure because of behavioural problems originating in the design and implementation of Information Systems (Dagwell & Weber, 1983; Land & Hirschheim, 1983; Friedman & Cornford, 1989; Sauer, 1993). Empirical studies indicated that the traditional approach to the development of new technology resulted in technological systems which were associated with a high degree of stress and low motivation among their users (Corbett, 1987; Wilkinson, 1983; Zuboff, 1988). The Scandinavian tradition and the human-centred approach to the design of technology, discussed in the previous chapter, arose as a reaction to this evidence. Bjorn-Andersen (1989) criticised the narrow definition of human-computer interaction used by ergonomics and systems design research which takes technology as its starting point with the words: "It is essential that we see our field of investigation in a broader context. A 'human' is more than eye and finger movements". These sentiments are echoed in the work of Checkland (Checkland, 1981; Checkland & Scholes, 1990) on 'soft' systems, which is concerned with multiple, socially-constructed views of the world and 'systems of purposeful human-activity'.

A common theme in the human-centred literature is that it is the process of technology *design* which determines the effect of that technology upon its human users. This is best illustrated by considering recent developments in the theory of technological determinism. Technology may be argued to determine work design (Braverman, 1974), or to be neutral in its impact, with the relationship between technology and work design being mediated by managerial intentions and values (Buchanan and Boddy, 1983), by managerial strategic choice (Child, 1972) or by organisational politics (Child, 1984; Mumford & Pettigrew, 1975). However, the *forms* of available technology have an independent influence on the range of social choices available (Scarbrough & Corbett, 1991; Wilkinson, 1983). An analysis of technology as an unexplored entity which simply embodies the intentions and interests of particular groups (Child, 1985) ignores the technological decision-making which *precedes* the managerial decision-making process: the process of design.

Existing research into the use of technology in organisations can, until recently, be viewed as pertaining to one of two perspectives:

- the social science perspective, which considers the organisational impact of information systems, with the technology seen as a ‘black box’
- the computer science perspective (also found in the field of Systems Engineering and much of the IS development methodology literature), which considers the design issues of information systems in terms of choices made on the basis of technological criteria.

The language used by the two worldviews is revealing. The computer science perspective uses the machine metaphor (Morgan, 1986), for example in its use of the term “human-computer interface”. Human beings are relegated, by the use of such language to a component of the information system ‘machine’. The social science perspective uses the organism metaphor (ibid.), for example in its use of the term “the learning organisation” to represent the evolution of organisational responses to the technological and competitive environment.

In much of the literature which takes the computer science perspective of organisational information systems there is an implicit lack of recognition of the role of the human as a source of error-correction, rather than as a source of error (Rosenbrock, 1981). The emphasis upon human beings as part of a machine tends to scientific reductionism in the design of organisational systems which, according to, leads to fragmented jobs for users, with little use of the richness of human capacity (Corbett et. al., 1991).

Similarly, in much of the literature which takes the social science perspective there is an implicit lack of recognition of the ability of technology to affect organisational work and structures. Whilst, for example, Mumford’s work in ETHICS (Mumford & Weir, 1979; Mumford, 1983) claims to be in the socio-technical tradition (implying the joint satisfaction of both social and technical interests), it deals exclusively with the design of work systems. Technology is seen as infinitely configurable to suit the organisation of workgroups, with no account taken of constraints imposed by either technology design or its implementation, although Mumford’s earlier work shows a high awareness of how technology design may limit emancipation, *e.g.* Mumford (1972) or Mumford and Sackman (1975). Technology becomes invisible and homogeneous in the social science perspective: technology is often referred to in the social science literature as a “black box” - an engineering term which indicates that the form of the technology does not matter, it may be treated as a set of electrical or data inputs and outputs. Little consideration is paid to how its form or function may impact the work of users, yet empirical research shows

that both technology design and its configuration can constrain workgroup design to a high degree (Akrich et al., 1987; Callon, 1987; Heller, 1989; Wilkinson, 1983).

This research provides an insight into the 'middle ground' of the bifurcation of interest between social and computer science, attempting to pull together the two different, and in some cases conflicting, research philosophies in a consideration of how technology 'form' is designed in the context of organisational fit - i.e. when users and other stakeholders are involved in the design of the social and technical systems which constitute an organisational information system. In this sense, it is hoped to "fill the gap" in our knowledge and understanding of information system design processes, by providing an *holistic* approach to research: one which considers the context and process of co-operative information system design combined with an understanding of the content of that design. This research takes as its starting point that design is both a technical and a social issue:

" Thus, in its design stage, the character of an object is endlessly debated: what will it look like? what will it do? what will it be used for? what skills will its users need? what maintenance will it require? Such talk is heterogeneous. Indeed engineers transform themselves into sociologists, moralists or political scientists at precisely those moments when they are most caught up in technical questions. Should a car be treated simply as a basic and economical means of transport? Or should it satisfy repressed desires for conspicuous consumption (Callon, 1987¹)? Should users be allowed to intervene when a solar lighting kit breaks down? Or should it be hermetically sealed to prevent damage by amateurs (Akrich et al., 1987²)? Answers to those questions - questions about design - are *both* technical *and* social. They imply decisions about the definition and distribution of roles between the object and its environment." (Callon, 1991, page 136).

2.2 The Design Of Organisational Information Systems

2.2.1 Organisational Information Systems As Interrelated Systems Of Human Activity And Information Technology

The overall paradigm reflected in this strand of research is one which sees the computer-based information system as a *servicing* system to the *served* human-activity system (Winter and Brown, 1994; Winter et al., 1995). A central concept embodied in the model shown in Figure 2-1, which is based upon the work of Checkland (1981, Checkland & Scholes, 1990), is that an Information System consists of *separate* sub-systems, with different organisational objectives and therefore different methods are appropriate for interpreting the requirements and outcomes of the served system and of the servicing system (Winter and Brown, 1994; Winter et al., 1995).

¹ Callon, M. (1987) 'Society in the making: The study of technology as a tool for sociological analysis', in W.E. Bijker, T.P. Hughes, and T.J. Pinch (Eds.) *The Social Construction of Technological Systems, New Directions in the Sociology and History of Technology*, MIT Press, Cambridge, MA

² Akrich, M. Callon, M. & Latour, B. (1987) 'A quoi tient le succès des innovations' *Gerer et Comprendre*, 11 and 12.

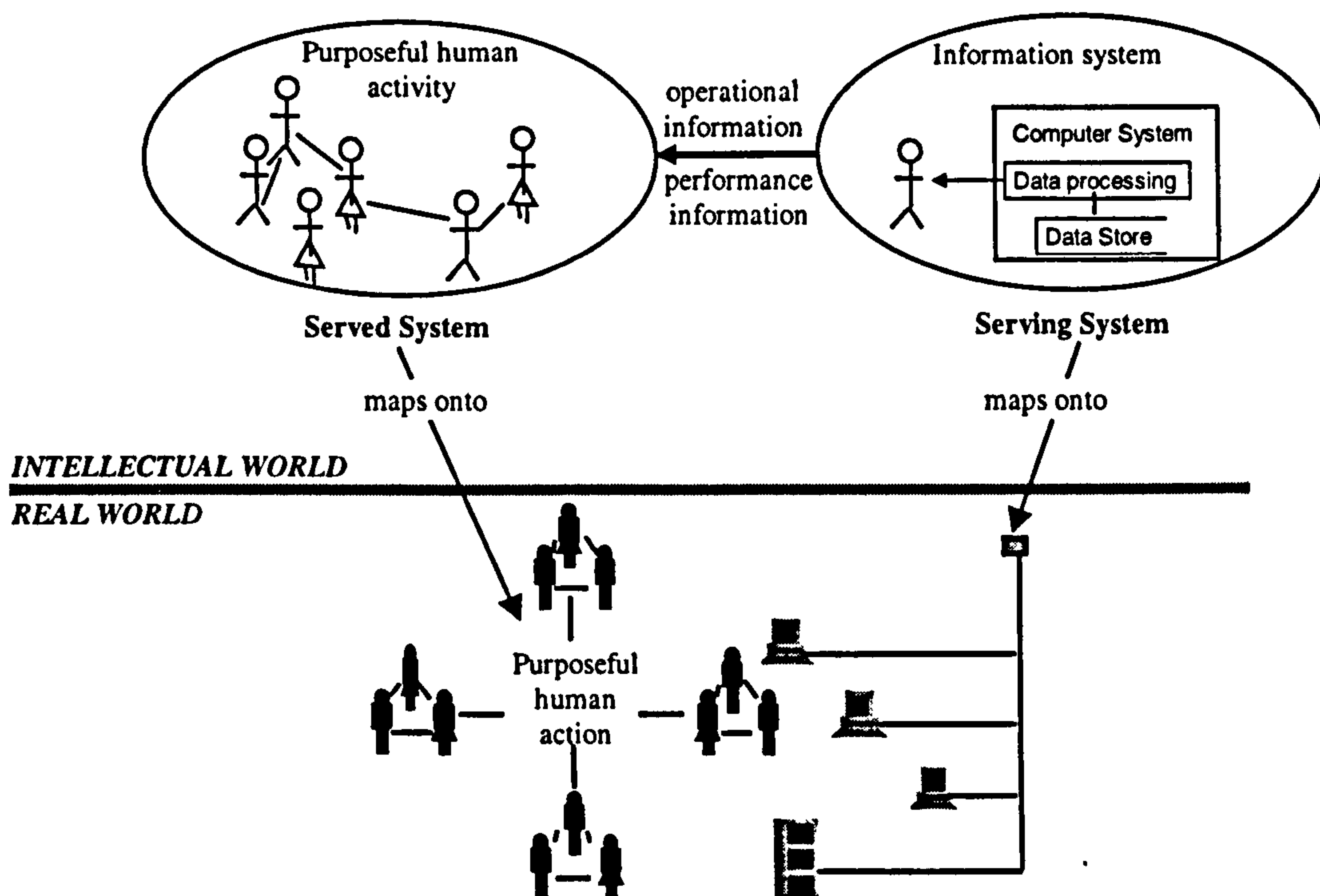


Figure 2-1: The Concepts of Served And Serving System (Winter & Brown, 1994)

2.2.2 The Linear Staged Model Of Information System Development

Separation of serving system analysis from served system analysis is the approach used most widely in practice: most organisations manage information system development according to the linear, staged model shown in Figure 2-2: the waterfall model (Boehm, 1988; Eason, 1982; Friedman & Cornford, 1989; Hopker, 1994; Hornby et al., 1992; Markus & Bjorn-Andersen, 1987; Moynihan & O'Connor, 1991; Saarinen, 1990).

Organisational “problems” are defined, a feasibility study is performed to assess business and organisational requirements, then technical requirements are identified, which are used as the basis for the design and implementation of the serving, computer-based system.

But the staged, linear (waterfall) model of systems development is misleading: in theory, feedback loops are only permitted between contiguous stages (Boehm, 1988), in practice design cannot be separated from other stages of the lifecycle: requirements specification, design and technical system implementation are intertwined (Bansler & Bødker, 1993; Fitzgerald, 1996b; Friedman & Cornford, 1989; Keen, 1987; Swartout & Balzer, 1982; Winograd, 1995). Design activities are central to and pervade the whole system development life cycle - for example, radical redesign of a technical system may occur at the system implementation stage when a problem is encountered during interactive user testing; such redesign is often referred to as ‘system maintenance’ (Lientz & Swanson, 1980).

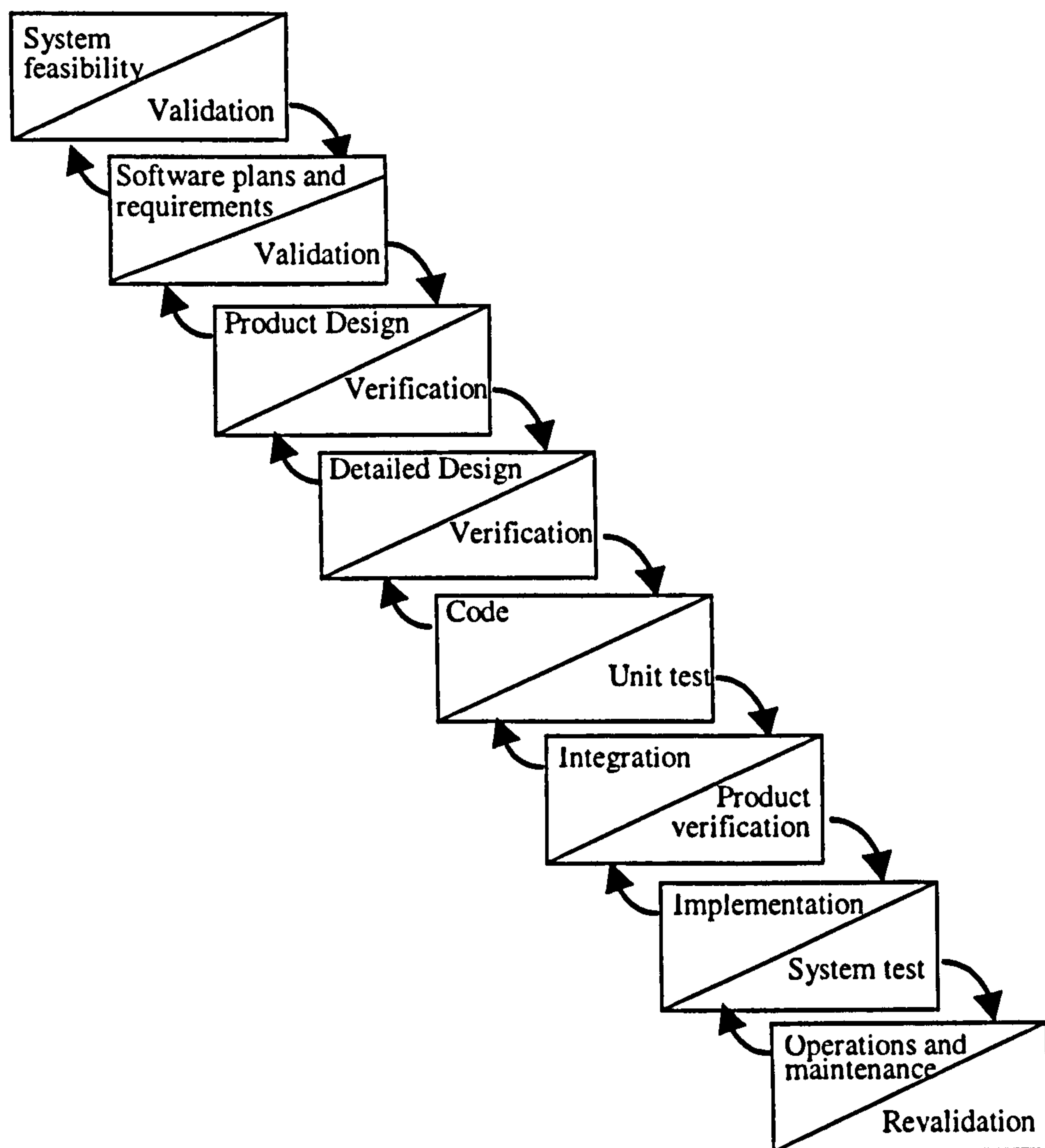


Figure 2-2: The 'Waterfall' Model Of System Development (Boehm, 1988)

Design is a cognitive process, and because of this it is often an *implicit* process, with implicit assumptions, parameters and constraints (Malhotra et al., 1980; Schön, 1983; Rosenbrock, 1983). Design decisions are rarely documented, especially for rejected, alternative designs (Guindon, 1990a, 1990b). Design and development is usually a group process whereby a *team* will be charged with the design and development of a system: group design involves social cognitive processes such as intersubjective understanding and distributed cognition (Norman, 1991; Flor & Hutchins, 1991; Lave 1991).

These characteristics present difficulties to IS managers as the key management roles of co-ordination and control are very difficult when dealing with design conceptualisations which are by their nature intangible, and where there can be no ultimate control of delivery of the ideas. Most IS development methods depend upon a clear understanding of system "requirements", yet the completeness of a system design appears to be controlled more by the constraints of the development project timescale than by a perception that the requirements are fully understood (Walz et al., 1993).

Research Issue: *Given that design is an integral part of all stages of the waterfall model of information system development, what models could be used to manage the activities of information system design?*

2.3 Methods For Organisational IS Design

2.3.1 The Use Of Development Methodologies

As discussed above, organisational problems and alternative system solutions are often ill-defined; methods for design requirements determination assume a greater understanding of users' information requirements than can be provided by available tools. To quote Galliers (1987):

“Reliance is placed on an analysis of the current information systems provision as compared with the information actually needed - the latter is, by some unidentified means, to be inferred from a study of organisational goals.” (*ibid.*, page 293)

This section examines the need for tools and methods to replace the “unidentified means” highlighted by Galliers (1987). The term ‘methodology’ is used by practitioners within the context of IS design and development to mean a set of stages, procedures and tools which support the development of a computer-based information system. As this is the term used by practitioners, I intend also to use the term methodology (strictly meaning a ‘study of method’, as we are reminded by Checkland, 1981) in that sense here. An information system development methodology is more than just a method (the ‘how’ of information systems development), or a process-model (the control element). A methodology embodies an holistic *approach* to design: it embodies a set of methods, tools and representational practices, a process-model which indicates the expected duration and sequence of development activities, together with a philosophy of action (Jayaratna, 1994; Maddison et al., 1984).

There is a widespread perception, in the literature on IS development methodologies that formal IS development methodologies reflect ‘good’ design practice (e.g. De Marco, 1979; Jeffries et al., 1981; Kautz & McMaster, 1993; Yourdon & Constantine, 1975). Much literature on IS development methodologies takes as a starting point the fundamental axiom that the use of a formal IS development methodology will produce the desired outcomes and that it is ignorance or lack of commitment on the part of the practitioner which leads to failure (e.g. Kautz & McMaster, 1993; Sumner & Sitek, 1986; Ward, 1991).

Research Issue: *Do formal IS development methodologies reflect ‘good’ design practice?*
There is a lack of congruence found between structured methodologies and system analysts’ cognitive behaviour (Vitalari, 1984). Whilst information system design is

represented by structured methodologies as a top-down, decomposition process, empirical studies (Malhotra et al., 1980; Guindon, 1990b; Visser & Hoc, 1990) show design to be a process of convergence between a mental model of the proposed solution held by the designer and the set of system requirements, which are re-framed when they cannot be reconciled with solutions available to the designer. Real-life system design is iterative and often recursive. Galliers and Swan (1997) argue that IS development is socially-mediated and based upon informal information and knowledge which is shaped by a wide variety of internal and external social networks, rather than involving the “codification of formal data” assumed by decompositional development approaches.

Research Issue: If the design of organisational information systems is not supported by top-down, decompositional methods, how might it be supported?

Parnas & Clements (1986), while recognising that structured methodologies do not reflect the processes of computer system design, advocate that designers “fake it” in order to benefit from the communication and maintenance advantages which arise from their use! Baskerville et al. (1996) argue that information systems are now developed amethodically - without method - and that this is a natural consequence of emergent forms of organisation. Methods cannot succeed repeatedly because such methods assume permanence in organisational structures. There is a strong element of conflict between the requirement of traditional forms of IS development organisation which assume permanence of structure and the requirements of emergent organisations which reject permanent structure; this is coped with by a rejection of method (Truex & Klein, 1991, Baskerville et al., 1996).

Research Issue: What IS development methodological approaches are in use and to what extent are they used?

2.3.2 User-Participation In IS Design

The served and serving systems shown in Figure 2-1 are interdependent; organisational system design requires designers to jointly optimise organisational/social and functional/technical requirements (Heller, 1989), but information system professionals do not appreciate the impact that they can have upon the various social structures and power bases in an organisation through their role as change agent (Dagwell & Weber, 1983; Hornby et al., 1992). Organisational information system design “involves the shaping of new forms of identity at work, social structures, and interests and values” (Walsham, 1993a, page 202). Users and other stakeholders (such as functional managers and financial controllers) are not fully involved in the design process; they may be excluded because of

lack of expertise, time and cost pressures, or lack of awareness on the part of designers that IS design affects organisational work (Curtis et al., 1988; Hornby et al., 1992).

The involvement of system users in design processes may be a critical success factor in information systems success (Hirschheim & Klein, 1994; Barki & Hartwick, 1994), while Eason (1982) and Corbett et al. (1991) argue that the extent of user-participation in design is directly influenced by the methodological approach taken to IS development. The Scandinavian tradition of participative systems design has acted as the basis for a new culture of IS development methods and approaches based upon user-participation (for example, Bjercknes et al., 1987; Bjorn-Andersen, 1989; Bødker et al., 1987; Briefs et al., 1983; Dahlbom and Mathiassen, 1993; Floyd, 1984, 1987; Floyd & Keil, 1983; Hirschheim, 1986; Hirschheim & Klein, 1994; Land & Hirschheim, 1983). But there is strong evidence that the primary approach to IS development is still based upon the use of structured methods, rather than those which encourage user participation. (Bansler & Bødker, 1993; Eva & Guildford, 1996a, 1996b; Hopker, 1994; Hornby et al., 1992; Saarinen, 1990; Sumner & Sitek, 1986; Wynekoop & Russo, 1993).

Empirical studies have suggested that user involvement in information system development is related positively to user perceptions of system usefulness (Amoako-Gyampah and White, 1993; Baroudi, Olson & Ives, 1986; Franz & Robey, 1986; Torkzadeh & Doll, 1994). But this does not mean that user involvement in information systems development is a necessary condition of success. Cavaye (1995) argues that there are also projects where users did not participate in the development but which are nonetheless successful and that the existing body of user participation literature is fragmented, presenting inconclusive results on the extent of a causal relationship. A traditional, (waterfall process-model based) development methodology excludes users, as their only contact with the process is via the validation of documents which they may not be in a position to understand fully. An evolutionary, prototyping approach to development, on the other hand, provides users with learning opportunities throughout the development process, permitting them to contribute to design decisions in an informed and powerful way. But in practice methodologies are not often used in the manner intended: IS professionals use tools and methods from a variety of methodologies, adopting a contingency approach to method customisation (Curtis et al., 1988; Hardy et al., 1994; Hornby et al., 1992; Vitalari, 1984). Users may be permitted to participate to a high degree in system development projects which use traditional methodologies (Hardy et al., 1994; Hopker, 1994) and may be excluded from projects which use prototyping approaches (Floyd, 1987).

Research Issue: *To what extent are users involved in the design of information systems and how is this involvement affected by the methodological approach to IS development?*

2.3.3 Methodological Support For The Processes Of Design

Traditional and structured development methodologies are based upon the staged, linear waterfall model which has, as its underlying assumption that the “problem” of IS design is well-understood at the beginning of the IS development process and that this problem may be successively decomposed until a solution is achieved (Boehm, 1988; Ball & Ormerod, 1995); this approach is popular because it permits greater management control (Fitzgerald, 1996b; Friedman & Cornford, 1989). There are two main criticisms which may be aimed at this model. The first is that, if IS design is seen as the mediation of organisational change, the design “problem” is complex and messy and unsuited to decomposition; the attempt to apply decompositional design approaches to such problems is problematic and a primary cause of stress among IS professionals (Wastell & Newman, 1993; Wastell, 1996). The second is that structured decomposition leads to fragmented work-tasks, which are not conducive to human-centred outcomes, being organised into system components on the basis of technical expediency, rather than meaningful work associations (Bansler & Bødker, 1993; Corbett 1989, 1992).

Hirschheim & Klein (1992) argue that there are two distinct aspects of a development methodology: *process* - the “tasks, tools and techniques used to accomplish the procedural component” and *framing* - “how the object system is perceived and the types of changes which take place” (Hirschheim & Klein, 1992, page 238). Whilst the first element - the need for management control - is a critical issue in IS development and a major reason for methodology selection and use (Hopker, 1994; Jenkins et al., 1984), there is an equal need for the second element, which provides the support required for effective design. The concept of framing is used within the literature as a cognitive construct, to explain the construction of mental models of the design; this concept is discussed further below. Research in this area has attempted to replace the waterfall model with an evolutionary model (e.g. Boehm, 1988; Eason, 1982; Floyd, 1987). However, such work is mainly based upon the development of pragmatic approaches which support selected themes, such as user-involvement in IS development, through the imposition of tools and procedures. Lyytinen (1987) criticises most research into IS development methods as being ill-founded in theory. An example of this is the widespread advocacy in the literature of “new” development methods based upon evolutionary prototyping (e.g. Bally et al., 1977; Floyd & Keil, 1983; Sol, 1984; Wilson, 1993). Most new methodologies are ill-founded in any theoretical appreciation of the information systems problem domain in its wider context

(Lyytinen, 1987). Many of these new methods appear to be more founded on pragmatic assumptions concerning organisational political processes than an appreciation of the nature of design processes. An honourable exception to this is the development of Multiview (Avison & Wood-Harper, 1990) which reflects the multiple social-emancipatory interests found in the work on Soft Systems Methodology (Checkland, 1981; Checkland & Scholes, 1990).

There is empirical evidence that IS development methodologies do not support the activities of design. Studies of IS development in organisational contexts (e.g. Curtis et al., 1988; Hornby et al., 1992; Jenkins et al., 1984) demonstrate that methodologies do not represent a 'theory-in-use', but a 'theory-of-action' (Argyris & Schön, 1978): they represent a rule-based interpretation of *what should be done*, rather than what people actually *do*. There is also evidence that where development methodologies are used, they are not used in full because of the domination of short-term interests which arises as a response to shorter product life-cycles and because of the need to employ modelling techniques which are easily understood by system users (Bansler & Bødker, 1993; Baskerville et al., 1992, 1996; Fitzgerald, 1996b). Given the failure of development methodologies to support the processes of design, the critical research issue of IS design is a need to understand the processes involved in information system design in a social and behavioural context. Only then can these processes be managed effectively and supported with really useful design tools.

Research Issue: *What are the critical processes of information system design?*

2.4 The Nature Of Information System Design

2.4.1 IS Design As The Solution of Ill-Structured Problems

The design of organisational information systems is concerned with "ill-structured problems" (Simon, 1973), "wicked problems" (Rittel & Webber, 1973) and "messes" (Ackoff, 1974). Such problems are associated with interrelated, organisational systems of activity; they cannot be "stated" or "solved" in the sense of definitive solution rules or requirements (Moran & Carroll, 1996) and are socially-constructed (Galliers & Swan, 1997). The waterfall model assumes the specification and decomposition of requirements for the solution of a single, well-structured design problem (Checkland, 1981), which involves hierarchical goal-structures, where solutions are decomposed from a well-defined set of solution requirements (Lawson, 1990); this process is driven by the availability of rule and problem data (Anderson, 1983). But the design of solutions to ill-structured problems is non-hierarchical: ill-structured problems are characterised by a lack of rule-

based criteria for when the design is complete and by an incomplete specification of design goals (Guindon, 1990a, Simon, 1973). Such design is recursive by nature (Malhotra et al., 1980; Guindon, 1990a) and even in the design of partial system solutions for problem sub-components, is not likely to be decompositional unless the problem is highly structured (Guindon, 1990a). Expert designers differ from novice designers in that they have a wider range of previously-encountered partial solutions available to them, with which to structure the problem space (Guindon, 1990b; Turner, 1987). In experimental situations, involving an ill-structured design problem, expert designers imposed structure upon partial design solutions, by constraining the space of design possibilities, whereupon problem decomposition could be used - i.e. they applied scientific reductionism to the problem (Ball & Ormerod, 1995; Guindon, 1990a, 1990b; Khushalani et al., 1994; Malhotra et al., 1980). The end-product of information system design is often not well-understood (Guindon, 1990b; Hirschheim & Klein, 1992; Moran & Carroll, 1996; Turner, 1987; Vitalari & Dickson, 1983). IS developers base their assumptions upon an inadequate models of system use (Hedberg & Mumford, 1975; Dagwell & Weber, 1983); this is caused partly by system developers working in isolation from system users and partly because the rule-based, functional specification approaches which are employed do not adequately reflect organisational structures and practices.

2.4.2 Situated Information System Design

The conceptualisation and design of information systems cannot be performed in isolation from those organisational processes in which the technical system is embedded: it is the design of an information system which mediates between objectives and function, between information and people. The development of organisational information systems relies on the joint management of technical and organisational design. While the design of information technology is well-researched in experimental contexts, little research exists on the nature of those design processes which are situated in organisational contexts. It is subject to political negotiation and involves organisational re-design combined with the design of technological artefacts.

Curtis et al. (1988) comment that the effect of tools and methods on software productivity can be seen as relatively small, compared to the impact of behavioural factors. An effective model of information system design must therefore support behavioural factors as well as technical ones. Information system design takes place simultaneously at many different levels within the organisation; this aspect is largely ignored by the literature, which tends to concentrate upon a single level of analysis (for example, Ball & Ormerod, 1995; Boland & Day, 1989; Bødker et al., 1987; Buckingham Shum et al., 1996; Jeffries

et al., 1981; Turner, 1987; Vitalari & Dickson, 1983). An exception is the layered behavioural model proposed by Curtis et al. (1988), shown in Figure 2-3. In this model, three levels of analysis are proposed: individual (cognitive and motivation), group (group dynamics from the perspective of the team of people engaged in a design project) and organisation (in the sense of the organisational work context and the wider involvement of other organisational actors in project decisions).

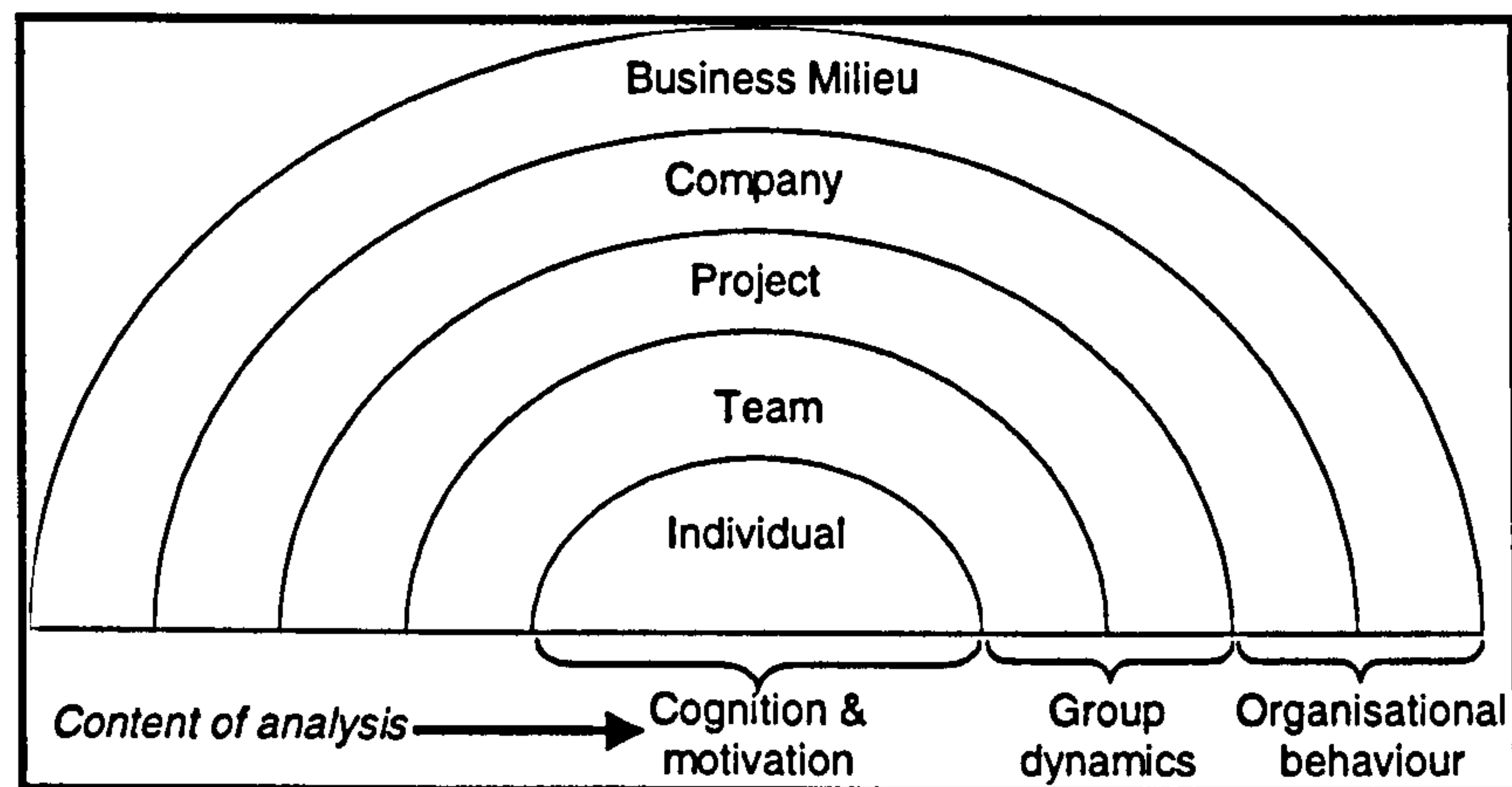


Figure 2-3: The layered, behavioural model of software development (Curtis et al., 1988)

A major problem with most approaches to design is that they support only the individual level. For example, the staged, linear (waterfall) model of system design is based upon the model of 'rational' decision-making proposed by Simon (Simon, 1960; Newell & Simon, 1972), which consists of four, sequential stages:

1. intelligence: searching the environment for conditions calling for decisions
2. design: inventing, developing and analysing possible courses of action
3. choice: selecting an alternative solution or course of action from those available
4. review: assessing past choices.

Simon's (1973) view is that design is planned and decompositional: the original, ill-structured, design problem is decomposed into a series of well-structured subproblems under the control of a mental, executive process that carries out the necessary co-ordination functions. Additional information, retrieved from long-term memory, converts the original, ill-structured problem into a collection of well-structured problems. Thus, we have the model of design as a series of successive, structured decompositions of a single design "problem", which was adopted across a range of disciplines. This model does not cater for group processes or the influence of organisational contexts.

A central assumption of the rational model of design is that the end, or outcome of design is well-understood (Ball & Ormerod, 1995; Guindon, 1990a) - the process is one of deciding between design alternatives, rather than synthetic analysis. It can be represented, by some graphical or verbal means and execution of the concept so represented is

unproblematic. The only uncertainty displayed is in the construction of a plan of action. A common theme in the practitioner literature on technical system development is the problem of project “estimation” - project managers fail to plan for time-slips due to unexpected events or unforeseen design problems. But, as discussed in the previous section, the end-product of design is not well-understood.

Suchman (1987) criticises the narrowness of the design as planning perspective, using the analogy of someone steering a small boat at sea. The steersman keeps a distant headland in sight as the journey’s objective, but must constantly adjust the tiller to compensate for sea-currents and wave swells. Whilst the overall objective may be well-defined, both the process and the path to that objective are contingent upon the situation in which the person at the tiller finds themselves and their understanding of the action which must be taken, with each swell and current of the sea, to head for the pre-determined point. The view of the headland differs according to the point from which it is viewed. Design may be viewed as such ‘situated action’ (Suchman, 1987) in the face of information system design requirements, which emerge during the whole of the development process, not just at the formal ‘design’ stage of the staged system development life-cycle model. Design goals are emergent rather than planned (Baskerville et al., 1996; Boland et al., 1994; Truex & Klein, 1991). The concept of emergent design has severe implications for IS development projects, when coupled with the linear, staged model which underlies most development. Design goals in the waterfall model are assumed to be fully defined early in the development process and therefore unproblematic.

Research Issue: How does the situated, emergent nature of IS design affect the critical processes of IS design?

2.4.3 The Social Processes Of IS Design

The underlying principle of situated action (Suchman, 1987) is that human activity cannot be fully planned: people fulfil planned action by deriving loosely-defined objectives, the attainment of which they continually monitor, enabling them to make their actions contingent upon organisational circumstances. Situated information system design thus has emergent properties, rather than being based upon the decompositional approach traditionally associated with technical design: the critical activities are the definition and monitoring of appropriate, short-term design objectives. At its centre lies the creation and maintenance of shared frames of meaning. Recent theories of distributed or socially shared cognition (Norman, 1991; Flor & Hutchins, 1991; Lave 1991) have emerged to explain the social processes of supporting group activity and negotiating group decisions. Humans construct mental models, which organise knowledge in structured ways and facilitate

learning and communication by allowing them to fill gaps in supplied information and memory. Organisational actors may hold partial mental models which, taken as a whole across a group of people, form a common frame of meaning which provides structure for group activity and sense-making. Distributed cognition seeks to understand shared frames of meaning by studying:

- the representation of knowledge inside the heads of individuals and in the world
- the propagation of knowledge among different individuals and artefacts
- the transformations which external structures undergo when operated on by individuals and artefacts, such as virtual technologies (Flor & Hutchins, 1991).

Information systems are designed in terms of a mental model of people as technology users which is influenced by the designer's own values, training and experience; such models do not normally include human factors such as the desire for job satisfaction (Hedberg & Mumford, 1975). Hoos (1976) argues that engineers, in which class she includes IT system designers, can be characterised as possessed of "a basic lack of sociability" and "a strong incidence of low people-orientation". Curtis et al. (1988) identified the scarcity of knowledge of user behaviour and the application domain as a major cause of poor resolution between conflicting design requirements within technical system development projects; they concluded that effective *communication* and *co-ordination* processes are crucial to coping with fluctuation and conflict among requirements. Markus and Bjorn-Andersen (1987) comment that:

" the 'models of man' literature suggests that systems analysts in several national cultures base their design decisions on a view of users that differs sharply from the views users hold of themselves."

Normative influences from the design context also play a part in design outcomes and emphasis. The conversion of organisational and technical possibilities into technological artefacts depends upon the construction of collective social alliances (Mumford, 1972; Kidder, 1981); further, Rosenbrock (1981) and Rose (1988) postulate that the paradigm (Kuhn, 1970) under which systems professionals work - their view of the world and the implicit norms, values and assumptions that it embodies - is promulgated through the process of group working, via normative influences during the design process. This process of group identification may, as noted by Mumford (1972), cause champions of the user interest to identify with the interests of an elitist system professional group. Technical systems professionals sacrifice behavioural priorities to technological issues (Hornby et al., 1992; Markus & Bjorn-Andersen, 1987; Mumford, 1972; Scarbrough & Corbett, 1991).

Determining and maintaining design objectives is problematic because of the difficulty in achieving intersubjective (cognitively shared) “mental models” of the system being designed. Design participants tend to hold over-simplified mental models of the system, as intersubjective understanding of complex models is difficult and as scientific reductionism enables them to reduce the psychological discomfort which they feel with respect to their role in designing interactions with a complex organisational situation of which they may have little or no experience (Boland & Day, 1989; Hedberg & Jönsson, 1987; Wastell & Newman, 1993; Wastell, 1996). Perceived design objectives are often implicit and often conflict with explicit requirements or objectives (Malhotra et al., 1980). Mental models held by design participants are insufficiently complex to model the organisational problem situation effectively and so they design only partial or ineffective solutions.

Design can be seen as a social activity, which is constrained by ineffective communication and co-ordination mechanisms. Lave (1991) suggests that the process of socially shared cognition should not be seen as ending in the internalisation of knowledge by individuals, but as a process of becoming a member of a “community of sustained practice”.

Research Issue: How do “communities of sustained practice” (Lave, 1991) function and how may they be facilitated in the processes of the design of effective organisational information systems?

2.5 Conclusions

This chapter has examined the problem domain of the organisational information system design and concluded that there are eight main research issues to be investigated:

1. Given that design is an integral part of all stages of the waterfall model of information system development, what models could be used to manage the activities of information system design?
2. Do formal IS development methodologies reflect ‘good’ design practice?
3. If the design of organisational information systems is not supported by top-down, decompositional methods, how might it be supported?
4. What IS development methodological approaches are in use and to what extent are they used?
5. To what extent are users involved in the design of information systems and how is this involvement affected by the methodological approach to IS development?
6. What are the critical processes of information system design?
7. How does the situated, emergent nature of IS design affect the critical processes of IS design?

8. How do “communities of sustained practice” (Lave, 1991) function and how may they be facilitated in the processes of the design of effective organisational information systems?

It was argued above that the design of organisational information systems may be seen as a “wicked problem” (Rittel & Webber, 1973); such problems are associated with interrelated, organisational systems of activity; they cannot be “stated” or “solved” in the sense of definitive solution rules or requirements (Moran & Carroll, 1996) and are socially-constructed (Galliers & Swan, 1997). Equally, the investigation of IS design is a ‘wicked’ problem: it is argued in Chapter 3 that the literature contains little in the way of theoretical models to guide the investigation of this problem and that many different strands of behaviour are involved (and consequently, many different literatures). There does not exist a coherent body of theory which explains the design and development of organisational information systems. The diagram in Figure 2-4 shows the main literatures drawn upon for this research.

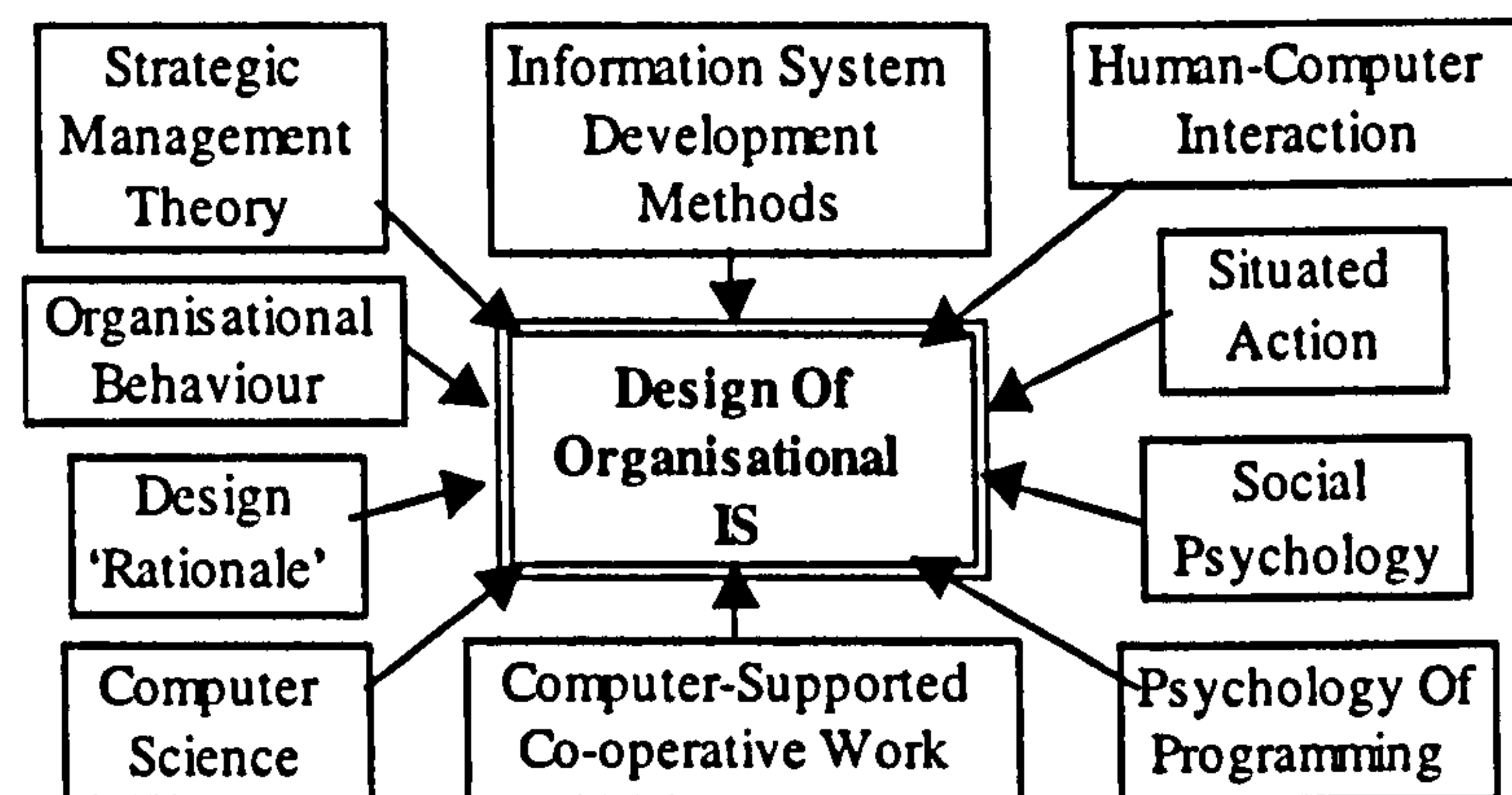


Figure 2-4: Literatures Drawn Upon By This Research

It was therefore determined that the investigation of this research problem would be conducted in two ‘iterations’, the first of which would examine the ‘macro’ issues of organisational IS design, based upon the IS development literature and the second of which would investigate the ‘micro’ issues of organisational IS design, examining the interior processes of design problem-investigation and the social psychology of organising which underlies design activity. The research design is discussed in detail in Chapter 4. Research issues 1 to 5 are related to the ‘macro’ issues of the research investigation and are examined in Chapter 3. Issues 6 to 8 are discussed in Chapter 7, which deals with the literature related to the second research iteration.

3. LITERATURE REVIEW: ORGANISATIONAL IS DESIGN FROM THE PERSPECTIVE OF THE IS DEVELOPMENT LITERATURE

3.1 Introduction

Following the discussion of the problem domain given in Chapter 2, this chapter reviews more fully the theoretical and empirical IS development literature relevant to the study.

This literature review has three main objectives:

1. To position the current study relative to previous and ongoing research in the Information Systems Development Methods field.
2. To serve as a source of explanation of phenomena observed in model construction.
3. To identify lacunae in existing literatures and to pose detailed research questions, based on these lacunae.

The previous chapter examined the problem domain of organisational information system design and concluded that there were five main research issues, related to the ‘macro’ issues of the research investigation, and that these issues would be investigated in the first ‘iteration’ of this research study:

1. Given that design is an integral part of all stages of the waterfall model of information system development, what models could be used to manage the activities of information system design?
2. Do formal IS development methodologies reflect ‘good’ design practice?
3. If the design of organisational information systems is not supported by top-down, decompositional methods, how might it be supported?
4. What IS development methodological approaches are in use and to what extent are they used?
5. To what extent are users involved in the design of information systems and how is this involvement affected by the methodological approach to IS development?

To investigate these issues, this chapter first explores models of design, then investigates the practice of design, by discussing the impact of development methodologies upon the design of information systems and user-involvement in that design.

3.2 Models Of Design

This section discusses the first research issue:

- *Given that design is an integral part of all stages of the waterfall model of information system development, what models could be used to manage the activities of information system design?*

3.2.1 Individual Process Models Of Design

Unsurprisingly, given the difficulty of studying such a complex process, there are few models of design which are based upon empirical work, rather than theoretical conjecture. Most models are rooted in the individual's cognitive processes of design, rather than those group processes which occur in most IS design contexts.

Simon's (1960; Newell & Simon, 1972) individual model of rational decision-making forms the basis for the 'traditional' model of design (i.e. that linked with traditional and structured methods for IS development: the waterfall model). A typical example of the application of this model is given in Figure 3-1; such applications are related to the planned and decompositional perspective of design, discussed in chapter 2. Lawson (1990) presents this model as typical of that used in architecture, to plan the design of buildings.

The four stages are presented as:

1. analysis: the ordering and structuring of a problem and the classification of design objectives
2. synthesis: the generation of solutions
3. appraisal: the critical evaluation of suggested solutions against the objectives
4. decision: deciding on a course of action.

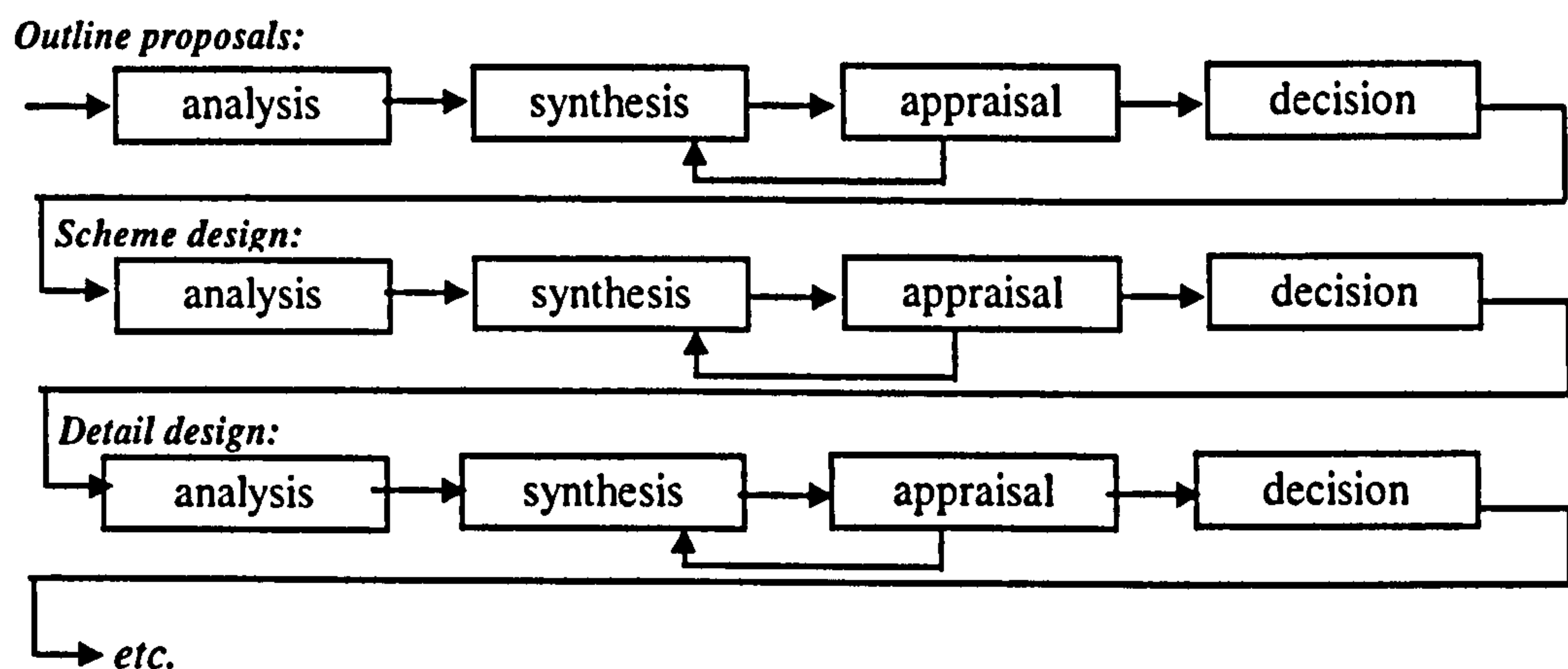


Figure 3-1: A Conventional Model Of The Design Process (Lawson, 1990)

Lawson (1990) criticises the lack of feedback between stages other than the appraisal/synthesis feedback loop and the assumptions that (a) all design requirements are known and may be completely specified, at each level of decomposition and (b) all design requirements have equal value to the designers and so can be assessed objectively. These assumptions are derived from the work of Alexander (1964), whose ideas influenced much of the early work in information system design methods. Successive decomposition has been rejected by many areas of creative design, such as architecture, as being unrepresentative of 'real-world' design processes (Lawson, 1990).

A clue to how requirements are prioritised by designers is presented in an empirical study of architects by Darke (1978). In this study, Darke discovered that there was a tendency to structure design problems by exploring aspects of possible solutions and showed how designers tended to latch onto a relatively simple idea very early in the design process (for example, "we assumed a terrace would be the best way of doing it"). This idea, or 'primary generator' was used to narrow down the range of possible solutions; the designer was able to rapidly construct and analyse a mental archetype of the building scheme, which was then used as the basis for further requirements search. Darke's (1978) model of the design process is shown in Figure 3-2.



Figure 3-2: Darke's (1978) Model Of The Design Process

The basis of this model is the application of scientific reductionism to the original, complex design problem on the basis of experience. Experienced architects tended to determine a suitable form for their design before analysing the detailed requirements of the architectural brief, against which the assumed form was tested. This architectural design model finds a parallel in the IS literature, in a protocol analysis study of information system design dialogues between designer and user (Malhotra et al., 1980) which concluded that design dialogues:

- 1) often consisted of implied requirements
- 2) often examined partially proposed design elements to test violation of an *unstated* goal
- 3) examined the substitution of other possible design solutions for the original solution
- 4) attempted to combine design components into a solution.

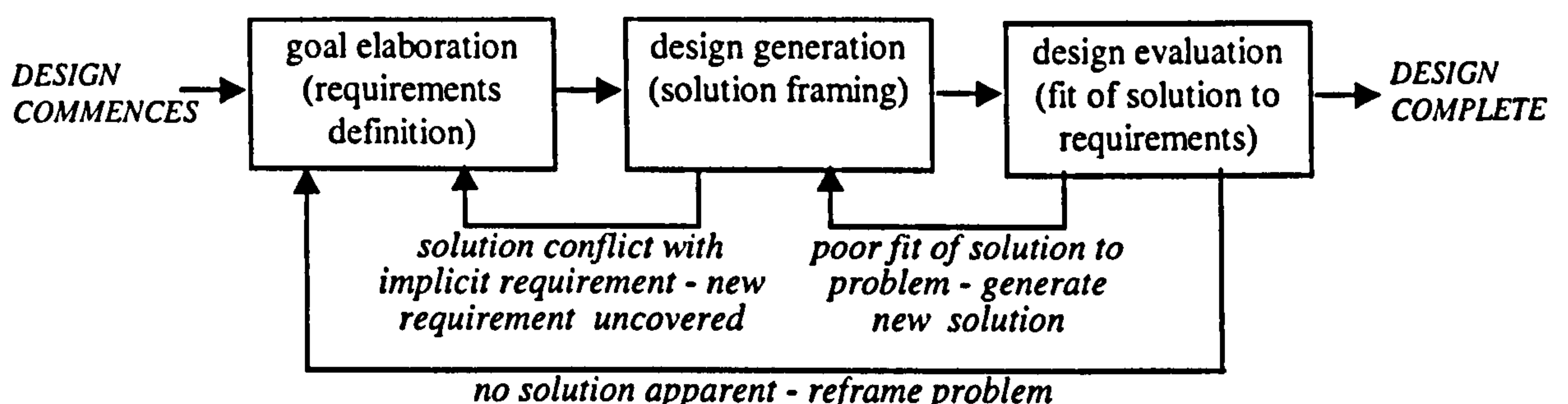


Figure 3-3: Model Of Individual Cognition in IS Design
(Author's model, based upon findings of Malhotra et al., 1980)

A diagrammatic model which interprets the findings of Malhotra et al. (1980) is given in Figure 3-3: the design process is seen as both iterative and recursive, redefining parts of the problem as well as partial solutions. In practice, only some ambiguities of design requirements and goals will be resolved and the central issue becomes one of discrimination between the significant and the insignificant (Turner, 1987). It would appear that goal definitions *evolve* with the design (Malhotra et al., 1980; Turner, 1987;

Guindon, 1990a, 1990b). Information System design can be conceptualised as a convergence of design-requirements framing and solution-forming, a progressive ‘fitting’ of the framework of system requirements and known solution forms, which are based upon the designer’s previous experience of problems of a particular type (Malhotra et al., 1980; Turner, 1987). Turner (1987) observes that, where designers’ own experience fails to provide a solution, they widen the search space to call on the experience of colleagues. This process is very far from the ordered decomposition of a single design problem proposed by the waterfall model.

3.2.2 Models of Information Systems Development

Lawson (1990) argues that it is not possible to prescribe a model of design processes, as the solution is not a predictable outcome of a problem, but there are certain outputs of design which may be managed. Information system *development* process models concentrate upon outputs and so are more project-management models than models of design processes.

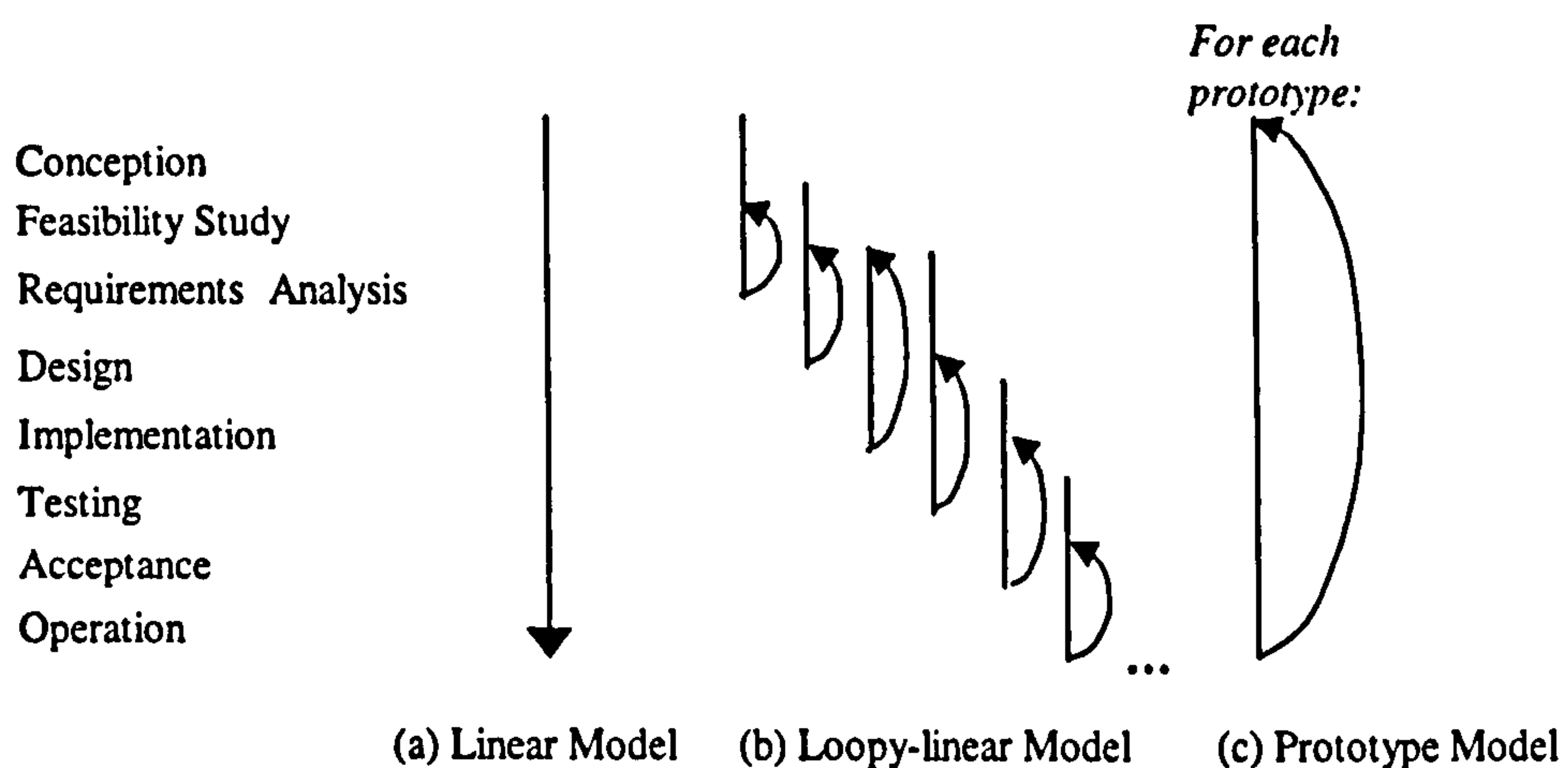


Figure 3-4: Models of System Development (Friedman & Cornford, 1989)

Friedman & Cornford (1989) present the alternative models shown in Figure 3-4. These models are presented, not as derived from any knowledge of the process, but as pragmatic models derived through prescriptive practice and are still essentially centred upon individual processes which are extrapolated to group management. Recent management concern has centred on more human-centred and business-oriented approaches to IS development (Hirschheim & Klein, 1994); evolutionary models are recommended to encompass these concerns (Eason, 1982). An attempt to encompass both macro processes and human and organisational concerns can be seen in the spiral model of software development presented by Boehm (1988), shown in Figure 3-5.

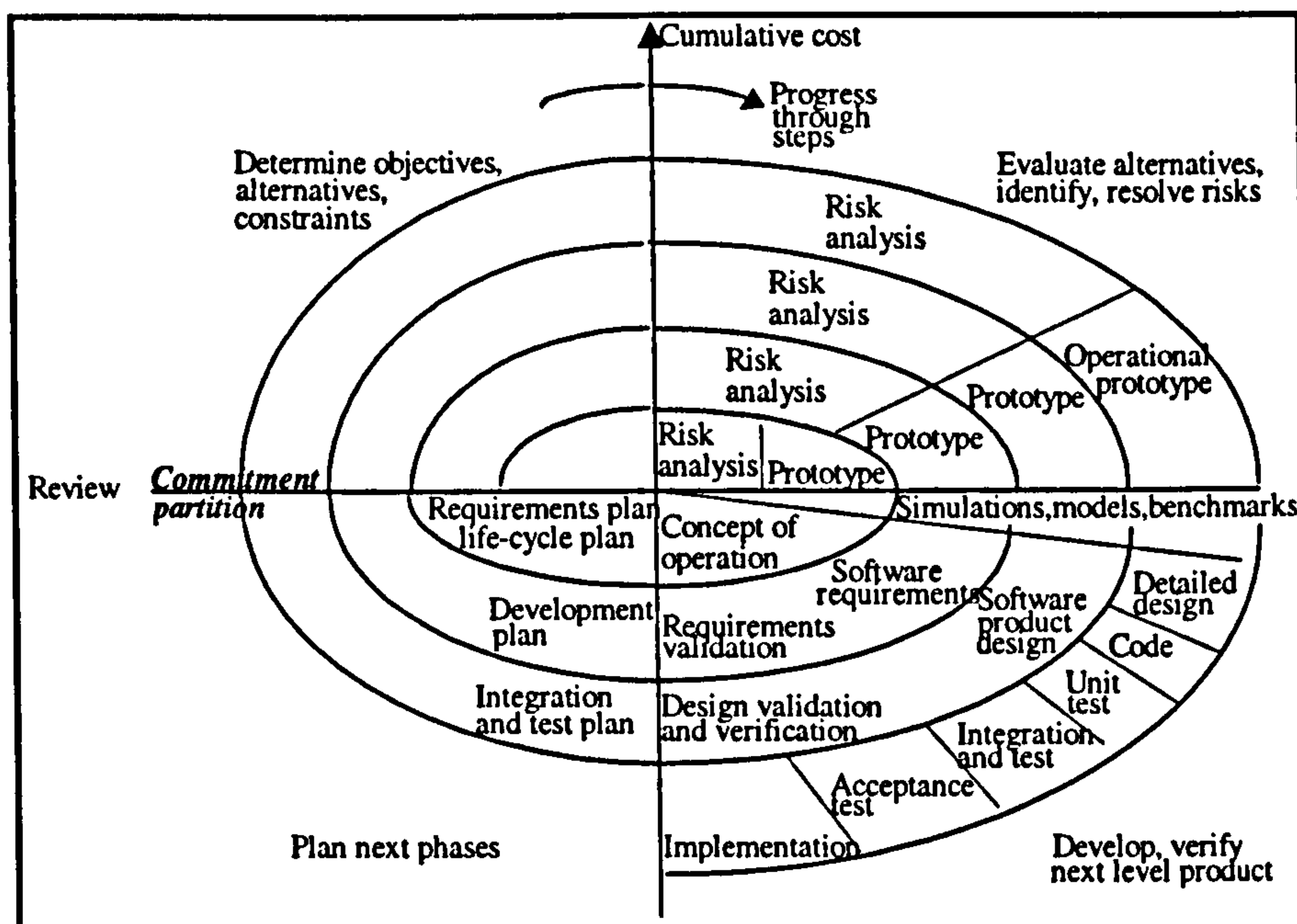


Figure 3-5: The Spiral Model Of Software Development (Boehm, 1988)

Boehm's (1988) spiral model is an attempt to manage uncertainty and risk in ISD project management. In this model, the radial dimension represents the cumulative cost of development to date, the angular dimension represents the progress made in completing each cycle of the spiral. An underlying concept of this model is that each cycle involves a progression that addresses the same sequence of steps, for each portion of the product and for each of its levels of elaboration. However, the model represents a pragmatic assimilation of recent trends in system development: it does not address outputs from empirically observed design processes, so it does not represent the behavioural issues which managers face in real-life IS development. The model cannot be said to represent IS development *practice*, even at a macro level: Boehm (1988) admits that it is not based on empirical observations, nor has it been tested experimentally.

Despite these criticisms, the model is a real advancement in theoretical thinking about IS development practice. It embodies an iterative process and encompasses human and organisational concerns through the inclusion of evolutionary prototyping as an essential component of organisational risk management. However, the four evolutionary stages of the model - determine objectives, evaluate alternatives, develop product and plan next phase - may be too akin to the "rational" model of decision-making (Simon, 1960), criticised in the previous section, to be of help in managing real-life processes.

Additionally, the model takes little account of the social processes of design.

What appears to be needed are models which structure the macro processes required for project control and progress management, while legitimising and supporting the behavioural and cognitive processes essential for effective design: synthesis, decision-making, negotiation, communication and learning (these processes are discussed in detail

in Chapter 7). It may be that the two goals are incompatible: that different models are required for the control of macro (project) processes and the support of micro (design) processes. However, the two are closely interlinked and any approach to IS development which adopts a single perspective will not succeed.

3.2.3 Conclusions: Identifying Appropriate Models Of Design

- **This section examined the following research issue: *Given that design is an integral part of all stages of the waterfall model of information system development, what models could be used to manage the activities of information system design?***

Individual, process models of design were examined and the evolution of individual design models was discussed. A 'convergent' model of individual design processes was proposed. The failure of the 'waterfall' model to describe observed design activities was noted.

Models of information systems development were then assessed, with the conclusion that they are based more upon pragmatic assumptions concerning the nature of the design process than upon empirical observation of actual design processes. Existing models of design are largely based upon a rational model of individual problem-solving, which provides little support for the social processes of information system design.

Research Question: What are the critical processes of design and can they be related in a process model of design activity, which may be used for the effective management of system development projects?

3.3 The Impact Of IS Development Methodologies

This section discusses the second, third fourth and fifth research issues:

- *Do formal IS development methodologies reflect 'good' design practice?*
- *If the design of organisational information systems is not supported by top-down, decompositional methods, how might it be supported?*
- *What IS development methodological approaches are in use and to what extent are they used?*
- *To what extent are users involved in the design of information systems and how is this involvement affected by the methodological approach to IS development?*

These issues are addressed below. First I shall briefly examine the role played by development methodologies in information system design.

3.3.1 The Role Of Methodologies In Information System Design.

The term methodology is used by practitioners within the context of IS design and development to mean a set of stages, procedures and tools which support the development of a computer-based information system. An information system development

methodology is more than just a method (the 'how' of information systems development), or a process-model (the control element). A methodology embodies an holistic *approach* to design: it embodies a set of methods, tools and representational practices, a process-model which indicates the expected duration and sequence of development activities, together with a philosophy of action (Jayaratna, 1994; Maddison et al., 1984). Kumar and Bjorn-Andersen (1990) state that the prescription of a particular methodology incorporates into the design process "the ontological assumptions about what constitutes reality and the epistemological assumptions about how to conduct the ISD enquiry", arguing that designers' value-systems are largely influenced by the choice of ISD methodology. This methodological determinism is challenged by Markus & Bjorn-Andersen (1987) who argue that designers' *existing* value systems influence the selection of development methodologies. It is probable that normative design practice forms designers' value-systems (Rosenbrock, 1981), which influence their choice of methodology, which reinforce normative practice ... and so on.

Use of a formal development methodology is argued to be important in four respects:

1. The methodology facilitates management control of system development, constraining individual discretion in design decisions (Fitzgerald, 1996b; Friedman & Cornford, 1989).
2. The methodology provides a set of analysis and modelling tools which permit designers to document and validate a design, and to maintain intersubjectivity, through the production of external, structured design representations (Flor & Hutchins, 1991).
3. The methodology embodies the values of technical development staff and propagates those values through the normative processes of design (Kumar and Bjorn-Andersen, 1990; Markus & Bjorn-Andersen, 1987). Through the selection of a design methodology, system professionals may not only justify the marginalisation of system users, but formalise that marginalisation in the rules and procedures used by all system professionals in that organisation. Formal IS development methods emphasise technical/functional optimisation because technical expertise is the basis of IS professionals' power (Hornby et al. 1992; Markus & Bjorn-Andersen, 1987).
4. The methodology has a direct impact on the nature, structure and content of users' jobs: traditional methodologies follow the principles of scientific management and consequently tend to produce highly structured and fragmented organisational procedures (Markus and Bjorn-Andersen, 1987; Corbett et. al, 1991), while evolutionary methodologies permit users to incorporate desired ways of working into the design of the information system (Eason, 1982; Floyd, 1987).

While a methodology may be seen to have two distinct aspects, process management and design framing (Hirschheim & Klein, 1992), empirical research would tend to indicate that managers focus on control of the process rather than support for design framing. IS managers and project leaders see systems development methodologies as being of high value because they improve process outcomes, such as productivity and specification adherence (Hopker, 1994; Jenkins et al., 1984).

Structured IS development methodologies are not thought to support the real activities of design (Bansler & Bødker, 1993), although Parnas and Clements (1986) argue that users of such methods benefit from their communication and design-maintenance advantages. Empirical research in organisational contexts (e.g. Jenkins et al., 1984; Curtis et al., 1988; Hornby et al., 1992; Davidson, 1993) shows that methodologies do not represent a 'theory-in-use', but a 'theory-of-action' (Argyris and Schön, 1978): they represent a rule-based interpretation of *what should be done*, rather than what people actually *do*.

Winograd (1995) argues for the creation of "environments for software design", which incorporate participatory design, supported by the use of models and prototypes and a contingency approach to design methods and languages.

Development methodologies may therefore be seen as exerting both formative and normative influences on the processes and outcomes of design. To what extent they do this in organisational information system development is examined in detail below.

3.3.2 What Methodological Approaches To IS Development Are In Use And To What Extent Are They Used?

There is a fairly widespread bias in the literature on IS development methodologies: many studies take as a starting point the axiom that the use of a formal IS development methodology will produce the desired outcomes and that it is ignorance or lack of commitment on the part of the practitioner which leads to failure. It is difficult to obtain a clear picture of how methodologies are used in organisational practice, as those empirical studies which exist are mainly surveys, which are uncritical of formal methods as they tend to assume that the methodology is used in full and as intended. A summary of such studies is given in Table 3-1, which summarises non-critical studies of IS development approaches and Table 3-2, which summarises critical studies. The studies are listed in date order, to highlight changes in literature attitudes over time.

Author	Focus	Most Significant Findings
Boehm et al. (1984)	A multi-project experiment. 7 teams developed the same software product 4 teams used a specification-driven approach, 3 used a prototyping approach.	The product of the design was evaluated, for each team. A mix of prototyping and specifying was recommended. Prototyping tends to produce a smaller product, with roughly equivalent performance, using less effort. Prototyped products rated slightly lower on functionality and robustness but higher on ease of learning and ease of use. Prototyped products rated lower on ease of integration with other systems, with less coherent design.
Sumner & Sitek (1986)	A postal survey of 45 respondents from 38 US firms, of existing systems development practices.	Respondents acknowledged the benefits of using structured tools, yet these tools were not being widely used in actual systems development projects, largely because of their lack of acceptance by developers and the perception of them as time-consuming to use. Their main use appears to be for documenting the completed design, rather than to facilitate design and analysis processes. There was poor fit between project management approaches (mainly traditional life-cycle stages) and tools used for development such as 4GLs and package customisation.
Necco (1989)	Two postal surveys of USA practice: 46 responses on use of programming techniques; 97 responses on use of development approaches and tools.	Development methods are used inconsistently and in part. Post-implementation audits are seldom performed. Few organisations have a standard approach to selection of methods, even when they have trained developers in more than one approach.
Kautz & McMaster (1993)	Case study of 12 interviews across IT dept. and client dept. of single company. Authors assume efficacy of formal method.	No overall approach to system development was commonly followed by all development teams; developers saw SSADM (introduced by IT manager) as inappropriate and "too long-winded". Methods had poor fit with existing organisational practices in IT dept.
Hardy et al. (1994)	Postal survey of 100 UK companies.	24% of sample reported using SSADM; next most popular method was none at all (!) followed by 38% using an in-house method (not described). No information on whether they were used in full, but respondents felt methods took too long to use, provided more techniques than needed (indicating incomplete use) and costs of using methods exceeded returns.
Hopker (1994)	Postal survey of 89 Welsh (UK) organisations	Traditional methods (not defined) were used by 75% of sample, either alone or in combination with other methods. Prototyping and structured methods are used by 43% and 33% of in-house developers, respectively. Most companies use a single method for development; where multiple methods are used, selection appears to be based upon company policy, familiarity or "pick-and-mix" selection, rather than upon rational selection considering problem or system contingencies.
Chatzoglou & Macaulay (1996)	Postal survey of 72 UK organisations	Only 53% of sample used a methodology overall, although 62% of companies use a methodology for requirements capture. Methodology use is lowest in industry and highest in consultancies/software houses. Failure to use methodology attributed to attitude of developers or to organisational constraints.
Eva & Guildford (1996a, 1996b)	Postal survey of 152 UK companies	SSADM most popular method (38%), followed by prototyping (37.5%) and "other" (24%, which included none at all) and RAD (15%). Only 17% of respondents used the whole of a method. The major reasons given for choosing a method were control ("forces deliverables"), flexibility and customisability. The presence of definable stages and the implementation independence feature of methods were also important to respondents.

Table 3-1: Studies Assuming Methodology Is A Sufficient Condition For Success

Author	Focus	Most Significant Findings
Jenkins, et al. (1984)	Interview-based Survey of 72 IS development projects in 23 major US corporations.	Most organisations have a formalised systems development methodology (SDM); either purchased or internally developed. In about half the cases, the SDM is used only as an estimating and project management aid; project managers rated the value of the SDM to the project with an average score of 7 out of 10. The majority of IS projects require one or more iterations of systems analysis before requirements are completely determined; cause is most often failure to identify user requirements rather than changing user requirements.
Curtis et al., (1988)	Field study of large system development projects in a single company.	Communication between developers and users and application-domain learning on the part of developers was seen as essential to a successful outcome. Developers were found to subvert the formal mechanisms of the development methodology, such as meetings for user-validation of the system requirements document, for these purposes. Methodology use often abandoned because of management deadlines or commercial/marketing pressures.
Saarinen (1990)	Interviews & Survey of development methodology and project success in 21 large Finnish corporations.	Study tested the application of prescriptive literature with respect to the use of prototyping and design problem characteristics. The use of prototyping vs. linear devt. strategy is not dictated by difficulty in specifying requirements; or level of uncertainty; or size of project; or type of tools (4GLs etc.). External integration is not related to structuredness of problem. Internal integration is not related to unfamiliarity of technology. Level of mgt. control is independent on size of project. Overall: selection and use of method is not performed consistently, rationally or according to literature prescriptions.
Baskerville et al. (1992)	Two case studies: hermeneutic analysis of two action research projects.	Projects may fail because new organisational forms/"regularities" may emerge during the long time-span of systems development. Methods impose artificial regularities upon the devt. process itself, inhibiting effectiveness. Internal structures of methods assume invariant structure (e.g. generally sequential sequences of activities). Underlying values, norms and ontology of method may conflict with those of organisation. Also organisations. are virtual, emergent, contingent and contextually-directed. Systems needed to address rapidly unfolding events are short-lived, contingent and disposable. The amethodical nature of projects was enabled by newer devt. technologies: LAN,4GL, CASE etc. Teams transcended method.
Bansler & Bødker (1993)	Exploratory case studies of 3 Danish companies using structured analysis	<i>Findings:</i> Designers only use the methods partially and the parts chosen differ between organisations and even between <i>projects</i> (in same organisation). May be due to size (small projects); inadequate training & weak mgt. support. Failure to construct models of both the new & old systems may be due to different interests and power relationships between the user and the DP dept. There are inherent structural weaknesses in structured analysis methodologies, which have a poor fit with design tasks.
Russo et al. (1996)	A postal survey of 92 US companies, asking about use of methodologies	20% of sample used no methodology at all (these were the smaller organisations); 31% of all projects were performed using no methodology. 74% of organisations who used a methodology perform at least part of their development using a structured methodology. 74% of the sample used more than one methodology. Only 6% of the sample claimed that their methodology was always used as specified. 60% of respondents state that their methodology is adapted to fit the project. Even when organisations develop their own methodologies, these do not entirely meet their needs.
Fitzgerald (1996a)	Postal survey of 162 Irish respondents, ranging from programmer to IS director.	60% of respondents did not use any methodology; only 14% used a formal, third-party methodology. Methodology use is associated with high levels of in-house development and low levels of customisation of packages and/or outsourcing; with larger projects (> 5 developers); with duration (> 9 months). ⇒ methodologies play a role in controlling large projects and facilitating intercommunication between developers. Developers select <i>tools</i> on a contingency basis.

Table 3-2: Studies Of IS Methodology Use Which Take A Critical Perspective

Most of the studies summarised here do not distinguish between traditional and structured methods and few of them examine if a methodology was used in full or only in part, so it is difficult to discern trends over time, particularly in the 'non-critical' literature. In the 'critical' literature, more recent studies appear to question the universal applicability of structured methodologies to a greater extent than the earlier literature. Russo et al., (1996) reported that only 6% of their sample used a formal methodology consistently and as specified, while Jenkins et al. (1984) reported that 50% of their sample did so. While Curtis et al. (1988) questions the inclusion/exclusion of some types of activity (particularly user-communication activities) in formal methods, Fitzgerald (1996a) questions whether there is a role for formal methods in IS development at all.

The uncritical literature reports that developers' perceptions of methodologies were that they were inappropriate to support development and too time-consuming to use (Hardy et al., 1994; Kautz & McMaster, 1993; Sumner & Sitek, 1986) - this position does not appear to form the basis for any conclusion other than that failure to use methodologies was attributable to the poor attitude of people involved or to organisational constraints (Chatzoglou & Macaulay, 1996; Hopker, 1994; Kautz & McMaster, 1993; Necco, 1989). Where methods were used, subjects reported that their main value lay in controlling and standardising the process and outputs of development (Chatzoglou & Macaulay, 1996; Eva & Guildford, 1996a, 1996b).

The findings in the critical literature also show a concern for management control, rather than support for the processes of design. IS managers and project leaders see systems development methodologies as being of high value because they improve process outcomes, such as productivity and specification adherence (Fitzgerald, 1996a; Jenkins et al., 1984, Saarinen, 1990). There is some evidence to suppose that methodology use is greater in large companies than in small ones (Fitzgerald, 1996a; Russo et al., 1996); Curtis et al. (1988), commenting on the centrality of communication and learning to the process of systems development, prescribed that more support for such processes was required in larger projects. However, most methodologies are not used in their entirety because of lack of acceptance by IS developers who perceive them as time-consuming to use (Hardy et al., 1994; Hopker, 1994; Sumner & Sitek, 1986). Curtis et al. (1988) found that use of a development methodology was often abandoned because of pressures due to management deadlines or commercial and marketing requirements. Fitzgerald (1996b) argues that methodologies are not used sufficiently rigorously, consistently or fully for their philosophical underpinnings to be brought to bear upon the problem context in hand.

There do not appear to be national, cultural differences involved in those studies undertaken in the western world: the dominance of traditional and structured methodologies was found in US studies (Sumner & Sitek, 1986; Wynekoop & Russo, 1993), in UK studies (Eva & Guildford, 1996a, 1996b; Hopker, 1994; Hornby et al., 1992), a Finnish study (Saarinen, 1990) and a Danish study (Bansler & Bødker, 1993). Chatzoglou & Macaulay (1996) found that formal methodologies appeared to be used less for projects with well-defined problem domains (only 34% of this subset used a formal methodology) than for those with moderately-defined (56% use) or poorly-defined (57% use) problem-domains. This supports a perspective found in the literature on design framing: that decompositional approaches to system requirements analysis are of most use when designers are inexperienced, or when the design problem is unusually difficult to define (Jeffries et al., 1981; Turner, 1987). But the literature does not tell us whether the methodology is useful for supporting design activity in these situations, or whether its function is to provide psychological support in conditions of high uncertainty, as suggested by Reynolds & Wastell (1996).

The extent of methodology use overall is unclear. In both the critical and uncritical literature, there is conflicting evidence as to whether formal methodologies are widely used; this may be because what is meant by the term 'methodology' is poorly-defined, both by practitioners and researchers, as is the distinction between different types of methodology. Many developers under-report their use of methodologies as they are often unaware of the provenance of many of the tools and methods which they use and are resistant to change: there is a widespread lack of awareness of alternative development approaches among practitioners (Bansler & Bødker, 1993; Fitzgerald, 1996b; Necco, 1989). Practitioners tend to acquire their knowledge about available methods through informal means, such as periodicals, seminars and vendor training; formal training plans and budgets are often non-existent. As developer training is largely achieved through normative learning (Rosenbrock, 1981), this means that many of the tools and methods used by a developer will necessarily be an amalgam of the various approaches used by teams with which they have worked previously, rather than a rationally-selected methodology, used in the philosophical context which was intended by its originator. The evidence is, that where a development methodology is used, a structured (decompositional) or traditional (staged, linear) approach is taken (Hopker, 1994; Hornby et al., 1992; Saarinen, 1990; Wynekoop & Russo, 1993), but there is no evidence to support the idea that a traditional or structured methodology is used in full in these organisations. Hopker (1994) found that 43% of her sample were using prototyping

methods, but did not investigate whether the prototyping approach was used to produce experimental, technical/functional prototypes or evolutionary, user-oriented prototypes. There is a huge discrepancy in the types of information elicited by the studies found, even for those studies which took a common position on the efficacy of methodologies as a means of determining successful development outcomes. For example, while Sumner & Sitek (1986) asked respondents to their survey about the value of user understanding and participation as a benefit of using a methodology, the survey by Chatzoglou & Macaulay (1996) concentrated on functional aspects of the methodology, such as ease of use, in terms of standard procedures to guide developers, or the design of the methodology being based upon sound principles and robust assumptions. It is very difficult indeed to form any clear picture of how development is approached and what role the use of development methodologies plays in that development. The empirical literature studies did not differentiate between approaches used at different stages of the system development life-cycle (SDLC), so it is not possible to say whether these methods were used throughout projects, or to support specific activities of design. Only one study (Curtis et al., (1988) studied both methodology use and the tasks of development in any detail and this is a study of very large IS development project teams in a single company.

There is no real basis in the literature on which a judgement may be made of how IS design and development are approached in organisations: many empirical studies are based upon postal surveys whose designers did not question whether the methodology was used in full and as intended. The majority of companies do not appear to use any methodology and those which do use a methodology only use it in part (Eva & Guildford, 1996a, 1996b; Fitzgerald, 1996a; Hardy et al., 1994; Hopker, 1994; Russo et al., 1996; Sumner & Sitek, 1986). While structured methods were reported as the most widely used in most of the studies found, developers' perceptions were that structured methods were inappropriate to support development and too time-consuming to use (Curtis et al., 1988; Fitzgerald, 1996a; Hardy et al., 1994; Kautz & McMaster, 1993; Sumner & Sitek, 1986). It may be that IS developers tend to use tools and methods from a variety of methodologies, adopting a contingency approach to method customisation (Curtis et al., 1988; Hardy et al., 1994; Hornby et al., 1992; Vitalari, 1984). Users may be permitted to participate to a high degree in system development projects which use traditional methodologies (Hardy et al., 1994; Hopker, 1994), or may be excluded from approaches which presuppose high levels of user participation (Davidson, 1993). Methodologies may only be used in part (Curtis et al., 1988; Russo et al., 1996; Vitalari, 1984). The development approach may be customised locally, with components selected from several

different commercial methodologies (Hardy et al., 1994). Curtis et al. (1988) found that use of a development methodology was often abandoned because of pressures due to management deadlines or commercial and marketing requirements; Sumner & Sitek (1986) found that project managers resisted using a methodology at all, because of time and cost constraints.

Baskerville et al. (1996) argue that information systems are developed amethodically - without method - and that this is a natural consequence of emergent forms of organisation. Methods cannot succeed repeatedly because such methods assume permanence in organisational structures. There is a strong element of conflict between the requirements of traditional forms of IS development organisation and method - which assume permanence of structure - and the requirements of emergent organisations, which reject permanent structure; this is coped with by a rejection of method (Truex & Klein, 1991, Baskerville et al., 1996). Fitzgerald (1996b) observes that many organisational systems are now subject to shorter development timescales and may often be constructed from standardised components, or using Rapid Application Development tools; such approaches militate against the use of formal development methods.

3.3.3 The Influence Of Development Methodology Upon User-Involvement In Design

Organisational problems and alternative system solutions are often ill-defined; methods for design requirements determination assume a greater understanding of users' information requirements than can be provided by available tools Galliers (1987). The involvement of system users may be seen as critical in clarifying user requirements of information systems design and development (Hirschheim & Klein, 1994; Mumford, 1983). Empirical studies have suggested that user involvement in information system development is related positively to user perceptions of system usefulness (Franz & Robey, 1986; Baroudi, Olson & Ives, 1986; Amoako-Gyampah and White, 1993; Torkzadeh & Doll, 1994). This does not mean, however, that user involvement in information systems development is a necessary condition of success. Cavaye (1995) argues that there are also projects where users did not participate in the development but which are nonetheless successful and that the existing body of user participation literature is fragmented, presenting inconclusive results. Kappelman & McLean (1992) argue that it is not so much user participation, as user *involvement* which leads to Information System success: that "state of psychological identification with some object, such that the object is both important and personally relevant". This argument develops the work of Barki and Hartwick (1989, 1994) in distinguishing between user participation, as the observable behaviour of system users in the information system development process, and user

involvement, as the need-based mental or psychological state of system users (i.e. their attitude towards the development process and its product). Kirsch & Beath (1996), in an interview-based study of eight development projects, undertaken at seven large, US firms, distinguish between *token participation*, where users appear to be active participants, but IS designers supply domain knowledge and control feature selection, *shared participation*, where domain knowledge comes exclusively from users, who control the selection of system features, and *compliant participation*, where IS designers educate users in the technical domain and convince users of the need for a technical solution which addresses the wider requirements of the firm, rather than local, user-centred needs. Whilst the authors were unclear about whether the outcome of compliant participation actually benefited the user, this form of participation is akin to the exercise of conceptual power reported by Markus & Bjorn-Andersen (1987), who observe that the influence of users in development decisions is constrained by IS professionals, who may exert *conceptual* power through the shaping of user concepts and expectations of information technology or by developing IT policies and procedures which constrain user choices.

While users may be encouraged to participate in development processes, this does not mean that users are truly involved as equal participants in those processes: implicit power-imbances and assumptions are embedded in formal IS development methodologies which prevent users being involved as co-agents in design (Beath and Orlikowski, 1994). User-involvement in design is constrained by conceptualisations of appropriate processes for user-involvement and by conceptualisations of which outputs of the system design are appropriate for user involvement. An *ambivalence* exists between the recommendation for “strong user involvement” in a particular development methodology and the degree to which users could be expected to be true co-agents with IS developers through the procedures and design mechanisms of that methodology (Beath & Orlikowski, 1994). Davidson (1993) demonstrated that the degree and nature of user-participation in Joint Application Development is constrained by time-pressures and the limited availability of business personnel; “joint” development often took place without significant user participation. User learning about technology is critical: Eason (1982) discusses the timing of user participation, arguing that a narrow “window of opportunity” exists when users can usefully contribute to a system design. There is a time-lag between the point when IS designers appreciate the implications of technical alternatives for the target system and the point when users reach this understanding. In traditional system design projects, the contribution of users to decision-making is limited to a short period of time following this

point, when many initial technical decisions have already been made and the design is gradually being frozen.

Human-computer interaction is often narrowly conceived by technical system designers; interaction means much more than screens, buttons and function keys, it means designing the whole computer application to support work tasks in an appropriate and human-centred manner, allowing maximum support and autonomy to the system user (Bjorn-Andersen, 1989; Preece et al., 1994). But developers appear unaware that they are engaged in the design of social as well as technical systems (Hornby et al., 1992). Eason (1982) and Corbett et al. (1991) argue that the extent of user-participation in design is directly influenced by the methodological approach taken to IS development. A traditional development methodology excludes users, as their only contact with the process of design is via the validation of documents which they may not be in a position to understand fully. An evolutionary, user-centred, prototyping approach to development provides users with learning opportunities throughout the development process, permitting them to contribute to design decisions in an informed and powerful way. To achieve this, the latter type of approach is centred upon the user's requirements of the new information system (Preece et al., 1994).

Figure 3-6 compares the 'traditional' system development life-cycle to a user-centred system development life-cycle, synthesised from the literature. The system development life-cycle is "rotated" through 90° from that used for the traditional approach. The implication of this rotation is that the definition of system form and purpose is driven by the requirements of the technology user, rather than by those pertaining to the technology.

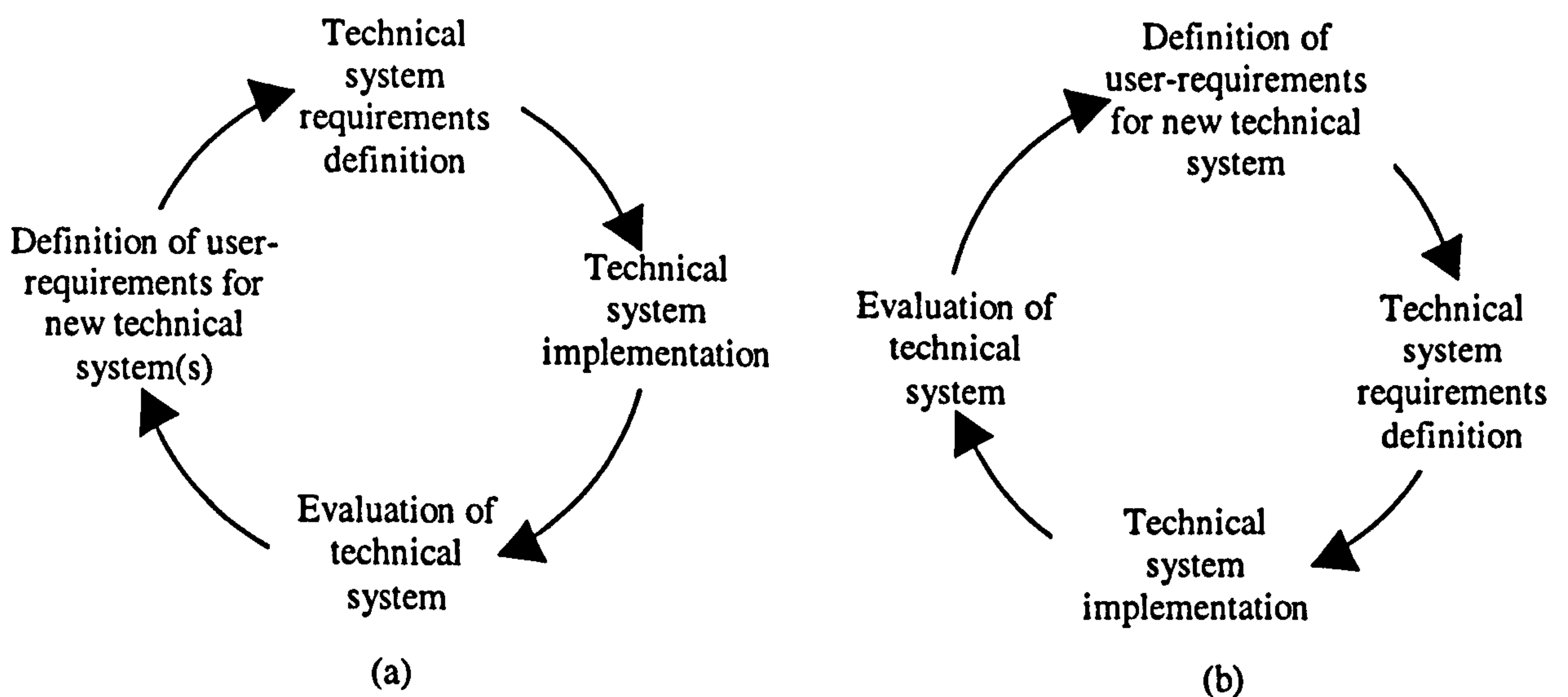


Figure 3-6: Comparison of (a) traditional system development life-cycle and (b) user-centred system development life-cycle

Many 'alternative' methodologies have been proposed which are based upon a user-centred approach; these facilitate more *significant* user involvement in the design process (e.g. Avison & Wood-Harper, 1990; Checkland & Scholes, 1990; Goldkuhl & Rostlinger, 1993; Mumford & Weir, 1979; Olle et al., 1982, 1983, 1986; Sol, 1984). But methodologies which are proposed by academic researchers often require practitioners to have a great deal of expertise and awareness in the analysis of social and political system impacts: such people are unlikely to be found in a commercial information system development group (Hornby et al., 1992). As discussed in the previous section, 'alternative' methodologies are not widely used in practice. Traditional and structured approaches to IS development predominate in the dynamic economic environments of the 1990s, where IS development resourcing is justified in terms of efficiency gains and is short-termist in nature - an ill fit with evolutionary systems development approaches or methods whose prime aim is to deliver system effectiveness, rather than system efficiency. It is likely that better design tools are required than are provided by structured methodologies, to support the creative and synthetic activities of design, but these must work within the linear, staged management approaches favoured in UK and US organisations, at least in the near future.

Much research on user-participation in Information Systems development focuses on requirements determination - the early stages of the system development life-cycle. But Cavaye (1995) observes that the extent and scope of user-involvement can vary significantly between different phases of a system development project. While user-input to IS requirements determination may be seen as emancipatory, it may be subverted through user exclusion from later decisions which affect the *form* of the target system; these are most likely to occur at the system design stage of the system development life-cycle, which is seen by organisational managers as having a predominantly technical focus (Hornby et al., 1992). Yet it is during design that "decisions about the definition and distribution of roles between the object and its environment" are taken (Callon, 1991). The 'expert designer', whose centrality to successful development is stressed in several studies led by Curtis (Curtis et al., 1988; Curtis & Walz, 1990; Curtis, 1992) can often have a great deal of influence over the tools and methods in use by a particular team, sometimes more influence than senior IS managers. Orlikowski (1993) found that IS developers believed that CASE tools helped them to appear more productive and hence more valuable to their employer and so were strongly advocated.

The extent of methodology use to support user-involvement is unclear from the available literature reviewed above, as is the overall *approach* taken to managing system

development, which moderates whether information system design has a primarily technical/functional focus or organisational/user focus. The literature does not really tell us much about how users are involved in design in practice. Studies of methodology do not often consider user-involvement as separate from a classification of which methodology was used; where they do so, they refer to user-involvement with a single question which asks if users were involved (e.g. Sumner & Sitek, 1986). Detailed studies on the part of academic researchers engaged in user-centred development do not present an accurate picture of to what extent users are involved in system development in practice.

3.3.4 Conclusions: The Impact Of Development Methodologies Upon IS Design

- **The first research issue addressed was: *Do formal IS development methodologies reflect 'good' design practice?***

It would appear that traditional formal methodologies - those based on the waterfall model of design - are valuable in supporting the management of design, inasmuch as control aspects of the process are concerned, but do not support the 'creative' aspects of design to any great degree. The processes of formal methodologies may be subverted, to encompass those aspects of design which they do not support, such as communication or user-requirements elicitation (Curtis et al., 1988).

- **The second issue addressed was: *If the design of organisational information systems is not supported by top-down, decompositional methods, how might it be supported?***

'Alternative' methods address particular limitations of traditional methods, in particular significant user-involvement for emancipatory outcomes. But alternative methods are not widely used in practice, so it is likely that they do not support many of the required activities of design or they do not fit with the resourcing constraints imposed as a result of dynamic economic environments. It is likely that less formal design tools are required, to support the creative and synthetic activities of design within the linear, staged management approaches favoured in UK organisations.

Research question: *What type of design tools might be useful, in supporting design managed by 'traditional' approaches?*

- **The third issue addressed was: *What IS development methodological approaches are in use and to what extent are they used?***

There is no clear evidence to indicate which methodologies are used in development and whether, indeed, methodologies are used at all, by most companies. It would appear that in practice methodologies are not often used in the manner intended and are only partly used.

Research question: *To what extent are information system development methodologies used in organisations and are they used consistently and fully?*

The literature tells us very little about how system development is approached at different stages of the system development life-cycle. Many completely different methodologies have similar philosophies, benefits or problems in practice and may use common tools and methods. Given the partial use of methodologies discussed above and the lack of awareness on the part of developers about the provenance or philosophy of the tools that they use, a superficial description of the methodology in use does not provide a sufficiently detailed picture of the context of IS development or the approach taken.

Research question: *How is the development of information systems approached in organisations?*

- **The fourth issue addressed was:** *To what extent are users involved in the design of information systems and how is this involvement affected by the methodological approach to IS development?*

Most studies of methodology refer to user-involvement with a single question which asks if users were involved. Detailed studies on the part of academic researchers investigating their own, guided application of a methodology, which they have designed themselves, do not count as impartial research into the impact of user-participation in design! Most of the user-involvement literature concentrates upon a factor analysis of the influence of user-involvement upon system outcome; much of this does not examine the extent, quality or scope of user-involvement and none of this literature examines user-involvement throughout the system development life-cycle.

Research question: *What is the extent, scope and quality of user-involvement in organisational information system design?*

User-involvement in information system design appears to be problematic. Even when development methodologies explicitly advocate user involvement, the extent to which users may be considered co-agents in the processes of information system design appears to be limited. User-involvement appears to be constrained by a narrow conception of what activities are appropriate for user-input and by an equally narrow conception of what parts of the system design affect users in their work. The adoption of methodologies for user-involvement is not a sufficient precondition for extensive user-involvement to occur, when the empirical evidence suggests that methodologies are only used in part and not in the manner intended by their designers. There is very little in the literature in this area which tells us under what conditions the use of a user-centred methodology may involve users effectively in the processes of design.

Research question: *Under what conditions can the use of a user-centred methodology involve users effectively in the processes of design?*

3.4 A Framework For The Description Of IS Development Approaches

The discussion above concluded that a more detailed framework than is provided by a description of the methodology is required to examine the overall *approach* to IS development. There was a need for a bridging framework between theory and practice (Keen, 1987) with which to assess the approach to information systems development and enable a comparison of the actual development approach to that intended by the methodology. The development and application of this framework is discussed here. The basis of the framework was an examination of the dimensions of the interaction between organisation and technology, using Leavitt's (1972) model of the organisation as its starting point (Figure 3-7).

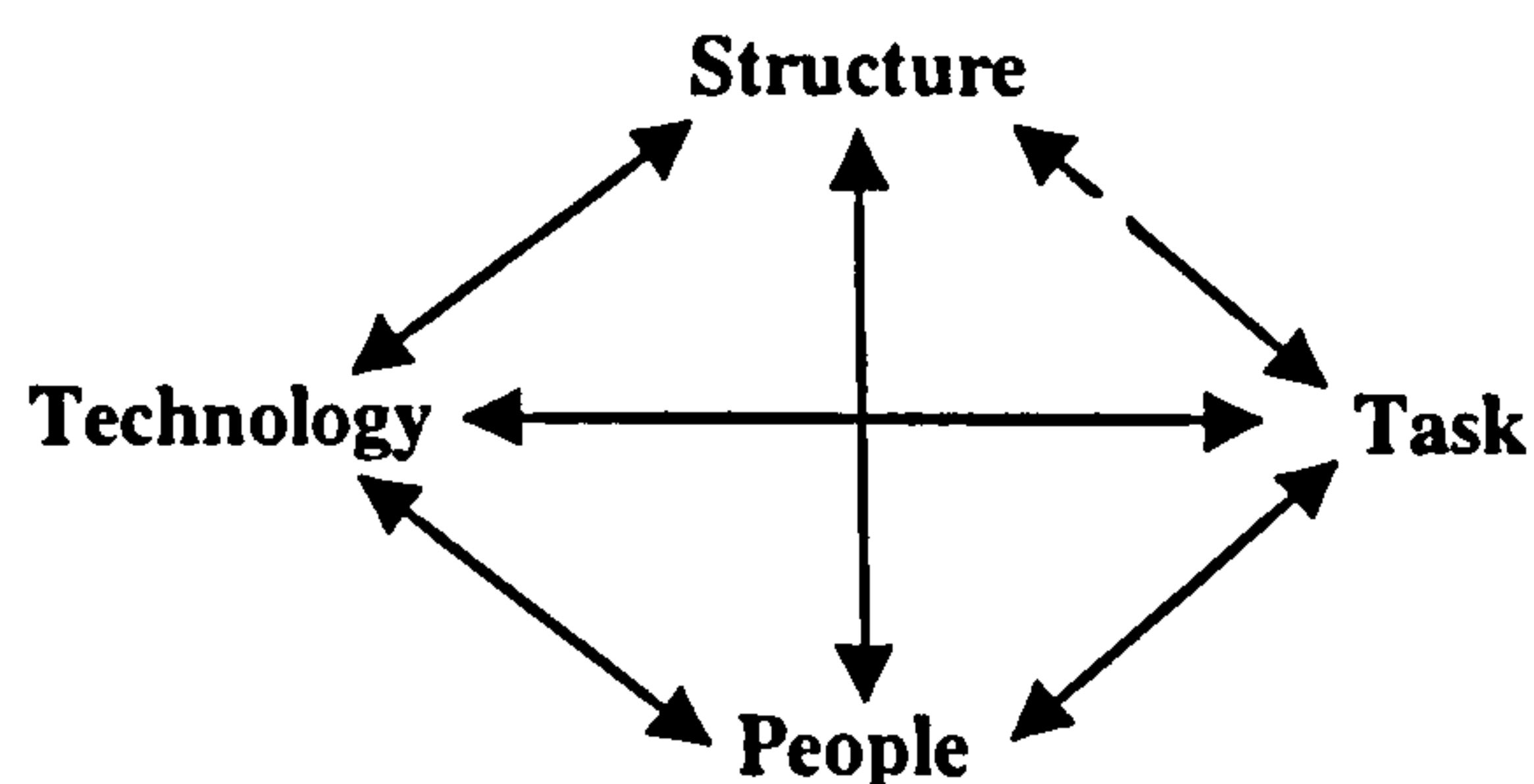


Figure 3-7: Leavitt's (1972) 'Diamond' Model Of The Organisation

This model was selected as it fitted with thinking in the information systems literature about the organisational context of IS development. A previous dichotomy of systems development between datalogical and infological perspectives (*c.f.* Methlie, 1980) has more recently been expanded to a trichotomy between the organisational context, the conceptual/infological (or language) context and the datalogical/technical context (*c.f.* Lyytinen, 1987; Iivari, 1989). Lyytinen's (1987) language context can be seen both as embodying the modelling of conceptual or cognitive knowledge and as signifying human action. Although crude, the terms "people" and "task", may be used to represent the dual objects of this language context; the framework can thus be seen to fit with thinking about the *domains* of information systems development.

Coupled with the above interpretation was a need to encompass the dichotomy between "hard" and "soft" systems thinking proposed by Checkland (1981). Hard systems thinking, typified by systems engineering or structured systems analysis, sees the system development problem as relatively well-defined: the methodological objective is to satisfy the given requirements through the technical implementation of a closed system. In contrast, soft systems thinking sees the problem situation as ill-defined: the target object

system is perceived as part of a wider, social and political system and the task of the analyst is to determine desirable and feasible change by exploring and expressing the problem situation. In hard systems thinking, the concern is with the properties of a physical (technical) system and it is believed that human behaviour can be modelled using rule-based systems, so the problem is *analysed*, by defining system objectives and requirements. In soft systems thinking, the concern is with a system of human activity, so the problem is *expressed*, by examining elements of structure and process and their mutual relationship.

The six dimensions of the framework were operationalised, using constructs from systems development practice, so that one extreme of each dimension represented hard systems thinking and the other extreme represented soft systems thinking. The resulting dimensions are given in Table 3-3.

Leavitt's Model	Operationalised Concepts	
	<i>hard</i>	<i>soft</i>
technology-structure	technical optimisation	work & social system design
technology-people	low user-participation	high user-participation
technology-task	top-down, technical approach to problem-investigation	bottom-up, task approach to problem investigation
task-people	function-oriented approach to system design	work-process orientation to system design
structure-people	formal, system specification orientation to project management	informal, user-satisfaction orientation
task-structure	long, waterfall approach to systems development	short, evolutionary approach to systems development

Table 3-3: Operationalised Concepts For The IS Development Approach Framework

When the framework was validated in initial questionnaire pilot interviews (see Chapter 7), it was discovered that the long, systems life-cycle approach vs. the short, evolutionary approach was insufficient to define all projects, as some were long, evolutionary projects (corresponding to staged functional delivery, rather than an evolutionary approach where the structural impact of the system may change with evolution) and some were short waterfall approaches (where the system development did not have significant impact on the organisation). To remove ambiguity from the application of the framework, it was decided to split this element into two dimensions, the time dimension and the process-model dimension, giving seven dimensions to the framework, as shown in Figure 3-8. The concept behind the framework was that managers and system designers could be asked to position their approach to IS development projects across a number of dimensions, giving a richer and more accurate picture of their practice than would be obtained from asking them to describe their approach. The latter method of elicitation would be more likely to result in a description of their espoused theory of design, rather

than their theory-in-use (Argyris & Schön, 1978). This method of assessment has the benefit of measuring consistency of approach, if the framework is designed appropriately, as well as providing a way of assessing the way in which development methods are applied. To permit the assessment of methodological consistency, the model was designed so that along the extreme left of the model's spectra lie the traditional, structured, technically-oriented ('hard') methods of development and along the extreme right of the model lie the evolutionary, flexible, user- and organisation-oriented ('soft') methods.

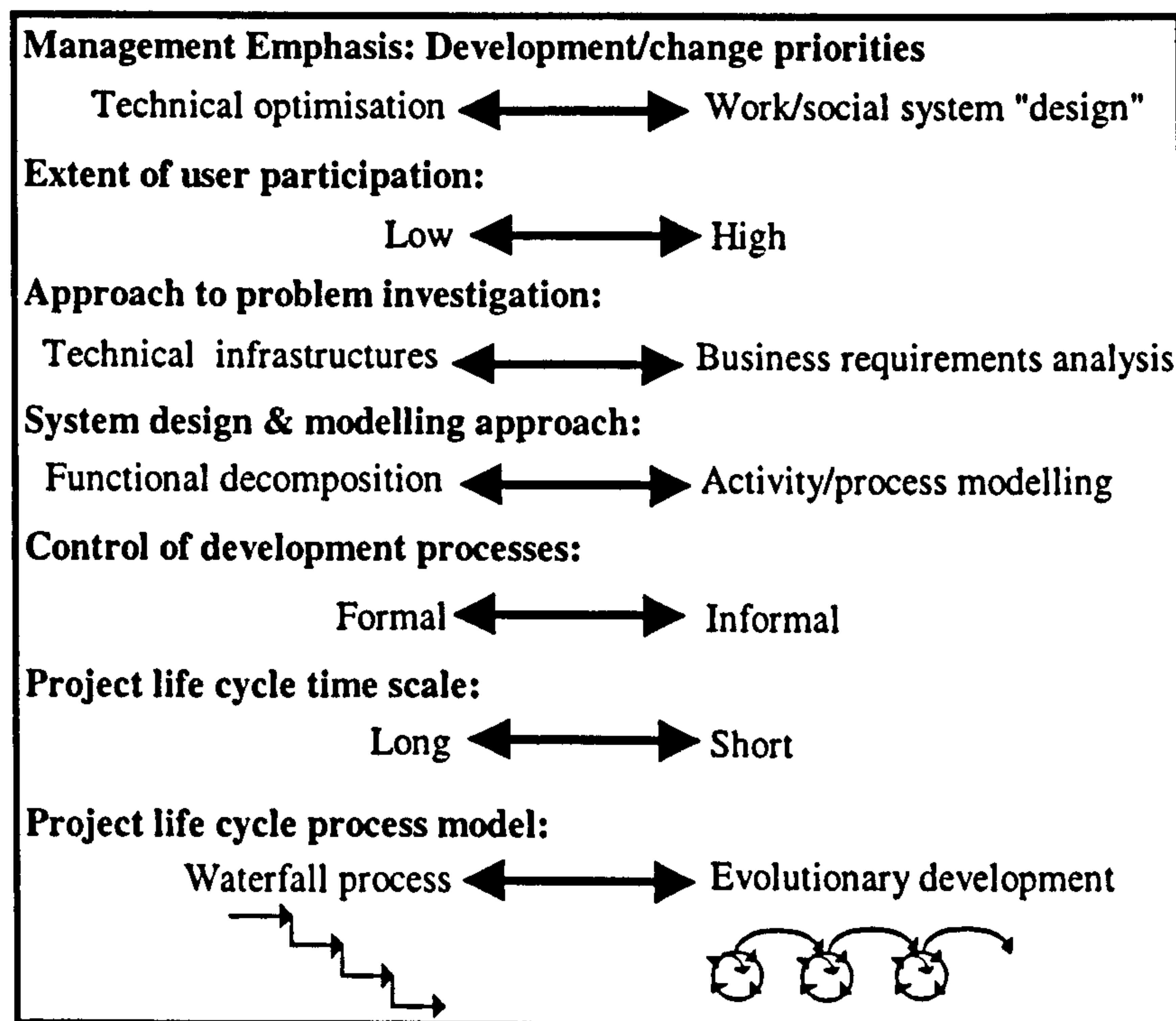


Figure 3-8: A Framework For The Classification of Approaches To IS Development

3.4.1 Validation Of The Framework And Using The Framework To Examine IS Development Methods

The framework represented in Figure 3-8 has been presented here as an aid for the analysis of methods in organisational use; many methods can have varying impacts depending upon their application. It is instructive to map organisations' use of development methods onto the framework; this is done in Figure 3-9.

The model was validated during informal interviews with four IS analysts and was also discussed at the BCS Methodologies Special Interest Group Conference in September 1994, by an audience which included many information systems analysts and consultants. The placement of various methods, shown in Figure 3-9, was derived from interviews, where an analyst was asked to position a method with which they had recent experience - other analysts may place these methods differently. It is the *process* of using the framework that is intended to be of value: applying thought to the likely impact of the use of alternative methods and assessing IS development approaches in organisations. When

selecting development methods, managers need to consider both the underlying philosophy of a particular approach and the context of its application.

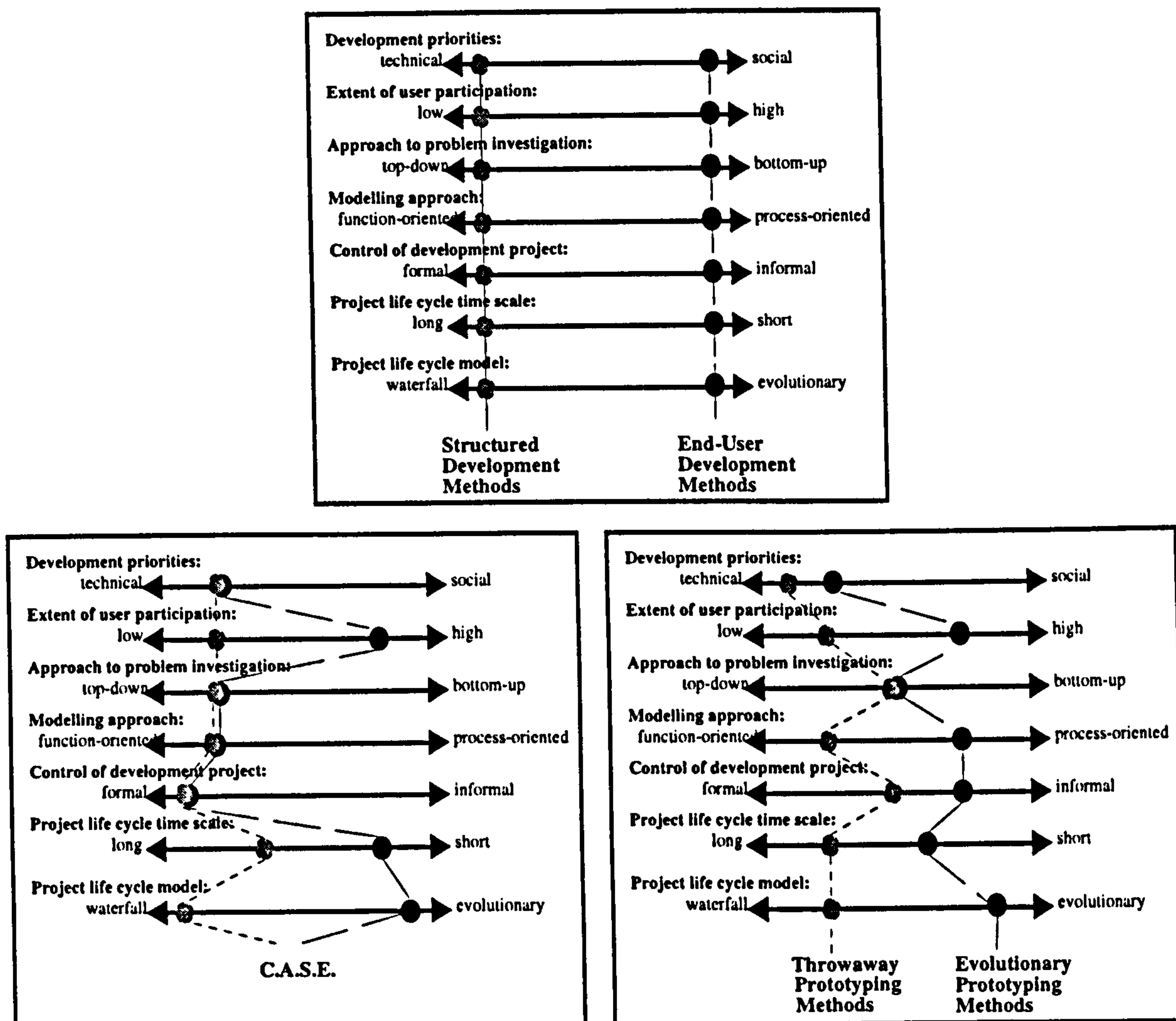


Figure 3-9: Using The Framework To Map Development Methods

3.5 Conclusions And Research Questions Arising From Literature Review

Following a discussion of existing models and methods of the design of organisational information systems, it was concluded that design was not well understood. Existing models of design were examined and were found to be largely based upon a rational model of individual problem-solving, which provides little support for the social processes of information system design. The following research question arose:

1. *What are the critical processes of design and can they be related in a process model of design activity, which may be used for the effective management of system development projects?*

The use of methodologies in supporting information system design and the involvement of users, via different approaches to information system design were discussed. While traditional methodologies - those based on the 'waterfall' model of design - are valuable in controlling the design process, they provide little support for the creative or investigative

aspects of IS design. 'Alternative' methods address particular limitations of traditional methods, most commonly user-involvement for emancipatory outcomes, but are not widely used in practice, so it is likely that they do not support many of the required activities of design or they do not fit with organisational resourcing constraints. It would appear that in practice IS development methodologies are not often used in the manner intended and are only used in part.

The literature tells us little about the extent, quality or scope of user-involvement differences in user-involvement at various points in the system development life-cycle are not examined. User-involvement appears to be constrained by a narrow conception of what activities are appropriate for user-input and by an equally narrow conception of what parts of the system design affect users in their work. There is very little in the literature which tells us under what conditions the use of a user-centred methodology may involve users effectively in the processes of design. The following research questions arose:

2. *What type of design tools might be useful, in supporting design managed by 'traditional' approaches?*
3. *To what extent are information system development methodologies used in organisations and are they used consistently and fully?*
4. *How is the development of information systems approached in organisations?*
5. *What is the extent, scope and quality of user-involvement in organisational information system design?*
6. *Under what conditions can the use of a user-centred methodology involve users effectively in the processes of design?*

The examination of the literature concluded that a more detailed framework than is provided by a description of the methodology is required to examine the overall approach to IS development. A bridging framework between theory and practice (Keen, 1987) was developed to assess approaches to information systems development across a range of dimensions.

4. RESEARCH METHODOLOGY

4.1 Introduction

This chapter introduces the research approaches that were used for this study. A research strategy which combined multiple research approaches was used to investigate the research problem from an holistic perspective. In this chapter, the overall research strategy is discussed with respect to the research objectives. The research process model and the research approaches used in this investigation are described.

4.1.1 Research Objectives And The Research Study Process Model

The overarching research objective addressed by this thesis was to investigate the nature and processes of co-operative information systems design in an organisational context.

This objective was split into an investigation of how system design is approached at two different levels of analysis:

1. *The macro level:* to investigate approaches to the design of information systems in an organisational context, with the aim of understanding how information system design is approached in UK organisations.
2. *The micro level:* to investigate the nature of individual and group information systems design processes in an organisational context, with the aim of obtaining rich insights into co-operative information system design in UK organisations.

The research model was designed on the basis of theory building, testing and extension. This model, shown in Figure 4-1, was based on the alternative models suggested by Galliers (1992) and was designed around the lack of existing theory in the ISD literature identified in Chapter 3, which called for theory building and investigation, rather than the validation of existing theory.

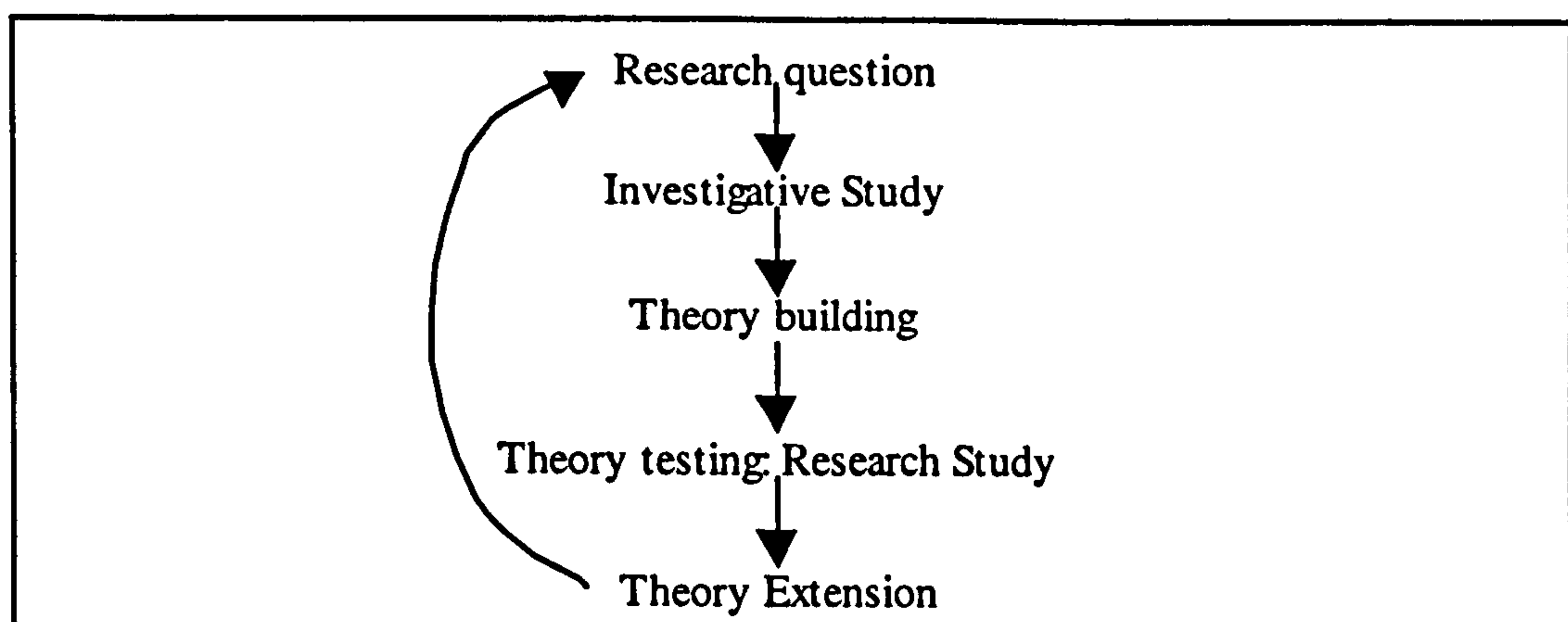


Figure 4-1: The Research Process Model (after Galliers, 1992)

By using complementary methodologies and research perspectives, the research objective was to achieve an holistic approach to the investigation of IS design in UK organisations, in order to obtain a rich understanding of co-operative information system design. A rich collection of data was used: interviews, survey data, observations of design meetings, design documents, user-generated representations of the design and stakeholders' frames of reference elicited through SSM modelling sessions, to build models of and to obtain rich insights into the processes of interaction and negotiation which constituted design activity in the development of organisational information systems in the contexts studied.

4.2 The Research Approach

4.2.1 The Interpretive Research Paradigm

Burrell and Morgan (1979) provide a model of sociological *paradigms* (Kuhn, 1970), which they define as 'meta-theoretical assumptions about the nature of the subject of study'. The model produces four paradigms of research:

- *functionalism*: concerned with social order and rational choice, "seeks to explain how individual elements of a social system interact to form an integrated whole" (Hirschheim & Klein, 1989)
- *social-relativism*: concerned with the frames of reference of the individual as social actor, seeks to explain how individuals attach meaning to the world
- *radical structuralism*: concerned with the structure and analysis of economic power relationships, seeks to overcome existing structural social and organisational constraints on human action
- *neohumanism*: concerned with emancipation, seeks to remove the barriers to emancipation, focusing on ideology, power and social constraints.

Orlikowski and Baroudi (1991), after Chua (1986) distinguish between three main paradigms for information system research: positivist, interpretivist and critical research paradigms. Positivist studies are based upon the premise of fixed relationships within phenomena, for which structured instruments of investigation are deemed appropriate. Interpretivist studies are based upon the premise that people create and associate subjective meanings with observed phenomena as they interact with the world - such constructed phenomena can only be understood by an examination of the meanings which people attach to them. Critical studies are based upon the premise that there are structural contradictions inherent in all social systems, which may be exposed by an analysis of the historical, ideological and contradictory nature of existing social practices. Walsham

(1993a) equates the positivist, interpretivist and critical paradigms with the functionalist, social relativist and neohumanist paradigms respectively of Burrell and Morgan (1979), based upon an analysis of the research literature by Walsham (1993a) and by Hirschheim & Klein (1989). Whilst Walsham (1993a) does not identify an extant body of research in the fourth quartile of this model, there is a large body of research which performs a political analysis of the impact of IT on work (for example: Markus & Bjorn-Andersen, 1987; Corbett et. al, 1991).

Hirschheim & Klein (1989) argued that most IS research in their analysis of the literature was focused only on the functionalist paradigm, but it is arguable that all of the paradigms identified can now be found within the ambit of Information Systems research. It is in the appreciation of *all* of the above paradigms and the constant dialogues between them that the strength of Information Systems lies; these dialogues mean that the discipline does not take a fragmented view of the use of IT in organisations. Whilst this research adopts the interpretivist perspective overall, it does not deny the validity of other research paradigms and employs, for example, the positivist perspective in the assumption that data collected via a postal survey can be used as a proxy for respondents' approaches to IS development. The neohumanist perspective is apparent in the motivation for this research.

Walsham (1993a), describes interpretative methods of research as follows:

“ Interpretative methods of research start from the position that our knowledge of reality, including the domain of human action, is a social construction by human actors and that this applies equally to researchers. Thus, there is no objective reality which can be discovered by researchers and replicated by others, in contrast to the assumptions of positivist science.” (Walsham, 1993a, page 5).

This statement positions not only the subject of the research study - the social system under analysis - in the 'corner' of social relativism, but also makes it explicit that, to conduct interpretive research, the researcher's own beliefs and assumptions about reality must pertain to social relativism. It is recognised that data obtained in the course of research is subject to a double filter of selection and presentation: from those people whose views and opinions were sought in compiling the data, and from the perspectives and expectations of the researcher (Lee, 1991; Walsham, 1995).

Epistemology	Ontology
Positivism: Facts and values are distinct and scientific knowledge consists only of facts	External realism: Reality exists independently of our construction of it
Non-positivism: Facts and values are intertwined and both are involved in scientific knowledge	Internal realism: Reality-for-us is an intersubjective, shared human cognitive apparatus
Normativism: Scientific knowledge is ideological and inevitably conducive to particular sets of social ends	Subjective idealism: Each person constructs his or her own reality

Table 4-1: Alternative Stances On Knowledge And Reality (Walsham, 1995 pg.76)

Walsham (1995) distinguishes between positivist and interpretivist research paradigms, describing the alternative stances on knowledge and reality reproduced in Table 4-1. He argues that either of the latter two positions (non-positivism or normativism) may be adopted by the interpretive researcher. While I would, rationally, adopt the normativist stance, I cannot claim to be unaffected by the non-positivist position, given that much of our training and education in the western world is based upon the assumption that a 'shared vision' is not only desirable but achievable.

4.2.2 The Use Of Multiple Research Approaches

Galliers (1991) distinguishes between research *approaches*, which are ways of going about one's research, and research *methods*, which are "ways to systematise observation". The selection of a research approach predicates the type of data to be collected and the way in which it will be analysed; different research approaches embody implicit assumptions about the nature of ascertainable knowledge and of reality itself (Orlikowski & Baroudi, 1991; Walsham, 1995). No single approach to research is appropriate for all purposes (Galliers, 1992); many specific research methods can be used in information systems research but an interpretive approach requires methods which deal carefully with context and process (Walsham, 1993a). Multi-disciplinary research adds insight and depth to the studies of organisational innovation and provides a safeguard against limiting the scope of enquiry (Wolfe, 1994). To obtain an holistic view of any research question, multiple approaches must be employed, which reflect (and thus question) differences between assumptions concerning the nature of the research problem and the generalisability of the data obtained for analysis. In the words of Cavaye (1996):

"It is widely accepted that the selection of a research strategy entails a trade-off: the strengths of the one approach overcome the weaknesses in another approach and vice versa. This in itself is a powerful argument for pluralism and for the use of multiple research approaches during any investigation." (Cavaye, 1996, page 229).

Klein et al. (1991) discuss five approaches to methodology selection. Supremacy believes in the universal applicability of a single method. Contingency argues for the objective selection of appropriate methods, based upon a-priori characteristics of the object of study. Pluralism takes the position that different methods are incommensurable, that each method socially-constructs the situation that it addresses and so defines the objects to be studied differently, and that knowledge is best furthered by permitting multiple approaches, with the free exchange of ideas between them. Eclecticism shares the belief of pluralism that there is a multiplicity of research approaches, but believes that one may pick and choose from different methods to build a specific approach that is most fruitful for a given situation. Dialectics holds that at any time there are two dominant approaches. Klein et al.

(1991) suggest positivism and antipositivism as the current dominant approaches in IS research) and that knowledge is achieved in the struggle between them, through the competing claims of those who advocate their chosen approach; a synthesis of the two approaches arises from this struggle, which creates a new dominant approach, to which emerges a new opposition.

It would be difficult for most researchers to state their position unequivocally. In the deconstruction of many writings, there may be detected implicit beliefs which conflict with the explicitly advocated research position. For example, in Galliers (1991), a contingency approach is taken, which presents a taxonomy of research approaches which may be selected according to criteria pertaining to the object of study and the research situation, yet emphasises the subjective nature of this taxonomy with the reservation that others may not agree with the judgements embodied within it (Galliers, 1991, page 340). Mingers (1996) states that a weakness of methodological complementarianism is that it does not deal adequately with the problems of paradigm incommensurability, or with cultural and cognitive feasibility, yet this perspective assumes an objective delineation of methods and that a method is applied consistently to reflect a particular paradigm or culture of its origin. An interpretivist position could reject this claim on the grounds that *all* research is socially constructed and subject to the subjective reality of the researcher (Walsham, 1993a) and that therefore a method cannot be said to belong to a particular paradigm or culture exclusively. Galliers (1991), for example, argues that the case study approach can fall under both scientific *and* interpretivist approaches to research, depending upon the particular 'appreciative system' (Vickers, 1980) or 'cognitive filter' (Simon, 1988) of the researcher - he takes this as an indicator that the case study approach cannot be considered as a method, while I would take it as an indicator that research claims to validity through the use of a particular method are, at best, weak.

I have tried, in the course of this research, to take the contingency position; however, in attempting to investigate the richness of the material presented in the course of the longitudinal case study, elements of eclecticism have been detected creeping in! I do not consider this a bad thing, whilst objective contingency has its merits, the claims to objectivism in much research are overstated and I believe that there is a role for serendipity as well as logic. Often, methods have been applied on a 'subjective-contingency' basis (i.e. on the basis of feeling or curiosity, rather than objective selection), to see what could be found and this approach has proved fruitful.

I have found it useful to observe the limitation that "any claim to truth is always at risk and subject to revision as one learns from the arguments of one's opponents" (Klein et al.,

1991, page 7). Galliers (1991), after Keen (1984), argues that too little knowledge is built cumulatively, from understanding previous research in one's area of interest, while Glaser and Strauss (1967) urge the grounded theory researcher not to read widely in their substantive field before starting the research, but to read widely in other fields of sociological research, to familiarise themselves with constructs of sociological theories and the way in which such theories are constructed, without prejudicing their own area of theory with preconceived hypotheses. I have tried to read both widely and deeply in areas where constructs and theories appeared relevant, while not being totally influenced by current theories of IS design (see Chapter 3 for a criticism of these). Because of this, much of this work may appear eclectic, but I would argue that the approach I have taken is holistic rather than eclectic. I have worked hard, sometimes intuitively and sometimes objectively, to achieve an holistic understanding of many, related areas of research. This has sometimes mitigated against the narrow focus required for a PhD thesis, but I believe that it has enabled me to achieve a much deeper and more useful insight into the realities of organisational practice in IS design and to understand the theoretical as well as the practical basis of a wider range of analytical methods than is usual in PhD research.

4.3 Research Questions and Appropriate Research Methods

4.3.1 Implementation Of The Research Process Model

The research problem is to investigate how multi-domain, design groups function: the processes of co-operative design in UK organisations. This involves empirical investigation of the nature of the information system design process, with respect to both the requirement for information technology and the social context of the system. This research problem is clearly of the 'wicked problem' type (Rittel & Webber, 1973), which is discussed in Chapter 7: it is inter-related with a multiplicity of other research problems, it has no clear termination-point and an understanding of appropriate solutions emerges with increasing understanding of the 'problem': research goals are emergent. It was therefore decided to use an *iterative* research design, to permit the nature of the research 'problem' to be reassessed in the light of emergent understandings. This is illustrated in Figure 4-2. The 'macro' and 'micro' analysis perspectives were built into this model: the first iteration investigated the research problem at a high level of analysis, the second iteration investigated the revised research problem in more detail. The objective of the first iteration was to understand how IS design is approached in UK organisations and to obtain a high-level perspective of the processes of design. The objective of the second

iteration was to develop an in-depth understanding of the design process, grounded in the findings of the first iteration.

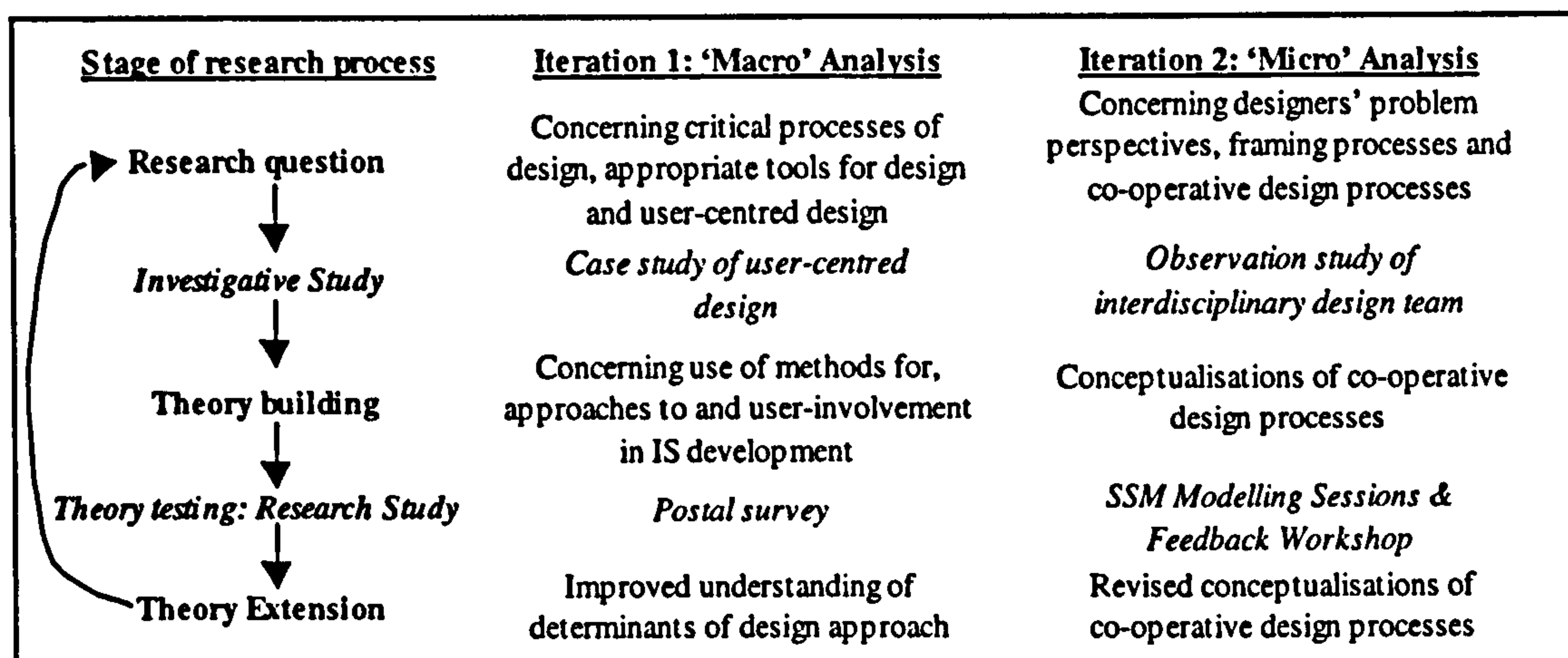


Figure 4-2: Implementation Of The Research Process Model

4.4 Research Iteration 1

4.4.1 Research Questions

The initial interest of this study was to investigate how co-operative design, involving users and other organisational stakeholders, might best be supported and managed, in the context of organisational IS development projects. The detailed research questions which were addressed in the first iteration of this study were:

1. *What are the critical processes of design and can they be related in a process model of design activity, which may be used for the effective management of system development projects?*
2. *What type of design tools might be useful, in supporting design managed by 'traditional' approaches?*
3. *To what extent are information system development methodologies used in organisations and are they used consistently and fully?*
4. *How is the development of information systems approached in organisations?*
5. *What is the extent, scope and quality of user-involvement in organisational information system design?*
6. *Under what conditions can the use of a user-centred methodology involve users effectively in the processes of design?*

4.4.1.1 Rationale For Selection Of Studies

An exploratory case study was conducted into an IT-based system research and development project, which explicitly employed a user-centred design process. Half of the design team were organisational psychologists, recruited for their understanding of system

fit with user-tasks and half were technical system developers, recruited for their technical design expertise. The research site was of interest because the design project had failed - it was in the final stages of abandonment - and so this study would shed light on the constraints of user-centred design in an organisational context. Almost all the empirical studies found of user-centred system design and development approaches are studies where an academic has sponsored and managed a design project which uses a specific approach to user-centred design, originated by the academic. Unsurprisingly, these projects do not fail. It was therefore of interest to investigate the processes involved in a real project involving design with user-representatives acting as co-agents in the design and the real constraints operating upon user-centred design in this situation. Following the case study, it was determined that the literature did not give sufficient information about the approaches to information system design currently in use by organisations. Chapter 3 concludes that this literature is contradictory and does not investigate approaches to design, only methodologies in use; these may be applied in many different ways. It was decided to conduct a postal survey, to assess the approaches to information system design used in UK organisations and the extent of user-involvement in those approaches.

4.4.2 The Case Study Method

As reported in the review of IS development literature (chapter 3), many studies have compared different approaches to the process of design, but this work has largely taken the form of *experiments*, with designers verbalising their experiences and insights during the solution of various types of design problem. Because of the experimental nature of these studies and the focus on certain psychological behaviours, the design problems set are all more or less structured: they do not represent the 'wicked' problems typically found in the context of organisational IS design. The main lacuna of these studies is that they provide little information about what groups of designers actually *do* when they are confronted with such a problem. Without such data, it is difficult to understand how design proceeds and what tools and management approaches may best support it. This position is admirably summed up in a paper by Curtis (1987), called 'By the way, did anyone study any real programmers?'. In response to this, this study took a phenomenological approach (Husserl, 1931), which attempts to "understand a particular social act by placing oneself in the position of the actor and interpreting their action as one of a general type" (Mingers, 1984). The focus is upon internal, individual interpretations of the world, obtained from interviews with individual actors in the situation being studied.

Yin (1994) argues that a case-study approach has an advantage over surveys, experiments, and other research strategies "...when a 'how' or 'why' question is being asked about a contemporary set of events over which the investigator has little or no control." (ibid., page 9). This description applies well to the exploration of design approaches. This research is exploring *how* a wicked design problem is approached, *why* design methods work in some situations and not in others, with no control over how an designer explores a design problem or uses a design method.

The basis of the case-study approach is to collect many different types of data and use them "in a triangulating fashion" (Yin, 1994, page 13) to converge on an explanation of what happened. Although the concept of triangulation is antipathetic to the interpretivist position, when multiple sources of information converge, there is a higher likelihood that the researcher has understood the series of activities which constitute the design process; how these activities were approached, how they were interpreted by the design team, and what result was achieved. This deep appreciation should permit an understanding of whether these processes and results are likely to reoccur with other developers or in another design project.

4.4.3 Deriving Grounded Theory For Co-operative Information System Design

The analysis of this case-study employed a grounded theory approach, which permitted rich insights into what the designers did and their confusion and insights about the approaches used. It also permitted the construction of a high-level model of the constraints which operated upon co-operative information system design in this context.

The grounded theory approach (Glaser & Strauss, 1967, Glaser, 1978) is designed to "develop and integrate a set of ideas and hypotheses in an integrated theory that accounts for behaviour in any substantive area" (Lowe, 1996). Glaser & Strauss (1967) differentiate substantive theory from formal theory by associating the former with empirical research, whereas the latter is associated with theoretical or conceptual work. Substantive theories are seen as emergent - by saturating oneself in the analysis of appropriate data, where the direction and quantity of data collection is driven by emerging patterns in the data, rather than by predetermined research 'design', one can generate original theories concerning human behaviour (Glaser & Strauss, 1967). Unlike more pre-designed research, data collection and analysis are interrelated: the analyst "jointly collects, codes and analyzes his data and decides what data to collect next and where to find them, in order to develop his theory as it emerges" (Glaser & Strauss, 1967, page 45) - this process is referred to as 'theoretical sampling' (ibid.).

The use of grounded theory is suited to a research question where there is no satisfactory, existing theory which explains behaviour in this context, as is the case for information system design. There is an emphasis upon rigour, rather than inference or description: the theory is based upon codes which are found in the data, not upon inference or association of ideas (Glaser, 1978). It should be emphasised that the process of grounded-theory analysis is highly iterative and recursive, relying upon “constant comparison” of the data (Glaser & Strauss, 1967) to uncover patterns which explain relationships between themes found in the data, as illustrated in Figure 4-3. The purpose of grounded theory analysis is not to provide a descriptive account of the processes observed, but to provide explanations for observed patterns of behaviour, which may provide the basis for a substantive theory of behaviour which is grounded in the context in which it is observed (Glaser, 1978, Glaser & Strauss, 1967).

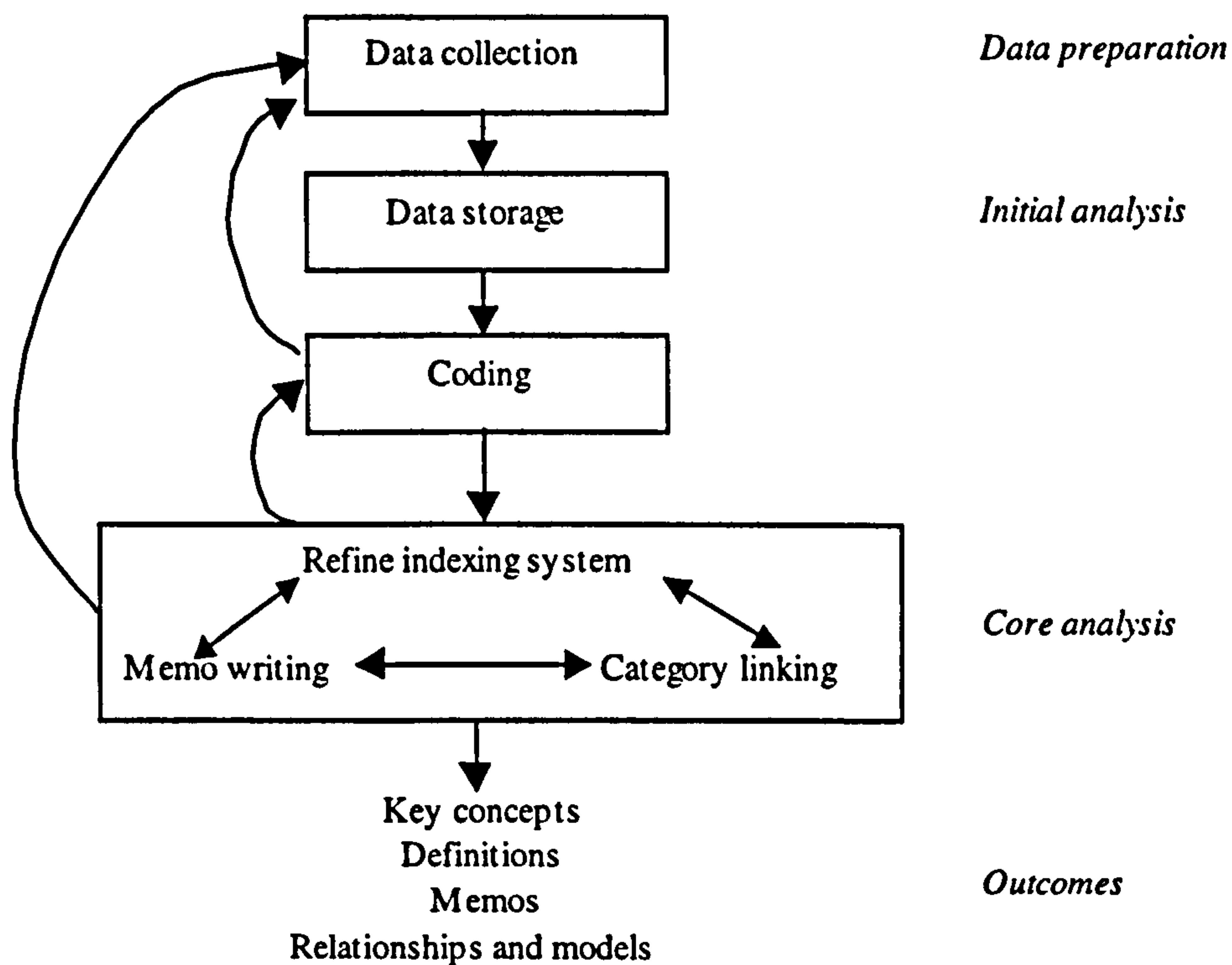


Figure 4-3: The Grounded Theory Approach To Data Collection and Analysis (Pigeon & Henwood, 1976)

The process moves from an “open” coding of the data to the identification of core themes and processes in the data through the use of theoretical memos (Glaser, 1978), which “are the theorizing write-up of ideas about codes and their relationships as they strike the analyst while coding” (Glaser, 1978, page 83). In the Glaser & Strauss (1967) and Glaser (1978) conceptualisations of grounded theory, the substantive theory which emerges is objective and waiting to be “discovered” in the data. But Pigeon (1996) comments that the idea that a set of social or psychological relationships exist objectively in the world

ignores “the mobile and constructed nature of all meaning” (Pigeon, 1996, page 81). The assumption that qualitative researchers can directly access their participants’ lived experiences is particularly problematic, in this light. While accepting this limitation, Pigeon observes that some inductive use of theory is required, particularly at the beginning of analysis, to guide the researcher’s understandings of the situation, and that the ‘emergence’ of theory results from the constant interplay between data and the researcher’s developing conceptualisations - a ‘flip-flop’ between ideas and research experience, which is better described as one of theory *generation* than theory *discovery*. Glaser and Strauss (1967) urge the grounded theory researcher not to read widely in their substantive field before starting the research, but to read widely in other fields of sociological research, to familiarise themselves with constructs of sociological theories and the way in which such theories are constructed, without prejudicing their own are of theory with preconceived hypotheses (this recommendation constitutes a recognition of the role which inductive reasoning plays in grounded theory generation). Unfortunately, this advice was encountered too late to prevent me reading widely in the intended field (organisational IS design and development). But as the conclusion of my initial literature search was that little literature existed which described organisational IS design activity in any depth, I do not consider this study to have been seriously prejudiced by this reading! Additionally, much of my reading was in fields other than ‘conventional’ IS literature (if such can be considered to exist): psychology, architectural design, organisational behaviour and sociology and was guided, during the study, by the threads emerging from the research analysis, rather than by a substantive body of work in the area of information system design. The IS literature is fragmented and inconclusive in most areas covered by this study.

4.4.4 The Postal Survey Approach

Whereas the case study approach investigates a research question, or set of questions, in depth, the postal survey approach investigates research questions in breadth. Validation of data obtained through a postal survey is more problematic than with case studies, because of the lack of personal contact between the researcher and the subjects: a postal survey cannot measure observable events, but only respondents’ attitudes to, and perceptions of, events, because of the biases inherent in this method of data collection (Fox and Tracy, 1986; Hufnagel & Conca, 1994). But the advantage of a postal survey is the ability to obtain the ‘big picture’: an overview of trends and patterns across a larger number of instances than is possible with case study interviews.

For this study, it was not intended to attribute the data with that degree of quantitative authority which a large-scale, statistically valid, postal survey would ensure. Rather, the survey was treated as an exploratory instrument, to qualitatively investigate a research question which was not answered by the literature, which was felt to be an integral part of the holistic nature of the research 'problem' under investigation. For this purpose, the conceptual framework used as the basis for the questionnaire was constructed to be comparative in nature, rather than ordinate. It was intended to investigate, subjectively, approaches to the development of organisational information systems, in UK companies, in the 1990s and the extent to which formal development methodologies played a role in these approaches.

4.5 Research Iteration 2

4.5.1 Research Questions

The main theme of the second iteration arose from the grounded theory analysis of the first iteration of this study. It was originally intended that there would be a need to understand the detailed processes of design as the basis for new methodological approaches to information system development, to replace those based upon the waterfall model. As the study progressed it became clear, both from the literature and from the exploratory case study that the philosophy of methodological approaches to development was either ignored or subsumed to the technical interest. The core research problem changed in focus, but not definition, to centre on the need to understand the detailed processes of design as the basis for new ways of making the design explicit and therefore more open to user-negotiation, with the emphasis shifting from behavioural process models of design to a need to understand the social cognitive processes of design-framing. The research questions arising from an examination of the literature were:

- 7. How do differing perspectives on the nature of problem-definition and analysis/investigation affect organisational actors approaches to information system design processes?*
- 8. How are individuals' different mental models manifested in design and are individuals aware that they hold different models from other individuals?*
- 9. What are the processes by which designers frame design models and what tools or methods are appropriate in supporting the construction of mental models by designers?*
- 10. How do members of a design group engage in a 'community of social practice'?*

11. To what extent is design scope constrained by political considerations and what role do explicit models of the design play in extending and obtaining consensus on the scope of a design?

4.5.1.1 Rationale For Selection Of Study

There is little theoretical work on social cognitive processes in IT-related change (Orlikowski & Gash, 1994). There was therefore little theoretical work upon which to build, for this study, so it seemed appropriate to use various approaches which supported theory-building. Several research methods were employed to achieve rich insights into the complex, research 'problem'.

It was decided to conduct a longitudinal field study in order to investigate the process of IS design, to obtain insights that are not available to case study based research. (Curtis, 1987; Curtis et al., 1988; Wolfe, 1994). The site was chosen because the company was at the start of a new design project, so the whole of the process would be open to inspection. It was also chosen because the design project involved a cross-disciplinary team engaged in organisational redesign coupled with information system design, so the project provided a rare view of the social processes of design-requirements negotiation which was particularly of interest, given the emphasis of this phase of the research.

An interview-based case study approach was used at the start of the project, to enable an appreciation of the design context and of individuals' attitudes to the design process.

Interviews were also obtained in the middle of the design project and towards the end of the project, so that changes in attitude could be ascertained.

Design is a process of change: as such, it is not easily studied from the 'snapshots' obtained from interviews of designers. Such interviews are also subject to post-rationalisation (Giddens, 1993; Suchman, 1987): they do thus not represent design participants' theory-in-use (Argyris & Schön, 1976), but an espoused theory of design practice. The main part of the study employed participant observation, using ethnographical data collection methods (keeping notes of activities observed in design meetings, recording actors' representations of the design, collecting design documents and analysing tape-recordings of the design meetings).

Finally, Soft Systems Methodology (SSM) was employed, both in interview-based modelling sessions and a group workshop involving the core design-team. This approach was employed with the joint objective of eliciting implicit design models and of facilitating reflective learning on the part of the design-team, about detailed system design objectives. In addition, the research findings were filtered back to practice through a

feedback workshop, where design team-members gained new insights of the process and my conceptualisations of the design process were criticised and added to.

In this way, multiple perspectives of the design process were observed and recorded, to provide the basis for an holistic, rich appreciation of the design process.

4.5.2 The Longitudinal, Participant Observation Method

Participant observation is a mechanism by which a deep understanding can be obtained of an experience by sharing that experience (Waddington, 1994). When attempting to achieve in-depth insights into organisational practice, participant observation offers the twin advantages of presence at key events and participation in the internal experience of those events. In order to obtain more in-depth insight than is possible with the interview-based approach of the case study, it is necessary to conduct an observation-based study of real, organisational practice (Curtis et al., 1988). A longitudinal design permits the analysis of change as it unfolds (Barley, 1990; Pettigrew, 1990) - particularly appropriate when the object of study is organisational change.

Easterby-Smith et al. (1991) propose four roles of the participant observer in a research context: researcher as employee, research as explicit role, interrupted involvement and observation alone. The first role was attempted (briefly) for an initial study in another company: it was discovered that it was very difficult to have access to key decision-making processes when the researcher is fully engaged in other parts of the work process, so the study was abandoned. Research as the explicit role requires continual, explicitly agreed presence with the research subjects: with a full-time teaching load, this was not possible. Observation alone consists of 'hidden' observation, where the researcher avoids sustained interaction with the subjects of the study. Apart from the obvious difficulty in setting up such a facility, "practitioners often fail to obtain people's accounts of their own action because of their detachment" (Easterby-Smith et al., 1991). Interrupted involvement requires regular attendance at key processes, coupled with regular interviews to ascertain any key events which have occurred when the researcher was not present. This was the role chosen (as it was the only feasible role): in the event, it was discovered that, because of other calls on the time of the design team, very little design activity took place outside of the regular meetings, so the record obtained was a reasonably complete record of the design process, supplemented with interview material to cover meetings which could not be attended because of other commitments.

4.5.3 The Ethnographic Research Approach

Ethnography (Van Maanen, 1988) was employed as the basis for the field study, due to the focus on "the inter-subjective practices through which actors construct their social

environment” (Mingers, 1984) which arose as an issue from the first iteration. The ethnographic approach may be seen as “the comparative, descriptive analysis of the everyday, what is taken for granted” (Toren, 1994, page 102). The researcher actively participates in a social world in which people are themselves engaged in interpreting and understanding their environment (Bannister et al., 1994; Giddens, 1993) and the researcher forms part of that environment, is influenced by and influences it. Ethnography within the ‘MIS context’ examines, from the viewpoint of the participants in a research situation, the meaning and the role of the information system in their social and organisational world (Preston, 1991):

“ From ethnographic accounts, the theoretical constructs and models of MIS may be challenged. It is the critical distance between managers’ views of MIS and the ‘theory’ of MIS that creates the tension necessary to reorient our understanding of the craft.” (ibid., page 46).

The ethnographic study attempts to explore the interior of the culture of design *as constructed by the actors in the situation*. Van Maanen (1988) comments that “The crucial problem ... is to balance, harmonize, mediate, or otherwise negotiate a tale of two cultures (the fieldworkers' and the others').”

Observation is “fundamental to understanding another culture” (Silverman, 1993, page 9). The interpretation of observations involves an appreciation of hermeneutics (Gadamer, 1975), which takes the view that frames of reference may be analysed at the level of intersubjective language. Hermeneutics has been applied to IS research by Boland (1985, Boland & Day, 1989), who views it as the search for meanings in the ‘text’ of communications, representations, (inter)actions and documents which constitute the context and content of IS design.

Hermeneutics and ethnography are closely related: Mingers (1984) differentiates them by explaining that ethnography focuses on the inter-subjective *practices* through which actors construe their social environment but neglects the intersubjectivity of meaning which accrues from *pre-existing* rules and resources which actors draw upon. Hermeneutics ‘interprets’ intersubjective *meanings* of beliefs or practices from other traditions relative to our own frame of reference. In both traditions, the world is viewed as subjective, the first tradition focuses upon action, the second upon intersubjective frames of reference. This study attempted to incorporate both traditions in the analysis of data from the study and to be conscious of the separation; this analysis is presented in Chapter 7.

4.5.4 Soft Systems Theory

The science of ‘wholeness’ proposed by von Bertalanffy (1973) forms the basis of modern systems thinking, with Aristotle’s axiom that the whole is greater than the sum of its parts. Checkland distinguishes between ‘hard’ systems thinking, typified by the Systems

Engineering approach to the design of information systems (Feigenbaum, 1968), which is concerned with finding a solution to a given problem, and 'soft' systems thinking (Checkland, 1981; Checkland & Scholes, 1990), which is concerned with *investigating* problem(s) and achieving consensus between multiple stakeholder-perspectives on a 'problem situation'. A soft system is seen as purposeful (in the sense that humans within the 'system' have the power to continually select and modify the objectives of their actions) and as pertaining to 'human-activity' rather than technology. Unlike the hard systems approaches, where the concept of a 'system' is used ontologically, as a label for things in the real world, Checkland (1981) emphasises "systems thinking about the real world". The term 'system', as used in soft systems thinking, is an epistemological cipher for thinking about a subjectively-bounded part of the real world. In Checkland & Scholes (1990), this use of 'system' is clarified by substituting the word 'holon' to describe the concept of a purposeful human-activity system with emergent properties. Checkland (Checkland, 1981; Checkland & Scholes, 1990) proposes a methodology, which uses systemic and abstract modelling tools - Rich Pictures, Root Definitions and Conceptual Models - to model and compare both 'real-world' problem situations and holons as the basis for a facilitated debate among system stakeholders about feasible and desirable organisational change.

A major element of Soft Systems Methodology (SSM) is the surfacing of multiple, often contradictory, perspectives of an object system: the negotiation of an appropriate system boundary and acceptable root definitions of the system purpose: a reflection of the contradiction inherent in attempting to model a 'wicked' problem (Rittel & Webber, 1973), even using soft methods. *Because of this, it is an excellent tool for use as a research method, especially given the holistic philosophy underlying the method, which fits well with the interrelatedness of 'wicked' problems.* For Checkland (1981) soft systems have four main properties: emergence (the exhibition of properties by the whole which are not exhibited by the component parts), hierarchy (entities which can meaningfully be treated as wholes are built up of parts which are themselves wholes, and so on), communication (the transfer of information) and control (the process by which a whole entity retains its identity and performance under changing circumstances). This can be contrasted with the hard systems approach - manifested in many positivist approaches to research - which sees organisational system properties as being objective, rather than emergent, with communication and control being human interactions with the material (computer-based) 'system', rather than properties of the system itself.

As discussed in Chapter 7, it is open to debate whether it is possible or desirable to achieve consensus using SSM. Checkland & Scholes (1990) state that a major goal of producing root definitions is to permit actors who are involved with the human-activity system being investigated to learn about that system and so to surface implicit properties of that system. There is the implicit position that it is not the role of the analyst/facilitator to make political decisions – the analyst should act as facilitator to the group of stakeholders in the human-activity system. Yet political mediation is a major part of the work of professional systems analysts (Boland & Day, 1989; Markus & Bjorn-Andersen, 1987). What SSM contributes, therefore, is a useful conceptual approach to organisational systems analysis problems, especially to information research, where it may be said to have initiated a new paradigm, but SSM does not yet provide a practical approach for IS professionals to use, given the normative emphasis of their task and the impact of management approaches and resource constraints upon IS development activities, discussed in chapter 3.

4.5.5 Actor-Network Theory

Mingers (1984) criticises ethnography for not accounting for how the interests involved in social construction of the world affect the intersubjective constructions and the exercises of power which result from the interplay of those interests. Actor-network theory (Callon, 1991; Latour, 1987, 1991) recognises the relationship between social and technical mechanisms in the construction of social reality. An actor-network can be viewed as a ‘web’ of human actors pursuing interests and non-human actors (technical artefacts and social arrangements), which embody (or ‘translate’) those interests. Stability (i.e. what is generally accepted as the ‘real world’ by social actors) is the result of aligning a diverse collection of interests to a single perspective; ‘irreversibility’ is achieved when it is impossible to go back to when a translation was only one amongst others competing for significance and when the translation shapes and determines subsequent translations (Callon, 1991). The radical element in this stance is that it does not differentiate, analytically, between human and non-human actors: “what counts as a person is an effect generated by a network of heterogeneous, interacting materials”. (Law, 1992). That is not to say that, ethically, humans cannot be distinguished from social effects; the position is an analytical one, for the purposes of tracing social constructions, rather than an ethical one.

Actors overcome resistance by translating (i.e. representing or appropriating in order to align) other actors’ interests to their own interest (Latour, 1987). To achieve this they have to convince others of the ‘rightness’ of their claim or object in the context of action, they

have to control the behaviour of others, they must gather resources and ensure that others perpetuate and spread the claim or object in time and space (Latour, 1987). Actor-network theory is particularly appropriate to design, as it permits analysis of how various actors' interests are embodied in a technical object, which "may be treated as a program of action co-ordinating a network of roles" (Callon, 1991, page 136). Thus, an analysis of the actor-network surrounding a design initiative permits an understanding of how "fact" and "knowledge" are constructed over time (Latour, 1987).

Monteiro and Hanseth (1996), argue that Actor-Network theory provides the potential to account for how interpretive flexibility (the ability of technology-users to use a technology in a way other than that for which it was designed) may be restricted, even over great distances. Actor-Network theory supplies an insight which is missing from structuration theory (Giddens, 1984), in that it provides a view of the *internal, constructed nature* (the 'specifics') of the technology which underlies an information system. Actor-network theory was preferred to structuration theory here because of the insight provided into the co-construction of design knowledge: the structures of the organisation during the longitudinal study were relatively stable (although they did change following the study - see Chapter 8), while the alignment of interests concerning "fact" about the organisation was key to both the success of the design project and the constraints it suffered.

4.6 Applying Research To Practice

By using complementary research methodologies and research perspectives, my objective was to achieve an holistic approach to the furtherance of all three of the IS research interests suggested by Jackson (1992). The practical interest will be served by the dissemination of the findings from this research back into practice, the technical interest will be served through the insights gained towards the design of new tools and management approaches to design and the emancipatory interest will be served by an examination of the interior processes of design, in questioning the legitimacy or otherwise of normative and non-normative design activities.

4.7 The Role Of The Researcher

It is explicitly recognised that I, the researcher, am a major influence on the research project and that I carry with me a set of assumptions and preferences, largely based upon my previous experience, through 12 years spent in systems design in industry. A periodic examination of my frameworks and assumptions was intended to increase my awareness of biases in the research and therefore decrease the effects of these biases. My perspective

affects the perspective of the research project; by a making both explicit the meaning and understanding of the project and its conclusions are illuminated.

My personal perspective is evolving and changing. When the research project was initiated, my background and training as a system designer let me to believe that the outcome of the research would be a grounded theory of design which led to a new methodology, supporting the theory-in-use of design, rather than the espoused theory (Argyris & Schön, 1978). Through the course of this study, I have come to discern that the production of yet another methodology, which will only be used in part and not in the way which its designer intended, is the last thing that the world needs! I have come to concentrate instead upon the generation of a grounded theory of design which supports group interactions as well as individual cognition. When one is working as a system designer, the stresses of the immediate situation: short timescales and lack of resources, lead one to concentrate upon one's individual modelling problems. The advantage of this type of study, performed with the wide research literature which is available in many areas concerning information system development, is the that it broadens one's horizons and presents the 'bigger picture'. The intention of the study is, as advocated by Preston (1991), to challenge the 'MIS' perception of design by obtaining rich insights into the situated nature of design processes.

My primary interests are (a) in *people* and how they are affected by new technology and (b) in *design* and how it functions. Both designers and information system users are affected by the approaches which are used to develop new technology. Designers are affected by the stresses of attempting to match the inappropriate methods by which such projects are generally managed to the processes required for perfective design. Users are affected by the stresses of attempting to match inappropriate technology implementations to the requirements of the tasks required to perform their work. Both of these interests in a design would therefore benefit from improved approaches to the design of technology, as used in an organisational context.

Finally, my main problem in conducting ethnographic research was in suspending my 'intellectual baggage' (Preston, 1991). In the initial case study, this was reasonably easy to do, I interviewed a group of people with whom I had had little contact and my reassessment of the initial analysis, conducted at a distance of two years from the initial assessment was perhaps more detailed (given my increased understanding of the IS design context), but not substantially different from the initial analysis in its conclusions. I also felt the survey analysis to have been conducted in a reasonably objective manner.

However, during the longer, field study in which I engaged, I found myself identifying

with the participants' perspectives (particularly the IS Manager, as I myself had a background in the same discipline) to such an extent that I had to completely redo the analysis when I reassessed it after a period of some months had elapsed. This is a salutary lesson and one I would communicate to other researchers in this field. Objective research is a fallacy: findings are socially-constructed within the socio-cultural framework of the researcher, as Mingers (1984) reminds us. I have tried to overcome some of this bias by constantly questioning my position in this matter and by using a variety of analytical frameworks and positions to examine the findings from various perspectives. What remains is my interpretation of situated, co-operative design.

4.8 Summary

This research uses multiple research methods to engage in a variety of perspectives upon the research 'problem'. The performance of an interpretive research study and the design of an organisational information system are similar in nature: both involve the investigation of a 'wicked problem' situation (Rittel & Webber, 1973), comprising many interrelated, ill-defined problems with no optimal solution and a multiplicity of subjective worldviews which may be applied to their definition. As such, no investigation of the research 'problem' can be planned in advance: goals are emergent and strategies contingent upon the discovery of new information relevant to the problem context. Because of the nature of the research problem, the design investigation was planned as a 'two-iteration' cycle. In the first 'iteration', investigative studies would be performed to explore the nature of the design of organisational information systems, in the context of IS development knowledge and practice. Two studies were performed for this first 'iteration': an exploratory case study, using grounded theory analysis to derive an understanding of how user-centred design may be constrained by organisational meanings attached to the development of information technology, and a postal survey, to investigate the wider context of IS development practice in UK organisations. For the second 'iteration', it was determined that a sufficiently detailed perspective of co-operative design activity in multi-domain design teams (i.e. teams involving stakeholders from domains other than that of IT development) could only be obtained by conducting a field study involving a single design team over a period of time. A variety of analytical approaches were employed: ethnography was employed to understand the rich context and processes of design from the perspectives of the multiple stakeholders involved, a hermeneutic analysis was employed to understand the social-cognitive processes by which the group of individuals which constituted the design team 'framed' the design, and a

genealogical analysis, drawing upon elements of actor-network theory was performed to analyse interactions between the 'network' of human and non-human actors involved in the design, in an attempt to understand the interplay of interests, both conceptual and political, through which the design was formed.

In the initial case study, discussed in the next chapter, the nature of the research 'problem' was ill-defined: the objective of the study was therefore to investigate the nature of the problem of how to conduct the co-operative design of organisational information systems, involving potential system users and other stakeholders in the design.

5. CONSTRAINTS UPON A USER-CENTRED SYSTEM DESIGN PROCESS

5.1 Introduction

This chapter investigates the design processes involved in a research and development project to investigate the design and use of a computer-based Intensely Supportive Learning Environment (ISLE) for students at a UK University. The target system concept was immensely innovative - no previous system of this kind had been implemented - so the creative design element was high. Students would be able to access sources of teaching material from a central data store, be able to interact over long distances, with each other and with members of staff, by placing a message in a message "mailbox". Students would be able to request help or submit comments on course-related topics, be able to place their own subject-related information in the central data store for access by other students or staff, and have a support-network of other students and staff, even though physically remote from the University. The project deliverables were not clearly specified at the start, as a major part of the project was the exploration of what *form* this type of system would take (which is why a user-centred design approach was selected and why it is of interest as a subject for study in this research).

This study focussed on research questions 1, 2 and 6 for the first iteration of the research model described in Chapter 5:

1. *What are the critical processes of design and can they be related in a process model of design activity, which may be used for the effective management of system development projects?*
2. *What type of design tools might be useful, in supporting design managed by 'traditional' approaches?*
6. *Under what conditions can the use of a user-centred methodology involve users effectively in the processes of design?*

The main interest of this chapter is an analysis of the design process-model which applied to a user-centred design project and the constraints exerted upon the user-centred system design method intended for the project by the activities of design. Newman & Robey (1992) describe a process model of Information System Development (ISD) thus:

"Process models provide the story that explains the degree of association between predictors and outcomes. Thus, ISD is conceived as a sequence of events over time. For example, the factors of user involvement or top management support assume dynamic properties when conceived as processes. They can become ingredients in a realistic political drama pitting analysts versus users or top management against lower levels." (Newman & Robey, 1992, page 250).

A process model is distinguished from a factor model in that the former portrays ISD as a "dynamic social process" where the latter demonstrates a relationship between predictors and outcomes, without explaining how or why the predictors and outcomes are related

(Newman & Robey, 1992). Thus, process models are most appropriate to the examination of ISD issues from an interpretivist perspective (e.g. Walsham, 1993a), where knowledge is seen as a social construction by human actors. Factor models, on the other hand, are more appropriate to a positivist research perspective, which *assumes* a dependency relationship between predictors and outcomes (Newman & Robey, 1992) and attempts to measure the extent of that dependency.

Because of subjects' sensibilities, I have refrained from identifying the University at which this study took place, and from using individuals' names in the descriptions that follow. This is not to imply that I view the problems which this project suffered as arising from individuals' perspectives; on the contrary, the analysis of this design project raises some interesting issues for structural and integrative constraints upon such design.

5.2 The Context Of The User-Centred System Design Project

5.2.1.1 Antecedent Conditions Pertaining To The Study

The Intensely Supportive Learning Environment (ISLE) was intended to form the basis for a ground-breaking approach to computer-supported education.

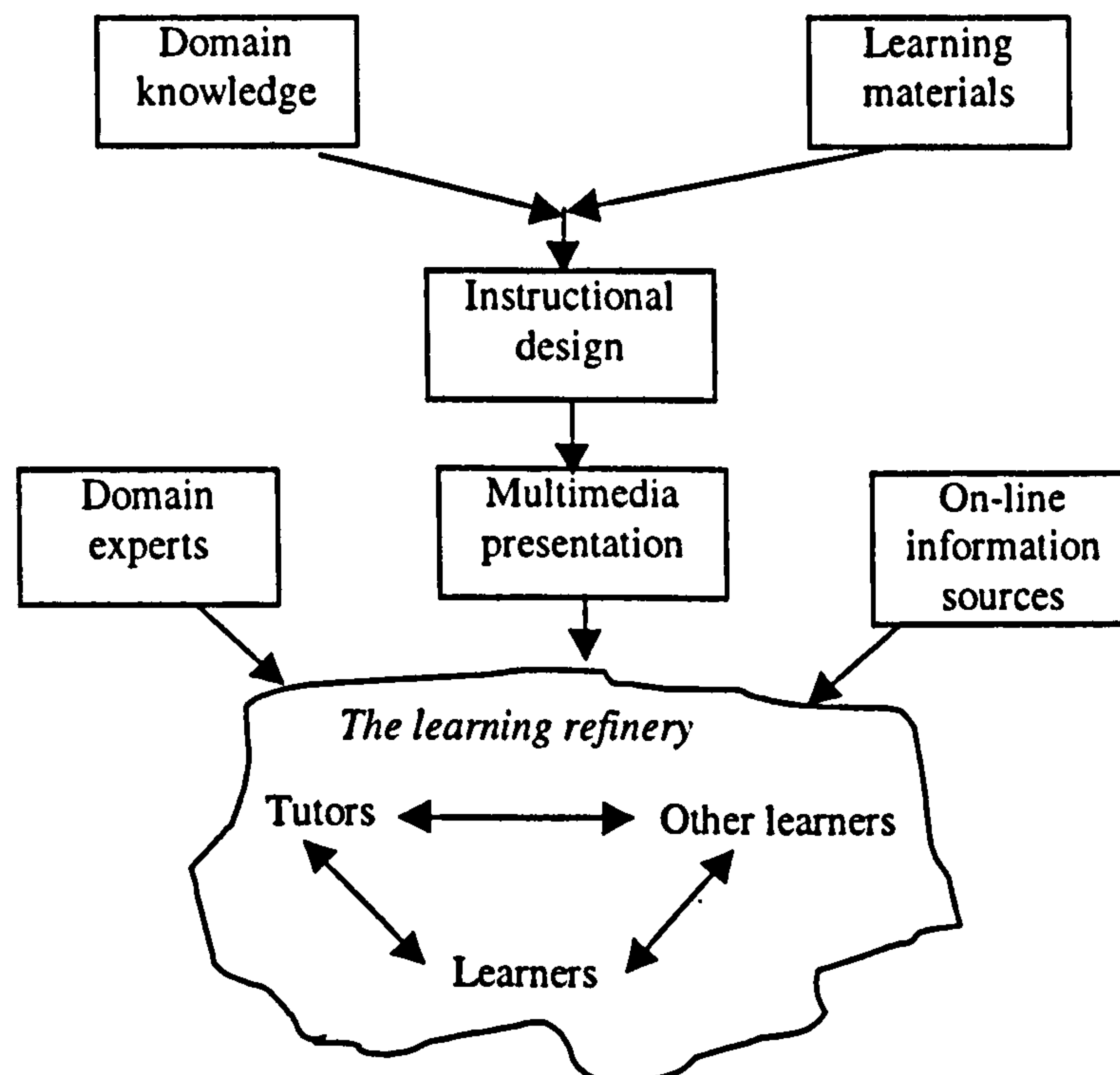


Figure 5-1: The Intensely Supportive Learning Environment (ISLE) Concept

The new information system would:

- provide an environment in which students could explore sources of information relevant to a subject, both internal to and external to the university,
- permit student to interact with tutors and each other to explore relevant topics,
- enable students to learn-by-doing in a particular subject area

- support students in structuring their own knowledge of a subject using relevant information-structuring tools which made this knowledge available to others, both students and tutors, in a communal 'knowledge base'
- permit tutors to monitor and assess student progress and performance.

It was originally intended that the Intensely Supportive Learning Environment (ISLE) research project should have a duration of three years, from January 1992 to December 1994, during which time the form that the information system would take would be explored by a cross-disciplinary team of psychologists (who were termed "evaluators", as their role was to evaluate user requirements of the system concept) and information technology software developers.

5.2.1.2 Group Organization

The constitution of the research project team over time is shown in Figure 5-2. The research design group under investigation was interdisciplinary in nature, comprising researchers with a background in information system development, organizational psychology and marketing.

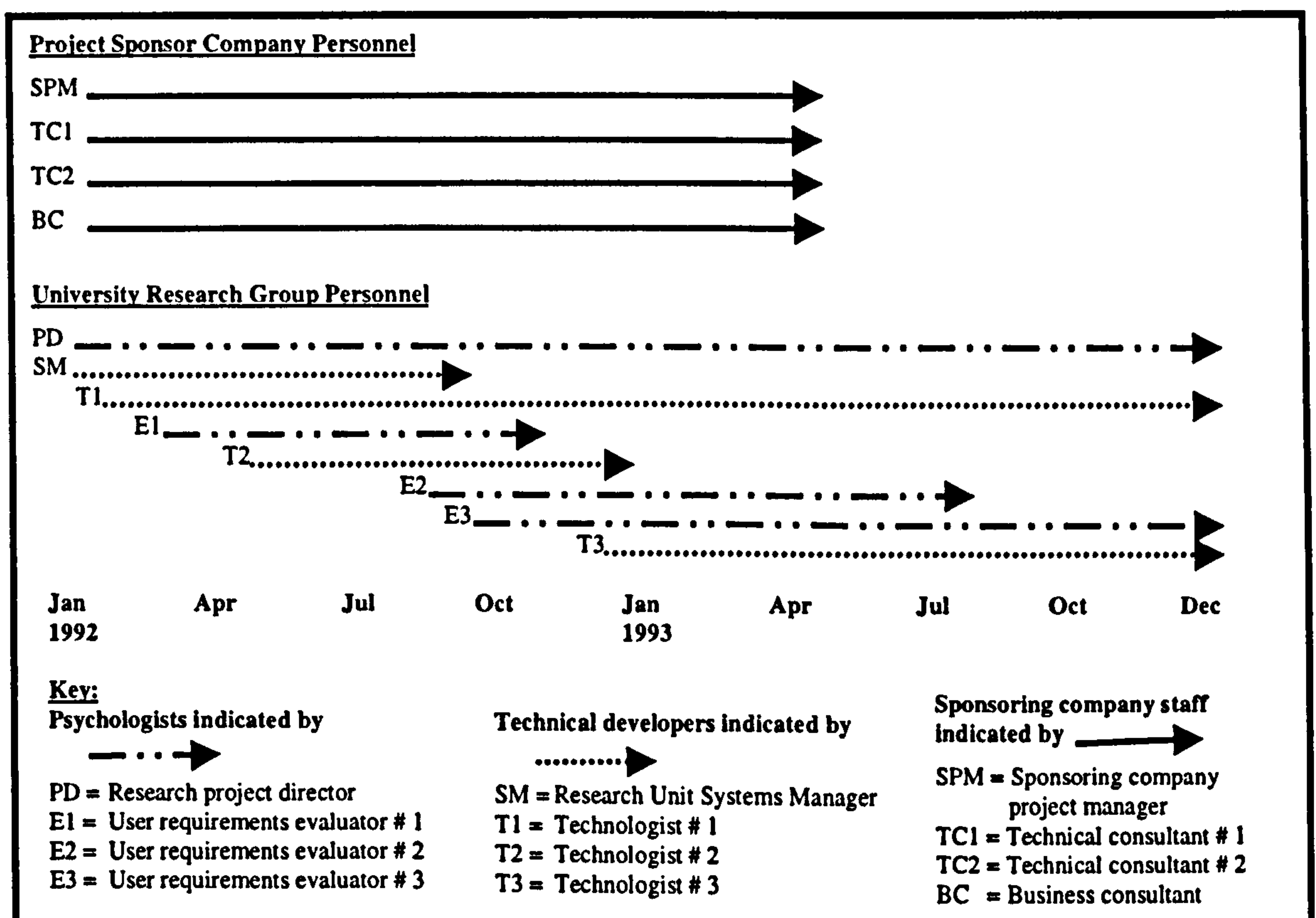


Figure 5-2: Involvement of Main Project Members Over Time

The group was, for most of the project's duration, composed of an equal number (two) of organizational psychologists and of technical system developers. It should be emphasised that the project was intended to be both a research project which was based around the development of a technical system which would demonstrate the ideas embodied in the ISLE concept. The project was not a development project; although some technical

development would be involved, there was expected to be a high element of collaboration between the psychologists on the team and the technical project team members.

5.2.2 The Process Model Of User-Centred Design

The ISLE system development approach was defined by a process model early in the project; this model is given in Figure 5-3.

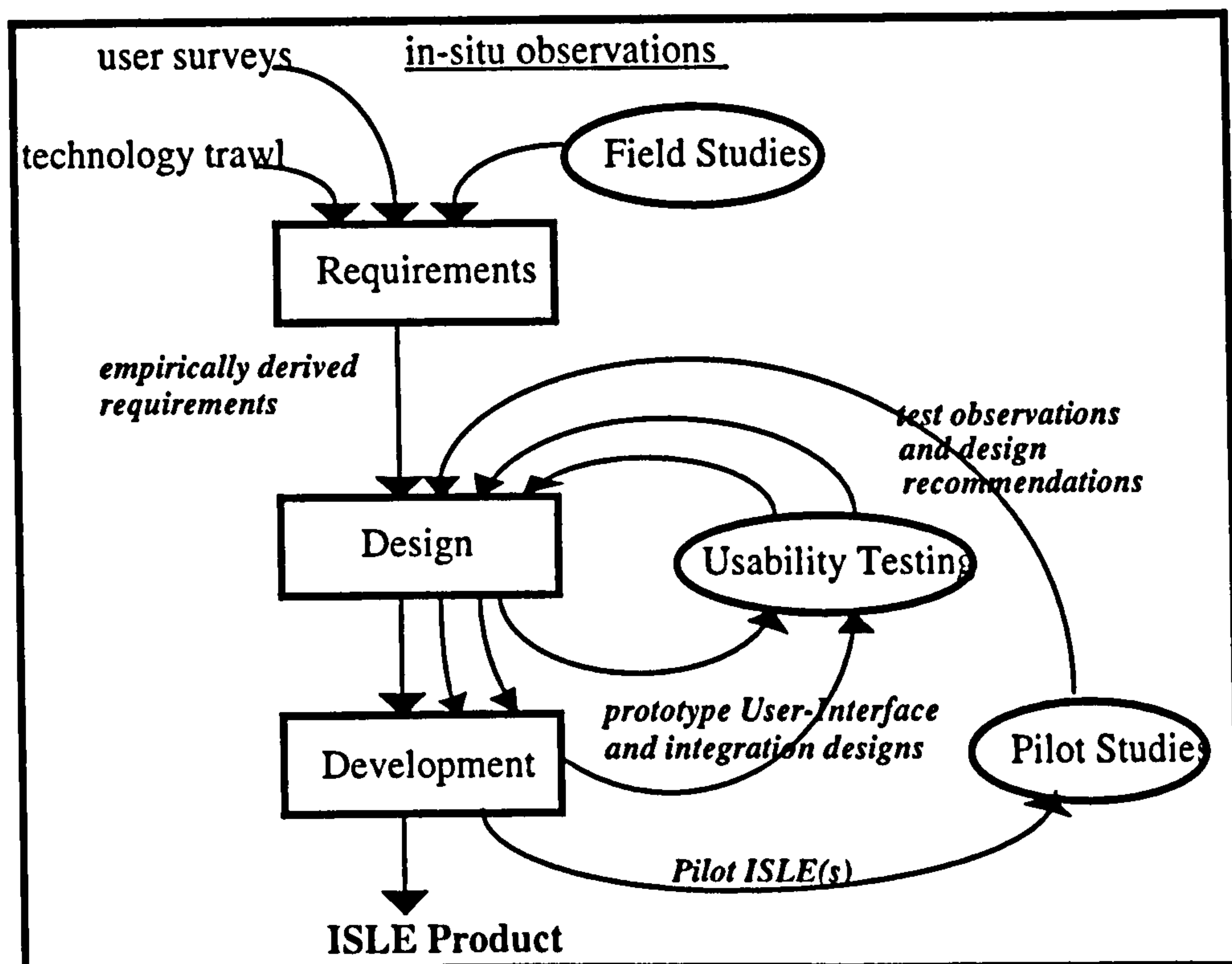


Figure 5-3: The Intended Process Model For The ISLE Development Approach

This process model was derived by the first organisational psychologist on the project team, with some input from the Project Director. It was agreed by the then members of the project team: at this time there were three technologists and two psychologists on the project team (including the research project director). The model shows a very clear intention to drive the process around the needs of the system users, where user requirements and user-evaluation define the nature of the system 'product'.

5.3 Research Method

5.3.1 Execution Of The Case Study

The research investigation started with the premises that user and/or stakeholder involvement is desirable for positive, user-centred outcomes in the design of information systems and that the employment of user-centred development methods can achieve this involvement. The study aimed to investigate a case study of user-centred IS design in detail, to determine to what extent using a user-centred development method supports user-involvement in design and how such involvement is constrained. A contact located at another University told me of an information system research and development project

which was about to be terminated; the project had been intended to use a user-centred design approach, but this appeared to have failed and so the project could not secure additional funding. I approached the project manager and requested permission to interview members of the design team.

A set of semi-structured interviews were carried out with the core design group members of the ISLE project, in December 1993, as the project was terminating. A set of questions were developed for the interviews, based upon the extent of adherence to the published process model (which was obtained beforehand) and upon the literature on user-centred design. It was not possible to interview all of those involved, as some of the external stakeholders were untraceable and one of the technical developers was reported as being alienated from the project to such an extent that he refused to be interviewed. However, the core of the development team were interviewed: the project manager, two organisational psychologists and two technical developers. Design group members were asked to describe the sequence of events during the design process and additional probe-questions were asked on incidents which individual group members perceived to be critical during the process.

Multiple sources of information, taken from both project documents and interviews with the system design team were used to triangulate the collected data, as it was intended that the study converge on an explanation of what had happened during the design project (Yin, 1994). The intention was to understand the series of activities which constituted the design process; how these activities were approached, how they were interpreted by the design team, and what result was achieved. To this end, the critical incident technique (Flanagan, 1957) was used to stimulate common recollections from the design team and the interview questions were left open and were not strictly adhered to, except as a guide to the topics to be covered. A list of interview questions is given in appendix 1.

5.3.2 Limitations Of The Study

There were two limitations of the study which constrain the reliability of its findings: The first limitation was that a technical member of the core design group declined to be interviewed, as he felt that the final stage of the project had become politically charged. This was overcome to some extent by the existence of several research papers by this member of the design team, which were used to determine a paradigmatic basis for that member's design approach, and by the interviewing of a technical support member of staff, who had been closely associated with the project throughout its life and was able to describe in detail the approach taken by the technical designer who declined to be interviewed, but it must undermine the validity of the case study to some extent.

The second limitation was that the interviews were 'post-mortem' interviews, with the problem that events are post-justified by group members and their perspective may represent (a) a consensus sub-group perspective or (b) an individual rationalisation of conflict. It was realised that there would be problems of post-rationalisation (Giddens, 1993; Suchman, 1987), so the critical incident technique (Flanagan, 1957) and data triangulation (Yin, 1994) were used in ascertaining the actual process of design which the team followed. The issues found in the phenomenological analysis were validated to some extent in a further interview with two of the team members (a psychologist and a technical professional), but there must be some post-rationalisation bias in the findings, which weakens the validity of the findings. However, it is considered that they raise sufficient issues of relevance to be worth considering here.

5.3.3 Data Analysis Method

There were two parts to data collection. The first part was an analysis of project documentation, produced by various members of the design team, to interpret the process-models of design and the 'stories' and metaphors which the documents contained. The second was a grounded theory analysis of interviews with the project director and four core members of the design team: two technical developers and two psychologist evaluators.

For the data analysis, commonalities were sought between interview-based accounts of the process, to produce a representative model of the *actual* (as distinct from intended) design process. This model was triangulated between interviews, then validated in a subsequent interview with two of the team members: one of the technical system developers and one of the psychologists. It was observed that this model was very different from that shown as intended in project planning documents.

Reasons for the difference between the two process-models (intended and actual) and an understanding of the constraints which had operated upon the user-centred design process were pursued by an analysis of interview-transcripts and project documents. This analysis used the grounded theory method discussed in Chapter 4. Given my own background in systems design, I was aware of the researcher's potential to subject the analysis to assumption bias: the grounded theory analysis was done as reflectively as possible, with an assessment of what assumptions were being brought to this analysis; these assumptions are listed here.

Assumptions Of Analysis:

1. That user-centred design is a 'good thing' *per se* and that exclusion of users from the process of design constitutes subversion of the process.

2. That the psychologists on the team were acting as proxy users, in the design process. Their role was to represent the user interest, in terms of defining and evaluating the information system from a perspective which would reflect its typical users.
3. That I, as a former computer system designer, had a great deal of sympathy with both the user and the technical interests, which I tried to keep as objective as possible, both during interviews and afterwards, during analysis.

The initial coding process was kept as open as possible. Although I was familiar with the user-centred design literature, the lack of empirical studies of this nature did not provide a preconceived set of themes for this study. These open codes were subject to many revisions and were gradually organised into the categories shown in the model in Figure 5-5, through the process of writing theoretical memos and constant comparison of data. Originally, this analysis used the NUD.IST software coding package, but the hierarchical models produced by this package were felt to be too restrictive for the iterative, contingency relationships which were emerging from the analysis, so a combination of paper and pencil analysis and a hypertext linking software tool were used for the model analysis. The final set of categories or 'themes' (Glaser, 1978) generated from the data is given here:

- Educational and work background
- Defining the scope of the design
- Explicit recording and evaluation of design
- Understanding of technology
- Defining the starting point of the design-cycle
- Conceptualising system functions
- Conceptualising system purpose
- Conceptualising system use
- Defining work roles and 'appropriate' tasks
- Defining design objectives
- Controlling design activities
- Co-ordinating design team activity
- Generating alternative design perspectives
- Communicating explicit design conceptualisations
- Integrating different design perspectives
- Achieving common design objectives
- Achieving a coherent design

It proved possible to follow up some of these themes in interviews with two of the original four core design team members interviewed (one technical developer and one psychologist evaluator). As it was not possible to obtain follow up interviews with all of the original interviewees, these interviews were used for data triangulation and process model validation, rather than for the further exploration of core issues. Because of the problem of obtaining further interviews, it was felt that, at best, this model is partial, but as the result of an exploratory study, it raised some interesting issues to explore in further studies. Glaser & Strauss (1967) emphasise that data collection is driven by the emerging conceptualisations which arise from data analysis, rather than treating each study context as conclusive in itself. Findings from the analysis are discussed in section 5.5.

5.4 Critical Incidents During The Design Process

Figure 5-4 shows the actual process of design, as described in interviews. Five critical incidents which occurred during this period were identified and are discussed below:

- 1: "Agreement" Of Project Plan
- 2: Marginalisation Of Psychologist Evaluator 1
- 3: Delivery And Evaluation Of First System Prototype
- 4: Withdrawal Of Project Sponsor
- 5: Delivery And Evaluation Of Second System Prototype.

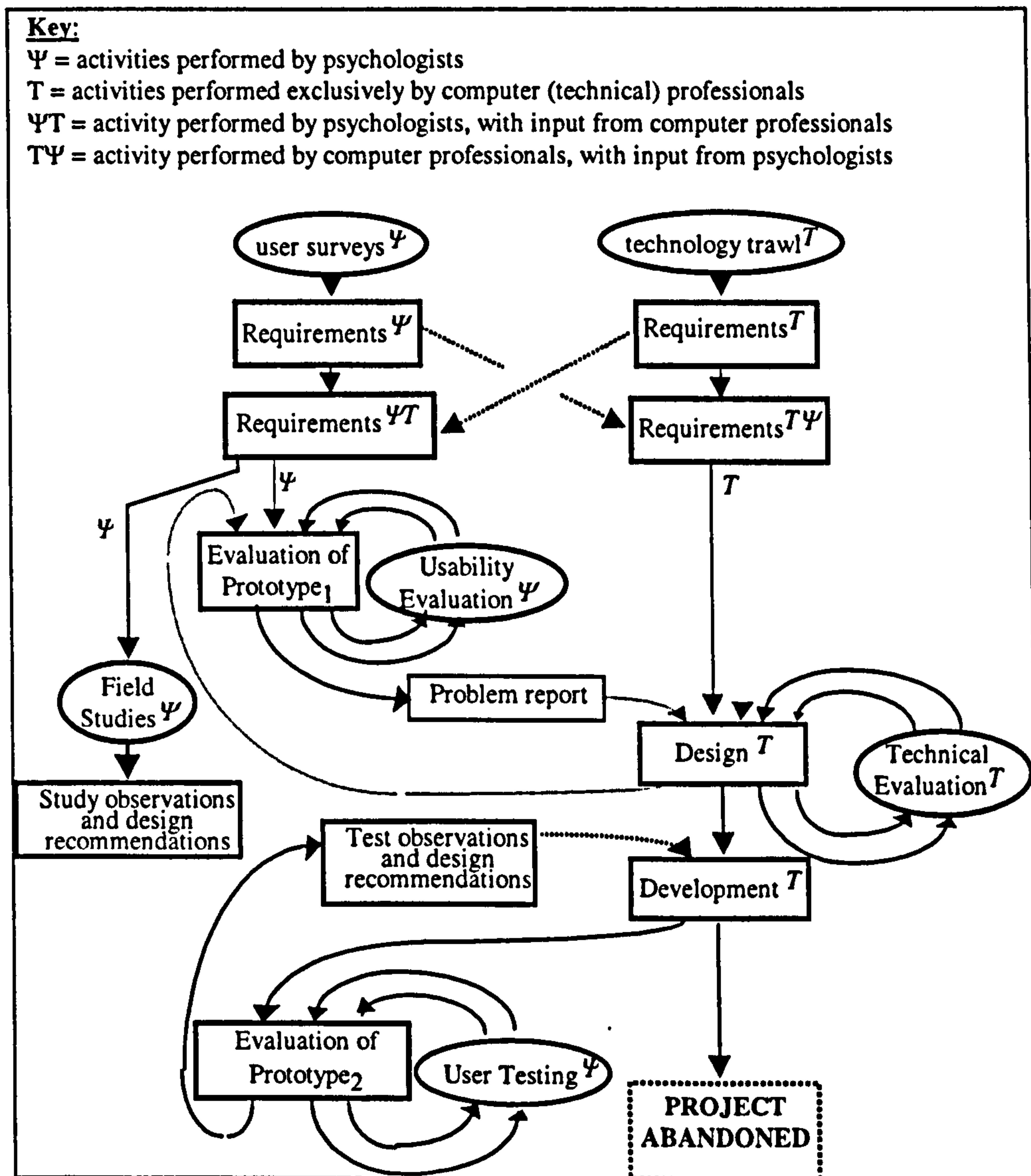


Figure 5-4: The Actual Process Model For The R&D Project

5.4.1 Commencement Of Project

The project commenced formally in January 1992. The project was instituted by the research project director (PD), with help from the research unit computer-systems manager (TC). Recruitment of staff started with the recruitment of a senior technical system developer, in February 1992. This technical developer (T1) was the most senior

member of the design team, in terms of research grade salary-point, which influenced both his own and other team members' perceptions of their relative roles. To quote E3 (who was appointed at a level several points below T1, in November 1992):

As he [technical developer T1] was the first and the most senior member on board, he felt he had a stronger ownership of the project than other people.

Shortly afterwards, in March 1992, the first psychologist-evaluator (E1) was appointed to the team. The first few months of the project were occupied with what all the team members interviewed called 'planning' activities: the determination of appropriate activities for user-centred design. It is clear, from their descriptions of early project activities that the purpose of this planning activity was interpreted differently, by different actors.

5.4.2 Critical Incident 1: "Agreement" Of Project Plan

The initial project plan is dated February 1992; it was produced by the research project director (PD) and the research unit computer-systems manager (TC). This plan gives four main objectives for the first phase of the project, to last until end June 1992:

6. To plan the three-year project in detail
7. To design an evaluation methodology for the introduction of technology-based teaching, with particular emphasis on the impact and usability of the technology
8. To conduct usability studies on the sponsor's existing tools in this application area and to integrate the sponsor's technology with existing university distributed IT systems
9. To initiate a development plan for the ISLE concept.

The involvement of the project sponsor, a multinational IT business systems supplier, required more formal planning and specification of intermediate deliverables than is usual for University research projects; as a consequence of this the next project plan, dated April 1992 was produced by the first organisational psychologist to be recruited to the project (as a user-requirements evaluator), E1. By then there were four people involved in the core project team: the research project director, the research unit systems manager, E1 and the first technical professional, T1. The plan contains little text and no description of project objectives, but consists of a Gantt chart, three decomposed (and highly complicated PERT charts) and a list of (human) resources required. By this time, the innovative nature of the project had attracted a number of stakeholders from other research or teaching groups in the University, who wanted their interests represented in the design. The difficulty of defining design objectives with multiple stakeholder interests can be seen from E1's comments about the process of producing a project plan:

I used a project planning tool to try to represent what appeared to be people's ideas on what the project would be and this was very difficult because there were now about nine people on the project who all wanted different things from it, so you were really going around canvassing their ideas, saying is this what you intend? ... I was basically trying to get people together and put plans forward, say is it right, alter it and put things forward for a deliverable. This did a great deal to make people realise how ridiculously ambitious their ideas were. People were totally head in the clouds. As soon as you try to put this down, my experience is you turn it into tasks and deliverables: you work backwards and say where will we be in 6 months' time and what will be the problems - go through this kind of process - it was very, very difficult. People were quite prepared, as soon as it got difficult, not to do it - people had no commitment to it.

The initial problem with obtaining agreement to project deliverables, then, arose with the lack of formal planning which is part of the University research culture. The concept of agreed deliverables, within a pre-defined timescale, upon which information system development projects rely, appeared to be difficult to obtain agreement upon. While E1, who had a background in IS development projects, was comfortable with the idea of specifying an outline set of requirements and planning for the detailed system requirements to emerge from the design process, most of the other people involved in the project were uncomfortable with committing themselves to a deadline or specifying deliverables for a design outcome when the form of that outcome was uncertain. To quote E1 again:

They'd never produced a project plan - never worked to a project plan - and I don't think they enjoyed the activity or wanted to do the activity ... the process was valuable, because people began to see that there were problems caching these ideas out into tasks - given the resources, we would do it over a particular period of time. They did not know how to read the plan, once we'd produced it. So they weren't used to the process, they weren't used to the formalisms and they didn't have any commitment to the discipline. People were really a bit dubious about that. So there was a project plan produced, but there was very little agreement to it.

The involvement of multiple stakeholders caused problems in defining system objectives.

TC, when asked if the design objectives were clear at this point, commented:

In terms of the ideas behind it: yes. In terms of what the backing was for, it was much less well developed. And indeed, it quickly got quite complicated in that we were looking at development of tools for Unix machines, evaluation of what was going on in terms of the University's investment in computer machinery, and then another University section was interested in offering distance learning over networks ... So there were a lot of interests starting to come together, all under the one thing. And [the project sponsors] themselves were changing direction: they were talking more about having something that could be taken to market - they were then starting to talk about PCs rather than our Unix machines, while the ideas that were really moving forward were the central ones to do with evaluation of the system that's installed here and technology trawls for information background. So that's what was actually moving forward while we were getting increasingly different pressures from [the project sponsors] about what they would like at the end of the day and they were investing a lot of time in business plans and possible commercial exploitation without being too clear of what the product was at that stage.

The picture which emerges is of a design project which has conflicting pressures: on the one hand, commercial pressures from the project sponsors were demanding increasing formalisation of the project objectives, while on the other hand, the need to investigate both the form and nature of the system concept was leading team members to avoid concretisation of their ideas. In response to these pressures, there was a divergence

between the only technical designer on the project at that point, T1 and the only user requirements evaluator, E1, as described by the research project director:

At that point we had two people ... [T1] very much wanted to develop the technology and he made more of the fact that that was his interest at the technology level. [E1], who was very concerned to try and plan the project properly and to pursue a coherent methodology, spent more time than [T1] wanted in the planning discussions and so on.

The technical designer's rejection of the formality imposed upon the design process by a methodology is a familiar theme in the literature, as indicated in chapter 3. From the beginning, the project seems to have had problems with differing expectations with respect to formality in defining information system objectives and the design approach to be taken. There were conflicting pressures between the commercial sponsor's needs from the project, which demanded formalism of objectives, and the innovative technical design needs, which expected technical system objectives to emerge from the process of design. This led to an antagonism between the two core design-team members at that time working on the project:

5.4.3 Critical Incident 2: Marginalisation Of Psychologist Evaluator 1

E1 took over responsibility for project planning and at first attempted to co-operate with T1 in the design activity underlying core system definition, as she conceived the core 'problem' of design to be the need for user requirements to feed into the technical system design. But there appeared to be a conflict in the way that T1 perceived the role of E1. In the words of E1:

I very much started out working as a member of the team. I'd quite happily go in and take the minutes of the meeting, I'd do the filing, I'd do anything which I felt was important for the project. ... Increasingly I saw that [T1] didn't see me as someone he ought to interact with. So I felt very much shut out of his activities. That was very difficult because the whole principle I was operating on, was that this would be highly iterative, interactive, design evaluation. ... He didn't. He appeared to feel threatened by my involvement, appeared not to want me to be involved, and it was very much 'stay away'. ... He did not perceive my role in the same way that I perceived it.

T1 was able to frustrate E1's involvement through his control of the experimental software that they were evaluating for the project sponsor. In the words of E1:

The experimental software, as far as I'm concerned, he wasn't interested in me getting my hands on it. I particularly feel that he set things all up running perfectly on his computer and mine was no go. Nothing worked on mine. If I'd go and say, 'why doesn't this work?', he'd say, 'it's got no path'. Alright, okay. So, 'which path is that?' So I went out and looked at his machine to see which path - and knowing, knowing quite well, quite enough about software, and this was, this was a HP-UX operating system on a DEC station, running X-Windows, which I hadn't used before. As far as I was concerned, I was gonna be using the experimental software as much as [T1]. There was no way I could use it, it wasn't set up. Previously I had been used to doing software demos. I was never asked to do software demos. I wasn't able to do software demos: I couldn't run it on my machine. When [T1] would go out, I'd go and run it on his machine to see how it worked. I mean literally, it was cut off from what I do. He definitely didn't want me involved.

The interesting element here was that T1 was able to define E1's role in the project, through his monopoly on specific technical expertise. E1 had a technical background and

so was competent to evaluate the experimental system and to participate in the process of technical system definition. But T1 was able to exclude E1 from this process by controlling the technical environment, to such an extent that E1's role was reduced to project planning and assessing general user requirements in studies of student-learning which were unrelated to the experimental technology. He could then ignore any system requirements which arose from E1's work as being irrelevant to the technology being tested. In this way, T1 not only marginalised E1's participation in the system design, but redefined the meaning of 'evaluation' - and hence E1's role in the design - in the context of this project. In the words of E1:

I think he saw evaluation - I had an HCI background: the whole philosophy is co-operative design, co-operative evaluation. The whole idea is, highly iterative, going through cycles of trying it out, putting it to other people, going through redesigning it. His model of evaluation, he was quite happy to have it evaluated. He saw it as, he'd build something, he'd give it to me when he'd finished and I'd evaluate it, probably positively, patting him on the head and saying "aren't you clever?"

T1 was able to pursue this strategy because of the lack of explicit design objectives; he may also have been influenced in this course by the pressure to produce something, while having no clear objectives for what he was to produce. In the words of the unit system manager [TC]:

Oh the definition was varying - we were trying to keep a grip on what it was that was wanted, but it was being driven by what happened in a sequence of meetings, rather than being fixed and well-specified. So while it was quite clear that we were getting different effort coming into it, it was not so clear what the final aim should be. In particular, whether it was going to be a direct output from this program or whether it would be based primarily on the evaluations and assessment of things in practice without working so much out a final tool. ... So people kept latching back to "well you've got to do something quite good, whatever it is" and the whatever-it-is tended to vary a bit.

So the issue tended to be one of legitimacy. T1 had to engage in an intensive learning process (which was described within the project as a "technology trawl") yet had also to appear to be delivering usable technology. He resolved the conflict between these two objectives by reducing the visibility of his work - if E1 had been permitted to participate in this work, T1's learning process might have been uncovered. E1 was reduced to obtaining information by stealth:

He [T1] had set himself the task of doing a technology trawl, find out what technology was available. Again, there was nothing written down, so I couldn't even see what he was doing and so, that was a very private activity. ... So what I did was, I drafted plans for the lab testing of the tools and I actually had a dialogue with the sponsor's developers. I produced a template and I got them to fill it in, through to the tools. I didn't know at this time what [T1] was hiding on his desk top. I got them to tell me for each application, who was using it, which version is it, are there any demos, has there been any training, whatever? I got them to answer thirteen questions on each one and that helped me draft a plan for the lab testing for the software.

The antagonism stimulated as a result of the conflict between formal reporting requirements and the need to investigate technological possibilities on the project took the form of a power struggle between E1 and T1. E1 concentrated upon producing a project

plan, which T1 ignored. E1 performed some field studies of other computer-based learning systems and interviewed students about their requirements. T1 produced a rival, technical system specification document which ignored the user requirements identified in the field studies. E1 became frustrated because her input had been disregarded and resigned from the project:

As time went on, I began to realise that three of us on this project - there was a Manager ... who doesn't know anything about software development ... - 'oh! I trust you guys to get on with it' and you know, and this is great because its like [T1] was trusting us to get on with it, because he couldn't get on with it. He let me say that 'oh, well, what I've done today, or what I've done this week is', 'oh yes, yes, oh great, ha, ha, super.' Wouldn't read it, wouldn't do it. ... I could see that there was no way that I was going to be allowed to input to the design of the - I mean the input wasn't gonna be received, so I split. Needless to say, the design was completely an idea from the developer. Now, had it gone through this [requirements analysis], it would have been fine, it would have been well within the model. I mean, it didn't have to go from here to here [technology trawl to design].

The above explanation is obviously not the whole of a very complicated story (which it would be difficult to obtain except by observation). There were other factors, including a reported personality clash between E1 and T1, as they both had very clear ideas of whether the project should be led by user requirements or technical requirements. In the words of the project director:

I was criticised at one point, I'm not saying who said what to who, but I was criticised at one point for having - what was the term? - I'd inhibited [T1]'s inclination to get on and start building stuff and doing things by being too concerned to try and plan and produce a project plan and try and pursue an HCI user-centred philosophy sort of approach that [E1] - I mean she'd been trained in that sort of approach. She and I were agreed that that was the sort of approach we should pursue.

But whatever the other contributory factors in E1's marginalisation and resignation, the mechanism by which this was achieved is interesting. By controlling access to the experimental technology and by refusing to communicate his ideas or findings with respect to the technical system requirements until he published a formal technical specification document, T1 was able to define the system, conceptually, with no interference from E1. The very act of publishing a formal system specification legitimised T1's system definition and marginalised E1's definition of the user requirements for the system, as the technical system had by now been defined.

5.4.4 Critical Incident 3: Delivery And Evaluation Of First System Prototype

At about the time of E1's departure, three new team members were recruited. A second technical developer, T2, had been involved peripherally with the project for a short while, on behalf of the project sponsor; he left shortly after E1. Two psychologists, E2 and E3 were recruited as system evaluators and an additional technical developer was recruited shortly afterwards.

It is interesting that the definition of the term 'evaluator' had changed by the time E2 and E3 joined the project. At the start of the project, the role of the evaluator had been defined, in the words of the unit system manager, as:

What they were evaluating was not so much this tool that I'm describing here, because that was always going to come along later, but the ideas behind ISLE that were quite well-expressed: that users should have access to tools, that they should have access to communication, that there should be a means of presenting information in the system. Those were all quite well-expressed and have remained clear throughout. So those ideas could be investigated through using other bits of teaching development - in particular our own teaching.

However, when asked about the evaluator role, E3 responded:

I'd say that evaluation is an ongoing process of looking at a product against both your idea of its requirements and the feedback that you have from the people using the product and then iteratively changing the product.

The concept of the user-centred design-cycle had changed between the start of the project and the time when E3 joined the project, so that the design-cycle had been 'rotated' (see Figure 3-6, in chapter 3), from the user-centred life-cycle model:

user-requirements definition → technical system requirements definition → construct technical system → evaluate technical system → (iteration to next cycle),

to the 'traditional' life-cycle model:

technical system requirements definition → construct technical system → evaluate technical system.

When pressed whether his interpretation of the evaluator role was shared by other team members, E3 responded:

Yes that's what I was taken on to do, at the recruitment interview.

The emphasis of the design had therefore shifted by the time the two new psychologists were recruited to the project, from a primarily user-centred emphasis, to a primarily technology-centred emphasis. However, E2, the second psychologist recruited to the team, was not prepared to be marginalised from the design and responded with personal antagonism to T1; this resulted in increasing formality of communications between the two sets of designers (psychologists and technical developers). In the words of E3:

Well, what seems to happen was that there would be E-mail exchanged between the two of them, where one of them would make a suggestion, and the other one, instead of discussing it, would fly off the handle and become enraged in a sort of polite way about the suggestions made ... it was in both directions.

Team members were corresponding by email, when the offices were only 25 yards apart.

When asked whether there were informal discussions about the design, E3 responded:

Yes, people did pop in and out sometimes. ...it could happen once or twice a week, or not for several weeks.

The hostility appeared to arise from an attitude, on the part of the technical developers, that only someone with technical skills was performing valid work and had a right to participate in defining system design requirements. To quote T3:

[E2], at the back of her thesis, has actually got a Pascal program, which amazed me when I saw it. [E3] obviously, has been doing programming. They do have technical skills, its just that they -- certainly [E2] chose to hide them. I mean, I didn't know she'd done a program. It was only by chance that I was flicking through her thesis and saw it at the back. She hid that very well. I always thought she was just a Psychologist - a "flower arranger" - they seemed to get money from doing stupid things.

The use of the pejorative term "flower arranger" was reported in several of the informal communications which I had with the team members - it was even used to someone's face in my presence. User-requirements investigation was seen as peripheral to the core problem of design, by the technical developers. T3 described the process of user-centred design as follows:

Well, I thought, from the original plans, that [E2] and [E3] would be interviewing potential users of an ISLE, asking them what they would want from such a thing, but what worried me was that it was all going to be hand-waving, because there was nothing for them to use. So any ideas that they came up with, I felt, would either be obvious ones or wouldn't really be of any use because there's nothing technical to back them up. But I saw that they were supposed to come up with some requirements and then [T1] and myself would start looking at these requirements and build a prototype. Then the prototype would be evaluated and then out of that evaluation more requirements would come for a future prototype and then that would be designed. And hence we'd get this design cycle. Now it sounds like a nice idea - I think we planned to start it at the wrong point, personally, in that it starts with trying to talk to users and come up with requirements, whereas we actually, in the end, started with a prototype, which I felt was being more valued anyway.

From this point on, the technical developers adopted a strategy of performing what they saw as the 'core' design independently of the psychologists and managed to define the psychologists' roles and activities in such a way that the psychologists had no direct participation in defining the target system, in any way. The psychologists were directed to tasks which removed them from direct contact with the technical developers, an avoidance in which they colluded, as can be seen from E3's comments:

The designers had rather more drive in that they could define the way the project seemed to be going rather more than the evaluators could.

[Interviewer]: And you were

... trailing along behind them.

[Interviewer]: Who drove project objectives?

The manager of the project tended to have the final word on the direction of these things, but again they often tended to be focused on technical issues, but I think that to some extent he was managing defensively, in that he was managing a project of which he did not have a great technical understanding and I think he felt that the easiest way to keep the project running would be to lean slightly towards the technical side because that's where the senior members of the team were.

[Interviewer]: So do you feel that your whole role, the definition of what you did as an evaluator, was really driven by what the technical people wanted to do?

Yes. It wouldn't be unfair to say that for most of the time the technical people just wanted us out of the way, so that they could get on with developing the product.

[Interviewer]: So do you think that they created things for you to do, to get you out of the way?

Well yes, but we sort of colluded with that as well, because there was this slight tension between the two sides, it was sometimes easier to just be doing something else. So both [E2] and I were doing other case studies which did not directly involve the two designers.

The project director attempted, at this point, to exert some control over the direction of the project by insisting that the two technical developers produce a prototype system for

evaluation, in time for evaluation in the context of a Spring Term MSc. course. T3's comment on the technical developers' reaction to this management action is revealing:

Now that prototype was ISLE - 1. But we were pushed into that ... basically, [T1] built a hierarchical structuring tool, using some of [the project sponsor]'s tools, and you had some communication facilities in there ... But, because the number of students was less than 20, this tool was never really used because there was never anybody - never a critical mass on there.

[Interviewer]: Presumably, only one person, or two, would be logged on at once?

Yes and mostly because they were all in the same class, they could talk to each other privately. That meant that they didn't need to use this computer-tool. But that was one of the important thing about ISLE that we wanted to experiment with: communications. One-to-one, one-to-many, many-to-many. ... But unfortunately, because [T1] didn't have much time to do all this, it was incredibly naff and broken and many of the students were very disillusioned with this. Now, I think, [E2] after that, was doing a report on it. But she never actually came up with any requirements as far as I could see. ... I think we just generally ignored any requirements that came out [from the psychologists], because we had much better ideas that we felt were ready to go: what we wanted to do for the first 'real' prototype. Obviously our minus one [Prototype₁] was produced - but we generally just disregarded it.

The prototype appears to have been produced to achieve two objectives: to test an experimental technical concept: the use of interactive, networked communications with a 'critical mass' of students and as a way of satisfying pressures from the evaluators without involving them in design input, as the first prototype was never intended, by the technical developers as an evolutionary basis for the design (this could be seen from the way in which the technical people spoke of this prototype and from the name: ISLE -1). The latter objective may have been emergent, but it certainly seems that the technical developers were not interested in user-perceptions of the system at all and did not see the first prototype as aimed at user-requirements elicitation, even though this was the objective which they were given, by the project director, in producing the prototype. The technical system manager commented that the use of the system was given a fairly low priority, by the technical developers:

Those ideas could be investigated through using other bits of teaching development - in particular our own teaching, where a prototype, I suppose, of the ISLE system was called "ISLE - 1", which was based on a file-view system, re engineered by [T1], but very quickly, to replace all of the object-store presentation by just viewing the contents of files, but with communications added to it.

[Interviewer]: How representative would you say that this "ISLE - 1" [the initial prototype] was, of your system here?

I think, in terms of explaining the concepts, it's quite representative. In terms of what it should look like, it's not at all. It doesn't really have any sophisticated interface to it whatsoever. It is a file-browser.

[Interviewer]: What did you mean by "investigating the concepts"?

Giving the students access to the range of tools that the final ISLE gives, so that they could get bits of data and they could communicate with each other and they could show multimedia things within some sort of environment. ... So the evaluation work here is to do with seeing how users are appreciating what they're using and what they would like and whether they find it helpful, not an evaluation in terms of appearance or HCI-type evaluation, which comes into the development side and was starting to appear only towards the end of this.

[Interviewer]: So why do you think these [evaluation] reports weren't being fed back into this part of it [technical design]?

Well, partly because the evaluation work was seen as an end in itself: part of what this project had been set up to do was to produce an evaluation of this idea and of what was going on. Whether it produced a tool or not, that was always part of its aim. So it was part of the design that it didn't have to fit in with the development work - that is a positive way of looking at it - on the other side though, as with any development work when it comes down to a couple of people working in an office, they have the pressures of actually trying to get things to work taking over from any idea and they also had quite strong ideas that fed into the requirements of it from the technology side: there had been this technology trawl, looking at what was possible and I think that once it got such fundamental ideas from the technology side - things like attributing the object store and separating out presentation from structure - that took up quite a lot of effort, working on the fundamentals of it, which didn't really need any further input from the evaluation team, because this was an underlying technology that the sort of evaluation work that was going on couldn't really say whether you are better off separating presentation from structure because that was a design decision to do with how the data was available. ... the user-interface work was quite delayed in this ... I think it was undervalued. I think it was a mistake to not worry too much about the presentation. There was an answer there, to say we're using [the sponsor]'s presentation tools, but even then, the whole things needed binding together. It is correct to draw something over all of these (*indicates underlying technical components in a diagram of the technical system design*): these aren't completely independent - they have to communicate, even if the communication happens by going back down to the object store, there is some level of communication. So, I haven't really got a good answer as to why it was so delayed, but I think it should have been [given priority] and I think it was quite possible to work on prototypes so that when they actually came down to it (*trails off*).

It can be seen from the above comment that, not only were user issues undervalued by the technical developers, but that the integrated design and development processes intended by the user-centred approach to design (Figure 5-3) had, by this time, become split into two, separate process-loops, controlled by the two, separate halves of the project-team in the actual process-model (Figure 5-4). In response to the combined efforts of the project director and the psychologists to exert structural power by defining tasks in a project plan, with imposed deliverables and deadlines, the IS professionals gained control over the process and *redefined the nature of the process* by using structural dependencies between the tasks. The technical nature of the production of prototypes for evaluation gave the IS professionals the ability to exert technical power, as the psychologists did not have the technical expertise to produce or to influence the technical design of these prototypes. Although there was a concerted effort, on the part of the psychologists, to participate in the design of the initial prototype (Prototype₁ in Figure 5-4), this appears to have been thwarted by their dependence upon the IS professionals to configure the technology. To quote the unit systems manager again:

So the evaluation work here is to do with seeing how users are appreciating what they're using and what they would like and whether they find it helpful, not an evaluation in terms of appearance or HCI-type evaluation, which comes into the development side and was starting to appear only towards the end of this. ... There was a lot of contact [between technical developers and psychologist evaluators] in terms of using the ISLE-1 that came from the technical strand and was used as a case study. But other case studies weren't coming from the project at all. They were being identified outside and the work was being carried out and reports being produced. They weren't really feeding back into the technical work so that was being driven ... by other events [e.g. the "technology trawl"].

There appears to have been an implicit agreement between the two IS professionals working on this stage of the project that the first prototype was not intended to be

incorporated into the target design, but was produced as a diversionary tactic, to occupy the psychologists while the IS professionals proceeded with the 'real' design. This was partly a negative reaction, on the part of the IS professionals to what were perceived as unrealistic deadlines for the initial prototype (which had been set by the project director and the psychologists, in an attempt to regain control over the project). The psychologists knew that they were being diverted in an attempt to keep them busy, but could do little except to go along with this diversion. To quote E3:

We had actually evaluated it and I'd done case studies on it, but it didn't have sufficient functionality as a support toolkit - it was a nice interface, but you needed to plug other things into it and the developers had already begun developing other things based on a different technology.... their thinking -- and they did say this explicitly -- was that the way you do it is that you build two prototypes and you throw one away.

When asked explicitly why the design and lessons learned from the first prototype were not used for the second prototype, the response from T3 was:

Well the cycle broke down because it was such a naff prototype. I think we just generally ignored any requirements that came out [from the psychologists], because we had much better ideas that we felt were ready to go: what we wanted to do for the first 'real' prototype. Obviously our minus one [Prototype₁] was produced - but we generally just disregarded it.

5.4.5 Critical Incident 4: Withdrawal Of Project Sponsor

The project sponsors, a major computer equipment manufacturer, decided to cease their involvement in the computer-support of academic and training systems and ceased funding the project in April of its second year. As they had funded the project in advance, the project actually ran for two years, instead of the intended three years; this meant that the project objectives had to be re-planned, early in 1993, with the intention of redefining deliverables. This re-planning of project deliverables occurred soon after the delivery of the first prototype.

The role of the project sponsor had always been disruptive to the design process, because of the commercial pressures which they exerted and the changing nature of their expectations. Initially, the project sponsor had intended that some experimental software, which was being developed in an association with a German university, would form the basis for the ISLE concept and that the research site's involvement would lie mainly in designing a user-interface for that software and in the configuration and evaluation of the learning system concept in use, with real students studying a real course. However, the relationship between the project sponsor and the German university appears to have broken down late in 1992 - possibly because the experimental software did not meet the sponsoring company's expectations - and the pressure on the UK research site to produce additional software became significant. To quote the project director:

At any one moment, if you'd asked me what did I think [the project sponsor]'s objectives were, I would have had an answer - the problem was they were not stable and they kept shifting as we learned more about them - it's quite complicated actually. For quite a while, it became talked about as the ISLE product and [the sponsor's representative] talked about - we've got to take this to market in twelve months and of course that made us feel very uneasy (laughs nervously), as you can imagine. So what had started out as primarily a testbed for stable, or at least, state-of-the-art technology, then after a few months was being talked about as though we were creating the technology and they were going to actually take it, they were going to test it in the market, rather than ... So, this was very disruptive to planning.

Pressures to produce were highest on the two technical developers, but they managed these pressures by concentrating upon their own, technical design objectives to the exclusion of shared, project objectives. To quote E3:

This was always gonna be a very long-term project because it was incredibly ambitious. ISLE, (as it was thought of), was really gonna be a fundamental change in education and even, I mean, the ISLE project was only meant to go three years. But I think, even three years wouldn't have really cracked the problem, at least produce something that you could actually put into a University or schools. While DEC were wondering whether we were gonna pull out as such, the DEC guy kept changing the direction, or focus, of what we were trying to do. Towards sort of, January/February time, he was talking about, 'we need to get something produced and out, so that we can sell it, to make some money, to help fund ourselves'. Now that was quite a radical departure from what we initially were working on - research, prototypes. ... [T1] and I didn't really take it too seriously. So we just kind of ignored changes of direction, because, after all, the direction we were heading could have been the product anyway. ...

This response appears quite rational in the face of continually changing objectives and stakeholders. To quote the unit systems manager:

People obviously wanted this project to be success and yet there were several setbacks in what had happened to it. Not just the big ones in that the project was cut off a year early, but the changing of the direction by [the sponsor] - because [the experimental software] of course wasn't in the original plan, but that was brought in and then taken out again, so that was a change in what people were going to do. The involvement of others around the university was another one that came in and then went out, because the Computer Science involvement was never carried through: they didn't build part of this system; and the EVAN project was not built into it in the end either. ... So - this was to do with where pressure comes from - there was a feeling that things had gone wrong and so people wanted what they were doing to show that things were still going ahead and that there was output.

The pressure to achieve something, then was high - this led to the technical designers cutting themselves off from the evaluators even more. When asked how he would prevent this type of problem now, the project director responded:

I think we could have established a [user-centred] methodology right from the very start and said this is what the of project is - it's going to be this structured methodology - and tell people that when they're being interviewed for the job, so we set the expectations straight from the start, then yes. I think that would have helped enormously, particularly if we had then maintained it through all the changing forces on us from Digital. The problem was that we never really agreed what our methodology was: we devised it, but people didn't take it that seriously - or not everyone took it that seriously - and that's usually the way that university research proceeds. There isn't that kind of culture.

5.4.6 Critical Incident 5: Delivery And Evaluation Of Second System Prototype.

The design and delivery of the second system prototype appears to have been totally driven by the technical developers, who by now were defining their design objectives with no reference to other project members. To quote E3:

Well, once [the project sponsor] pulled out, it then became [the project director's] project ... I mean, he kept changing his mind as to the intended target and what needed to go into it. One of the issues was, whether we should actually populate the database and the ISLE system, with courseware, before putting it to students and that was where one of the....(stops mid-sentence). Well, [T1] and myself felt that we needed to actually have something in there, but [the project director] resisted this, because it would involve time and effort on some lecturers part, which obviously, they hadn't got the time and then, anyway, he was more interested in the structures that students and users would build, as opposed to what the lecturer would build. Its probably a good thing anyway, because the ISLE prototype - it would have required quite a bit more work to support different users at the same time, working on the same bits of information. I sort of finessed a lot of that.

[Interviewer]: So did it occur to you and [T1] to try and get out a part-working prototype, something along the way for people to start playing with? Or was your aim, to actually try and 'crack' a prototype before you released it?

Erm, well, we were both quite shy of handing out whatever we were doing. But [T1] made this stuff available, once we'd got the database in place, plus, (see, nothing would work without the database), so we needed the database in place and that took a fair amount of time. Then [T1] got a notebook up and going.

The lack of visibility of the technical design processes is a recurring theme in this discussion. By refusing to interact with other team functions, the technical designers could determine the scope of the design unimpeded: when faced with time pressures, they reacted by reducing interaction, as is shown in this comment from T3 about the changes in project objectives:

I thought it was completely impractical. But it would have been 'punch drunk'? if we'd really gone for it. There was never enough....(stops mid-sentence). To have really gone for it, we would have had to have dropped the psychologists report and whatever, I think.

The unit system manager, ascribed the problems to a lack of well-defined technical objectives, which would have defined the scope of the project:

My version of our initial objectives would have had us delivering material more - using our own development - to the University. My ideal would have been more - that of someone watching it from the outside - out of this would have come something that was University developed and was able to deliver material written by people within the University - University students. So I don't think we have got quite that - instead we have just got it clearer what the ideas are behind that and a tool which goes some way towards doing that, but being realistic, which is unlikely ever to go forward as a University product. ... we played down the technology side and promoted the evaluation side - where it was clearer what we could do - but left it vague that we could do something quite good on the technical side.

It would appear that team-members from neither discipline fully understood the requirements of the other discipline and both sub-groups attempted to resolve this conflict by prioritising their own requirements. The need for IS professionals and users to learn from each other during system design and development is a common thread in information systems literature: Eason (1982) highlights the time-lag between developer understanding of technical potential and user understanding, while Curtis et. al. (1988) discuss the critical role of the 'expert designer' - who has prior experience of a particular application-domain - in educating other, technical team-members. However, this team lacked the integrative mechanisms which were necessary for such learning to take place with high levels of interdependency between their tasks. They coped with this by separating their

own design work from that of others, to ensure that it became a manageable, separate task. To quote the project director:

The problem with iterative design, it now seems to me is that you can't ever wait for the stages to proceed one after another, you know: test - you wait until you've finished your testing and then you do your redesign. You can't have your technical people sitting round for a month while you do the empirical testing. So they get on with what they think should be the redesign anyway, and so, you know... When you've got a team of four people, it's difficult to keep that a sequence.

Given that they were now defining the intended system scope independently of each other, both disciplines attempted to *control* the development process: the psychologists by agreeing project task-structures and deadlines with the project-sponsor, the IS professionals by using the problematic nature of the unproven technology to separate the technical development processes from learning-evaluation. But this was a natural response to the extent of complexity and uncertainty which underlay the design 'problem'. To quote the project director:

I was aware that there was quite a long learning curve on this. I think the prototype that we've actually finished with is one we can all subscribe to, funnily enough. The technical people, it seems to me, have come round to my way of thinking about what should be in this, although this had to get their own get there in their own way. ... Well, (pauses), I think my own view would be that there is a long learning curve to actually get a feel for this area -- and as I say this, I can hear that the others wouldn't agree with this and they would think this is a bit arrogant -- but I think that I underestimated how much learning the people I would employ on this - who came from related backgrounds, but not from quite from the sort of learning technology area - how much learning they would have to do to understand what I was, by then, taking for granted. Because I'd been in the field for a long time and I think I'd never really understood that, I'd never understood that they would hear what I was saying that they wouldn't quite connects with it as they didn't have really the background. And I think there is a long learning curve and one year contracts are not long enough and I think if you talk to [E3] and [E2], they would say that they were just beginning to get a real feel for this, the whole problem, the whole area, by the time their first year was coming to an end. If you've only got people for a short time ...

An interesting side-effect of the technical developers' isolation was the way in which they were able to manage other team members' expectations of what they could produce, while setting their own agenda for the design. E3 commented that:

The prototypes that were produced were not really up to scratch -- partly this was due to the fact that they were done on a very short timescale and partly, to only have two people developing a complex prototype was really too ambitious.

[Interviewer]: So you feel that the technical side of the project was really under-resourced?
Yes.

To quote the project director:

Everything took incredibly longer than I had imagined it would, (indicates the process diagram) - these cycles. Even with the amount of money and the number of people we had, which for us was quite large, we still didn't have the resources to do this properly. We certainly didn't have the time. ... The timescales and the resources that you need to do the work - I never realised how much greater than I ever thought at the beginning - and also the need to take your technical people along with you is of crucial importance.

However, according to T3:

The reason for that [that the prototype took ten months to produce], to be blunt, ... is because, of all the problems this ISLE project had in respect of funding and so on. Personally, I lost a lot of interest in it. Obviously I can't speak for [T1], but I believe [T1], he wasn't that interested either. Because what we've done, if we'd been motivated properly, we could have done it in three or four months easily.

A second prototype was eventually produced, which was intended to form the basis for an evolutionary ISLE system. E3 commented on the difference between this prototype and the ISLE -1 prototype:

I think it was what we were trying to do with the system, because the original prototype had been little more than a file browser, but with different kinds of objects attached to the file nodes, so you might have a node which was a text file, you might have a node which was a piece of video. In the second prototype, you actually had distinct sense of tools which were sort of integrated, in that you could do drag and drop operations between them, so it was a different set of tools, but they were still designed to be support tools.

But the technical developers were affected radically by changes in project objectives and responded by cutting themselves off from the rest of the project and concentrating on experimenting with technology to define their own system objectives, independently of the rest of the project team. To quote T3 again:

So, he [the project director] first of all wanted a prototype that could be shown to people and then he got much more het-up about actually having a report on the various bits, and he wasn't at all fussed about us finishing this prototype (and this was while [T1] was away on holiday). Then [T1] came back and I told him this and he sort of said, 'oh, we don't want to do nothing - that's a boring plan - lets just carry it on. Then [the project director] changed his mind around again, and said, 'right, yes, we must have a prototype'. And, and, he then started pushing for, actually testing it on some users, doing an evaluation and sort of, 'closing this loop', producing some requirements from that. And suddenly, [E3] was landed with all this work to do, in sort of, the last two months of his employment here. [T1] and myself were tasked with actually getting a prototype that novice users could use and then [T1] went on holiday again and left me to it, (left me and [E3] to it) and the two of us managed to get enough of a working system that interested six or seven people. Then, this was in the last week and we sort of managed somehow to write lots of crap. It's unbelievable - we're very good at writing crap (interviewee laughing). I think that's what makes us Psychologists - you know - you've got to be able to dribble onto the screen.

The technical developers obviously saw the formal ways in which the psychologists had been trained to communicate user requirements as valueless. They did not see the requirements documents produced as a result of the user evaluation studies which were being performed as being relevant to their work at all, as they were not couched in terms of *technical* system requirements. When asked whether they had received any input on user-requirements, T3 commented:

Not on what was required. No, no. ... Well, we had decided ... and anyway, what we did was pretty much based on what's already out there, but just bringing it into one big system. I mean there are already notebook systems out there. There are already, mind mapping tools out there, news readers, etc. and all this stuff is out there. But, they're all in separate packages.

But the exclusion of the psychologists from defining user requirements meant that the second prototype was still unusable. E3 commented:

In the second prototype we had had quite a number of discussions to talk about the functions which would be desirable in such a system but we didn't have any direct input into the physical design of the system until the second prototype had been produced. ... there were lots of peculiarities about the interface which largely sprang from the fact that the X-windows interface is slightly non-standard, especially for people used to the normal Microsoft windows interface so there were issues like the use of control keys, the fact that there was little or no help provided by the system, some of the operations to perform specific tasks like creating links on the concept mapping tool were far too complex and it was never apparent how you should do them -- if you didn't know how to do these operations you would have to look it up, there was no way you could happen upon it by accident.

Towards the end of the project, the feeling of shared adversity may have brought the two sides closer together. The situation was also helped by the departure of the second psychologist, as the remaining psychologist was perceived as being much more technical (and therefore valued by the technical designers). The project director had this to say about the perspectives of the technical developers:

I was aware that there was quite a long learning curve on this. I think the prototype that we've actually finished with is one we can all subscribe to, funnily enough. The technical people, it seems to me, have come round to my way of thinking about what should be in this, although this had to get their own get there in their own way.

Individuals' descriptions of the constraints of iterative, user-centred design appear to centre on the need to manage problem definition and to define agreed design objectives. It is interesting to compare the five 'recipes for success' obtained from the interviews:

[From the project director]:

I think user-centred design works if you've got a -- if you can conceptualise at the start of the thing -- if you can constrain the problem sufficiently that you can see, you can go through a couple of iterations... Let's say we were going to design a drawing tool. By saying that, you've already encapsulated the problem in a way that - we were nine months into this project before we really had a clue ... So a lot of this - even user requirements analysis, you can't... We went through what I think is a necessary phase of defining the problem and taking off a chunk of it that we could tackle.

[From the unit system manager]:

We did do out quite a lot of the requirements in the ideas in the beginning but they weren't expressed in any formal sense and we weren't working to it, which was the big mistake. I would have still put the first thing to do would be to take the concepts and investigate - allow a bit of freedom to investigate - and of course you have new staff coming in, it's no good to say here are the concepts, turn them into something and build it, you need to allow some freedom and experiment. A lot of University software needs to be viewed as experimental. Then you need to pause and get the requirements written down and agreed with somebody - the somebody who is paying the money - and then get back on track with development and where evaluation fits into all of this is (I've been convinced by the project director) is that it fits in along here [the definition of user requirements of the system] - that there's a HCI evaluation rather than case study evaluation: it gets involved in a looping process around here: so even before it is released it should be involved in a formal examination - something that at least is formal enough so it's not taken personally and also perhaps has some documenting of the process going on alongside it, because even when you're developing things that you aren't planning - pure prototypes - there is a lot of experimentation which needs to be recognised because you need to look at why you're doing things and this needs to lead to a report which stands separately from any software and then have some sort of software out of the end of this.

[From evaluator 1]:

Needless to say, the design was completely an idea from the developer. Now, had it gone through this [requirements analysis], it would have been fine, it would have been well within the model. I mean, it didn't have to go from here to here [technology trawl to design]. ... understanding this activity [user requirements evaluation] gave you an understanding knowledge, information, call it what you want, that helped you understand what these [system design requirements] were.

[From evaluator 3]:

I think I would want the people involved on the project to follow a plan which starts with in-depth requirements and proceeds from that point only when a stronger idea of the actual requirements for that system had been elicited. This you could do either by informally or formally interviewing and also you could use things like mockups to illustrate the sort of things you might want. ... I think the problem lies in actively managing it. The problem we had was that the technical people were allowed to go off at a tangent and if the project were to be properly managed you would want somebody to have greater control over what the technical people were doing and to force them to co-operate more with the educational side of it. ... I think it's a great shame about the way the project went, because I get the impression that initially everybody did start with the best of intentions to produce a product which students would want to use, but there were so many issues, with lack of control of the project, and with conflict between the different sides of the project, that it was almost inevitable that it would fail. There was in fact at some times quite a lot of barely-hidden animosity between the two sides of the project and the project management were unable to reconcile the different needs of these two sides.

[Interviewer]: So how would you have resolved that?

I think to some extent, part of the problem was that some of the technical side had a very strict view of what they wanted the project to do and I have to say that these people would have been better off working more on a technical project and less involved in a user-centred environment.

[From technical developer 3]:

I saw that they [the evaluators] were supposed to come up with some requirements and then [T1] and myself would start looking at these requirements and build a prototype. Then the prototype would be evaluated and then out of that evaluation more requirements would come for a future prototype and then that would be designed. And hence we'd get this design cycle. Now it sounds like a nice idea - I think we planned to start it at the wrong point, personally, in that it starts with trying to talk to users and come up with requirements, whereas we actually, in the end, started with a prototype, which I felt was being more valued anyway. ... the main reasons [for project failure] were: there was no real management of the project and the evaluators were given other tasks to do and never given the time to actually go and do an evaluation.

[In response to the question whether more frequent prototype deliveries with rapid psychologist evaluation would have helped to solve the problems]:

I think that would have worked very well, because of the nature of this thing, that it has to work with non-computer users. ... There would have been lots of compromises on the way and I think, the first of these prototypes wouldn't have been as polished or as functional, but then again, you know, its just to get some idea of whether you're on the right directions. Then you can progress it in another three months, or you have to scrap it. ... I find it incredibly difficult to understand why people find computers difficult to use.

5.5 Grounded Theory Model Derived From Analysis

A comparison of the intended process-model Figure 5-3 with the actual process-model (Figure 5-4) of the project is illuminating. From the beginning, there appears to have been a dichotomy of approach between the two disciplines, despite attempts by the project manager to co-ordinate process-paths, which reflected team-members' disparate interests. This dichotomy reflected very different conceptualisations of the nature of an effective design process. There were two routes through the process model: two separate sets of information system design requirements documents were produced at key stages of the project, one reflecting innovations in the *use* of the system, another reflecting its basis in leading-edge *technology*. Even when the results of the initial requirements documents were combined, two rival requirements specification documents were produced, each reflecting only part of the other perspective. This section examines a grounded theory

analysis of the interview data and discusses a theoretical model of the design processes *on this particular project*.

Figure 5-5 shows the structure of the categories derived from the data and the themes identified. Taking the advice of Lowe (1996), the gerund form (ending in -ing) was used to label each identified theme, to “sensitise the researcher to the processes and patterns which may be revealed at each stage” (Lowe, 1996, page 8). These labels formed the basis for the model shown in Figure 5-5. The open coding scheme was gradually refined: codes were merged and some new concepts were added, with, as far as possible, triangulation between interviews used for core concepts. The analysis was, as far as possible, hermeneutic in nature: that is to say that the process of analysis tried to understand themes and constructs as interpreted by the subjects of the study, rather than applying the researcher’s own interpretation to them. As discussed above, this is not an unproblematic process and any model produced will necessarily rely on the researcher’s subjectivity, even if only in discriminating the significant from the insignificant.

It should be stressed therefore that this model is, at best, partial and inductive (see section 5.3.3), yet it raises some interesting issues. The model concepts are discussed here by starting at the left of the model and following paths through the model. Links between concepts are not always intended to be causal. In the nature of a SSM conceptual model (Checkland & Scholes, 1990): they show contingency relationships.

Individual actors’ educational- and work-backgrounds affected both the extent to which they understood the information technology involved and their perception of the starting-point of the system development life-cycle (as discussed in Chapter 3, this cycle is ‘rotated’ through 90°, depending upon whether a technology- or user-centred perspective is taken to the nature of the task of designing an information-system). These two elements together formed the meaning attached to work roles and ‘appropriate’ tasks of design. The technical background of the system developers, coupled with their perception that the design-cycle started with the construction of a technical artefact, affected the meaning attached to the work-role of ‘evaluator’, which they defined as evaluating technical artefacts. The psychology background of the evaluators, coupled with their perception that the design-cycle started with the investigation of user-requirements, meant that they defined ‘evaluator’ as someone who evaluated user needs, rather than technical artefacts. The dominance of technical knowledge in attaching meaning to work-roles led to the meaning of evaluator having been redefined by the point when E3 was recruited, which in turn meant that the starting-point of the design-cycle was redefined for the project as a whole.

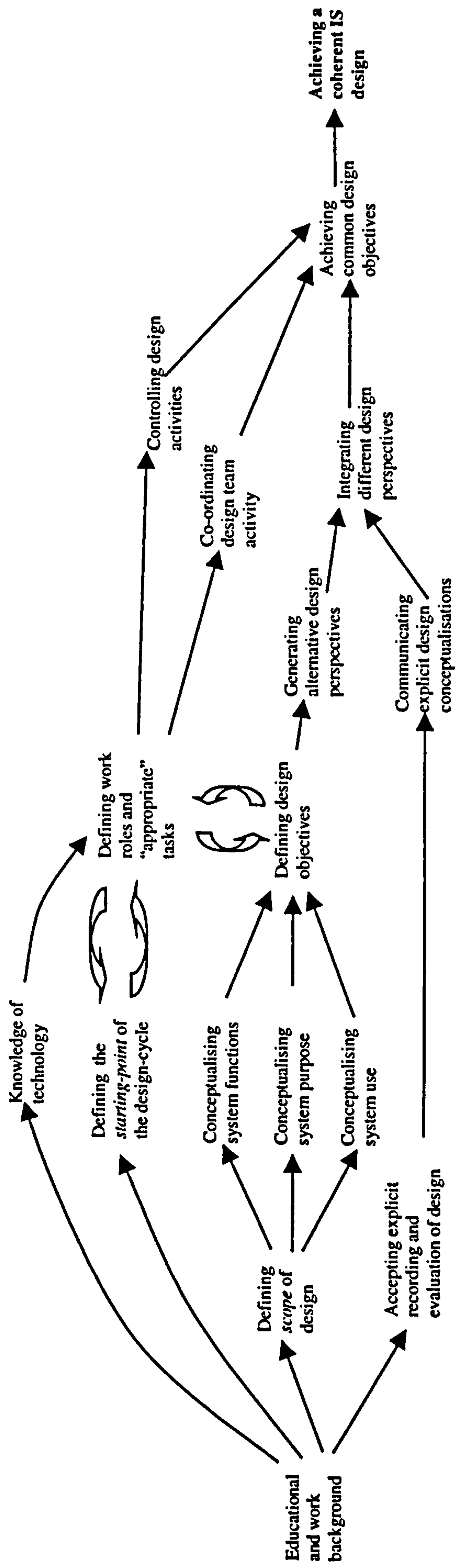


Figure 5-5: A Model Of Design Influences, Derived From Grounded Theory Analysis Of Data

Individuals' backgrounds were also important in defining the scope of the design. System purpose, functions and use were defined differently by the two worldviews of technical developer and evaluator. For example, T3 indicated that design requirements arose from technical preconceptions held by the two technical system developers, rather than from explicit debate. The technical developers were able to limit the scope of the system design to a conceptualisation of *function*, excluding debate on system *purpose* and *use*. The meaning which the technical developers had imposed upon work-roles and design tasks constrained the wider vision of design objectives which the psychologists attempted to pursue. This constraint reinforced the work-roles and design-task definitions driven by the technical developers, which in turned controlled which design activities were able to take place (as evidenced by E3's admission that tasks were undertaken in order to avoid conflict with the technical developers). The technical developers were also able to control how team activity was co-ordinated, as the redefined design tasks centred upon the development of technical systems.

The different backgrounds of design team members manifested itself in two different cultures, particularly with respect to recording the design. The psychologists had a culture where knowledge was formally recorded; information did not exist in the public domain unless it had been circulated in a written form. The technical developers, on the other hand, avoided written "documentation": knowledge was communicated and validated informally. They were therefore able to constrain the work of the evaluators, in refusing to acknowledge written design representations. By avoiding personal contact with the evaluators, they were also refusing to accept their design knowledge as valid. When challenged by evaluators with a technical background, the technical developers avoided the threat by defining what technical knowledge was relevant to the project. People without relevant technical knowledge were excluded from effective decision-making, as illustrated in the following quote from T3:

We decided fairly early on to use object-oriented methodology as much as possible for the database ... it just seemed - well, first of all object-oriented is the latest buzz-word, well one of the latest buzz-words, so - and it seemed to fit into what we wanted to do with ISLE. There was discussion on whether we could just get away with using UNIX files and something much simpler. Between [T1] and myself and a PhD student who was in our office. So he had some bearing on that. And a Professor over at CE as well. So that was really the technical team. Nobody else was that qualified to comment. But it wasn't a major discussion - it was based, well the PhD student said he could do this in this way, as a simple file system, and I said well, yeah, but where's the fun in that?

Even though this decision would affect the timescale and complexity of the design, evaluators were not consulted about the decision described here. Instead, the opinion of a PhD student, who happened to be in the same office, and a Professor from another department were sought, as they were "qualified to comment", by dint of having a

relevant technical background. The narrow design objectives defined by the technical developers constrained the number and variety of alternative design perspectives generated. Those which were generated by the technical developers were not exposed for view to the evaluators, as they were validated informally and in private, so the integration of the very different design perspectives held by the two sub-groups failed.

The lack of control which the evaluators had over which design activities to pursue, coupled with the dependence of their activities upon technical design completion and the lack of integration of design perspectives, led to a failure by the team to achieve common design objectives: when the technical developers presented the evaluators with their designed system, the evaluators were horrified that it was so difficult to use. The design team therefore failed to achieve a coherent design which fulfilled the initial, user-centred design objectives and, when research funding was withdrawn because of restructuring at the sponsor company, the design was insufficiently innovative or coherent for the project director to obtain further funding.

5.6 Discussion Of Findings

5.6.1 What are the critical processes of design and can they be related in a process model of design activity, which may be used for the effective management of system development projects?

The development process has formed the basis of a number of theoretical models (Boehm, 1988; Guindon, 1990; King & Galliers, 1992; Sabherwal & Robey, 1993; Khushalani, Smith & Howard, 1994). Each of these models is formed from a different context of the development process and each of the papers mentioned criticises the inappropriateness of the waterfall model which forms the basis of structured development methods. However, there is little empirical research which can form the basis for alternative models of design, which represent actual or required design processes, as distinct from prescribed design processes.

The user-centred design process model is clearly based around a user-centred prototyping concept. In their study, Boehm et al. (1984) found that the products which has used prototyping methods were found to have slightly lower functionality and robustness, but a higher degree of ease of learning and ease of use (the differences are summarised as “statistically ... at least reasonably significant”). The choice of a prototyping-centred development process model was therefore appropriate for this type of research project (an intensely supportive learning environment), where the ease of learning and ease of use must be of major importance. There were two observed critical processes upon which the

effectiveness of the user-centred design approach appeared to hang: determining the starting-point of the system design cycle and defining the scope of the system design. The priorities which different members of the team place on these aspects of the design will depend upon the design 'schemas' (Jeffries et al., 1981) or 'technological frames' (Orlikowski & Gash, 1994) employed by different members of the team. A design schema is seen as a set of rules and assumptions about the nature of design processes and acceptable solutions, which is independent of the application domain, but formed by the educational background and design experience of the individual.

5.6.2 What type of design tools might be useful, in supporting design managed by 'traditional' approaches?

The meaning attached to various forms of design 'knowledge' was highlighted by this study, together with the technology-centred nature of this knowledge. The informal nature of the design knowledge which formed the basis for decision-making in this project echoes the work of Galliers & Swan (1997), who concluded that ways must be found to recognise that knowledge about and information system is not encompassed by formal representations of that system. It is likely, therefore, that effective design tools must be able to communicate and represent informal knowledge about a design, in a way which does not 'concretise' such knowledge, but makes it open to debate and change.

5.6.3 Under what conditions can the use of a user-centred methodology involve users effectively in the processes of design?

The technical dominance illustrated in this case study was extremely surprising, given the explicit nature of the user-centred design objectives attached to this study. Part of the problem, of course, resides with the management of the project. The project director acknowledged that he did not have sufficient experience of technical system developers to manage effectively the way in which they worked. But an important aspect of this project is the way in which uncertainty and complexity with respect to the design problem reinforced the secretive processes of design adopted by the individual technical developers, making them unwilling to share their design objectives with the wider team, as they perceived their role as understanding the design to a greater extent than they were able to achieve. One could conclude, therefore, that frequent explicit review of detailed design objectives is key to the effective involvement of users in IS design.

5.7 Conclusions & Implications For Further Research

Group design is a research problem domain which has not been explored in the literature to any great extent. There is a great deal of literature on individual design strategies: in

particular, the psychology of programming and individuals' conceptualisation of design problems.

A core problem of group design appears to be the tension between individual problem conceptualisation and group decision-making and negotiation of the problem scope.

Conflict arises when individuals feel that their perspective is not adequately represented in the agreed design. To avoid this conflict, external design representations must be produced which reflects all of the group-members' perspectives of the design; such representations can then act as the basis for explicit design negotiation and decision-making.

Reductionism arises when the problem domain is too widely-defined for individuals to conceptualise it. To avoid this reductionism, design approaches and techniques are required which permit improved abstraction of the problem domain: an 'expanding' of the problem scope, with techniques or representations to manage and make explicit areas of problem complexity across different domains. An essential part of problem conceptualisation is learning: about the problem domain and about the potential which technology holds to support the key tasks and activities of the problem domain. A critical problem which arises in design contexts is the absence of legitimacy which recruits to learning activities. While learning is a core activity of design, it is an implicit activity and therefore not subject to management, in the half sense of process control and progress assessment, it is also not viewed as a legitimate activity because of its implicit nature and its lack of management visibility. Learning must therefore take place inevitably: in design team members' spare time, or through the subversion of legitimate design activities for the purpose of learning.

The key management tasks which arise from this analysis are:

1. To legitimise and support the processes of individual learning.
2. To minimise problem reductionism by the use of design approaches and techniques which support improved abstraction of the problem domain and handle the twin design problems of complexity and uncertainty.
3. To manage the process in such a way that explicit, external representations of the design are produced which reflect each, individual team-member's perspective of the design and to subject these representations to a value-free process of negotiation and decision-making, in arriving at definitions of the target design.

Markus & Bjorn-Andersen (1987) propose that, if both analyst and user are aware of their potential for the exercise of power in IS design, then mutual negotiation is possible. From the results of this study, the conclusion is that, although mutual negotiation may be possible, it may also be unlikely, as both parties will struggle for dominance where their

interests are more closely aligned with their professional group than with their work group. Perhaps an area for future research would be to investigate the awareness of power in relation to the negotiation outcomes in interdisciplinary teams, with respect to the 'Internal Customer' concept - i.e. that the user of one's work [system component] outcomes may be another team member.

A major area of concern raised in this study is the lack of understanding which exists in how designs are conceptualised by groups of people working together and how such work can be integrated into a coherent design. This study raises the need for integrative mechanisms, to manage uncertainty and complexity in design, but the literature does not tell us what types of process these integrative mechanisms are to support. This will be investigated in iteration 2 of this study (chapters 8, 9 and 10).

6. AN INVESTIGATION OF IS DEVELOPMENT APPROACHES IN UK ORGANISATIONS

6.1 Introduction

This chapter investigates the approaches taken to IS development by project teams in UK organisations, through the perceptions of the most senior IS manager in each organisation. It describes the survey of approaches to ISD, relates this to the operationalisation of constructs in the conceptual framework and discusses the survey findings.

This study focussed on research questions 3, 4 and 5 of the first “pass” of the iterative model described in Chapter 5:

3. *To what extent are information system development methodologies used in organisations and are they used consistently and fully?*
4. *How is the development of information systems approached in organisations?*
5. *What is the extent, scope and quality of user-involvement in organisational information system design?*

A survey of the most senior IT manager in 400 large UK organisations was performed in 1995. 49 valid responses were received.¹ The survey was conducted in conjunction with a management consultancy, who were investigating organisational approaches to IT-related change through a set of questionnaires distributed to senior IS, functional (general) and finance managers². The company sent out different types of questionnaire, intended for three different classes of manager: general managers, human resource managers and senior IS managers. This chapter discusses only the design and analysis of responses to the questionnaire intended for senior IS managers (defined as the most senior manager responsible for IT in each company surveyed), as I was responsible for the design and analysis of this questionnaire. The findings of the data analysis were made available to the management consultancy involved in the survey, in exchange for their collaboration, in the production and distribution of questionnaires and the collection of questionnaire responses.

The literature on the use of ISD methodologies gave a contradictory picture of ISD methodology use: that use of an ISD methodology is widespread and that the application of ISD methodologies is a critical factor in the success or otherwise of systems

¹ Out of 51 responses, two were from different IT managers in the same company, which referred to the same project and one was from an IT project team-leader, who was judged too junior for his response to be included without biasing the senior management perspective of the sample.

² Copies of the full report can be obtained from Transition Partnerships, Hernshaw, Knowle Lane, Cranleigh, Surrey GU6 8JH, Tel: 01483-278452

development (e.e. Chatzoglou & Macaulay, 1996; Kautz & McMaster, 1993; Ward, 1991); or that ISD methodologies are not used in full, or in the manner intended (e.g. Curtis et al., 1988; Hardy et al., 1994; Hopker, 1994; Sumner & Sitek, 1986) and cannot ensure full user-involvement as co-agents because of their contradictory nature (e.g. Floyd & Keil, 1983; Beath & Orlikowski, 1994). It was determined to investigate, in companies which might be considered experienced in the development of organisational information systems, what methods were in used, whether they were used in full and to what extent users participated in IS development projects. The intention was to investigate actual practice in experienced UK companies, not just through questions on their use of ISD methodologies, but through questions on their approach to IS development over a number of dimensions, using a conceptual framework derived from the literature (this is discussed in chapter 3).

A postal survey is not ideal for an investigative study, as it provides a wide picture without providing a rich picture. But it does have the advantage that a relatively large amount of data may be collected fairly quickly. For this reason, the survey method was used to investigate whether perceptions of the IS development process acquired through the earlier case study applied to a wide range of contemporary UK practice and to provide a perspective not available in existing literature. Because the research instrument was subjective, no advanced statistical analysis was performed. The results presented here are summary results and exploratory, rather than confirmatory, in nature. The findings do, however, provide a rich and interesting picture of IS development practice in large UK companies.

6.2 The Survey Design

6.2.1 The Survey Perspective

The survey was used to determine senior IS management perspectives across a wide range of organisations, to ascertain whether development practice is changing to a more business/process oriented approach and the impact which this has upon user participation in IS development processes. Whilst a survey was judged the best method to collect data from a large number of organisations, the research instrument was not intended to be used for quantitative measurement, but as a qualitative framework for assessing IS development practice in large UK companies, who might be considered to be experienced with IT and so provide a picture of 'best practice'. The data collected represents a subjective, single stakeholder perspective on the practices of IS development, rather than a quantitative assessment of IT change approaches.

6.2.2 Questionnaire Design

The design of the questionnaire intended for IT managers was based upon the conceptual framework discussed in chapter 3. Questions used in the survey questionnaire are given in full in Appendix 1. The questionnaire was piloted in two stages. First, two organisational managers were asked to comment on their interpretation of the questions. In response to their comments, the general terms used to ascertain the organisation's experience with respect to IT development (questions 1 and 2) and the mechanisms for user-involvement (question 7) were replaced with specific examples of technology architectures, business IS functionality and representative methods for involving users, based upon my own experience as a system designer. Secondly, two experienced IT managers were asked to comment upon their interpretation of the questionnaire and the terminology was further refined to reflect their feedback.

The initial section of the questionnaire asked managers to provide some basic information about their company, their formal position in the organisation (on a seven-point scale from junior management to head of function), a short description of the IT-change project, the turnover and number of staff for that part of the organisation affected and the reasons for change. The next section contained questions derived from the conceptual framework discussed in chapter 3.

Questions 1 and 2 were intended to ascertain the organisation's level of experience with respect to the implementation of organisational information systems. These questions were based upon the Stages of Growth model of IT maturity in organisations (Nolan, 1979; Galliers & Sutherland, 1991). The model observes a "transition point" at the end of the third stage (the second stage in Nolan's (1979) original, four-stage model), at which point the emphasis of IT management shifts from managing the technology - acquiring experience with and imposing control upon the acquisition and operation of organisational IT-based systems - to managing organisational data - exploiting organisational information systems (as distinct from information *technology*), through IT user-facilitation, support and connectivity. The rationale behind the inclusion of these questions is that organisations in the early stages of growth are too inexperienced in information system implementation to provide models of informed practice (in the same way as the psychology of programming literature differentiates between novice and expert programmers as reflecting informed practice in the application of design methods - see the literature review in chapter 3).

In question 1, respondents were asked to indicate the type of IT architectures used within the organisation, from a range of exemplars which represented increasing sophistication of

IT with respect to technical connectivity. In question 2, respondents were asked to describe the business functions supported by their organisational IT, again with respect to increasing sophistication of user-integration and support.

Questions 3 to 7 operationalised the conceptual framework for mapping IS development approaches discussed in chapter 3. This framework was used as the basis of this questionnaire in order to elicit the theory-in-use (Argyris & Schön, 1978) underlying the approach to IS development in each organisation. As discussed in chapter 3, most research which investigates IS development method use assumes that if a method is in use, it is used fully and in the manner intended. The use of this framework was intended to investigate the validity of these assumptions and also to avoid leading questions (for example, questions about how a methodology is implemented, which might lead to an answer which reflected the espoused theory of that methodological approach).

Questions 3 and 4 ascertained the process life-cycle model and its duration. Question 5 elicited the development priorities, the approach to problem investigation and the approach taken to system design and modelling, with the response-scale for the approach to problem investigation reversed, to prevent respondents merely going down one side of this scale for all elements without considering the meaning of each separately. Question 6 was an open question, which served two purposes. The first was to obtain a description of the methods used at the three main divisions of the system development life-cycle: requirements analysis, system design and system implementation. The second was to ascertain the extent to which project control was formal or informal.

This latter element of the framework proved the hardest to operationalise in the questionnaire. When the questionnaire was initially piloted, none of the pilot subjects interpreted the terms originally used for this element as intended and none could suggest an alternative phrase which was interpreted as intended by the other subjects. Eventually, it was decided to use the open question, combined with the response to question 8, which asked the respondent whether approaches to planning and project management helped or hindered the change process, as a means of assessing this, although obviously, this type of interpretation is highly subjective.

Question 7 used the mechanism of examples, suggested by the pilot study subjects, to ascertain the extent to which users were involved in the process of developing and operating the information system. The examples were broken down into the three main stages of development used for question 6, with the addition of system operation, as a way of ascertaining to what extent system users are involved in the management of change which follows on from the development of the technical system.

Question 8 asked to what extent external consultants were used in the project, to ascertain whether company staff were directly responsible for the development of the information system. Question 9 reinforced the data obtained from questions 6 and 7, by asking the respondent directly for their opinion of the extent to which user-involvement and formal process control helped or hindered the effective implementation and introduction of a new organisational information system. Question 10 was another open question which elicited a summary of success-factors and problems from the IS manager. Seven-point Likert scales were used where possible, to permit reasonably fine distinctions in responses. But when piloting the questionnaire, it was found that the original terms used in the framework permitted ambiguities; questions 3 and 6 were re-phrased to use clear examples of meaning. For question 6, the two systems designer pilot study subjects were asked to rank the example mechanisms of user-involvement according to the extent to which they involved users in a meaningful way and to suggest mechanisms that they thought were missing from the list. This ranking was consistent between the two subjects, although the original five user-involvement mechanisms were expanded to six in only two of the four stages, which necessarily compromised the use of a consistent scale for all dimensions of the framework; the rankings were adjusted to be comparable across all four stages and with the seven-point Likert-scale responses during data analysis.

6.2.3 Bias And Validity In Postal Surveys

Fox and Tracy (1986) identify two sources of error in surveys: sampling error, which arises because a segment of the population is studied instead of the complete population, and non-sampling error, which arises from random errors on the part of the respondents, or from bias. Mathematical formulae exist to calculate the size of sample required to ensure statistical validity in removing sampling error, assuming that a random sample of the population is taken (Kalton, 1983). All survey data contains some amount of random error or deviation from the actual state of affairs: this is most difficult to ascertain when assessing human characteristics that are not directly observable (Hufnagel & Conca, 1994). Non-response bias may arise due to differences between respondents who do and do not respond to survey questions.

6.2.4 Limitations Of The Survey

There are two potential weaknesses in the method by which this survey data was obtained. It was originally intended that the survey data be validated for non-sampling errors by short interviews with each of the 49 managers whose survey responses were analysed. This did not prove possible in the event, as the management consultancy who were responsible for conducting the overall survey of which this questionnaire formed a part

conducted their own interviews with respondents and did not feel that they should be approached for further interviews. Copies of their interview summaries were provided, but the issues discussed centred on business organisation issues which, while of great interest, did not serve to validate the response data to any great extent. Additionally, it was not possible to follow up on non-response bias, as I had no access to the original distribution list of managers surveyed. I discussed non-response with the management consultant who managed the survey; her perception was that most non-response bias originated from project failures. She quoted as typical one particular IT manager, who had refused to respond, saying "Not likely, the project was a disaster!". This type of bias accords with that found in the literature on IS development project failure (e.g. Ewusi-Mensah & Przasnyski, 1991), which found that managers are less likely to provide information concerning unsuccessful system development projects. The validity of the data must largely rest upon the representativeness of the sample, in terms of UK organisations. As this survey was investigative in nature, exploring practice with descriptive statistics, rather than confirming hypotheses with complex analytical statistical methods, these were felt to be acceptable limitations.

6.2.5 Representativeness Of Response Sample

Of the 400 survey questionnaires despatched, 49 valid responses were received¹, giving a response rate of approximately 12.5%. The sample responses were analysed according to size and business sector, using questionnaire information and company data from online sources and electronic business directories: a breakdown of business sector is given in Figure 6-1. The analysis of the sample showed that the responses were representative of large companies in the UK.

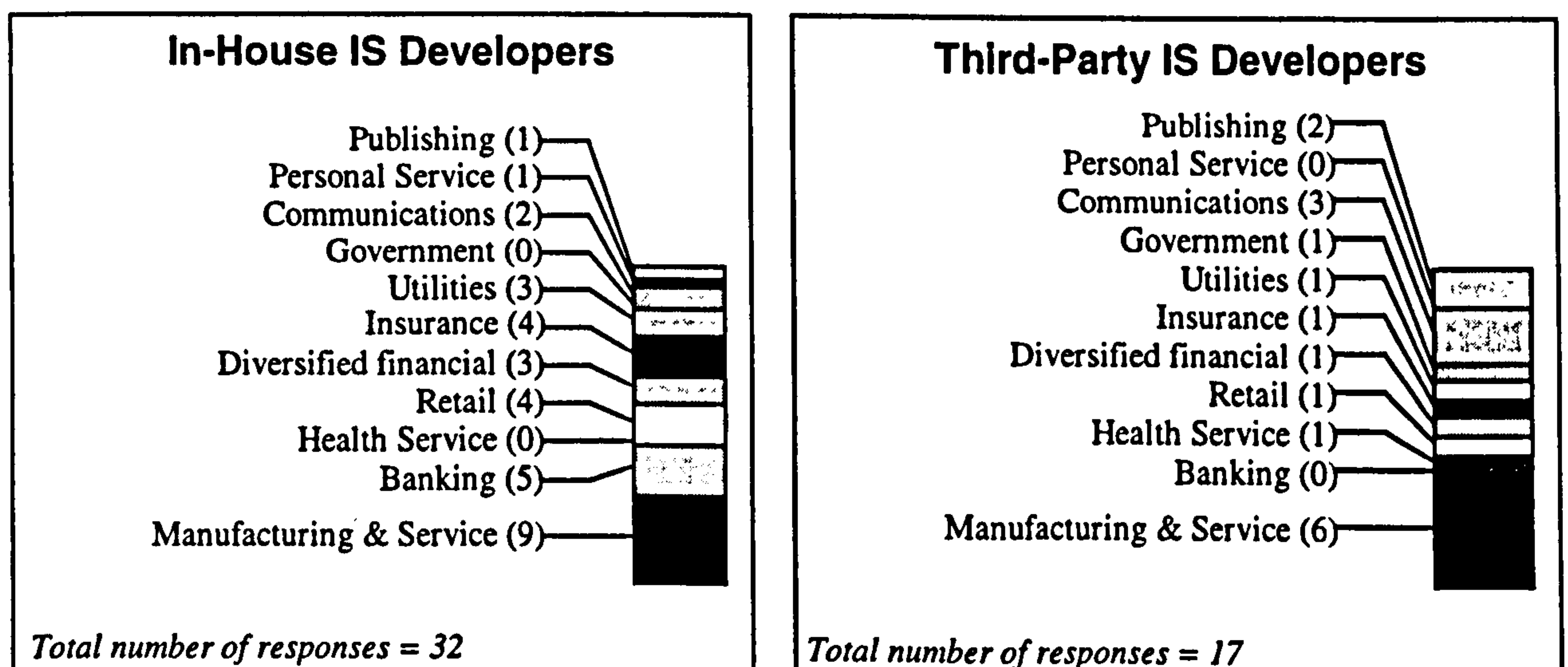


Figure 6-1: Profile of Survey Respondents (Number Of Firms In Each Category In Brackets)

Managers were asked to classify their seniority in the function they represented on a scale of 1 to 7, where 1 was a junior manager/specialist and 7 was the head of the function. The average management level given was 5.59, with 81% (26) of the respondents being at management level 5 or above. Respondents at level 3 or below were excluded from the study, as a strategic overview was required. However, there is the danger that senior managers may not know what methods and approaches were taken, in detail. When the data was judged to be insufficiently detailed, or when sections were left blank (or returned marked: "don't know"), that respondent's answer was excluded from the analysis. This was the case for most of the development methods used in system developments where external consultants had performed the major part of the implementation; it was therefore not possible to obtain a breakdown of development methods used by the sample sub-group who did not develop an information system in-house.

Although it was not possible, because of the lack of access which I had to the original survey distribution list, to follow up on non-response bias, it is probable, as discussed above, that responses received were representative of the more successful projects. Company experience with IT development and change was ascertained by using the responses to questions 1 and 2 to classify the companies with respect to the Galliers & Sutherland (1991) six-stage model of stages of growth with respect to IT. This was a fairly subjective assessment, determined from the organisation's current use of IT and was performed with less detail than that recommended by Galliers & Sutherland (1991), as the need to keep the survey of manageable length indicated a focus on the primary interest of the survey, which was the processes of IS development in the context of IT-related organisational change. But it was required to determine that the respondents were at a relatively advanced stage of growth, in order to determine whether their responses represented companies which have a reasonable extent of *experience* with IT-related change and could therefore be considered representative of "good practice" in the UK.

6.2.6 Analysis Of Response Data

The coding scheme used to analyse the responses is given in Appendix 2. There are many approaches to the statistical analysis of survey data. Because of the variability of the projects and the companies involved, one could identify subgroups within the sample and analyse their properties. This can be done either through obvious characteristics, like the main business of the company or the type of project, or through the use of a more subtle approach of cluster analysis based on objective data. Unfortunately, the response sample was already fairly small, so any subgroups identified would be too small for any

proper or conclusive analysis. Additionally, the fairly low response rate meant that statistical correlation analysis would not be reliable.

Another approach, and the one I have taken, is to take the sample as a whole and use descriptive statistics to analyse individual properties, then to analyse differences in terms of the summary statistics describing those companies which developed their own computer-based information system and those companies who contracted out the system development stage to third-party consultants. The choice of sub-group was determined largely by the quality of the data: more detail concerning the methods employed was available from those managers whose companies had been directly responsible for system development than was available from those who had contracted out system development.

6.3 Survey Findings

6.3.1 Companies' Stage Of Growth With Respect To IT

Whilst most respondent companies had a Local Area Network installed, only half of the sample had Wide Area Network access. Responding companies who used consultants to develop their IT systems used slightly more advanced Information Technology than companies which performed their own development in-house.

Respondents showed a remarkable lack of sophistication in their application of IT to support business functions for what were large companies, by UK standards, in 1995: just over half the sample had central information databases or access to integrated office systems, whilst less than a third could access shared business applications from a network. Again, responding companies who used consultants to develop their IT systems were slightly more advanced in their use of Information Technology.

Using the coding system described in Appendix 2, it was determined that all companies whose data was used in the analysis had a stage of growth (Galliers & Sutherland, 1991) of 3 or greater, with respect to IT exploitation. 86% of all responses were from companies at stage 4 to 5, the other 14% were from companies considered to be at an advanced point in stage 3 - the transition-point between managing the technology and managing corporate information (Galliers & Sutherland, 1991). The sample as a whole was therefore judged to be sufficiently experienced with IT to be representative of good practice in large UK companies.

6.3.2 Type Of Project And Use Of External Consultants In IS Development

The projects described by respondents were broken down into four sub-groups, as follows:

Type of project	Number
In-house development of an organisational information system	32
Implementation of an information system, based upon a bought-in software package or environment	13
No involvement in system development (external contractors were responsible for the complete analysis, development and implementation).	2
Implementation of a technical infrastructure project, such as integrated internal networking, which involved external consultants	2

Of those responses considered valid, two-thirds of the sample (32 companies) had performed development of an organisational information system in-house. One-third (17 companies) had contracted out the major part of the development of the computer-based system to a third-party company or had implemented a system based upon bought-in software or technical infrastructure components.

6.3.3 Overall Management Emphasis Of Change

The results from this analysis are shown in Figure 6-2.

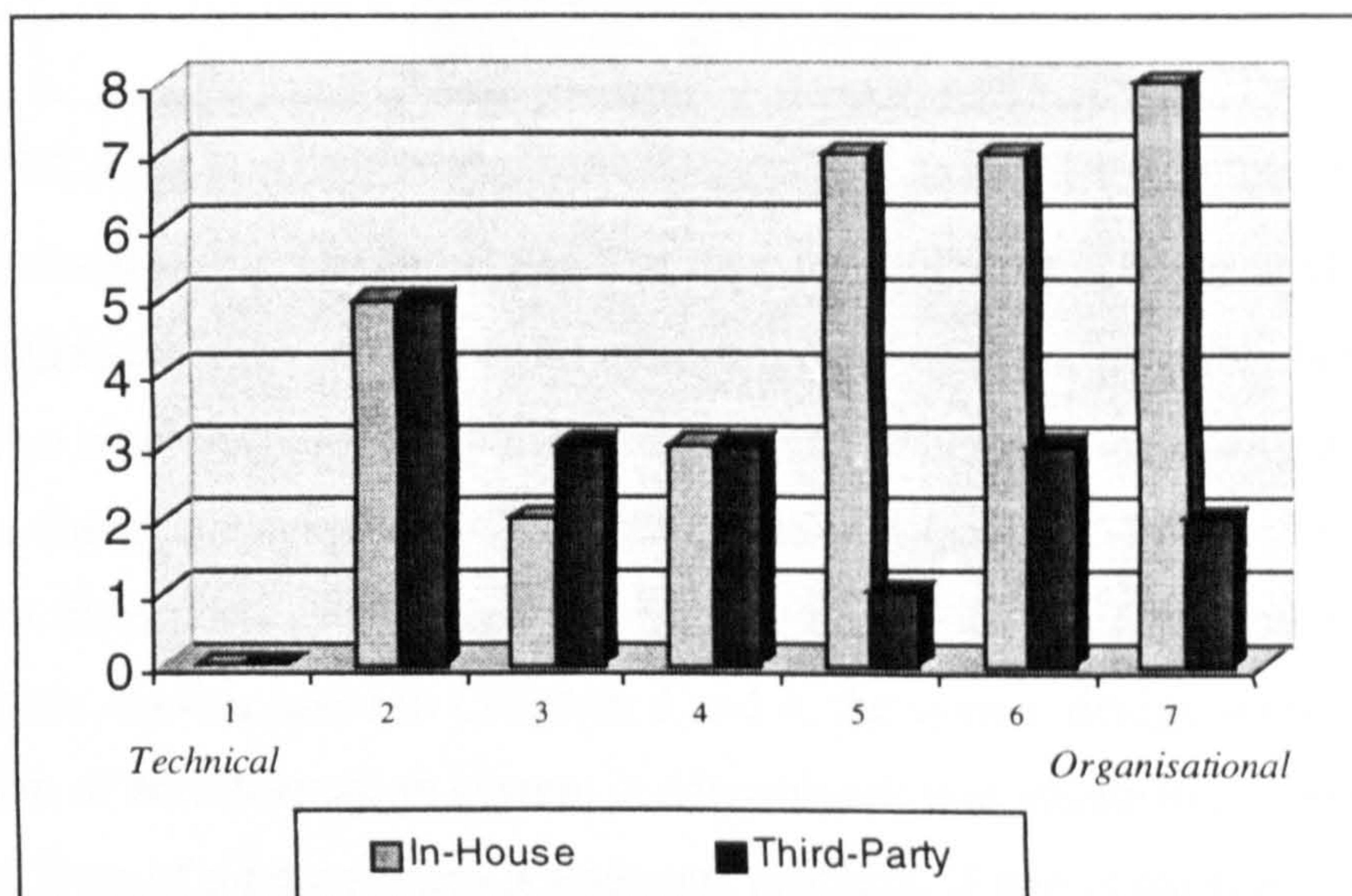


Figure 6-2: Overall Management Emphasis Of Change

Sample responses were divided into sub-groups of in-house and third-party development projects. It is interesting (but not surprising, given that IT consultancies market themselves on their technical expertise) that third-party development projects placed a greater emphasis on technical opportunities. It is likely that the sort of project suitable for contracting out development or using a bought-in package was more likely to have a technical emphasis, although it may well be that the technical emphasis was the driver for the decision to buy rather than to develop the system in-house.

6.3.4 User-Involvement During System Development And Implementation

The extent of user-involvement was examined at the four main stages of the system development life-cycle (SDLC): requirements analysis, system design, system implementation and system operation. The results, adjusted for a seven-point scale, are shown in Figure 6-3.

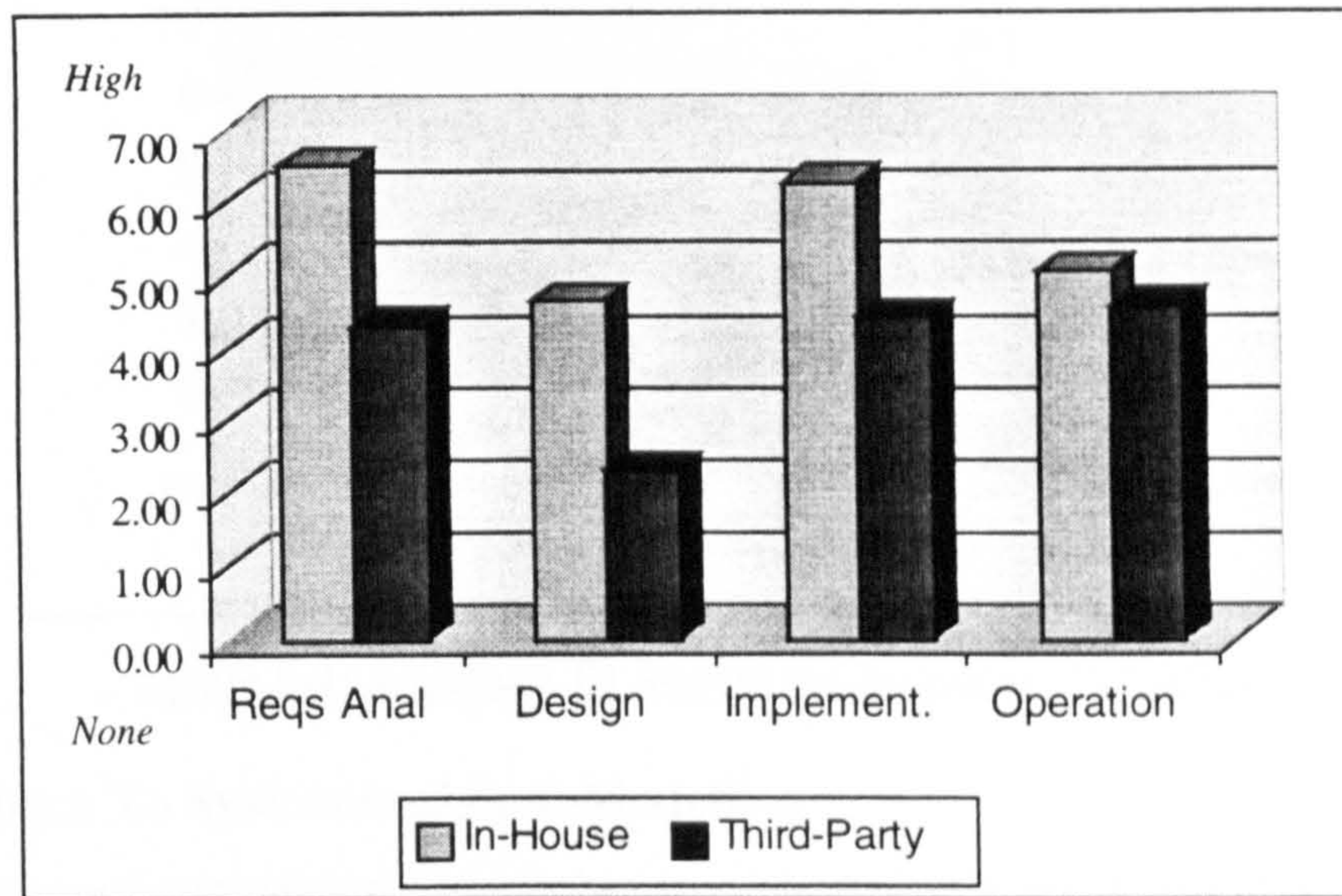


Figure 6-3: User Involvement At Different Stages Of System Development Life-Cycle

It is again noticeable, but not surprising that user-involvement is lower at all stages of the system development life-cycle for contracted-out development, probably because of the more technical emphasis placed upon these projects. What was surprising was that user-involvement during the system design stage of the SDLC was so low for both sub-groups (in-house and third-party developers), even though this rose again with system implementation. As discussed in Chapters 3 and 4, the system design stage of the SDLC is when the *form* of an information system is determined: user exclusion from decisions affecting the form of a new system is a serious problem, if one is considering the extent to which the system will support user-tasks in the organisation.

6.3.5 Approach To System Requirements Definition

The distribution of companies' approaches to system requirements definition is shown in Figure 6-4. In a sense, given that respondents were senior IS managers in their companies, the organisational emphasis is not surprising, although this evidence does refute a widespread perception in the IS literature that IS managers emphasise technical rather than organisational aspects of the system. It must also be considered that the respondents were (a) more likely to have been in charge of system development projects which were considered successful by their organisation (as discussed above, in section 6.2.4), or (b) aware, because of their relatively senior management position, that they should take an

organisational, rather than technical approach to system requirements definition. Unfortunately, as it was not possible to conduct interviews to investigate non-sampling bias, one can only speculate which of these explanations underlies the finding.

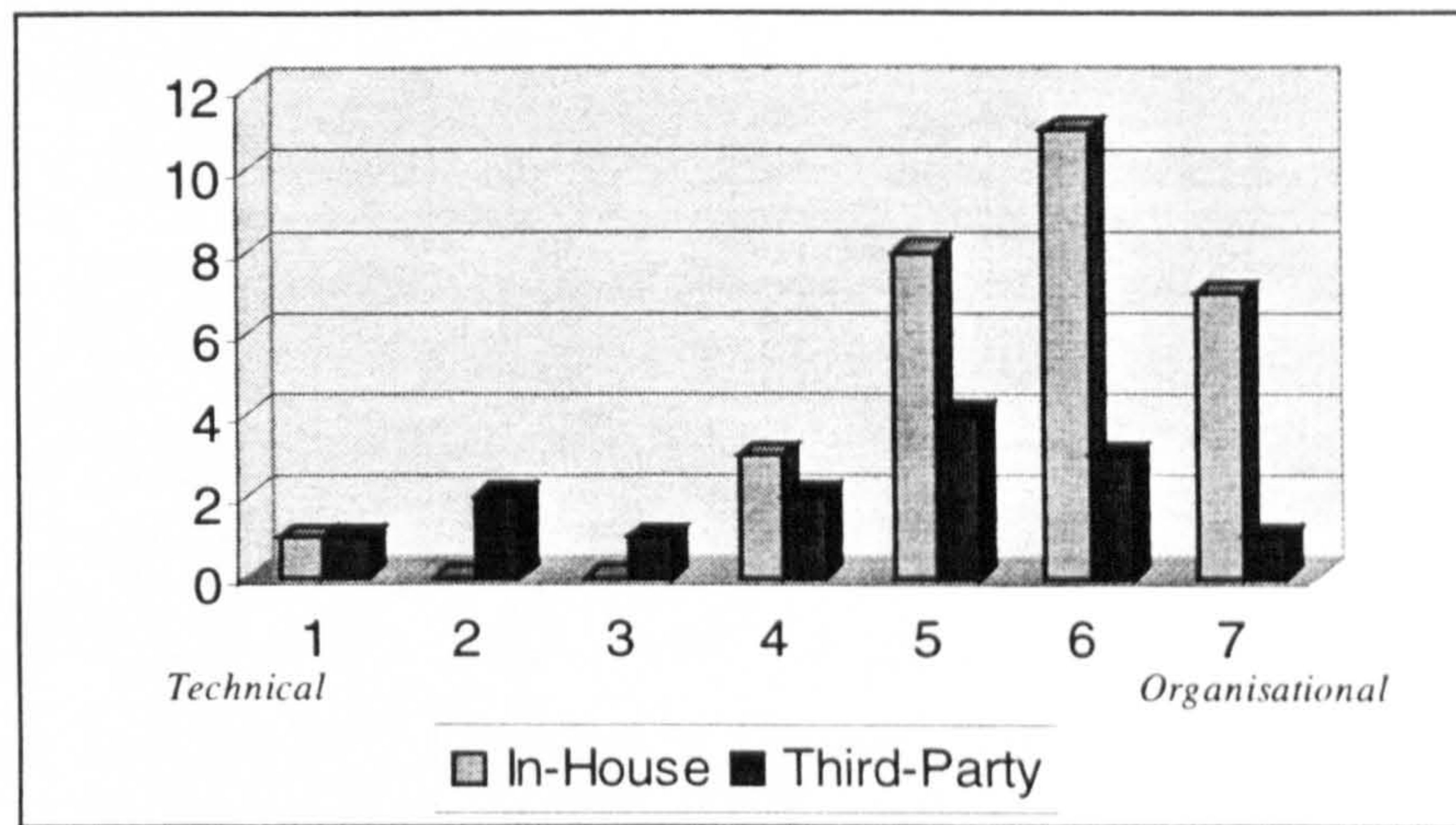


Figure 6-4: Approach To System Requirements Definition

6.3.6 Approach To System Design & Modelling

The distribution of companies' approaches to system design and modelling is shown in Figure 6-5. 44% of the sample organisations developing systems in-house viewed system design and modelling as pertaining more to technical, rather than organisational issues, with only 31% of the companies attempting to achieve a balance between the two and 28% favouring organisational issues.

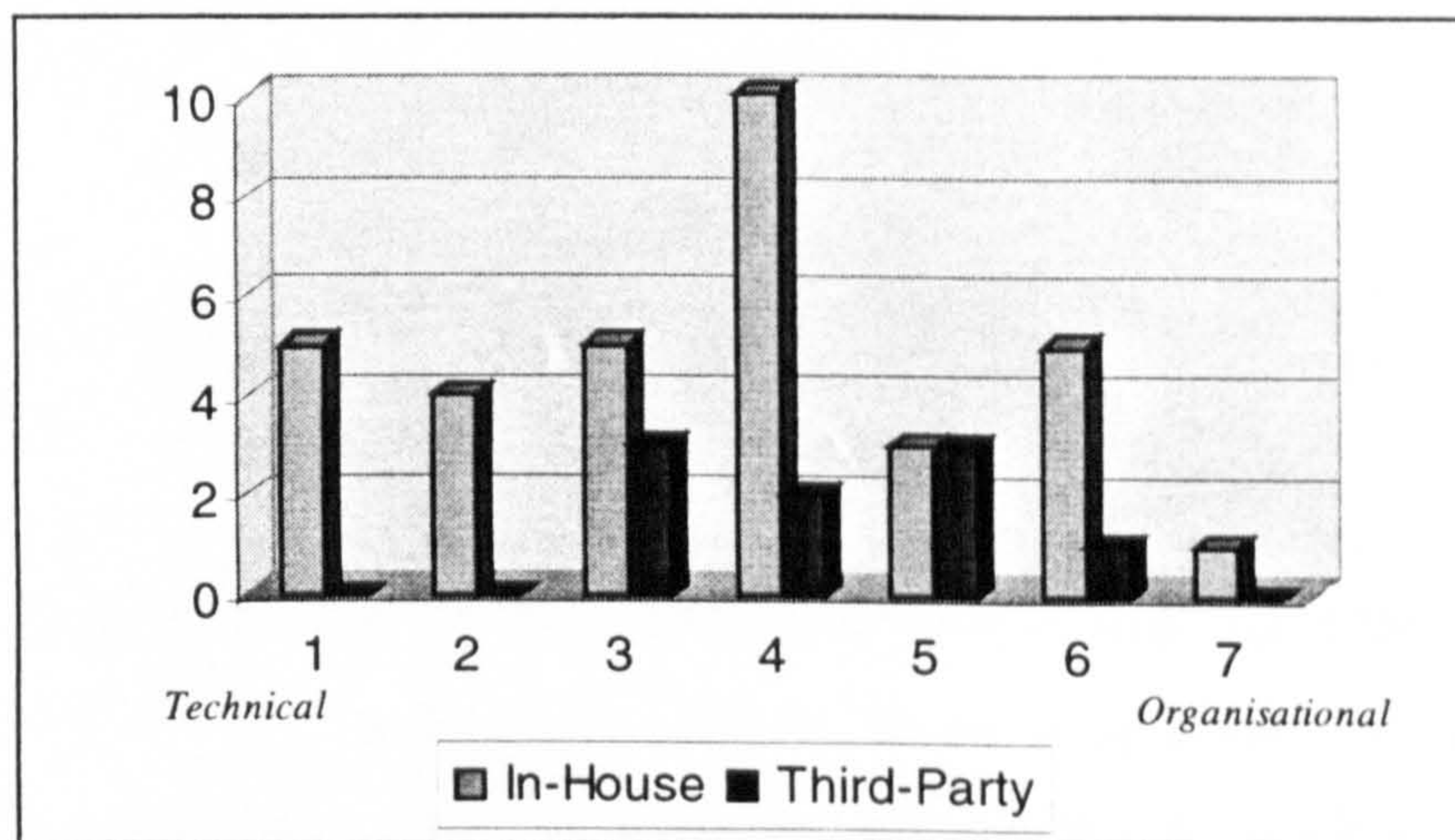


Figure 6-5: Approach To System Design & Modelling

This was less true for the third-party developed projects, where the emphasis was slightly more towards organisational issues, although not greatly so.

6.3.7 Control Of Development Project

On the whole, control of development projects tended towards the formal, with an average rating of 3 for companies which conducted system development in-house (on a seven-point scale where 1 is rigid and 7 is informal). It was not possible to ascertain the level of control for companies which contracted out their system development or used bought-in packages. 23 (72%) managers from those companies which performed their own system development felt that their approaches to planning and project management “helped a great deal”; this figure was 11 (65%) managers from companies which contracted out their system development or used bought-in packages. This does not necessarily mean that control in these companies was formal or inflexible, but that managers placed a great deal of emphasis on planning and project control. When coupled with an analysis of the tools used for project management (see section 6.3.8), the overall picture gained is one of managers who place a great deal of emphasis on the formality of planning and project control.

6.3.8 Methods And Tools Used For Project Management

A breakdown of the methods used for project management by companies performing in-house development is given in Figure 6-6

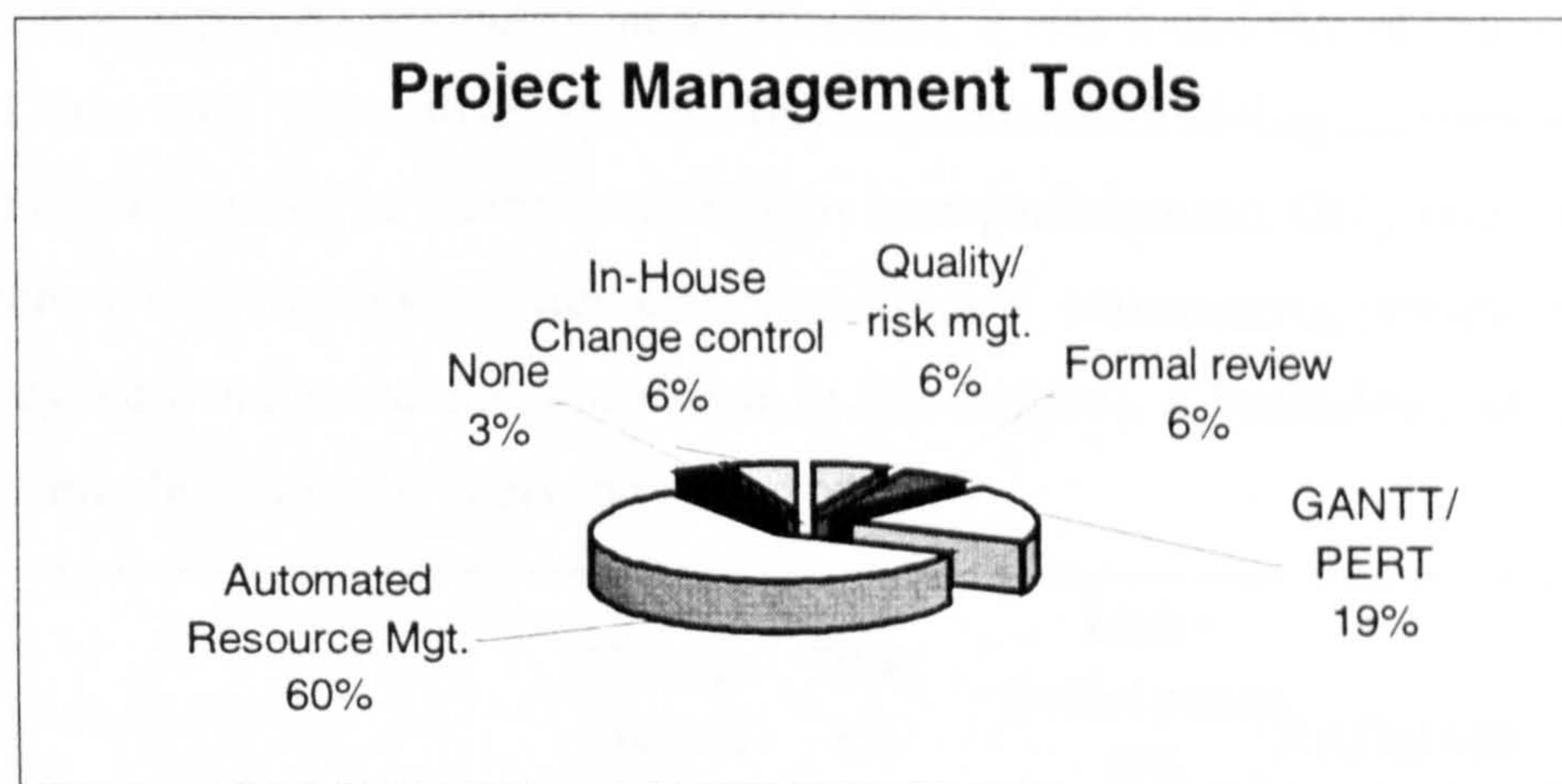


Figure 6-6: Project Management Tools/Methods Used For In-House Development

It is noticeable that 78% of respondents reported the use of an automated or manual project-scheduling tool. The meaning of project management has so clearly become synonymous with scheduling and resource-allocation, that managers do not use any tools to support other areas of responsibility such as facilitating and recording user-input to the development process. This finding would tend to reinforce previous findings in this area, which report that IS development is largely seen as a scheduling management problem and as a functional/technical responsibility (Hornby et. al, 1991).

6.3.9 System Development Life-Cycle Model

It had originally been intended that the survey would provide information about the system development life-cycle model employed in information system development projects. Unfortunately, there were problems encountered in developing a short form of words which communicated this concept adequately. During additional piloting of this question, it quickly became apparent that the technical systems developers consulted were unaware that there was an alternative life-cycle to the waterfall model, for IS development project management. They did not equate “alternative” methods with an evolutionary development life-cycle and, when this concept was drawn for them, just saw it as staged delivery, based on the waterfall model. This was therefore the conceptualisation used in the questionnaire.

An examination of the responses to this question proved inconclusive: there were indications that a small number of respondents had not understood this question in the way intended. Data from this question was therefore not used in any qualitative assessment of IS development approaches.

6.3.10 Methods And Tools Used For Project Management and System Development

Of those 32 respondents who performed their software development in-house (and were therefore able to report on development approaches), it was found that only a small minority of sites used ‘alternative’ systems development methodologies, such as evolutionary prototyping, or methods to support user-participation. Only one company reported using a tool which supported user-participation, commenting proudly that they believed they were unique in this (they were, in this sample). A breakdown of methods used for system development is given in Figure 6-7.

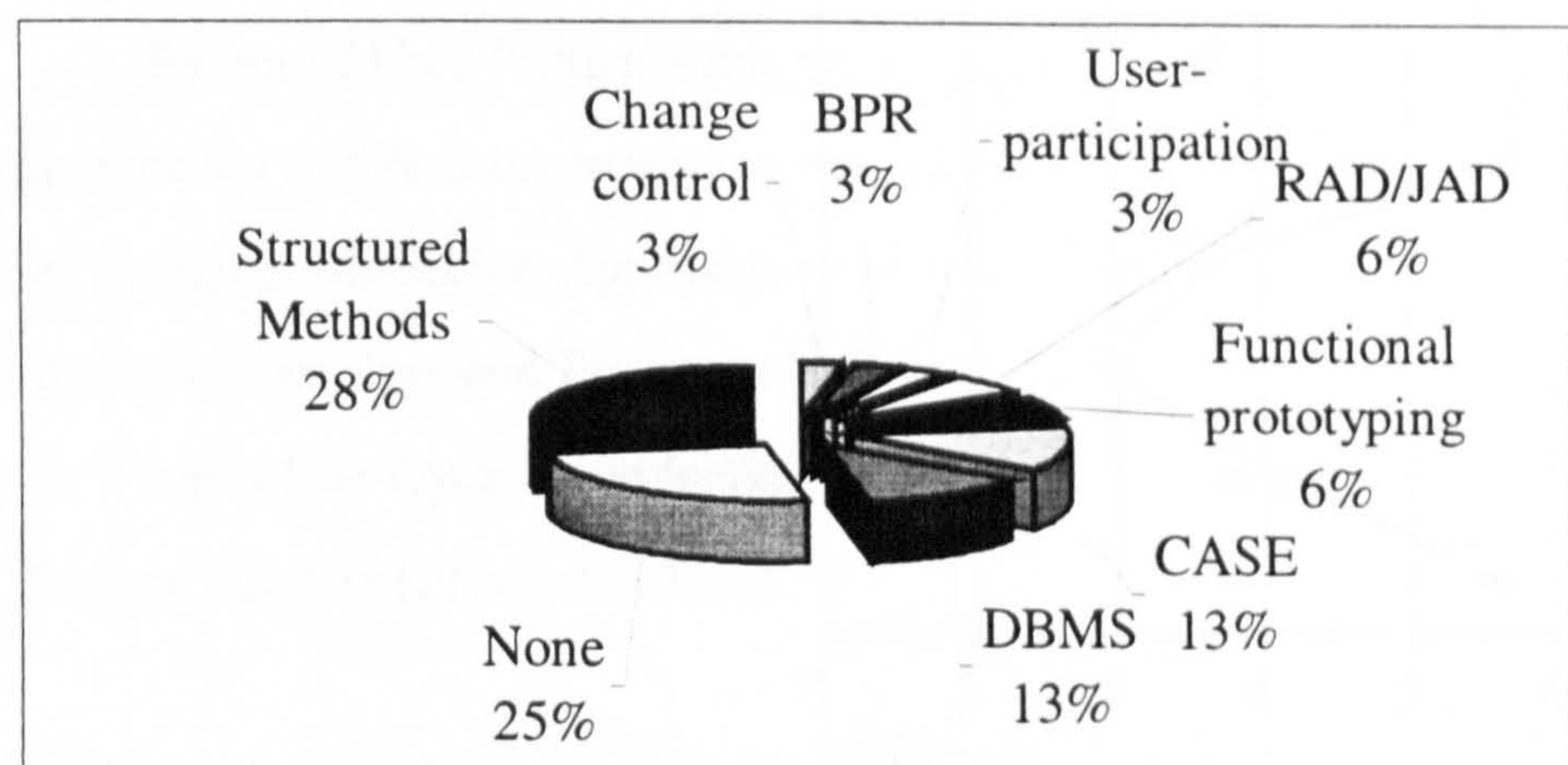


Figure 6-7: System Development Methods Reported By In-House Developers

Only one company claimed to have used the same methodology (a proprietary Rapid Application Development methodology) across all three stages of the SDLC

(requirements analysis, system design and system implementation). Only 37% of the sample (12 companies) used a method in the same *group* of methods for all stages (using the classification of Figure 6-7). This finding perhaps shows a contingency approach to method selection for different tasks - a finding that reinforces that of Fitzgerald (1996a) that tools for information system development are selected on a contingency basis, or perhaps it reflects the “pick-and-mix” approach observed by Hopker (1994), who observed that selection of development tools and methods was driven more by developers’ familiarity with them than by any rational selection.

The most popular methods for system development were structured methods, closely followed by none at all. Responses show a high use of automation and fast-build approaches, using RAD/JAD, 4GL and DBMS and CASE tools: one-third of the sample used a fast-build approach at one or more stages of the system development lifecycle. The latter were often combined with structured methods in developing an information system. A large proportion of those papers and journal articles aimed at practitioners discuss merits and problems with the CASE approach, but consideration of the diffusion of fast-build methods is largely missing from academic literature, although as Fitzgerald (1996b) comments, fast-build approaches are increasingly used in response to shorter product life-cycles and turbulent business environments.

6.4 Mapping Results Onto The Conceptual Framework

The results were mapped onto the conceptual framework discussed in chapter 3: this is shown in Figure 6-8.

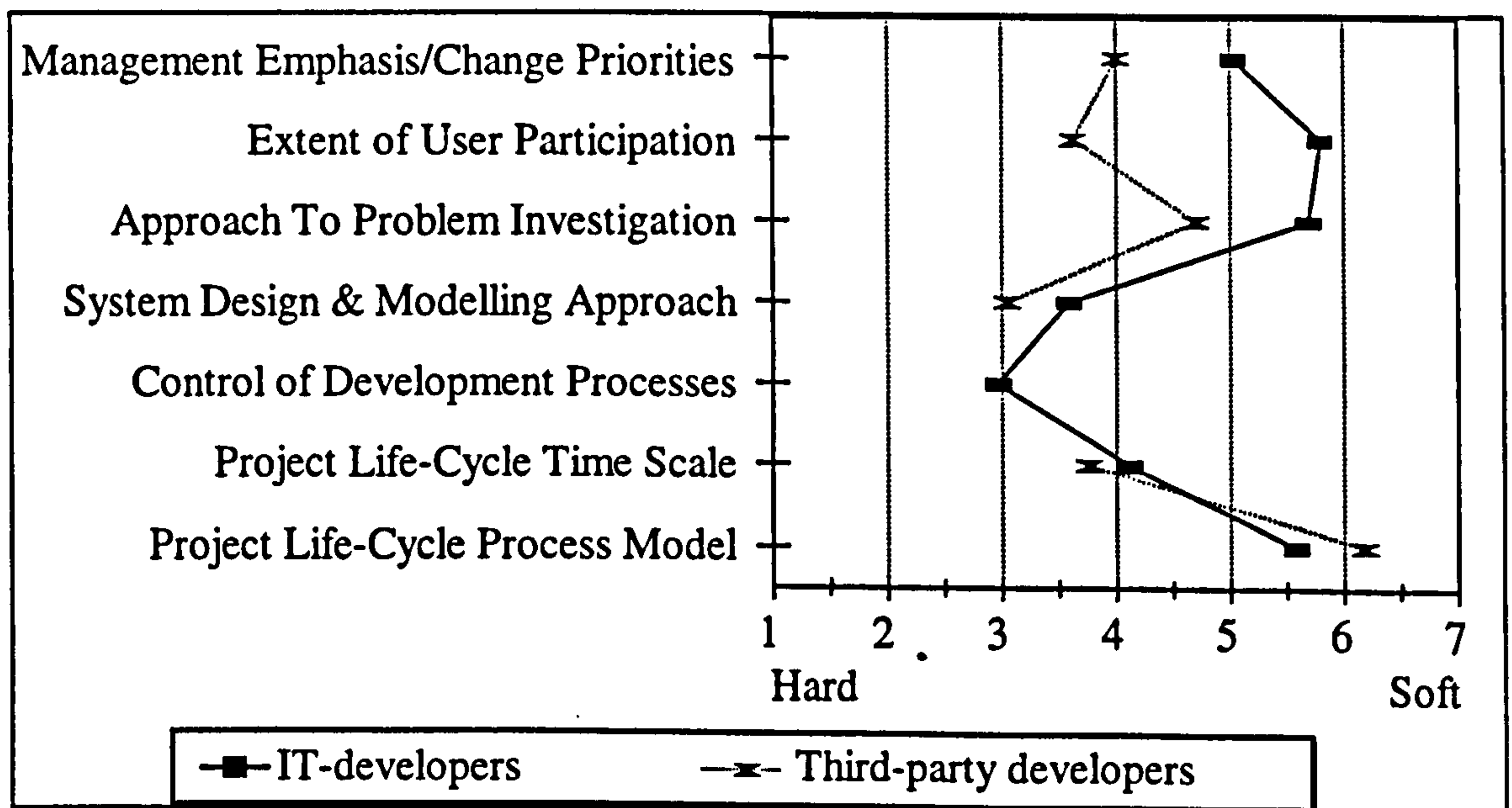


Figure 6-8: Approaches To IS Development

A *coherent* methodological approach is underpinned by a consistent philosophical basis. One would expect organisations using structured methodologies to be mapped firmly along the left-hand axis: given that over 30% of organisations who performed development in-house reported the use of structured methods and that the majority of methods reported were on the 'hard' side of the spectrum, the swings between hard and soft aspects of the development approach would indicate that methodologies are not selected to support a particular approach to development, but for other reasons, such as management control.

Most organisations in the sample saw their overall change priorities and their approach to problem investigation as relatively soft, but for all companies, the approach to system design and modelling was appreciably harder and more technically-oriented. Although the majority of companies reported using the same type of development *methodology* at all stages of the SDLC, their *approach* to system development varied dramatically at different stages. An analysis of development methodologies in use does not tell the whole story: there is a "pick and mix" approach to development which supports a certain approach. This approach will be a negotiated outcome, depending upon the relative power of technical developers, potential system users, functional and technical managers and other organisational stakeholders. It would appear that development is driven by a contingent adoption of various methods rather than by the philosophical underpinning of a coherent development methodology and selection of methodologies is underpinned more by a desire for control of the process than the support of system design.

6.5 Discussion Of Findings

6.5.1 To what extent are information system development methodologies used in organisations and are they used consistently and fully?

The majority of the reported methods were primarily concerned with *controlling* the process (structured methodologies, computer-aided software engineering and internal change control). Structured methods were the most popular type in use, closely followed by none at all. In later stages of the SDLC, there appeared to be a switch to that group of methods concerned with speed or automation of system/program generation - fast-build tools, such as the use of 4GLs in Rapid Application Development, CASE or DataBase Management Systems - possibly in response to fast-changing business environments. The evidence from the survey is that IS development methods are used partially, inconsistently and rarely formally. Only one company was found which claimed to have consistently used the same method across all three stages of the development life-cycle and that was Rapid Application Development - itself a negation of the values of formal,

structured methodologies. Most other companies appeared to use several different tools and methods, but no data is available on how these were selected.

6.5.2 How is the development of information systems approached in organisations?

The overall management perspective of IT-related change is to see it primarily as a business/organisational change, with the exploitation of technology as a secondary consideration. Whilst the initial driver may be a change in technology, the system requirements analysis stage of the system development life-cycle is overridingly seen as being pertinent to business requirements rather than to technical infrastructures. However, once the system design and modelling stage begins, this business process emphasis is subsumed by the technically-driven approaches used by IS professionals and users are largely excluded from participation at this stage.

The findings summarised in Figure 6-8 show that the approach to systems development tends, overall, towards the 'soft' end of the continuum, with the exception of two elements: development project control and the approach to system design. Perhaps as a response to the issues identified by Curtis et al.(1988) - short timescales and high levels of commercial pressure - IS managers felt the need for tight management control over development projects. The technical emphasis of IT-system design and the corresponding low degree of user-involvement at the system design stage of the life-cycle confirm the view found in the initial case study that system design is a technical activity. These findings appear to support the hypothesis of Hornby et. al. (1992) that both managers and IT professionals perceive system design as a primarily technical process. Design for technical functionality, rather than design for user-support, is prioritised.

6.5.3 What is the extent, scope and quality of user-involvement in organisational information system design?

User-participation varied significantly at different stages of the system-development life-cycle. While users were involved heavily at the implementation stage of the SDLC, Eason (1982) argues that user involvement at this stage is mainly token: the system design will, by this point, have become "frozen". The user therefore has little influence, except to change small, operational aspects of the system. Its scope, its effect on users' work-tasks and the extent to which it supports business processes cannot be affected at this stage in the change process. But the survey found that attitudes to user-participation were positive: 88% of respondents felt that user-involvement in the change had helped a great deal - a higher percentage than the 72% of respondents who felt that project management and planning had helped a great deal.

One of the survey respondents commented that “we involved the users in the selection of new systems and implementation, which is unique in my experience”. A feeling of pride or uniqueness in permitting user-participation in various ways was quite frequent among respondents’ comments and raises the issue of the perceived *legitimacy* of user-participation in information systems development processes.

A particularly significant finding is the relatively high level of user-participation shown by users in companies performing their own IS development and the relatively low levels shown in companies which contracted out IS development to third parties. As for the development approach, user-participation declined markedly during the system design and modelling stage - the stage when their input could most affect the form of the new system and its impact upon the way in which their work is structured.

6.6 Summary

It would appear that the most popular methods for developing information systems in organisations are still structured (linear, decompositional) methods, although ‘fast-build’ methods such as CASE, RAD/JAD or 4GLs are also popular, often in combination with a structured approach. The emphasis on structured methods may well reflect managers’ desire for the control over the development process which such methods appear to provide: this is supported by the emphasis on project control shown in the selection of project management approaches.

The overall approach to IT-based change in organisations would appear to be organisational rather than technical: this refutes the widespread perception found in the literature that IS managers take a technical approach to IT-related change. Users were widely involved in IT system development to a high degree, during system requirements analysis and implementation. Most IS managers perceived this as unusual: their comments reflected their pride in involving users.

The low levels of user-participation at the design stage of the SDLC is significant and is matched by a hardening, at the design stage, of the overall ‘soft’ approach taken to information system development. As this is the stage at which the *form* of the technical system is determined, this emphasis may significantly affect the organisational fit and user-centredness of the resulting information system.

Those systems which were developed by external consultants were found to have significantly lower levels of user-participation than those developed by IT staff within the organisation. This may be that the types of IT system for which third-party development was appropriate were those supporting the technical infrastructure of the company, rather

than those providing information support to knowledge workers, but this was not always the case and this finding may indicate a previously overlooked problem with the growing trend of contracting out IT functions to third parties.

6.7 Implications Of Findings For The Second Research Iteration

A core element in the findings of the initial case study was the management of meaning: the inter-subjective practices through which actors constructed their social environment in the context of user-centred IS development. Actors' perceptions of the design process were formed by the perspective that the success of the process depended upon successful design of the technology and that technical design was a specialist activity in which only those with a technical background could participate, and in turn reinforced that perspective. The re-framing of work roles, legitimate activities, 'valuable' knowledge and the scope of the design was achieved through the technical designers' exploitation of the meaning of the design process, which conferred power to exclude or include various actors and to remove their work from the public gaze. The central process of framing socially-constructed meaning was therefore seen as critical to the processes of design. The findings of the postal survey revealed that senior IS managers approached the development of information systems as a business- and organisation-centred activity, rather than as a technology-centred one. But the majority of projects were managed using a staged, linear lifecycle approach, user-participation in formative design activity was perceived as exceptional and user-centred design was only encountered in one company out of the thirty-two who reported their development methods in detail. Additionally, during the design and modelling stage of the system development lifecycle, the emphasis was largely technical, with little user-participation. This indicated that the under-valuation of user-knowledge and the processes of user-marginalisation observed in the initial case study were unlikely to be unique. It was therefore decided to focus the second research iteration upon the following research problem:

- *How is a design framed, in a team which involves stakeholders from multiple domains within the organisation?*

Following an investigation of the theoretical and empirical literature pertaining to design-framing in multiple disciplines (discussed in chapter 7), the main research issues were determined to be:

- i. the processes of problem investigation and framing, *and*
- ii. the social-cognitive activities of design.

These issues are discussed in relation to the literature in these areas, in the next chapter.

7. LITERATURE REVIEW FOR SECOND ITERATION: ORGANISATIONAL 'PROBLEM-SOLVING' AND THEORIES OF SOCIAL COGNITION

7.1 Introduction

Following the themes raised by the research findings for the first research iteration, discussed in Chapter 6, this chapter explores the literature for two areas of theory which underlie design. This chapter explores theories of design as organisational problem-solving and theories of design as social cognition.

7.2 Design As The Investigation And Solution Of Organisational 'Problems'

This section addresses the sixth and seventh research issues following from Chapter 2:

- *What are the critical processes of information system design?*
- *How does the situated, emergent nature of IS design affect the critical processes of IS design?*

7.2.1 The Nature Of IS Design Processes

Design is often regarded in the context of 'problems':

"design is to be viewed as the process of problem understanding and problem solving with the aim of producing an artefact." (*Khushalani et al., 1994, page 13*).

The assumption that problems may be clearly understood and defined in the context of IS design is a misapprehension. Curtis et al. (1988) quote a system engineer, from one of their empirical studies of large development teams:

"Writing code isn't the problem, understanding the problem is the problem." (*ibid., page 1271*).

This perspective of IS design is also reflected in the management literature:

"We fail more often because we solve the wrong problem, than because we get the wrong solution to the right problem." (*Ackoff, 1974*).

Lanzara (1983) argues that an understanding of the model which underlies problem-solving behaviour in design can explain the core problems which constrain the information system design process in organisations. He identifies three models of information system (IS) design:

1. Design as functional analysis. In this model, design goals and criteria for achieving those goals are pre-defined; the process of design is one of *rationally selecting* means for achieving given ends.
2. Design as problem-solving. The design context contains cues which permit the designer to perform an intelligent search by which the designer *learns* about the structures inherent in the situation and to construct an interface between those

structures and the external context. The final solution is just one among many that are feasible.

3. Design as problem-setting. This involves a process of collective enquiry and search taking place through transactions and conversations among several actors with mixed interests concerning the problem at hand. What needs to be created is what the problem-solving model takes for granted: an appropriate problem representation which reflects a decisional structure.

It will be argued below that, while each of the above models can be found underlying both theoretical and empirical studies of IS design, these three models are insufficient to represent a contemporary understanding of design processes. An additional model is added in the analysis of design problem-solving perspectives discussed below:

4. Design as evolutionary learning. The notion that structure is inherent in a situation (as in model 2) is rejected: organisational contexts are seen as dynamic and the objective of design is viewed as an evolutionary convergence between problem-understandings and solution-definitions. This process involves reflective action on the part of the individual: i.e. learning-by-doing, where individuals' courses of action are created and modified by the organisational structures they are acting upon and individuals' actions create and modify organisational structures in turn.

A design context may be characterised by the degree of complexity: the amount of relevant information available in a given situation; and the degree of uncertainty: the availability and reliability of the information available (Matthiassen & Stage, 1992). Each of the models of design is discussed with respect to how it deals with uncertainty and complexity in organisational problem-definition.

7.2.2 Design As Functional Analysis

This model, described as "functional analysis" by Lanzara (1983), is rooted in the scientific management tradition (Taylor, 1947). The rational model of design is based upon a computer information processing model of human cognition (shown in Figure 7-1), which assumes that all information pertaining to design requirements is available to the designer and that such information can be easily assimilated (Mayer, 1989).

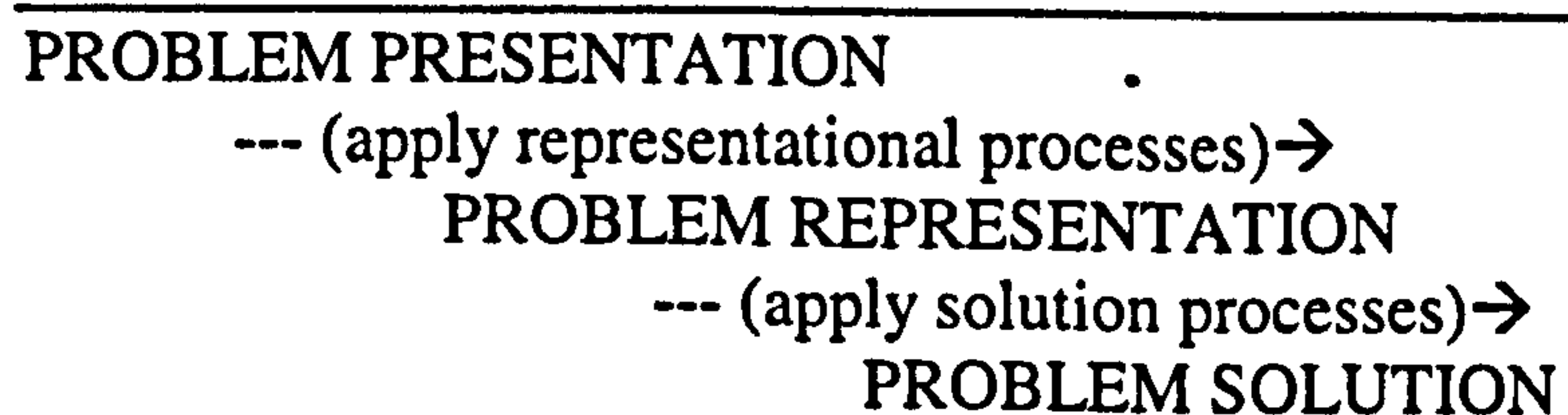


Figure 7-1: An Information-Processing Model of Problem-Solving (Mayer, 1989)

Psychological models of human problem-solving have been dominated by the metaphor of computer information-processing (Gilhooley, 1989). Representation involves moving from a statement of the problem in the world to an internal encoding of the problem in memory by mentally encoding the given state, goal states, and legal operators for a problem - i.e. by structuring the problem. Solution involves filling in the gap between the given and goal states, by devising and executing a plan for operating on the representation of the problem - i.e. by making a rational choice between alternative courses of action. This model assumes that there is perfect knowledge of design requirements before the problem is structured, as in Alexander's (1964) "synthesis of form".

The functional analysis approach to design involves scientific reductionism (Corbett et al., 1991; Wood-Harper, 1990). A single, technical problem-definition is derived from a 'rational' analysis of organisational goals (Galliers, 1987); this reduces design uncertainty. The removal of organisational and social aspects pertaining to the IS "problem" until the system requirements are defined solely in terms of technical functions reduces problem complexity (Matthiassen & Stage, 1992). While the rational, problem-solving model underlies many of the structured approaches to IS design (e.g. De Marco, 1979; Gane & Sarsen, 1979; Yourdon & Constantine, 1975; Yourdon, 1989, 1993) and has been very influential in forming practitioners' expectations of the process of design, it does not reflect the complexity of problem-solving seen in organisational information system design.

The information-processing perspective uses the 'machine' metaphor to describe the organisation: humans may make a rational decision between alternative solutions only if organisational problems are sufficiently structured to be solved by choice between alternative solutions. Mayer (1989) questions four premises of the information-processing model: that humans can pre-determine what course(s) of action are required to reach a given state; that problem representation and solution are independent of each other; that organisational problem-solving can be accomplished by mechanical, algorithmic processes; and that novel problems can be solved by deductive, rather than inductive reasoning. The information-processing perspective is refuted by empirical research, which indicates that designers solve novel problems by generalising from a similar problem, engaging in random solution attempts or reframing the problem (Lawson, 1990; Mayer, 1989; Malhotra et al., 1980; Turner, 1987).

7.2.3 Design As Problem-Solving

Simon (1960, 1973, 1981; Newell & Simon, 1972) rejected the rational model of problem-solving, with the notion of "bounded rationality". Simon argued that the rational problem-solver is assumed to understand all information relevant to the problem, and to have clear goals and priorities. The concept of bounded rationality accepts that human-beings have cognitive limitations which constrain the amount of information they can absorb and process; the complexity involved in processing and evaluating available information can prevent the individual from selecting the optimal outcome. Individuals also have access to incomplete information about alternative courses of action, which leads to high levels of uncertainty on the part of the individual. Individuals respond to problem uncertainty by developing a simplified model of the real situation: "bounding" the problem until it becomes sufficiently well-defined to be resolved, they then evaluate alternative solutions sequentially until an alternative is discovered which satisfies an implicit set of criteria for a satisfactory solution. The solution reached is not optimal, but *satisficing*, in that it satisfies a minimal, rather than optimal set of solution criteria. (Simon, 1981).

Simon (1973) describes design problems as "ill-structured" problems. Guindon (1990b) presents a framework for distinguishing between well-structured and ill-structured problems; this is given in Table 7-1.

Well-structured problems	Ill-structured problems
Complete and unambiguous specification of problem	Incomplete and ambiguous specification of the problems
Definite criteria to evaluate the solution and mechanizable process for evaluating if a solution is reached	No stopping rule - no definite criteria to evaluate whether a solution is reached
Any knowledge needed by the problem solver can be represented in one or more "problem spaces"	Many sources of knowledge (problem spaces) that cannot be determined in advance and need to be integrated
Enumerable set of operators that can change the initial state into another state and there is at least one problem space in which can be represented initial state, goal state and all intermediate states	No exhaustive, enumerable list of operators to reach a solution and absence of predetermined solution path from initial state to goal state
<u>Examples:</u> Checkers, Tower of Hanoi, Chess, Theorem-Proving	<u>Examples:</u> Design (software, architectural), Planning, Management, Document and music composition

Table 7-1: Some contrasting features between well-structured and ill-structured problems (Guindon, 1990b)

In Simon's model of bounded rationality, individuals decompose an ill-structured problem under the control of a mental, executive process that carries out the necessary coordination functions. Additional information, retrieved from long-term memory, converts the original, ill-structured problem into a collection of well-structured problems: i.e. the process involves inductive reasoning, in addition to the 'rational', deductive reasoning

assumed by the rational model of functional analysis. The nature of the problem is no longer unitary - as in the functional analysis model of design - but scientific reductionism is still an integral part of the bounded rationality model of design behaviour, as the individual simplifies the problem to reduce uncertainty. The ill-structured organisational problem is viewed as reducible to a set of well-structured sub-problems. Inductive abstraction is required to reduce complexity; Simon (1973, 1981) argues that this behaviour is far from the 'rational' decomposition of problem requirements assumed by the functional analysis model of design. In a hermeneutic study of design performed by Boland & Day (1989), a system designer was observed to deal with organisational complexity and political conflict by defining the system in a way which excluded organisational and political issues.

Studies of highly-skilled practitioners indicate that they rely on "intuition" (i.e. inductive reasoning) to problem-solving; such individuals are said to be in the autonomous and most advanced stage of knowing (Anderson, 1983). Schön (1983) refers to this application of intuitive reasoning as "reflection-in-action". Expert system designers have been observed to apply "data-driven rules" (Guindon, 1990a) - the extrapolation of empirical solutions for similar technical problems - rather than more effective goal-directed behaviours, as data-driven behaviour imposes a lower cognitive cost (Anderson, 1983).

7.2.4 Design As Problem-Setting

Wood and Wood-Harper (1993) argue that the use of information technologies has been dominated by the rationalistic tradition discussed in the two categories above; they suggest that design of 'new' technology requires "a focus on the formulation of the 'problem' rather than merely providing an 'objective' description of the problem" (ibid., page 100). But Guindon (1990b) argues that information system design involves the integration of *multiple* knowledge domains: the application domain, software system architecture, computer science, software design methods, etc.. Each of these domains represents a problem-space in which a more or less guided search takes place (depending upon which solution paths look most promising and the previous experience of the designer in this domain). The IS development process should encompass the discovery of new knowledge, in particular the discovery of unstated goals and evaluation criteria. Rittel (1972; Rittel and Webber, 1973) defines organisational problem-situations as "wicked" problems. While the concept of wicked problems is similar to Simon's (1960) concept of ill-structured problems, in Simon's (1960) perspective, ill-structured problems may be structured by the application of suitable decompositional analysis techniques - i.e. they

may be *analysed* (even if not rationally, in a way that may be justified on rational grounds) - whereas wicked problems cannot be formulated because of their complexity and their interrelatedness with other organisational problems (Rittel & Webber, 1973); they must be *framed* (this framing process is discussed further in section 7.3). A wicked problem (Rittel 1972; Rittel and Webber, 1973) has the following characteristics:

- a) it is unique
- b) it has no definitive formulation or boundary
- c) there are no tests of solution correctness, as there are only 'better' or 'worse' (as distinct from right or wrong) solutions
- d) there are many, often incompatible potential solutions
- e) the problem is interrelated with many other problems: it can be seen as a symptom of another problem and its solution will formulate further problems.

Whereas, in the problem-solving model, problems may be objectively bounded and decomposed, solutions to wicked problems require a more subjective approach: Rittel (1972) advocates 'second-generation design methods' to replace the rational model of design. These methods should include "designing as an argumentative process", which Rittel sees as "a counterplay of raising issues and dealing with them, which in turn raises new issues and so on". This approach is more related to the third model of design described by Lanzara (1983): design as the search for appropriate problem-definitions as well as solutions.

An area of research which explores how designers explore the problem space is the work on 'design rationale'. Echoing Rittel's (1972) advocacy of 'second-generation design methods' (i.e. involving argumentation and debate), the 'design rationale' theorists (e.g. Buckingham Shum et al., 1996; Lewis et al., 1996; Moran & Carroll, 1996) argue that design requirements are often implicit; they can be surfaced most effectively in the course of social interaction and negotiation if represented explicitly and so made open to inspection and negotiation. The design rationale perspective sees design as taking place within a 'design space' - a concept borrowed from cognitive psychology (c.f. Anderson, 1981). The exploration of this design space may be expedited by the explicit representation of design criteria and solution alternatives, using design-space analysis techniques such as the issue-based IBIS technique (Rittel, 1972) or the Question-Option-Criteria (QOC) notation (Maclean et al., 1993).

The design rationale approach sees its objective as recording and understanding the basis of decision-making employed in achieving a (usually technical) design solution. The

problem is defined only inasmuch as the requirements of the designed system are understood and debated by design participants. Whilst the design rationale perspective explores the problem through an exploration of design alternatives and sub-problems and so concentrates upon a problem-space exploration which leads to learning about the solution requirements, the nature of the problem situation and its social and organisational context are ill-defined and remain invisible to the processes of design. Design-rationale goes some way towards the negotiation of problem-definitions: by representing problem-definitions, they are laid open to inspection and negotiation, but these representations are detailed and complex, meaning that non-technical design participants are likely to find their construction problematic, and they are static representations, coping poorly with the emergent and dynamic nature of problem exploration. The approach is seen as most valuable in recording design-space decision-making for the future maintenance of technical systems (e.g. the design of an IT user-interface).

The fifth characteristic of wicked problems (a problem's interrelatedness with other problems) is characteristic of Ackoff's (1974) 'messes', which are described as "a system of problems" (Ackoff, 1974, page 4). These five characteristics typify the central contradiction of information system design: how may multiple, conflicting problem goals, requirements and constraints be merged into a coherent whole which is acceptable and comprehensible to all those affected by the design - the design team, managers, users, clients and other stakeholders.

Design as problem-setting sees design as a process of collective enquiry and search, taking place through transactions and conversations among several actors with mixed interests concerning the problem at hand (Lanzara, 1983). What needs to be created here is what the problem-solving model takes for granted: an appropriate problem representation which reflects a decisional structure (Lanzara, 1983). While the rational, problem-solving perspective of design attempts to reduce uncertainty through problem-structuring and to reduce complexity through scientific reductionism, the systemic enquiry perspective accepts that complexity is a necessary facet of organisational systems; this perspective manages uncertainty through viewing design as holistic, systemic enquiry into the problem context and manages complexity by recognising that there are multiple potential target object systems which can be made explicit and subject to negotiation by organisational actors (Checkland, 1981).

The resolution of "wicked" problems in design (Rittel, 1972) is concerned with debate and negotiation to achieve consensus and choice among different, target "object systems"

(Welke, 1983); the critical processes are concerned with problem-framing. This perspective argues that there are no objectively given object systems, rather people have viewpoints which enable them to perceive object systems; a multiplicity of viewpoints may prevail among the members of a development team (see Figure 7-2) and among other stakeholders (Checkland, 1981; Hirschheim, 1985; Hirschheim & Klein, 1992; Lyytinen, 1987). Information system design encompasses multiple perspectives of system objectives, which are ill-defined and open to debate and negotiation (e.g. Mumford, 1983; Checkland & Scholes, 1990; Avison & Wood-Harper, 1990); the subjectivity inherent in this model is encompassed in the use of the term "soft systems" (Checkland, 1981; Checkland & Scholes, 1990).

Lyytinen (1987) proposes that the critical processes of a design team are concerned with achieving consensus on which object system(s) are to be operated upon and the form and scope of the target object system(s).

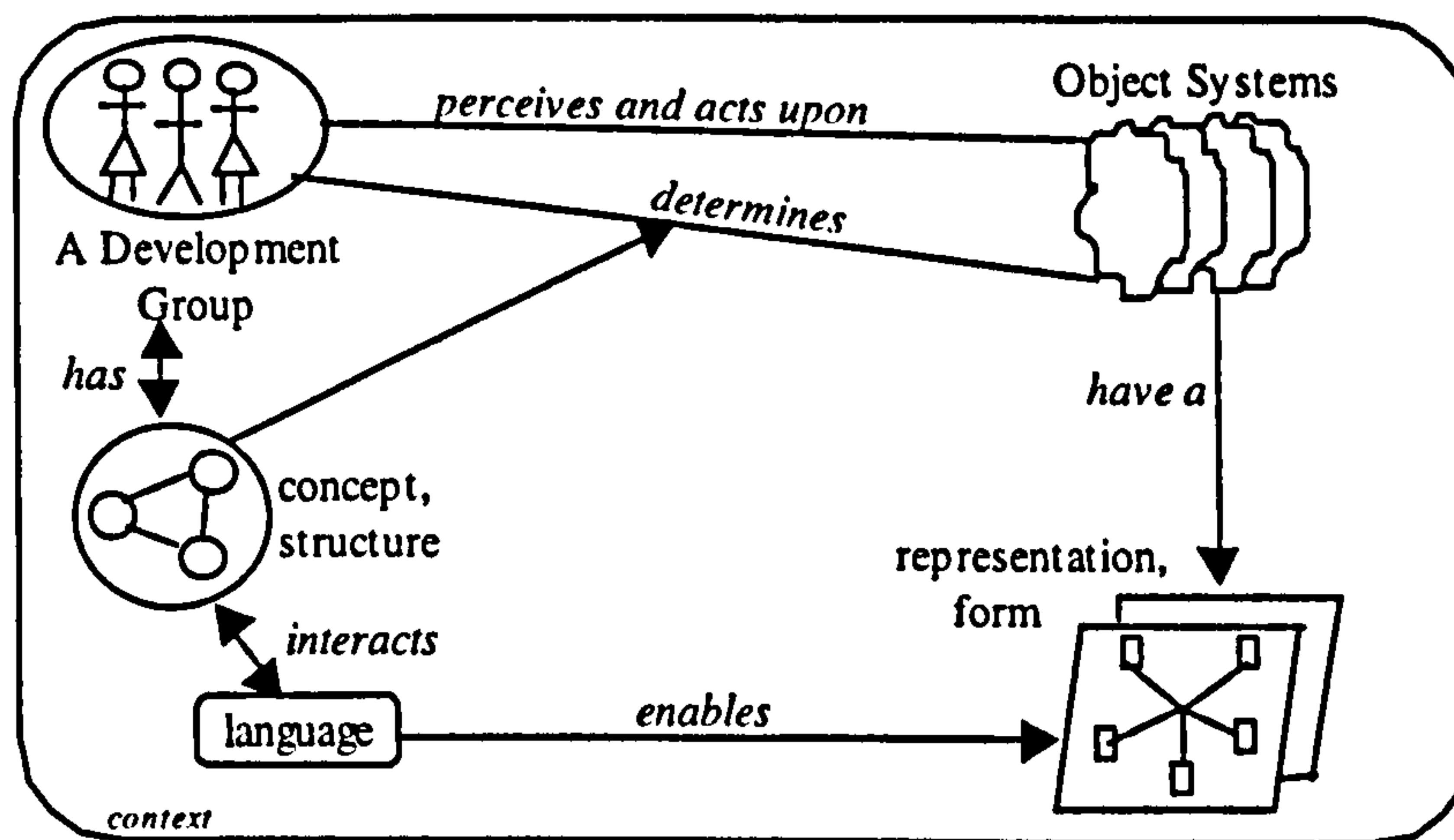


Figure 7-2: Object Systems In Systems Development (Lyytinen, 1987)

Consensus may mean that perspectives are unitary in nature, reproducing a primary constraint of the previous two approaches to problem-solving. The soft systems perspective is still becoming established: even many writers who have attempted to merge practical approaches to ISD with 'soft' approaches speak of a single, 'primary-task system' (Wilson, 1984) or the need, early in the IS development process for a "clear statement of system objectives" (Veryard, 1986). Checkland (1980, Checkland & Scholes, 1990) is unclear on this point, but his work has been criticised for privileging the management interest through the search for consensus, which is unrealistic in a political context where management interests dominate (Burrell, 1983). This unitary emphasis can partly be explained by the need for commitments and promises in the negotiated 'contract' which represents ISD in practice (Ciborra, 1987) or the need to constrain system

requirements in order to meet tight deadlines and resource constraints (Curtis et al., 1988) or because of the individual's need to reduce problem complexity (Mathiassen & Stage, 1992), but may also reflect the formative influence of rational models of design.

Organisational information system design reflects the support of many different tasks and it is the job of the designer - normally a technically trained system analyst - to make sense of the multiplicity of tasks for which support is required and to mediate between the impact of the technical information system being designed and the users of that technology (Boland & Day, 1989; Friedman & Cornford, 1989; Kumar & Bjorn-Andersen, 1990). This task involves the resolution of conflicting goals (Methlie, 1980) or multiple constraint satisfaction, defined as "the evolution and testing of part of a design to gradually satisfy its requirements" (Buckingham Shum et al., 1996).

Galliers (1993a) presents an approach based upon SSM, but retaining the plurality of system definitions, while Flood (1995) attempts to deal with the political aspects of systemic design with a "total systems intervention". He suggests that there are three main types of problem-solving methods required for such an intervention: designing, debating and disimprisoning, which are respectively concerned with finding a solution to either efficient processes or effective organisational design, changing people's beliefs and attitudes, and preventing designs and decisions from becoming 'prisons' - i.e. the challenging of received wisdom by questioning whose interests are being served.

For Checkland (1981) soft systems have four main properties: emergence (the exhibition of properties by the whole which are not exhibited by the component parts), hierarchy (entities which can meaningfully be treated as wholes are built up of parts which are themselves wholes, and so on), communication (the transfer of information) and control (the process by which a whole entity retains its identity and performance under changing circumstances). This can be contrasted with the hard systems approach, which sees system properties as being objective, rather than emergent, with communication and control being human interactions with the material (computer-based) 'system', rather than properties of the system itself. While soft systems approaches to IS design see IT as the "serving system" to a "served system" of purposeful human-activity (Winter et al., 1995), hard systems approaches see IT as the target object system. However, this view is still static: the soft systems literature views design as being a process of negotiating a consensus on organisational system definitions, which embody structure and persistence. It may also be argued that the whole thrust of the 'problem' investigation literature in the field of IS is aimed at structuring problems and constructing structured data (Preston, 1991). An

alternative model rejects organisational structure as the basis for design (Truex & Klein, 1991): organisations are seen as emergent and dynamic, with design defined as situated, evolutionary learning.

7.2.5 Design As Situated, Evolutionary Learning

This section deals with design as the convergence of problem and solution, as distinct from Lanzara's (1983) last perspective of design as problem-setting. Although design is still viewed as being properly rooted in a process of collective enquiry and search, it is recognised that both problem and solution representations do not reflect an appropriate decisional structure, as required by Lanzara (1983), but are emergent and ill-defined; solutions are no longer optimal for that context, but satisficing. There is evidence in some areas of literature (particularly in the field referred to as social psychology) that our conception of design is changing, with an acknowledgement that design is "situated" in organisational contexts (Gasser, 1986; Suchman, 1987; Lave, 1991; Lave & Wenger, 1991). Star (1992) ascribes this change to "the failure of the rational to account for or to prescribe people's behaviour" (Star, 1992, page 398). From problem-solving in a rational sense, the situated action perspective views design as a cyclical process of learning about a situation, then planning short-term, *partial* goals (Suchman, 1987), which emerge from the process of design. The nature of the emerging "problem" becomes more complex and unbounded (and, indeed, unboundable) than that assumed in either the problem-solving perspective or the soft systems perspective. Aspects of a solution are explored in conjunction with aspects of a problem understanding; the designer's understanding of both may change as a result of the process. The 'problem' is thus dynamic and constituted of many, interrelated parts.

The evidence from studies of cognitive design strategy indicate that a further model of problem exploration is required to understand design; even the systemic, problem-investigation model discussed in section 7.2.4 assumes that it is possible to define organisational problems before appropriate solutions can be formed (although the literature is ambiguous on this point, this assumption does appear to underlie the notion of 'consensus' in the soft systems literature). But an understanding of organisational problems - and appropriate design goals - *emerges* as partial solutions are explored. Mayer (1989) demonstrated that representation and solution are interactive processes, i.e. the problem representation is continually reformulated during the process of problem solution. Lave & Wenger (1991) argue that design abstraction is situated in the organisational context: abstract representations of a solution are meaningless unless they

can be made specific to the concept at hand. This theory is supported by experimental studies of design (in laboratory conditions), which indicate that designers solve novel problems by generalising from a similar problem, or by reframing the problem to fit partial solutions which are already available to them from their own or colleagues' experience (Lawson, 1990; Mayer, 1989; Malhotra et al., 1980; Turner, 1987). Problem and solution are thus interrelated: this concept is synthesised in the diagram of Figure 7-3.

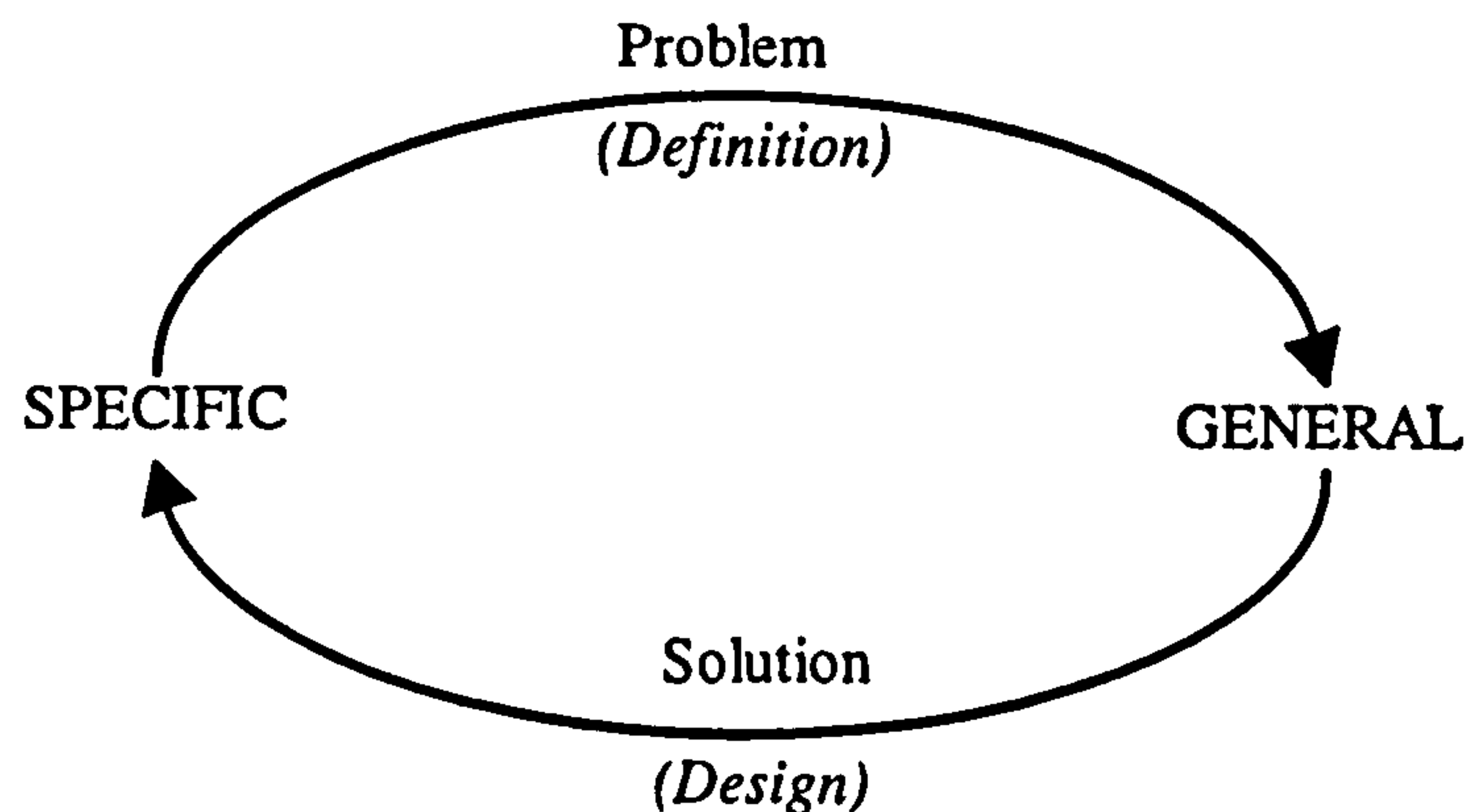


Figure 7-3: The Inter-related Nature Of Design and Problem Definition

Both Turner (1987) and Malhotra et al. (1980) differentiate IS design from more structured problem-solving by an absence of well-defined goals. In empirical studies of dialogues between designers and clients, Malhotra et al. (1980) observed that designers reframed subproblems to fit an available solution and found that design goals were often partial, implicit and unstated - they were uncovered only when the user stated a system requirement which conflicted with them. They concluded that problem-framing and solution-synthesis were interrelated: problems and solutions converged towards completeness.

So not only is the problem unclear at the start of the process, but the *goals* of the design are also ill-defined in this perspective of problem 'solving' - unlike Checkland's perspective, where one structures the problem situation through defining the goals of a solution. The situated action school of thought considers complication of the problem understanding an aim, rather than complexity-reduction (Boland et al., 1994). Organisations are "organised anarchies" in which people discover analysis and design goals from what they are doing: the processes of bargaining, learning and adaptation (Clegg, 1994).

Turner (1987) argues that "requirements and solutions migrate together towards convergence" and that the process of designing information systems is subjective as well as emergent:

"Design appears to be more ad hoc and intuitive than the literature would lead us to believe, solutions and problems are interrelated and the generation of solutions is an integral part of problem definition. Problems do not have only one solution; there may be many. Consequently, design completeness and closure cannot be well-defined. There are two categories of design factors: subjective and objective. Objective factors follow from the subjective concepts on which designers model the system. The difficulty in the past is that we have not acknowledged, explicitly, the presence of subjective factors, with the result that, in many cases, objective factors appear to be arbitrary." (Turner, 1987).

Such subjectivity in design problem-investigation is linked with "opportunism" in design (Guindon, 1990a, 1990b; Khushalani et al., 1994). Ball & Ormerod (1995) review the notion of opportunism in system design, which they define as deviation from top-down (decompositional, breadth-first) design approaches and compare opportunistic design with the more structured problem-solving approaches observed in earlier studies of software design. They conclude that much of the structure observed in the early studies of design arose from the more structured nature of the problems set for subjects in experimental situations.

Opportunistic design strategies naturally fit with the prototype or evolutionary systems development approach which permit "learning by doing" (Jeffries et al., 1981). Schön (1983) describes this type of planning through his description of design as "art", which he bases upon the concept of "reflection-in-action"; this concept describes purposeful action which calls on tacit knowledge for its execution. The concept is best described in Schön's (1983) own words:

"Even when he [the professional practitioner] makes conscious use of research-based theories and techniques, he is dependent on tacit recognitions, judgements and skillful performances." (Schön, 1983, page 50).

This perspective is contrasted with Simon's (1973) 'rational' problem-solving model by Dorst and Dijkhuis (1996), in Table 7-2. A critical feature of this perspective is that *each design problem is viewed as unique*: solutions cannot be analysed, only inductively synthesised from the social constructions of designers.

Item	'Simon'	'Schön'
designer	= information processor in an objective reality	= person constructing his/her reality
design problem	= ill-defined, unstructured	= essentially unique
design process	= a rational search process	= a reflective conversation with the situation
design knowledge	= knowledge of design procedures and 'scientific' laws	= the artistry of design: when to apply which procedure/piece of knowledge
example/model	= optimisation theory, the natural sciences	= art/the social sciences

Table 7-2: The rational problem-solving paradigm and the reflection-in-action paradigm contrasted (Dorst and Dijkhuis, 1996)

The critical processes of design thus become the exploration, representation, sharing and *evolution* of partial, emergent design goals and the inductive assessment of when a satisficing solution has been reached. This perspective is echoed in the work on modelling design rationale, where the importance of generating and recording subproblems - also referred to as microproblems (Lewis et al., 1996) - is a central concern in making design decision-making visible.

The focus is no longer on the individual designer as *decision-maker*, but on the individual as "*conversation-maker*" (Boland et al., 1994), both through reflective action and through interaction with other stakeholders in the design. Human-beings do not plan actions which are followed through without reflection, but are guided by partial plans which are locally contingent upon the context of activities and material conditions involved in the problem situation (Suchman, 1987). Design problems and partial, ill-defined design goals emerge from the processes of engaging in design activity (Hutchins, 1990, 1991, 1995). This concept can be assimilated with the concept of emergent strategy proposed by Mintzberg and Waters (1985): design problem and goal conceptualisations emerge or are discarded continually through the duration of a design.

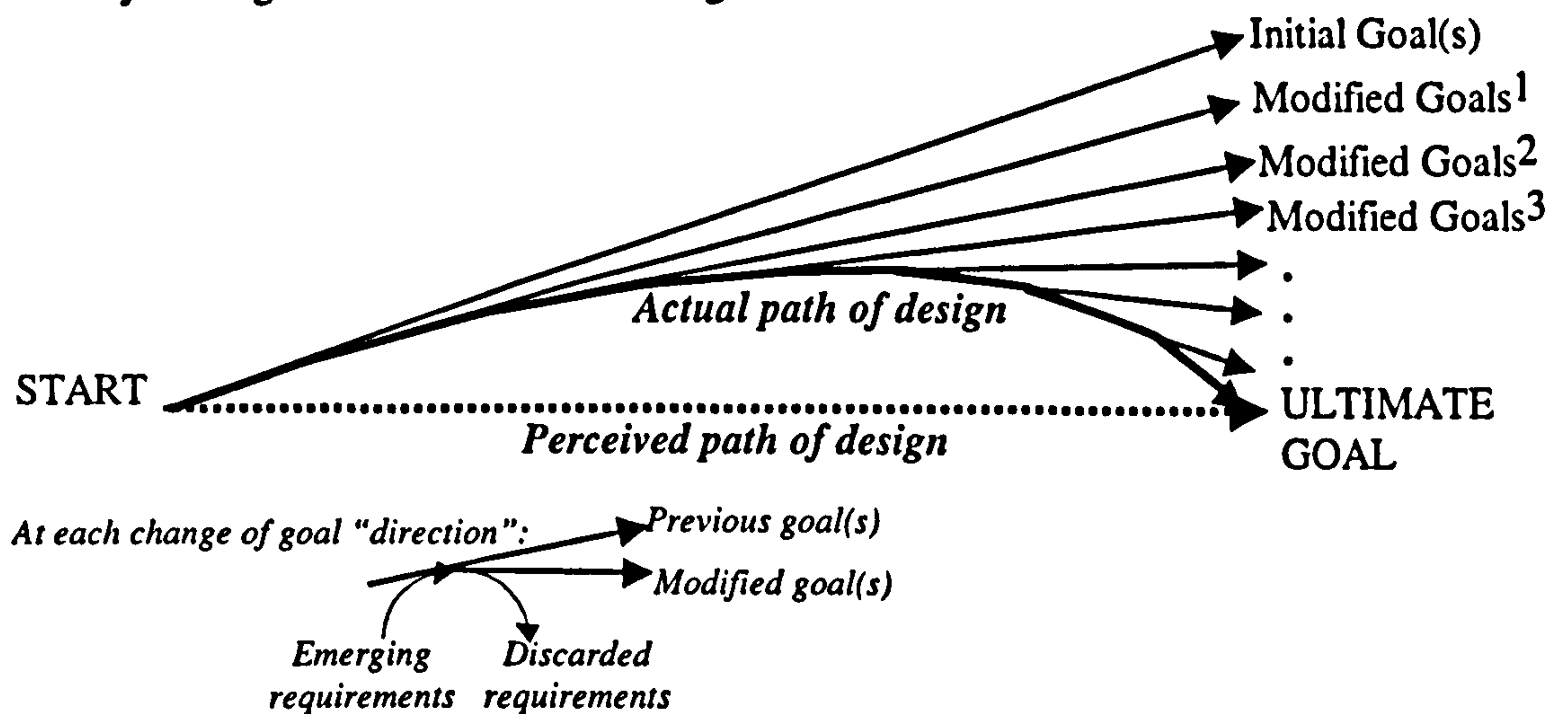


Figure 7-4: The Implications Of Emergent Design

The implications of emergent design are illustrated in Figure 7-4. Goals are constantly evolving with an understanding of the design and the actual path of design is much more complex (and longer) than that perceived by actors external to the design process, who only see the start and end points of the design. This model may explain why timescales always 'slip' in IS development projects - a common comment from those not involved in such projects is "why did it take you so long?". A critical process of design must therefore be the management of external perceptions of the design process, particularly those of the

“global network” (Law & Callon, 1992) - the informal network of influential decision-makers affected by, and indirectly attached to a design project.

7.2.6 Discussion Of The Critical Processes Of Design

This section addressed the fourth and fifth research issues.

➤ *What are the critical processes of information system design?*

Problem-solving perspective	Prescribed process for problem resolution	Metaphor for organisation	Assumed nature of problem	Nature of problem-exploration	Critical processes of design
Rational (functional analysis)	Decision between all alternative solutions (parallel analysis)	Machine	Unitary, well-structured	Problem solving	Assessing alternative solutions for optimality
Bounded rationality (problem-solving)	Sequential analysis of solution alternatives	Brain	Ill-structured: reducible to well-structured sub-problems	Problem structuring	Assess alternative solutions against minimal, satisficing set of criteria
Systemic (problem-setting)	Exploration of problem situation; achieving consensus on desirable & feasible action	Web	Multiple, inter-related & socially constructed & static	Collective enquiry and problem-search	Shared investigation of and learning about a problem situation; Structuring problems to explore solutions
Emergent (evolutionary learning)	Inductive convergence of emergent problem & solution definitions	Organism	Multiple, inter-related, socially constructed & dynamic	Reflective action: learning-by-doing	Discovering partial, dynamic goals and solutions; managing external perceptions.

Table 7-3: Four Perspectives On The Resolution Of Organisational Problems

A synthesis of the four organisational ‘problem-solving’ perspectives discussed above is given in Table 7-3. It can be seen from this table that the critical issues of design differ, depending upon the perspective of problem-solving which is adopted.

According to Stage & Matthiassen (1992) the basic characteristics of a design situation may be described in terms of their degree of uncertainty and their degree of complexity, while approaches to design may be characterised as analytical (expressed through requirements specification) or experimental (expressed through prototyping). There are two modes of operation in approaches to design: analytical and experimental, which are used by designers to reduce complexity and uncertainty respectively. Stage & Matthiassen’s (1992) ‘*principle of limited reduction*’ states:

“ Relying on an analytical mode of operation to reduce complexity introduces new sources of uncertainty requiring experimental countermeasures. Correspondingly, relying on an experimental mode of operation to reduce uncertainty introduces new sources of complexity requiring analytical countermeasures.” (Stage & Matthiassen, 1992, page 173) .

From the above discussion of problem-solving conceptualisations, it can be seen that there are radically different ways of ‘seeing’ the design ‘problem’ (or problem situation) and each way has different methods for reducing problem uncertainty and complexity. Figure 7-5 maps the perceived degree of complexity and uncertainty with respect to the product

of design (the design 'problem'). This framework permits an analysis of how a changing perception of the design *product* affects the *process* of design.

Uncertainty	High	Vague problem definition: <i>aim is to clarify nature and boundary of problem</i> (2)	'Wicked' problems: <i>aim is to both clarify and simplify/separate problems</i> (4)
	Low	Unitary, well-defined problem: <i>decompositional approach feasible</i> (1)	Multiple problem definitions: <i>aim is to simplify and conceptually separate problems</i> (3)
		Low	High

Complexity

Figure 7-5: Uncertainty Vs. Complexity In Information System Design

It should be stressed that this framework represents individuals' *perceptions* of the design problem, which may predicate the design approach chosen. Quartile 1 is the 'holy grail' of traditional IS design. Low complexity, coupled with low uncertainty as to the design problem make solution requirements specification and decomposition straightforward: this is the basis of the waterfall model. At the opposite end of the design spectrum, high uncertainty, coupled with high levels of complexity in the perceived problem (quartile 4) indicate a 'wicked' problem. The designer's natural reaction to this perception may be to move the problem into one of the other quartiles of the matrix by applying a reductionist design approach, aimed at reducing either problem uncertainty or problem complexity, in order to make the design problem more manageable (permitting the designer to reduce or simplify the problem). *Each of the four perspectives discussed above deals with complexity and uncertainty in different ways.*

1. The *rational perspective* (design as functional analysis) reduces complexity by applying scientific reductionism to the problem so that the problem as defined is well-structured and uncontentious. Uncertainty is not an issue as the problem is seen as unitary and well-structured.
2. The *bounded-rationality perspective* (design as problem-solving) sees the problem-solver as reducing an unstructured problem to a set of well-structured sub-problems; this process reduces complexity, but leaves uncertainty to be dealt with by the application of scientific reductionism in defining sub-problems.

3. The *systemic perspective* (design as problem-setting) sees complexity as a necessary (and therefore not undesirable) facet of organisational problem situations. Uncertainty is reduced through the negotiated definition of problem scope (the "system boundary") and achieving consensus on system definition; complexity is managed, rather than being reduced, by the shared learning which accrues through the joint exploration of shared "system" definitions.
4. The *emergent perspective* (design as evolutionary learning) sees both complexity and uncertainty as natural and not necessarily reducible. Complexity is dealt with, to some extent, by the learning-through-doing which accrues from "reflective action" (Schön, 1983) but uncertainty can only be managed in the short-term, by the definition of intermediate goals which are accepted as partial in nature. In the longer-term, uncertainty may be viewed as productive, as it leads the individual to engage in reflective learning.

➤ *How does the situated, emergent nature of IS design affect the critical processes of IS design?*

The situated, emergent nature of IS design can be viewed as one of the four perspectives presented in this section. The critical processes of design are concerned with the more or less objective analysis of solutions to design problems, for the first two perspectives of design as functional analysis and as problem-solving. The perspective of design as problem-setting sees the exploration and definition of suitable design goals and boundaries as critical. But the situated, emergent perspective moves away from the idea that problems or design boundaries may be defined in advance: design is seen as a continuing process of defining, exploring and adapting target system goals through the reflective action involved in design itself. The critical processes of design are thus concerned with reflection, learning, negotiation and adaptation, for this perspective.

These perspectives are, to some extent, incommensurable. Although some ideas are held in common across perspectives, each has arisen as a response to perceived inadequacies in design practice and represents a paradigm held by designers. It is likely that design methods based upon a situated, emergent paradigm would not radically affect the approach to problem-solving taken by those operating under one of the other perspectives. The following research question thus arises.

Research question: How do differing perspectives on the nature of problem-definition and analysis/investigation affect organisational actors' approaches to information system design processes?

A major problem with all of the above perspectives is that design is viewed as pertaining to the individual. Even the systemic perspective does not concern itself with how a solution is achieved by a group of designers, acting in concert. The nature of design cognition within an organisational IS *development team* is addressed in the next section.

7.3 Social Cognitive Aspects Of Design

This section addresses the sixth research issue derived in Chapter 2:

- *How do “communities of sustained practice” (Lave, 1991) function and how may they be facilitated in the processes of the design of effective organisational information systems?*

Social cognition is primarily concerned with the *framing* processes of design (Hirschheim & Klein, 1992), which arise from the subjective exploration of “wicked” problems (Rittel, 1972). Framing may be seen as “providing the ordering of activities and meanings whereby ontological security is sustained in the enactment of daily routines” (Giddens, 1984, page 87). This ordering is managed by an interactive interpretation of organisational rules, where actors jointly and discursively make sense of the activities in which participants engage. Verbalisation of joint frames means that they can be invoked in ways that *implicitly* formulated rules cannot be: rules become explicitly defined through the interpretations applied to them by actors in particular circumstances (Giddens, 1984). Actors both control and are controlled by such frames.

The design of organisational information systems is a *social* process, achieved through argumentation and negotiation (Rittel, 1972; Walsham, 1993a); it involves the negotiation and merging of ‘technological frames’ (Orlikowski & Gash, 1994; Davidson, 1996). The social cognitive perspective recognises that these processes take place at different levels; to this end the layered framework of Curtis et al. (1988), which was presented in chapter 2, is used to structure the discussion contained in this section. Social cognitive aspects of design are discussed from the three perspectives of this framework: individual cognition, group cognition and organisational ‘cognition’. While the brain metaphor is widely used in the re-use by much IS development literature of the concept of the ‘learning organisation’ (Argyris & Schön, 1976), the organism metaphor is more appropriate here, as in Weick’s (1979) conception of an organisation as a dynamic body of thought and social interactions.

7.3.1 Individual Cognition In Design

7.3.1.1 Schemas, Frames and Mental Models

Theories of design which operate at this level centre upon the concept of *schemas*: “a schema is an abridged, generalized, corrigible organization of experience that serves as an initial frame of reference for action and perception” (Weick, 1979).

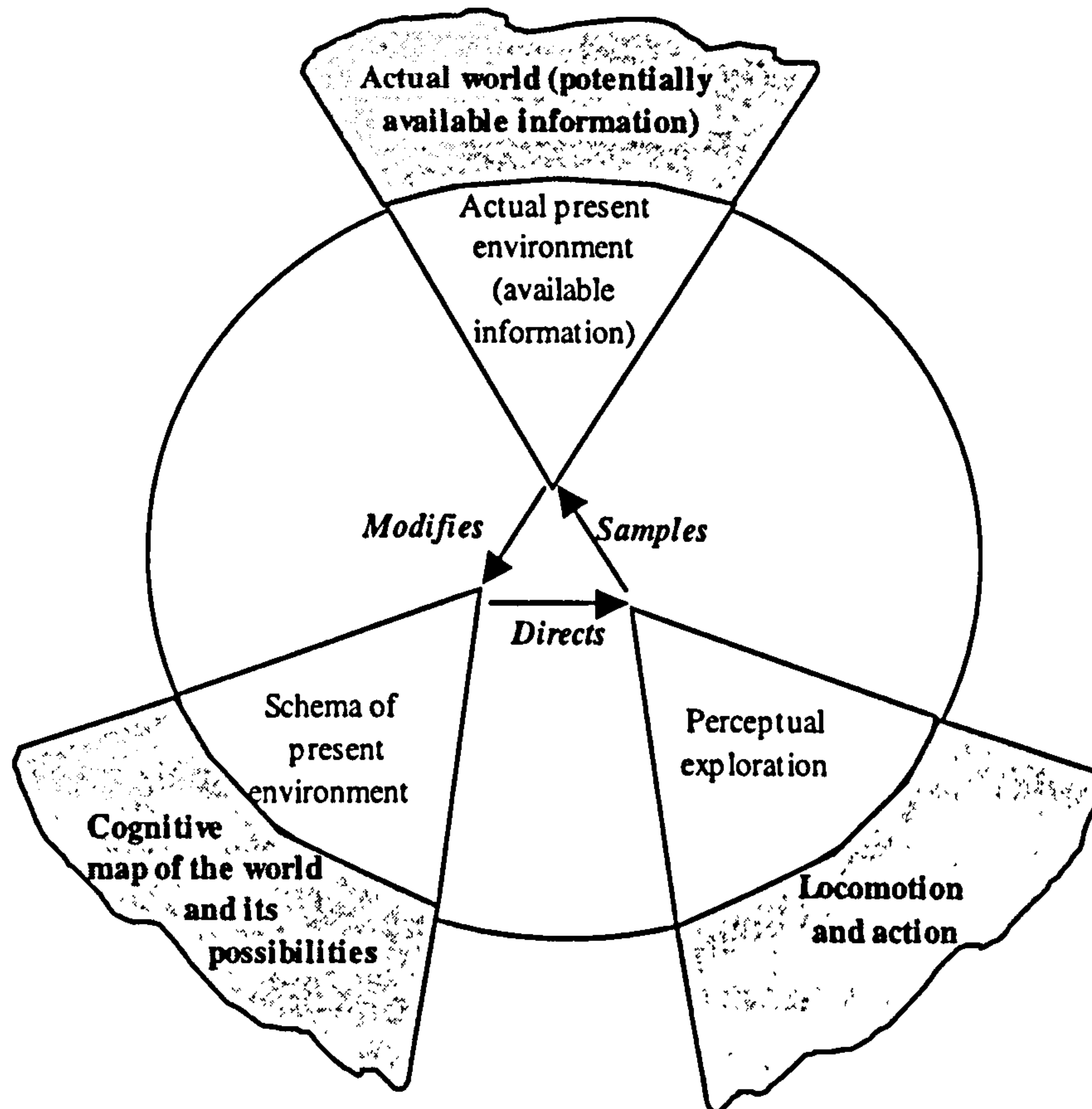


Figure 7-6: Neisser's Perceptual Cycle (Weick, 1979, after Neisser, 1976, page 112)

Schemas are cognitive structures that represent organised knowledge; they are conceptualised as subjective theories derived from the individual's experiences of how the world operates (Markus & Zajonc, 1985). Weick (1979) gives the model shown in Figure 7-6 as an illustration of how schemas direct action; this cycle is seen as continuous. An existing schema directs perceptual exploration of the environment, which samples information from the environment to modify the existing schema, and so on. Schemas can therefore be seen as the cognitive structure underlying an actor's 'theory-in-use' (Argyris & Schön, 1978); they become more complex, abstract and organised with experience: this is pertinent in the area of design, where experience is valued because of the increased ability for abstraction (Vitalari & Dickson, 1983).

Several types of schema may exist (Markus & Zajonc, 1985). In particular, individuals may hold schemas which concern their self-image, organisational roles, and scripts, which are seen as action/event schemas (Markus & Zajonc, 1985), which are associated with

'mental models' (Gentner & Stevens, 1983; Norman, 1986, 1988, 1991, 1992). Mental models are distinct from schemas in that they are seen as dynamic entities, constituted from the interplay between the schemas which represent different knowledge domains (Finke et al., 1996). As such, they bypass a major limitation of schemas, which is that schemas and scripts are seen as static and, as such, constitute a constraint upon learning (Finke et al., 1996; Markus & Zajonc, 1985): schemas distort information-processing by "filling gaps" in knowledge to be consistent with the existing schema, rather than instituting information-search. Mental models are seen as partial, adaptive and satisficing; they are incomplete, unstable and may be partly *ad hoc* (Eysenck & Keane, 1990). Eysenck & Keane (1990) note that the term 'mental model' is used inconsistently in the cognitive psychology literature: sometimes it is used to refer to a static, representational construct, which can be verbalised (and thus is nearer to the concept of schema, as defined here, than that of mental model) and sometimes it is used to refer to a composite, dynamic construct, which is held implicitly (which is nearer to the concept of 'technological frame' as used by Orlikowski & Gash (1994)). I observed that the terms 'script', 'schema', 'frame' and 'mental model' are used inconsistently and unreflectively across much of the literature on cognitive aspects of design. For example, Orlikowski and Gash (1994) use the term "technological frames" to refer to shared cognitive structures that concern technology. Whilst this is an interesting addition to knowledge in this area, it is unhelpful to create a term which refers specifically to technology in an area where the primary academic argument is that the term 'information system' embodies social as well as technical arguments. In the context of this work, unless authors have used specific terms, I use the term "mental model" to denote an individual's cognitive model with respect to an issue or concept, "frame" as a verb, to denote the framing (the unconscious construction and modification) of mental models and refer to shared, intersubjective or distributed mental models, rather than "technological frames".

It is useful here to distinguish between the HCI literature and that of cognitive psychology. although both literatures have been used to inform this research, Rogers (1992) warns about the problem of granularity in using the two literatures interchangeably. The literature on cognitive psychology uses constructs such as schema and mental model to refer to cognitive constructs which are researched empirically using techniques of micro analysis, such as detailed observation or protocol analysis. Whilst the same terms are used in the HCI (and IS) literature, these terms are largely used as convenient constructs to explain phenomena which are investigated using macro techniques, such as case study

analysis or interview protocol analysis; they will be used as such here and are not intended to form the basis for detailed psychological study. Although the cognitive structures have proved difficult to measure and to specify (Davidson, 1996; Markus & Zajonc, 1985), these concepts provide a useful theoretical tool with which to explain differences in framing, perspective and individual motivations in design contexts.

Orlikowski and Gash (1994) suggest that the social cognitive processes underlying IS development have a major influence on the ways in which organisational actors conceptualise and interpret information technology and hence affect the outcomes of information systems development. They explain technology change outcomes in terms of significant differences in key actors' technological frames: the "assumptions, expectations and knowledge of the technology, which then serve to shape their subsequent action towards it" and stress the often shared nature of these frames, which leads to intersubjectivity: the assumed basis of interactions at the group and organisation layers. They note that these conceptualisations (i.e. mental models) are significant, but have not been systematically studied in IS research and that little theoretical or empirical work exists on social cognitive processes in IS development.

Weick (1979) observed that schemas guide the search for, acquisition of, and processing of information and guide subsequent behaviour in response to that information. These, explicit elements of human behaviour are observable, which permits behavioural, phenomenological or hermeneutic study (as distinct from experimental, cognitive study, as found in the area of cognitive psychology) of the operation of design schemas in action. The basis of individuals' schemas and mental models may be conveyed by the analysis of organisational 'stories' and 'legends' (Hirschheim & Klein, 1989; Mitroff & Kilmann, 1975) use of metaphor (Hirschheim & Klein, 1989; Morgan, 1986; Walsham, 1993b), by specific language acts which reinforce the intersubjective nature of meaning within the design team (Lanzara, 1983; Lyytinen, 1987) and by an analysis of other communication mechanisms, such as external representations of a design (Flor & Hutchins, 1991).

Research question: how are individuals' different mental models manifested in design and are individuals aware that they hold different models from other individuals?

7.3.1.2 Domain Knowledge and Learning In Design

Design expertise is also associated with the development of knowledge schemas: knowledge structures abstracted from previous attempts at understanding and solving similar problems, which incorporate an understanding both of appropriate solutions for this type of problem and also of appropriate processes for design of this type of system

(Rumelhart & Norman, 1981; Jeffries, Polson, Turner & Attwood, 1981; Norberg & Bansler, 1992). But organisational design problems are characterised by a lack of rule-based criteria for when the design is complete and by an incomplete specification of design goals. In their search for appropriate solutions, designers must punctuate the retrieval of known solutions with the recognition of partial solutions at different levels of abstraction and the creation of new solutions (Guindon, 1990b), this is best achieved through argumentation and negotiation (Rittel, 1972) and communication is critical to this process (Curtis et al., 1988).

Winograd & Flores (1986) define design as "the interface between understanding and creation", making the point that an artefact only exists as an objective entity when it breaks down. In its use, one is concerned with how it is used, not its nature. One cannot understand a technology without having a functional understanding of how it is used; that understanding "must incorporate a holistic view of the network of technologies and activities into which it fits" (Winograd & Flores, 1986, page 6). Understanding on the part of designers is achieved only when the assumptional framework already held by a designer breaks down in the face of new information about its function. The concept of an artefact being "ready-to-hand" (Winograd & Flores, 1986, *after* Heidegger, 1962) - the intuitive congruence between the user and the technology-interface - is central to the effective design of computer systems. This coupling is not obtained from an intellectual understanding of the functional and business requirements of the system, but from an inductive understanding of the *use* of the system in a functional and business context (Norman, 1986, 1988, 1991, 1992; Winograd & Flores, 1986). A *breakdown* (the cognitive limitation and/or lack of knowledge which leads to the properties of an object being made explicit, rather than using the artefact unreflectively) occur when an external event causes the individual to question their mental model of an artefact (Winograd & Flores, 1986). Madsen (1989) describes this point as that at which "detached reflection becomes necessary"; the *explicit nature* of a concept requires to be defined.

The implicit nature of mental models of technical artefacts is conceptualised in Norman's (1986, 1988) model of design, given in Figure 7-7. Meaning is defined through use of the artefact, which leads to the construction of an information system user's mental model of the artefact. Norman (1988) gives the following explanation of this model:

" The design model is the designer's conceptual model. The user's model is the mental model developed through interaction with the system,. The system image results from the physical structure that has been built (including documentation, instructions and labels). The designer expects the user's model to be identical to the design model. But the designer does not talk directly with the user - all communication takes place through the system image. If the system image does not make the design model clear and consistent, then the user will end up with the wrong mental model." (*ibid.* page 16).

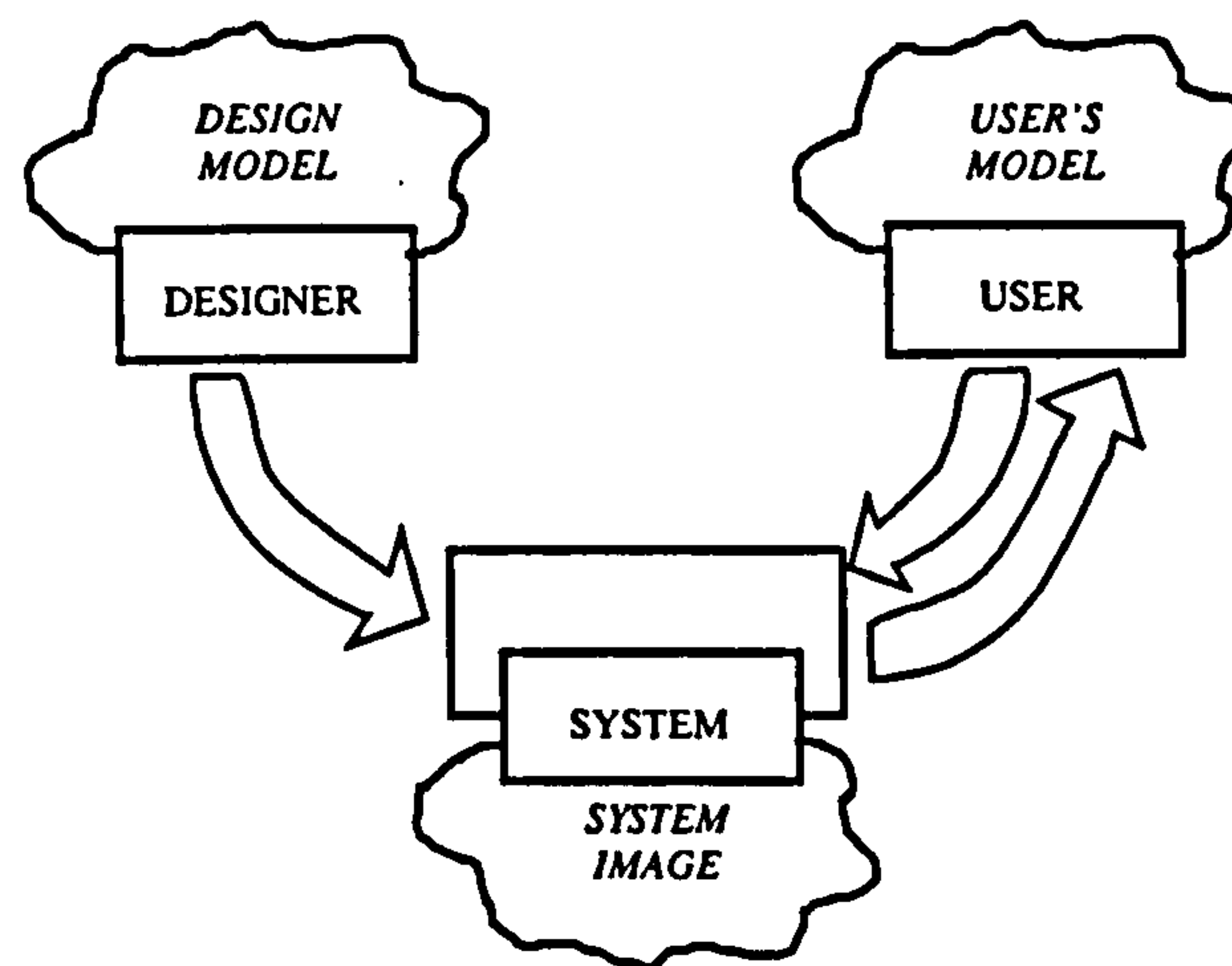


Figure 7-7: Conceptual Models in Design (Norman, 1988, page 16)

Design in this model is seen as the assimilation of conceptual models of the system artefact; the model presents these conceptual models communicated through the *system image*, which is created through the processes of design (Norman, 1986). Neither users or designers can fully understand the artefact except through its use; this is analogous to Schön's (1983) concept of reflection-in-action.

The concept of domain learning is significant in an appreciation of how mental models function in design and may be useful in explaining why developed information systems so often fail to meet user-expectations. Learning is situated in the context of design: abstract and concrete are false concepts, as abstract representations are meaningless unless they can be made specific to the concept at hand (Lave & Wenger, 1991). Vitalari & Dickson (1983) conclude that developers attempt to classify problems and relate them to previous experience. They argue that effective, experienced designers are able to abstract problems to a higher degree than ineffective or inexperienced designers, but this may be because "expert designers" have a deeper understanding of the application domain than others (Curtis et al., 1988). Highly-rated designers have been observed to prioritise the quality of user-designer relationship; this indicates an implicit recognition of the importance of user-domain learning in the process of design (Vitalari & Dickson, 1983).

Two different types of mental model can be distinguished from the literature (Booth, 1989): conceptual models, which represent an individual's model of the purpose and function of an artefact or system and procedural models, or task-action-mapping models, which represent an individual's model of the way in which an artefact or system should be used, to achieve a certain result. It should be noted that Norman (1986, 1988, 1991, 1992) uses the term "conceptual model" inconsistently and in a way which does not conform to the use of this term in the cognitive mental models literature. Norman usually uses this term to indicate the system image embodied in the physical artefact (although sometimes

he uses the term to indicate the way in which the term is used here). The extent of psychological fit between a technical artefact and user-tasks could therefore be described the relationship described in the model of Figure 7-8.

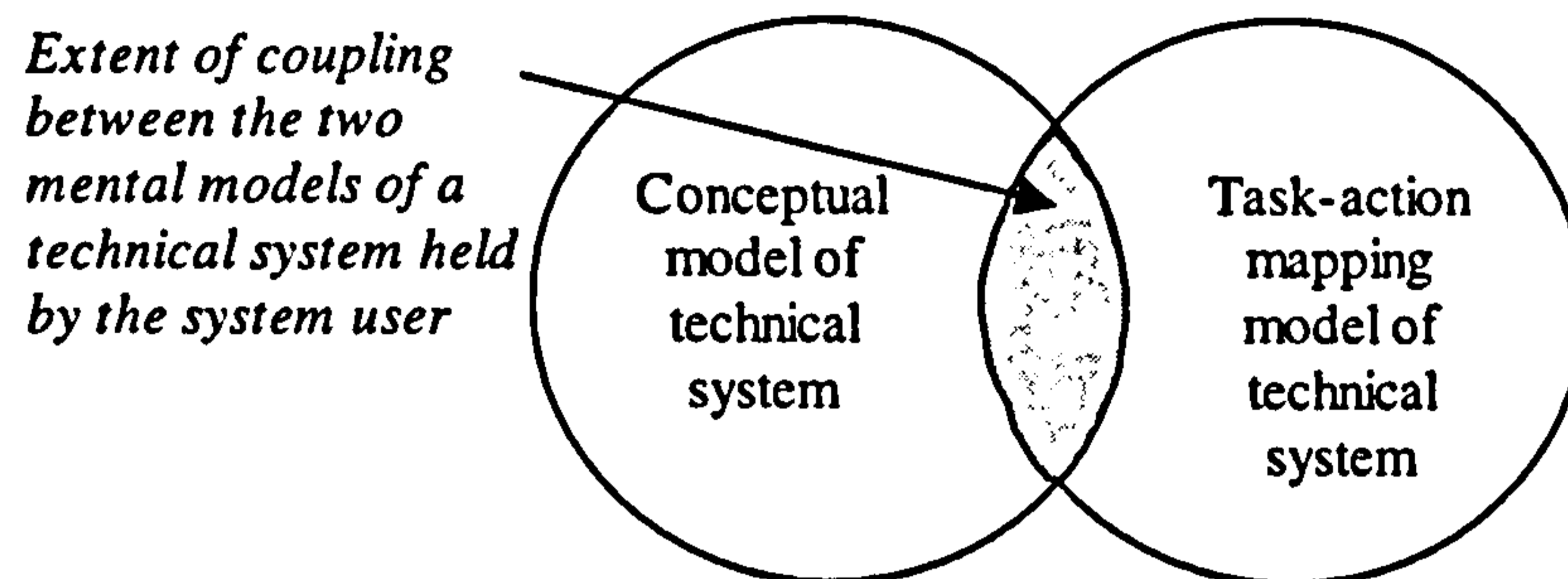


Figure 7-8: Coupling Between A User's Conceptual Model Of A Technical Artefact And Their Task-Action-Mapping Model

The closeness of the coupling between the two mental models of the technical system held by the user (shown as the extent of intersection between the two models in the diagram) determines the quality of the design, in terms of support for user work-tasks. A user will find a technical system intuitive to use if the operations which require to be performed are closely coupled with the tasks which the user wishes to achieve. A car's steering system is an example of a closely-coupled technical system: the driver turns a wheel on the interface to the steering to make the car's wheels turn; the steering-wheel is turned in the direction which the driver wishes to go. A user-centred design approach should therefore concentrate on maximising the coupling between the two mental models of a new technical system. A major problem with traditional approaches to design is that the designer assumes that s/he is representative of a typical user in the way in which s/he approaches work tasks. Not only are technical professionals less sociable and more goal-driven than the average system user (Hoos, 1976), but also the technical professional suffers from only seeing the explicit reasoning which pertains to work tasks: the espoused theory of work and not the theory-in-use (Argyris & Schön, 1972). An effective user-centred design approach must therefore centre upon eliciting users' mental models and ensuring that these models are embodied in the system image presented to the user. Wood and Wood-Harper (1993) recommend that mental models be formulated on *emulation*, emphasising "the familiar use of the user's knowledge" through the analogies and metaphors of an existing system, and *innovation*, exploiting representational properties of the new technology to emphasise "new ways of thinking and doing". By this means, both the user's conceptual model and the task-action mapping model might be elicited. The cognitive psychology literature on mental models is closely aligned with theories derived from research on information system design processes, which suggests that

designers construct a 'design schema'. Jeffries et al. (1981) stress the importance of 'learning by doing': experience enables concepts to be linked on the basis of the utility of keeping the concepts together and provides a coherent executive model of the processes of and of possible appropriate solution forms to design problems: in design teams this becomes a shared design schema. Studies of design behaviour (e.g. Jeffries et al., 1981; Guindon, 1990a, 1990b; Khushalani et al., 1994; Malhotra et al., 1980; Visser & Hoc, 1990) have seen individuals' mental models as significant in determining design behaviour. Design requirements are often rooted in individuals' schemas to such an extent that they cannot be stated explicitly (Malhotra et al., 1980; Guindon, 1990a): such requirements only surface when they are in conflict with a requirement which is explicitly stated, for example in communications with users.

Detailed studies of design found in the literature, such as those discussed above, mainly concentrate upon experimental studies of program design. There seems to be a preoccupation with the optimality of problem decomposition strategies, based on the rational, problem-solving model, and a lack of interest in the selectivity of such strategies: the processes by which designers frame design goals. An exception is the study by Bansler and Bødker (1993), who refer to the mental model of the design held by individuals as a 'theory' which encompasses technical and social aspects of the situation at hand. Any formal system specification or 'system model' must be considered as subordinate to the individual's mental model, or 'theory', as the latter is more readily available. The quality of a design method must therefore be judged on its ability to support designers in building up their 'theory'.

Research question: what are the processes by which designers frame design models and what tools or methods are appropriate in supporting the construction of mental models by designers?

The value of mental models, or design "frames" as a research concept must be examined with respect to what they represent. The concept of situated action (Suchman, 1987) claims that psychological models, in terms of beliefs, goals, schemas, inferences, strategies etc., describe and explain patterns of behaviour of an agent-in-an-environment, not processes of the brain. As discussed in section 7.2.5, the situated action perspective views design as a cyclical process of learning about a situation, then planning short-term, *partial* goals (Suchman, 1987), which emerge from the process of design. The nature of design models is therefore emergent and dynamic, with learning, which is situated in the

context of design, being central to the construction of design framing. The sociocultural nature of such learning is explored in the next section.

7.3.2 The Group Level

7.3.2.1 Situated Learning and Design Practice: The Sharing Of Sociocultural Knowledge

In many, recent studies, design is seen as a socially-shared activity (Brown & Duguid, 1992; Lave, 1991) and learning is seen as central to situated design (Brown & Duguid, 1992; Lave, 1993; Lave & Wenger, 1991; Star, 1992). The importance of external artefacts and representations in clarifying design goals is stressed by empirical studies of design interaction (Flor & Hutchins, 1991; Norman, 1986, 1988, 1991; Star, 1992).

The situated learning perspective is grounded in the work of Lave (1988, 1991; Lave & Wenger, 1991). Lave's writings are concerned with the process of problem formulation and skill acquisition: she is concerned that cognitive theories of learning in the literature are inadequate as they suggest that all knowledge can be written down in symbolic models. The question of what constitutes cultural knowledge and how such knowledge is communicated and learned, through "legitimate peripheral participation", through which individuals are educated in the normative practices of a sociocultural group is explored in these writings. This concept is linked with that of situated action (Suchman, 1987), which claims that psychological models, in terms of beliefs, goals, schemas, inferences, strategies etc., describe and explain patterns of behaviour of an agent in an environment, not processes of the brain. Lave & Wenger (1991) stress the centrality of situated learning to "communities of practice". To master knowledge and skill legitimately, newcomers must "move towards full participation in the sociocultural practices of a community", as in an apprenticeship:

" Viewing learning as legitimate peripheral participation means that learning is not merely a condition for membership, but is itself an evolving form of membership. We conceive of identities as long-term, living relations between persons and their place and participation in communities of practice. Thus identity, knowing and social membership entail one another." Lave & Wenger (1991), page 53

The importance of normative practice is also recognised by Rosenbrock (1981), who sees this as a constraint upon social change in technical design: while technical professionals adopt existing sociocultural value systems, human-centred methods and approaches to design can have little impact. But this perspective ignores the dynamic nature of sociocultural systems: social groups are not static, but are affected by their changing memberships.

In empirical studies, Curtis et al. (1988) stress the centrality of group learning processes and the critical role played by an 'expert designer' in communicating application domain

knowledge to other team members. Expertise, according to Curtis et al. (1988) is not defined by technical knowledge, but by a valued operationalisation of technical knowledge in specific, local application domains. Communication and co-ordination activities are critical to design group functioning. In a study of small group design meetings, Olson et al. (1992) discovered that design teams spent only 40% of their time on direct discussions of design. The groups spent one-fifth of their time on "pure co-ordination activities" and *one-third* of their time on "clarification of ideas" - the sharing of expertise among group members. Walz et al. (1993) performed an observational study of design knowledge sharing and acquisition in videotaped design meetings; the authors "were surprised to see how important context-sensitive learning was to the design process". The issue was raised that much information was presented to the team during design meetings but never captured; Walz et al. (1993) do not examine whether this information was important and what prompted information capture.

Formal project documentation and design models - what Flor & Hutchins (1991) refer to as "external, structured representations" may play a significant role in the communication of situated knowledge in design teams. The way in which design information is represented fundamentally affects the way in which knowledge about that design is communicated and conceptualised (Simon, 1988; Winograd & Flores, 1986). Checkland & Scholes (1990) emphasise the centrality of the group learning which accrues from the production of joint models of the target object system during SSM workshops, to effective participation in organisational activity. Olson et al. (1993) observed that small design groups working with and without a group editor (which produced external structured representations of the design) generated more design ideas without the editor, but fewer and better ideas with it, indicating that the representations helped the supporting groups to remain more focussed on the core issues in the emerging design and to capture what was said as they proceeded. Flor & Hutchins (1991) note that external representations are critical in achieving intersubjective understanding; this concept is explored in the next section.

7.3.2.2 Intersubjectivity And Distributed Cognition

Curtis et al. (1988) conclude that "developing large software systems must be treated, at least in part, as a learning, communication and negotiation process." Designers have to integrate knowledge from several domains before they can function well. They identify the importance of designers with a high level of application domain knowledge: in their studies, these individuals were regarded by team members as "exceptional designers",

who were adept at identifying unstated requirements, constraints, or exception conditions, possessed exceptional communication skills. Exceptional designers spent a great deal of their time communicating their vision of the system to other team members, and identified with the performance of their projects to the point where they suffered exceptional personal stress as a result. They dominated the team design process, often in the form of small coalitions, which “co-opted the design process”. While these individuals were important for the *depth* of a design study, teams were important for exploring design decisions in *breadth* (ibid.).

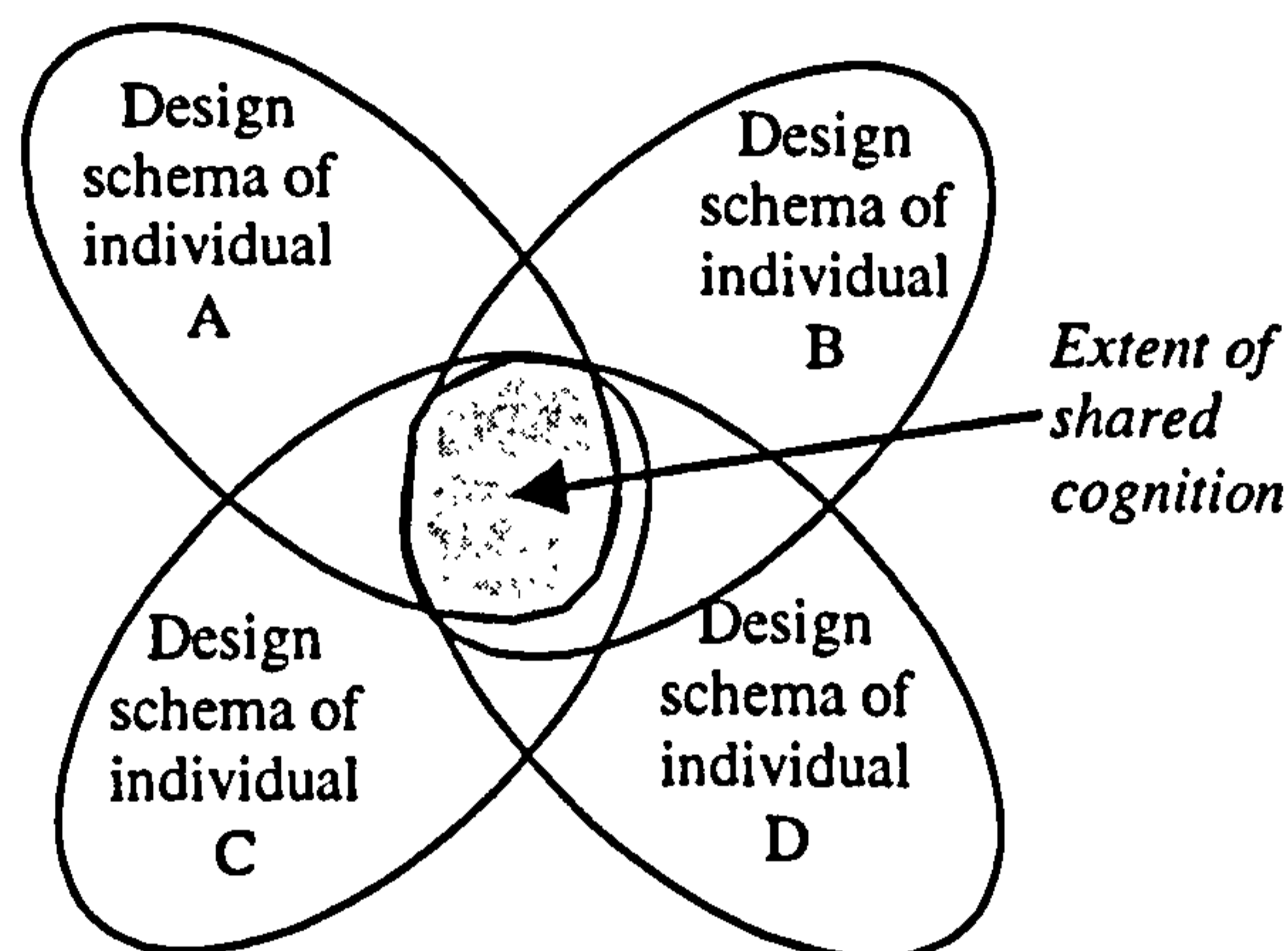


Figure 7-9: The Concept Of Shared Cognition (adapted from Laukkanen, 1994)

The acquisition of knowledge by design teams involves both *shared* cognition and *distributed* cognition. The concept of shared cognition is illustrated in Figure 7-9 and represents the extent of intersubjectivity (shared meanings) between organisational actors. Design depends upon intersubjectivity for effective communication between team members to take place (Flor and Hutchins, 1991; Hutchins, 1990, 1991, 1995; Orlikowski & Gash, 1994; Star, 1989). Technical system designers, “successful in sharing plans and goals, create an environment in which efficient communication can occur” (Flor and Hutchins, 1991). Orlikowski & Gash (1994), in a hermeneutic analysis of different interest groups’ assumptions, knowledge and expectations of a new groupware technology, refer to intersubjectively-held mental models as “shared technological frames”:

“ Because technologies are social artefacts, their material form and function will embody their sponsors’ and developers’ objectives, values, interest and knowledge regarding that technology” (Orlikowski & Gash, 1994, page 179).

The importance of intersubjectivity is emphasised by Lanzara (1983), who sees design as a dynamic process of framing and reframing of situations by a transactive process where different actors negotiate “their perspectives, values and (even!) facts”. The different metaphors used (*c.f.* Morgan, 1986), at different times or by different actors, to frame the target system lead designers to emphasise differing *objects* through the design methods

which they use. He gives the example of two extremes of metaphor in office systems design: the office may be seen as a "machine", in which case the object of design is functions and procedures, or it may be seen as a "community", in which case the object of design is conversations and transactions (Lanzara, 1983).

Little is known about how developers themselves perceive intersubjectivity or frames of reference (Flor and Hutchins, 1991; Orlikowski & Gash, 1994). Jeffries et al. (1981) stress the importance of 'learning by doing': experience enables concepts to be linked on the basis of the utility of keeping the concepts together and provides a coherent executive model of the processes of and of possible appropriate solution forms to design problems: in design teams this becomes a shared, intersubjectively-held design schema, which enables the team to function coherently.

The objects of different actors' frames of reference can be seen as distinct and may be in conflict (Corbett, 1995). Orlikowski and Gash (1994) note that the frames of reference of IT managers and designers affect their decisions to adopt a particular information technology and to implement specific features of that technology; whilst those of business managers and users affect the way in which the technology is interpreted and used in business processes. A critical design activity is therefore that of making stakeholders' frames of reference explicit and subject to debate, in the interests of intersubjectivity. There is a trade-off between intersubjectivity and the exploration of design alternatives: if group members possess too much common ground, they may communicate more efficiently but there may be less of a tendency to explore alternative courses of action (Flor and Hutchins, 1991; Wilson and Canter, 1993). An experimental study by Rugs & Kaplan (1993) stressed the importance of goal congruence (i.e. intersubjectively-held goals) in group decision-making. As might be expected group (shared) goals facilitated greater *normative* influence upon decision-making (based upon social relations) and task goals facilitated greater *informational* influence (based upon evidence about reality). The implications for design teams are that effective consideration of organisational design requirements is only possible when there is a high degree of divergence between individuals' models, whereas effective synthesis of solutions requires much higher levels of intersubjectivity. Viewed from this perspective, the separation of requirements analysis and design makes sense: in the early stages of design, members of a design-team are likely to hold diverging models of design requirements and goals and thus cannot effectively synthesise solutions; during later stages, levels of intersubjectivity may be higher and so solution synthesis could proceed more effectively. However, one should distinguish

between co-operative design (where all design team members are working on a solution for the same subproblem) and co-ordinated design (where design team members synthesise solutions to different subproblems which are then brought together in a system solution): the former may require high levels of intersubjective understanding, the latter may function through distributed cognition.

Design activities do not just take place at the *individual* cognitive level, but also involve *distributed* cognition (Norman, 1991; Hutchins, 1990, 1991, 1995) in the social processes of negotiating design requirements and joint elicitation of design solutions. Distributed cognition implies interdependency between actors' individual schemas:

“Distributed cognition is the process whereby individuals who act autonomously within a decision domain make interpretations of their situation and exchange them with others with whom they have interdependencies so that each may act with an understanding of their own situation and that of others.” (Boland et al., 1994, page 457).

Hutchins (1990) describes the distributed mental models of the situation accessed by an aeroplane cockpit crew in plotting a course when control equipment broke down. No one actor held a complete model of the situation, but individual actors held both partial models of the solution and a process model which enabled them to co-ordinate other actors' partial models to reach a complete solution. Hutchins (1991) studied how the social organisation of distributed cognition affects the cognitive properties of groups in a study of how communities arrived at shared versus differing understandings. He concluded that cognition in this type of situation is shared among agents in organisationally-prescribed roles and also among the artefacts that they use, such as work-procedures, charts, plans and routines for route-calculation - i.e. that models of how a situation may be handled are embodied in the artefacts used to expedite its handling. This echoes the work of the actor-network theorists (e.g. Callon, 1991, Law, 1992; Latour, 1987), in treating technological artefacts as 'non-human actors' in the analysis of the 'web' of distributed interactions in organisational decision-making. This perspective is discussed further in section 7.3.3. Star (1989) addresses the process of combining evidence from different perspectives, in terms of how decision-group participants decide that sufficient, reliable, and fair amounts of evidence have been collected. Star discusses two studies, one of two different groups of physiologists and one of two different groups of biologists, making the following observations:

- Different groups can co-operate without having good models of each other. They can successfully work together while employing different units of analysis, methods of aggregating data, and different abstractions of data

- Different groups can co-operate although they have different goals, time horizons, and audiences to satisfy
- Co-ordination activities are supported by creating "boundary objects" which can be adapted locally to needs and constraints while maintaining a global identity.

The concept of boundary object is also raised by Norman (1992) who refers to cognitive aids used by commercial aeroplane crews. Individuals created artefacts to better understand the state of affairs in the cockpit, such as metal or plastic tabs that pilots move around the outside of the airspeed indicator to help remember critical settings. Crews used checklists to provide a mechanism for shared understanding and group memory. A member of the crew reads the list while others perform appropriate operations or checks - using this mechanism, the entire crew is informed about the state of the aircraft and a record of actions performed and the current state of the aircraft is kept. Designers in the study by Flor & Hutchins (1991) were observed to use external structured representations as a means of sharing knowledge.

Empirical evidence as to how design is managed in groups is inconclusive and scarce. There is evidence to show that intersubjective understandings are key to group design (Flor & Hutchins, 1991) yet there is evidence from studies of non-design group processes which involve co-ordinated action to indicate that *distributed* understanding - actors holding only partial mental models which are interdependent upon other actors' partial mental models for effective action - is also critical. There is some evidence to show that design is a collective *learning* experience: information systems designers jointly develop an intersubjective model of the system on which they base their design assumptions (Curtis et al., 1988; Flor and Hutchins, 1991; Reynolds & Wastell, 1996; Walz et al., 1993. But here is little evidence of how intersubjectivity and distributed cognition are achieved and maintained in design groups: what processes and criteria are involved in determining if information is significant and in sharing or emphasising significant information? The concept of distributed cognition implies that design groups adopt satisficing, rather than optimising behaviour in design: individually, each team member does not have the cognitive capacity to understand the whole of a complex system, but individuals construct partial models of the problem situation, expecting that a co-operative design outcome will result from coherent group co-ordination in design.

So from an individual design focus of imposing structure upon a problem situation to facilitate convergence between a design problem-definition and potential partial solutions, we have reached a group design focus of co-ordinating and sharing partial design

solutions. Lave (1991) suggests that the process of socially shared cognition should not be seen as ending in the internalisation of knowledge by individuals, but as a process of becoming a member of a "community of sustained practice". Design groups need to maintain intersubjectively-held mental models of design goals and process, if they are to function effectively, yet each group-member may only hold a part of the knowledge and understanding necessary for design to take place. A group of individuals can pool their partial models to perform design activities through the mechanism of distributed cognition. This may be achieved through the shared meanings attached to artefacts used in common by a group - "boundary objects" (Star, 1989; Norman, 1992) - but there is only one study (Flor & Hutchins, 1995) which examines how such distributed models are maintained and this focussed on the extent to which external representations of the design were shared in a single experiment involving two programmers. Whilst some studies examine shared knowledge and learning in IS design (e.g. Curtis et al., 1988; Reynolds & Wastell, 1996; Walz et al., 1993), they do not examine how individuals frames of reference contribute to group perspectives of the design and how these group perspectives are constructed and maintained. The creation of 'communities of practice' (Lave & Wenger, 1991) is critical to co-ordinated design processes, but there are few studies of the mechanisms for achieving this in information system design. As software tools and methods are usually designed for individual problem-solving, they do not support those design processes which emerge from the social behaviour of the development team or the organisational behaviour of the company: we need research into the nature of group design processes to inform the provision of design tools.

Research question: How do members of a design group construct and maintain intersubjectively-held mental design models in practice?

7.3.3 The Organisational Level: Interest Groups, Transitional Objects And Organisational Change

Organisational information system design "involves the shaping of new forms of identity at work, social structures, and interests and values" (Walsham, 1993a, page 202) and reflects the negotiation of pluralist interests (Checkland, 1981; Galliers, 1993a). Technical professionals, who are those generally concerned with the primary development of information systems, are often unaware that they are engaged in organisational re-design (Hornby et al., 1992); technical designers minimise the cognitive effort required by such complex organisational contexts by adopting an approach based upon scientific reductionism (Anderson, 1983; Boland & Day, 1989; Corbett et al., 1991). Information

system design is conceptualised in organisations as a largely objective process and the organisational impact of this process is ignored or subsumed to technical interests, leading to a narrow and possibly sub-optimal scope in design outcomes.

Morgan (1986) indicated that the many paradigms which apply to perceptions of the organisation are reflected in the metaphors in use. Such metaphors underlie models which represent the function of an organisational information system: the "brain" metaphor, embodied in the MIT90s model (Scott-Morton, 1991); the "tool" metaphor, embodied in the served and serving system model produced by Winter & Brown (1994), which was discussed in chapter 2; the "machine" metaphor, which underlies the structured, linear (waterfall) model of system development adopted in most technical information systems development projects (Boehm, 1980) and also underlies approaches to IT-enabled business process redesign (e.g. Davenport, 1993); the "organism" metaphor, which underlies the concept of the "learning organisation" (Argyris & Schön, 1978) and others. There is a multiplicity of paradigms which apply to organisational information systems, but in each organisational culture, existing exemplars of an information system reflecting the prevailing paradigm, will form designers' expectations of the system and will constrain design alternatives (Mackenzie & Wajcman, 1985).

Technology is shaped by, and shapes in turn, social expectations: the *form* of technology is derived from the effect of these social expectations upon the design process (Berger and Luckman, 1966; MacKenzie and Wajcman, 1985). The social constructivist approach reveals the *social* interior of technological design: technology no longer stands as an independent variable, but an outcome which is the result of socially-constrained choices made by designers. Perspectives on the social construction of information systems are provided by structuration theory (Giddens, 1984) and by actor-network theory (Latour, 1987). Structuration theory conceptualises a duality of structure, where "the structural properties of social systems are both medium and outcome of the practices they recursively organize" (Giddens, 1984, page 25). Organisational structures are both formed by and form the outcome of human activity in organisations. Through design, IS professionals both concretise and modify the organisational structures which the system reflects (Orlikowski, 1992). Actor-network theory is concerned with the sequence of events and inscriptions through which technical artefacts and scientific knowledge are constructed (Latour, 1987). Non-human actors (technical artefacts and social arrangements) have embodied in them the intentions and claims of human actors and they, in turn, may enable or constrain the intentions and behaviour of human actors (Akrich,

1992; Callon, 1991; Latour, 1987), as these artefacts or arrangements become accepted as a "black box", the origins (and thus the basis of the claims) of which remain unexamined, as the inscribed context of their use now constitutes "fact". Akrich (1992) describes how designers "inscribe" their vision of the world in the technical content of the designed object. Application of the concepts of actor-network theory can demonstrate how "different and incompatible elements of a seamless web or network" may be joined in practice (Star, 1992). Latour (1991) demonstrates how one set of human actors' interests (guests at a hotel) may be "translated" into another set of interests (in this case the hotel manager's) by the intentions and claims embodied in a technical artefact: he describes how attaching a weight to a hotel key enforces the return of the key by hotel guests upon leaving the hotel.

In the translation of interests, negotiated decision-making and intersubjectivity become central to the design process. The design process constrains the available choice of technology (Scarbrough & Corbett, 1991; Wilkinson, 1983). The process of system design is highly political - a perspective which is often ignored by technical, system professionals (Hornby et al., 1992; Markus & Bjorn-Andersen, 1987). System design is seen by organisational managers as objective, but to quote Lawson (1990):

"Because in design there are so many variables which cannot be measured on the same scale, value judgements seem inescapable." (Lawson, 1990, pg. 59).

Alternative models of power view power as based in an individual's ability to reward, coerce, legitimate, exercise expertise or act as a reference-point for others (French & Raven, 1960); in expertise, control over information, political access and sensitivity, assessed stature and group support (Pettigrew, 1975); through the shaping of interpretations (Smircich & Morgan, 1982); through the creation of myth and ceremony (Pettigrew, 1985); or through the creation of knowledge elites (Pettigrew, 1973).

Frameworks which are particularly appropriate to this analysis are those which apply to the exercise of power in design *framing* - the subject of this, social cognitive analysis of design. A dominant theme in the literature on the exercise of power in IT-related change is the critical role played by the '*management of meaning*' (Smircich & Morgan, 1982), whereby privileged organisational actors interpret the organisational environment for other actors by the meanings which they attach to external events and artefacts. One of the central constraints on individual action is the power which accrues through the identification of IT professionals as a knowledge elite (Markus & Bjorn-Andersen, 1987; Pettigrew, 1973; Scarbrough, 1996). A particularly appropriate model is that presented in

a theoretical paper by Markus and Bjorn-Andersen (1987), shown in Figure 7-10.

According to this model, IS professionals may exert power over users in four ways:

- ◆ *technical power* may be exerted in advocating a particular course of action without providing users with the evidence to make their own evaluations
- ◆ *structural power* may be exerted by developing IT policies and practices which constrain user choices
- ◆ *conceptual power* may be exerted by shaping users' concepts of what IT can provide
- ◆ *symbolic power* may be exerted by shaping user values with respect to IT (normally through the provision of system exemplars).

		<i>Target of power exercise</i>	
		Issues of fact	Issues of values
<i>Context of power exercise</i>	Specific development project	Technical	Conceptual
	IS management policy	Structural	Symbolic

Figure 7-10: Types of Power Exercised (Markus & Bjorn-Andersen, 1987)

Reynolds & Wastell (1996) see systems development as “a dialectic, in which developers learn about the application domain and users learn about the transformatory power of information technology”. But Markus and Bjorn-Andersen (1987) describe how IS professionals limit users' access to decision-making during Information System design, by exerting power to constrain users' conception of technology potential. IS professionals (systems analysts, designers and developers) act as an interest group: they thus constrain the potential *scope* of the design.

The importance of user-participation in design teams is highlighted by Robey et al. (1989), in a study of group conflict and influence in information system development: they concluded that participation had a positive effect upon influence and that influence positively affected both conflict and conflict resolution. However, users are systematically excluded from decision-making in design through the selection and use of particular development methodologies which may act against the interests of system users, for example in excluding them from participation in certain design activities, or by reducing their role to the formal validation of completed design documents (Markus & Bjorn-Andersen, 1987).

Collaborative interest groups are likely to hold similar mental models (Orlikowski & Gash, 1994) and are likely to incur less conflict and to achieve higher goals convergence, but little work has been done to observe what the effects of shared or dissimilar frames has upon the negotiation of design. Different perspectives may influence the design scope and boundary (Checkland, 1981; Willcocks & Mason, 1987). Conflict should be seen as constructive to effective design (Krasner et al., 1987): the goal of design teams should not be to suppress conflict, but to surface and resolve it, as part of the process of generating a wide variety of alternative solutions.

Studies by Mumford & Pettigrew (1975), Markus (1983, 1984), Wilkinson (1983) and Zuboff (1988) have demonstrated the politicised nature of IS development and the constraints which political considerations may have upon the potential *scope* for technology to benefit the organisation of work (*c.f.* Child's, 1972, 'managerial strategic choice of technology'). Different political interest groups have implicit beliefs and assumptions about the potential of technology to affect the organisation; design is necessarily a negotiation of those interests. Reynolds and Wastell (1996) stress the importance of reducing anxiety about the object of technical change: developers and other design participants 'manage not to learn' through defensive behavioural routines, including engaging in political behaviour. They advocate the use of explicit, 'transitional objects' (they compare these to a child's teddy bear, which helps it to become independent of mother, by acting as a surrogate protective figure) to which developers and users can transfer their dependency. Although the organisational study reported by Reynolds and Wastell (1996) was incomplete, they did report some success in creating an explicit design model as a transitional object, using the 'learning organisation' (Argyris & Schön, 1976) as an ideal conceptual state, to reduce anxiety.

The use of transitional objects echoes the use of boundary objects (Norman, 1992; Star, 1989) in supporting distributed cognition. The common theme is of an explicit artefact which facilitates the removal of barriers, cognitive or political, from the process of sharing and merging or co-ordinating the differing frames of reference held by group members and to make differences of design *scope* explicit.

Research question: *To what extent is design scope constrained by political considerations and what role do explicit models of the design play in extending and obtaining consensus on the scope of a design?*

7.3.4 The Construction Of Communities Of Practice Through The Social Cognitive Processes Of Design

This section addressed the following research issue:

- *How do “communities of sustained practice” (Lave, 1991) function and how may they be facilitated in the processes of the design of effective organisational information systems?*

A discussion of design framing, schemas and mental models concluded that the framing perspective has not been systematically studied in the context of information system design. The basis of individuals' schemas and mental models may be conveyed by the use of metaphor, or by specific language acts which reinforce the intersubjective nature of meaning within the design team, or by other mechanisms.

Research question: how are individuals' different mental models manifested in design and are individuals aware that they hold different models from other individuals?

The centrality of application domain learning to design and the role of physical artefacts in forming and expressing individuals' mental models was discussed. Design goals, conceptualised by individuals' mental models were seen to be implicit in nature; they are only 'available to hand' when an explicitly-stated goal conflicts with an implicitly-held mental model of the design. Effective tools and methods for design must support the construction of mental models by designers.

Research question: what are the processes by which designers frame design models and what tools or methods are appropriate in supporting the construction of mental models by designers?

Design in groups requires some degree of intersubjectivity, in which shared frames or models are constructed to achieve a 'common vision' of the design. Distributed cognition, in which partially-held models are co-ordinated by a group of designers as the basis for effective action, may also play an important role in design. It was noted that the creation of 'communities of practice' (Lave, 1991; Lave & Wenger, 1991) is critical to co-ordinated design processes and that 'legitimate peripheral participation' (Lave & Wenger, 1991) in the sociocultural practices of a design group is critical to situated learning in such communities, but there are few studies of the social nature of information system design, which is conceptualised as an individual activity by designers of design tools and methods.

Research question: How do members of a design group engage in a 'community of practice'?

Information system design may be seen as a political, negotiated process, in which organisational structures both form and are formed by the design. Technology is socially-constructed, yet information system design is conceptualised in organisations as a largely objective process and the organisational impact of this process is ignored or subsumed to technical interests. Design is constrained by prevailing paradigms of how technology is constructed and used within the organisation, leading to a narrow and possibly sub-optimal scope in design outcomes. It was noted that different interest groups are likely to hold similar frames or mental models of the design and it was suggested that the agreement and negotiation of accessible, explicit representations of the design - an accessible design model - might reduce political conflict and act as a psychological transference mechanism.

Research question: To what extent is design scope constrained by political considerations and what role do explicit models of the design play in extending and obtaining consensus on the scope of a design?

7.4 Synthesis And Summary Of Research Questions

Theoretical Perspective <i>Emphasis:</i>	Problem-solving	Social Cognition
<i>Individual</i>	Problem definition and goal-determination (planning vs. emergent action)	Situated learning and constructing mental models of problems and solutions
<i>Group</i>	Deriving and validating consensus models	Learning and constructing joint models
<i>Organisation</i>	Stakeholder negotiation of political design objectives, scope & strategy	Social construction of meaning and legitimacy; alignment of diverse interests
<i>Perspective (re: the individual)</i>	Exterior (reflected through objective models of a design, which exist separately from the designer)	Relationship between interior and exterior (reflected through external representations of mental models)
<i>View of Agency</i>	<i>Objective:</i> Plans determine outcomes, to a greater or lesser extent.	<i>Constructionist:</i> agents socially construct their world, or <i>Interactionist:</i> Agent & their world co-constitute each other.
<i>Representative Metaphors</i>	"Surfacing" objectives; Design "rationale"; A "common vision"	"Framing" a design; "Constructing" a model; "External representations"
<i>Management Focus</i>	Achieving consensus and co-ordinating coherent action	Achieving intersubjectivity and collaboration in distributed cognition

Table 7-4: Comparison Of Two Worldviews Underlying Organisational IS Design

In Chapter 3, it was concluded that design was not well understood. This Chapter presented and compared two competing worldviews of design: design as organisational problem-solving and design as social cognition. Differences between the two worldviews are summarised in Table 7-4.

This chapter examined perspectives on organisational problem-solving and how these affected the critical processes of design. It was concluded that there were three main

perspectives which were incommensurable, but that may affect how designers approach the processes of design. The following research question arose:

7. *How do differing perspectives on the nature of problem-definition and analysis/investigation affect organisational actors approaches to information system design processes?*

The social cognitive processes of design were examined at three levels of analysis: individual, group and organisation. The diffusion of frames or mental models, both individual and jointly-held was discussed, with several models presented as to how these are constructed, shared and negotiated. It was concluded that there is little literature in the area of information system design on which to base an appreciation of how 'communities of practice' (Lave, 1991; Lave & Wenger, 1991) are formed and maintained, at any of the three levels. The following research questions arose:

8. *How are individuals' different mental models manifested in design and are individuals aware that they hold different models from other individuals?*
9. *What are the processes by which designers frame design models and what tools or methods are appropriate in supporting the construction of mental models by designers?*
10. *How do members of a design group construct and maintain shared mental models of a design?*
11. *To what extent is design scope constrained by political considerations and what role do explicit models of the design play in extending and obtaining consensus on the scope of a design?*

The investigation of each of these research questions is considered in detail in chapter 5, which presents a discussion of the research methodology employed for both iterations of this study. Research findings appropriate to these questions are discussed in Chapter 11, which summarises the findings of the three analyses of the longitudinal field study presented in Chapters 8, 9 and 10.

8. AN ETHNOGRAPHIC STUDY OF THE PROCESSES OF DESIGN

8.1 Introduction

This chapter and the following three chapters present an analysis of an information system design process engaged in by a small, multi-domain design team. The analysis is taken from observation-notes, tape-recordings of design meetings and also short interviews with design team members over the course of the project.

It should be emphasised that this study does not reflect the company as it now is, but as it was during a specific period of the company's history, when it was moving through a period of radical change: the organisational problems and inefficiencies commented upon by the design team were addressed either during or after the period of this research study.

Research questions 7 to 11 (from Chapter 7, summarised on the previous page) are addressed by this second iteration of the research. The analysis of this field study is presented in four parts:

- This chapter introduces the design project which was the subject for the longitudinal field study. It presents an ethnographic analysis of the situated design process.
- Chapter 9 presents a social cognitive analysis of the processes of design.
- Chapter 10 presents a genealogical, sociocultural analysis of the design process, drawing upon some elements of actor-network theory.
- Chapter 11 addresses research questions 7 to 11, presenting a synthesis of findings from the three analyses presented in this chapter and the two following chapters.

8.1.1 The Context Of The Field Study

This chapter discusses findings from an ethnographic field study of a small design-team engaged in information system design, performed through participant observation. The study was carried out over a period of eighteen months, from November 1995 to April 1997, with Fujitsu Telecommunications (Europe) Ltd., a medium sized company specialising in the manufacture and installation of telecommunications equipment, mainly for UK and European clients. The company employs 650 people in total, 580 of whom are based at the company headquarters, in Birmingham, where this study took place.

The study commenced as the company was starting to engage in a new information system design project. The project, which was initiated by the Information Systems Manager, was intended to have three stages:

1. A business process redesign stage, during which changes to organisational processes would be initiated, information requirements specified and the form of the supporting information technology determined.
2. An information technology (IT) implementation stage, to run in parallel with the process and information requirements design.
3. An integration stage, where the two 'systems' (the new work processes and the new IT) would be integrated with the organisation, through the establishment of new work procedures backed by a comprehensive training program.

The design project was of particular interest to this research because of the multiple domains from which design team members were drawn, because of the explicit recognition of the need for business process investigation to precede the technical system design and because the nature of this process was new to the company and gave the researcher the opportunity to observe the nature of a reflective design process, rather than unreflective, normative design procedures. The project was also of intense interest because the company was attempting to do everything recommended by 'strategic IS' literature: aligning IT with business strategy, planning applications to support work-processes rather than vice versa and viewing IS design as a social and organisational problem.

Originally, this project was intended to have a duration of approximately three to six months. It is clear that the complexity of business process redesign was underestimated by the IS Manager. This change project was particularly interesting as an object of study because of the implicit recognition, on the part of the IS Manager, that the object of IT-related change was organisational processes as well as the supporting technology - a recognition which the literature would have us believe is missing from the worldview of IT development managers, but which was found to be surprisingly prevalent in the survey performed as part of this research and discussed in chapter 6.

8.2 Research Method

8.2.1 Execution Of The Case Study

The main part of this investigation was a participant-observation study of IS design in practice, in a company which is experienced in designing organisational information systems. The study was centred on the design process, as experienced by a small-group design team, which involved stakeholders the whole of the company. As this research is interested primarily in multiple-domain design teams, this project was of particular interest because of the wide cross-section of the company represented within it.

The case study was performed in three stages:

- Initial interviews were held with project team members, and the project manager, to discover their expectations and preconceptions of the project
- Project design meetings were observed over a period of eighteen months (a schedule of project meetings attended is given in Appendix 3). Notes were made during each meeting on the conduct of participants, the content of the meeting and the external representations of the design which were produced during the meeting. The meetings were tape-recorded; these recordings provided the basis for later analysis, particularly of the social cognitive processes of design. Project documentation was also collected.
- Reflections on the process from team members were captured regularly through short interviews; these were mainly from the IS Manager and the Process Improvement Manager (with whom the IS Manager jointly administered the design meetings), but other design team members frequently stayed to comment at the end of meetings.
- Soft Systems Methodology (SSM) modelling sessions were performed with individual team members, followed by a facilitated group SSM workshop. These sessions explored the objectives and issues of both the designed system and the processes of design. A feedback presentation and discussion also took place. These sessions and the feedback meeting were tape-recorded and contemporary observations recorded.

8.2.2 Limitations Of The Study

It was not possible, because of my teaching and other work commitments, to attend every design meeting during the period of the study; approximately one-third of the design meetings held as part of this project were attended. Design meetings would occur bi-weekly over a period of several weeks and then suffer from interruptions as other company priorities or holiday periods intervened: the contact schedule given in Appendix 3 reflects the sporadic nature of the process at some points. Interrupted involvement requires regular attendance at key processes, coupled with regular interviews to ascertain any key events which have occurred when the researcher was not present: this was achieved by regular contact with the IS Manager and the Process Improvement Manager, who engaged in lively periods of reflection following design meetings and who were extremely helpful in keeping me informed of what had transpired for periods when I was unable to attend meetings.

As the IS Manager led the project and also enabled my access to the meetings, the majority of the reflections on the project represent the perspective of the technical interest in multi-domain design. This is a constraint on the study of which I was aware during the analysis: I have tried not to be influenced to too great an extent by this perspective, but to use the meeting observations to achieve a rounded view of the process. An advantage of

this contact is that it permitted an *internal* view of the role of the IT professional in shaping and controlling the processes of multi-domain design, in the context of the FTEL longitudinal study - a perspective which is largely missing from IS literature.

8.2.3 Use Of Soft Systems Methodology To Model Design Perspectives

During episode 5 of the design process (discussed below), members of the core design team were involved individually in Soft Systems Methodology (SSM) modelling sessions, with models being elicited facilitatively using the modelling techniques suggested by Checkland & Scholes (1990). Team members were asked to suggest and then model system transformations which represented objectives of the designed system, issues and problems of the designed system or design context, objectives of the design process and issues and problems of the design process. Conceptual models were constructed of the transformations which individuals considered the highest priority. The resulting transformations and individuals' priorities are given in Appendix 4. A team workshop was also held, at which team members were encouraged to "think the unthinkable" through the use of SSM techniques - i.e. to think through the objectives of the design without regard to the explicit, organisational system boundary imposed on the designed system.

From the models constructed and tape-recordings of the interviews, two cause-and-effect diagram models were produced to represent (a) issues and problems pertaining to the designed system and (b) issues and problems pertaining to the process of design. These are also contained in Appendix 4. The models were presented to the design team in a feedback workshop at the end of episode 5 and individuals were asked to comment upon them for validation purposes. Although little detailed feedback was received, typical comments included "Boy, this is good stuff!" and "I wish we could go back and start again". Given the pressure for deliverables, which was driving the IS Manager at this point, the models were not incorporated into the design discussions as he did not want to change the design process at this late stage, although elements of them surfaced several times in design meetings over the next few weeks and I believe that the joint learning objective of these modelling sessions was achieved, at least in part.

8.2.4 The Analysis Of Data For This Study

The analysis discussed in this chapter involves a situated action (Suchman, 1987) perspective of the design process. This perspective argues that human knowledge and interaction cannot be divorced from the world. One cannot look at just the situation, or the environment or the person acting in isolation: to do so is to destroy the phenomena of interest. The emphasis is upon "constructing accounts of relations among people and between people and the historically and culturally constituted worlds that they inhabit

together.” (Suchman, 1993, page 71). Norman (1993) presents a ‘devil’s advocate’ view of the situated action perspective, in describing it as behaviourist: everything is controlled by the environment, independent of internal processing. The analysis contained in this chapter does use a behavioural analysis - the examination of the role of external representations, processes and historical and cultural influences on the process of design - but it also attempts to view the internal processes of design at FTEL by the incorporation of a hermeneutic approach to data analysis.

Data recording was achieved by tape-recording all interviews and design meetings that I attended, coupled with written observation notes from interviews and meetings, which reflected the context, the process and the content of contemporary events. Data analysis was achieved through a process of immersing myself in the data: repeatedly listening to tapes of the meetings, using the observation notes taken at the meeting as a guide, transcribing interviews and interesting segments from design meetings (I found the use of a computer-based dictation package, acquired towards the end of the research study, invaluable for this, both in terms of saving time and in terms of the familiarity which comes from re-enunciating someone’s reflections or opinion).

The ethnographic analysis examined contemporary accounts of the design process: transcripts of interviews with members of the design team and my written records of context, behaviour and verbal contributions from each of the design meetings.

Observations made while listening to tape-recordings of interviews and design meetings also fed into this analysis. These accounts were coded and analysed using the grounded theory method discussed in chapters 4 and 5.

The hermeneutic analysis concentrated upon the tape-recordings of the design meetings and contemporary interviews: these were listened to repeatedly, to understand the process of interactions and design contributions which had taken place from a fresh perspective. Theoretical codes and memos were generated at this point, then selected portions of the tape-recordings were transcribed, to be treated as a ‘text’, from which an understanding of the meanings of individual and group beliefs and practices could be interpreted. The results from the hermeneutic analysis also fed into the grounded theory process: writing theoretical memos, searching for common themes and performing a constant comparison between different episodes of the study for comparative models. The process was iterative: reflections from one analysis would cause previous analyses to be revisited, until I felt that the design process was understood in its richness and complexity - i.e. that a process of data saturation had been achieved. The main ‘episodes’ of the design process are

summarised in Table 8-1; dominant themes and issues derived from this analysis are summarised at the end of this chapter.

8.2.5 Assumptions Of Analysis And Position Of Researcher

As this study progressed, I found that my background in IT design led me to identify closely with the design team and to take a very task-focussed approach to their problems, when engaged in discussions with team members. A later review of the analysis which I performed contemporaneously with data collection made me realise that I had subconsciously abandoned the ethnographer's position of "a stranger in a strange land", adopting the values and assumptions of the design team, so that I shared their intersubjective value-systems to some extent, rather than observing them objectively. A new data analysis was performed, following the end of my association with the study and the findings presented here are the results of this, more impartial analysis. I have attempted to profit from my close association with the design, in that I understand the issues of the design much better than a disinterested observer and so can use this for a situated action study of the design process, which I believe is richer than the more usual, interview-based observation techniques applied to organisational studies. But I spent the period of the second analysis closely questioning the values and decisions of the team, rather than accepting them in context, as I had done previously.

I am aware that what follows is a selective account of the observed processes of design during the period of this study, although I recorded everything that I observed during the design meetings, rather than recording particular aspects of the design. In the interpretive tradition, I have tried to remain as objective as possible while trying to present as rich a picture as possible. I wanted to understand the whole process, so what follows is not a cognitive, group or political analysis of the process, but as rich an analysis as I could make it, to present the interactions of the cognitive (individual), group and political levels of the processes of information system design.

8.3 The Context Of The Design Project

8.3.1 Company History and Culture

Fujitsu Telecommunications (Europe) Ltd. (FTEL) was in a period of rapid growth, prior to and during the study. The turnover of the company had risen from £20 millions to £70 millions in a period of four years, driven by its acquisition from British Telecom (where the company was a telecommunications equipment manufacturing division) by the Fujitsu group and the appointment of a new Managing Director. Working practices were changing rapidly; this was meeting resistance among some of the more established employees. The

Managing Director was perceived by staff to be “dominant” - he personally drove company tactics to a large extent, as well as strategy, so independent management decision-making was not felt to be supported by distributed information access. The company saw its strengths as lying in the manufacture and marketing of “high-tech” telecommunications equipment, in which there was a growing market. However, the company was felt to be constrained by the dominance of the engineering culture, where client strategy and product marketing considerations were secondary to technology-driven decision-making (the engineering groups were described by several people as “gung-ho”). There was a growing consensus that the company needed more distributed decision-making and information access; this project was initiated in response to that consensus. The project was managed by the IS Manager, who described his role as a design *facilitator*. He explained that the company did not use formal development methodologies in IS development:

The MD would have my guts for garters if I used formal methodologies. I'd need three times the team to support formal methods and we would never get a project off the ground if we had to do it. It would take 18 months to get a project off the ground, so forget it!

The intended IT development approach would be to observe and document information flows and documents used in the existing process, to manually simulate required computer systems in making information and documentation available to people in the way that the computer system would eventually do and for the technical system development to participate in weekly design reviews: “to gather what has been learned”. The IS group developers used “more traditional methods” for IT system analysis and design: written technical requirements specification, entity modelling and database design.

8.3.2 Antecedents to the Design Project

The change project was initiated by the IS Manager, in response to a perceived need for the IS department to be more responsive to, and to anticipate, the changing nature of the business. He had attended a short management course in business process redesign and was also supported by the new Director of Quality and Business Improvement, who had joined the company a year previously. The two managers agreed that FTEL required fundamental changes in working practices and decision-making and sought approval from the Managing Director to initiate a programme of organisational redesign and change. Their initial change initiative was based upon the previous experience of the Quality Director, who had been involved in business process redesign (BPR) in his previous company, who had adopted a “brainstorming” approach to BPR. Teams of managers had defined existing business tasks on Post-It notes, then rearranged the notes to redefine business processes. Reorganisation was seen as radical, yet informal. This approach was

tried, prior to the commencement of this project, at FTEL, but was described as “a disaster” by members of the design team. Two business processes had been identified for change by the initial project team, against the criteria that the processes should be reasonably compact and that the redesign team would, in the words of the IS Manager, “go for quick wins”. The selection of processes was thought to be ill-judged, as “the wins were not quick and the projects have not been small, compact and reasonably manageable”. The breakdown of this initiative was also perceived as being due to a personality clash due to the incompatibility of design team members, who were selected as a cross-section of the company, and insufficient commitment to the team initiative.

The team for the second initiative, which formed the subject of this study, had been “hand-picked” by the IS Manager, in collaboration with the team facilitator, a senior quality manager. A rich picture of the design context is given in Figure 8-1.

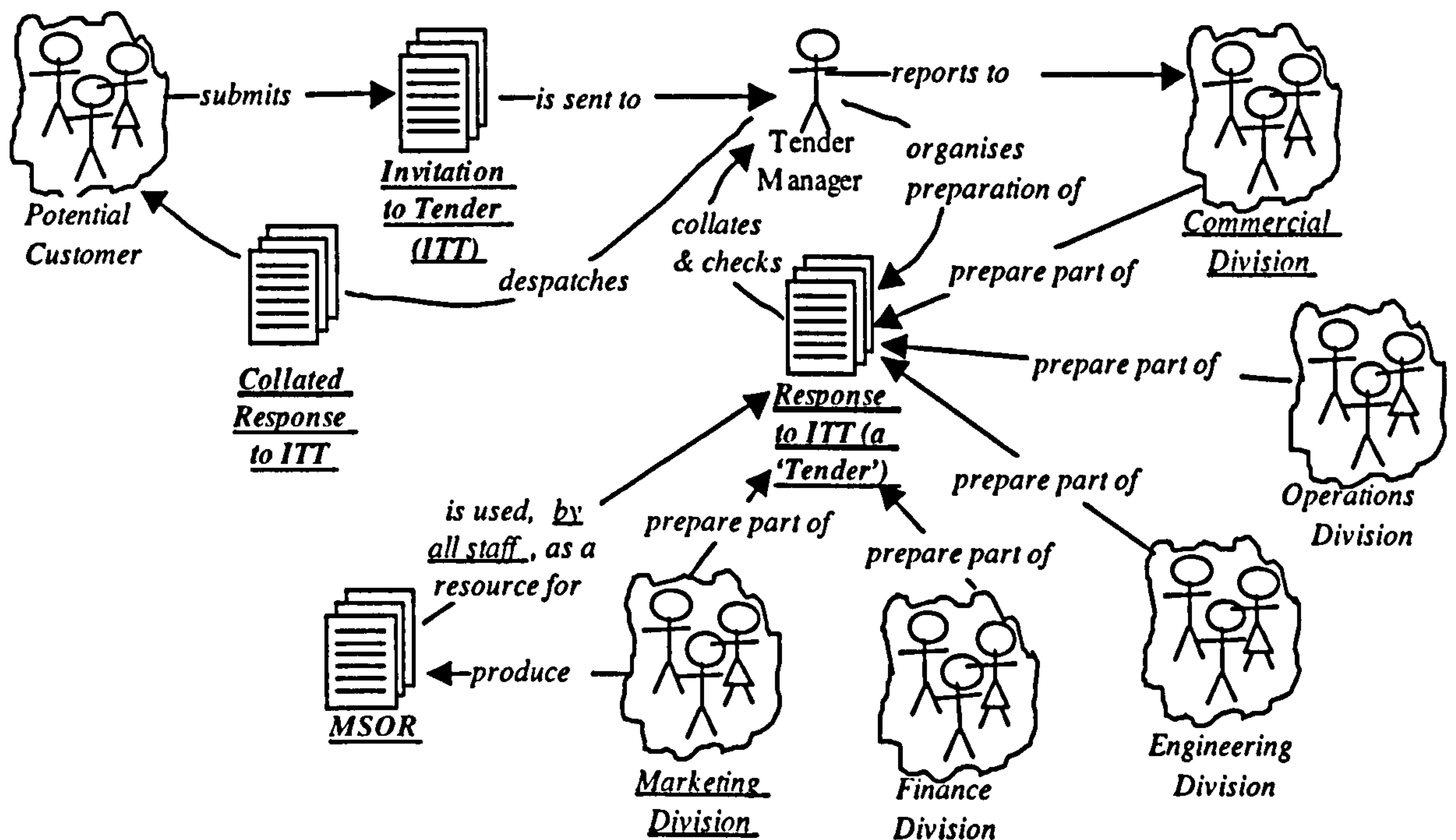


Figure 8-1: A Rich Picture Of The Tender Response Process (The Target System To Be Designed In The Research Study Project)

This project started at a time when the company in general and the IS Manager in particular had some experience of organising cross-functional design teams and selecting suitable business processes as the object of design. The IS Manager had the personal sponsorship and support of the Managing Director, who felt that the incremental approach to business process redesign proposed by the IS Manager would be good for the company. The team had decided to start with a redesign of the company’s responses to customer Invitations To Tender (ITTs), as this process was felt to be relatively “stand-alone”, in terms of its interdependencies with other business processes. The following business

requirements for the new work processes and the supporting IT system were described by the IS Manager, who was to lead the new design project:

Business Requirements For New Information System

There is a need for a new system to support the process of securing customer contracts by effective response to customer Invitations To Tender (ITTs). The IS Department has provided two new "emergency" IT systems in the short term, to automate facilities for ITT response. In the longer term, it is intended to conduct a feasibility study on the whole process. A "Business Improvement Team" was set up, to study order capture across the organisation. They derived two main requirements for order capture, which will be followed up by the new initiative:

1. Improved document management: typified as an electronic document filing, scanning and handling system
2. A database to underpin work activities, giving:
 - project control
 - an interface to commercial order management to give a measure of prospective new business
 - assistance with costing, margins and order analysis.

It can be seen from the above statement of requirements that, although the process was seen as "business improvement" (or business process redesign), the outputs were seen, at least by the IS Manager who led the project, as an IT-supported system of information-management.

8.3.3 The Design Project Organisation

The Managing Director sponsored the team's legitimacy and backed the IS Manager's requirement that functional managers should consistently allocate time for the core team members to attend the project meetings. Time was set aside for regular, two to three hour meetings, to be held twice-weekly. Team-members were selected who would have a positive attitude to organisational change from a wide area of organisational responsibility. A company organisation chart is shown in Figure 8-2. Members of the design team are shown in **bold type** in the diagram.

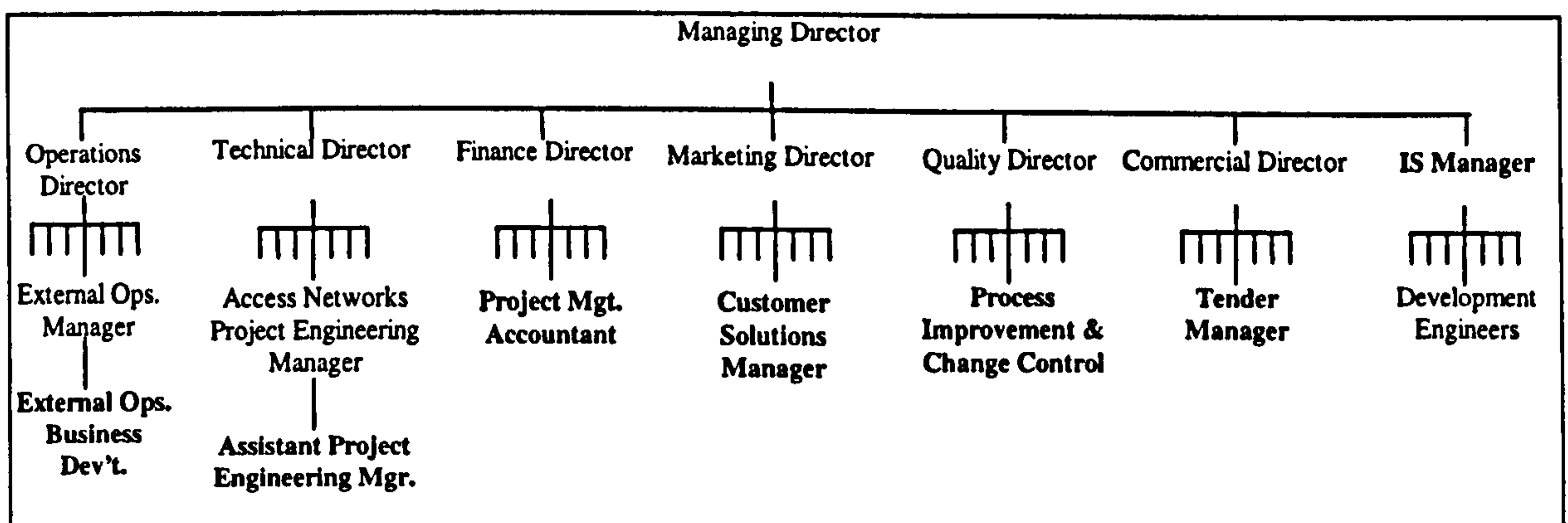


Figure 8-2: Fujitsu Telecommunications (Europe) Ltd. Company Organisation

Although the IS Manager was not a board member, he reported directly to the Managing Director and was involved in determining company strategy. The core design team was multi-disciplinary in nature, chosen to represent a cross-section of interests across the organisation. Its membership included people with a background in order-processing (the purpose of the target information system), information system development, marketing, engineering, accounting, commercial finance and quality control. By the constitution of the core design team, the IS Manager was able to constitute a design network which extended throughout the organisation; this is illustrated in Figure 8-3. Team members were expected to perform a 100% workload in addition to this project, so were not always able to devote time to project meetings on a regular basis.

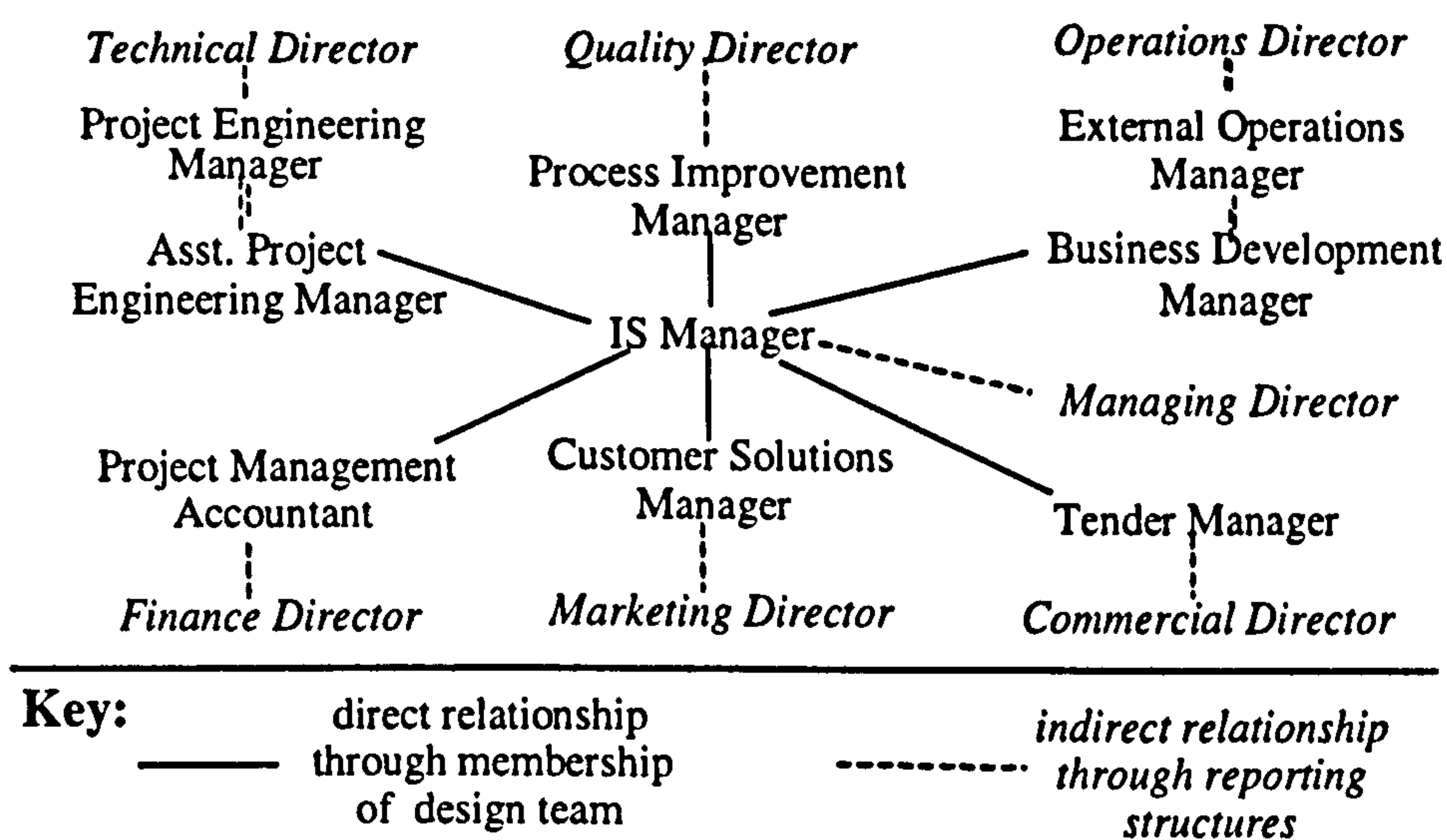


Figure 8-3: An Organisational Network Representation Of The Core Design Team And Their Contacts

Despite the MD's sponsorship, the average rate of attendance, for those meetings which I attended, was 68%. This is not unusual for this type of initiative at this particular company, but as a consequence of the low priority given to the project by design team members' managers, very little design or project work was performed outside of the project meetings. This proved a great advantage for the research purposes of this study, as it permitted observation of the core activities involved in the design, even though research attendance was interrupted. But for the design initiative, it had the consequences that the whole process took longer than it might have done in an environment where people were seconded to the initiative on a more formal basis and that design team members could not treat this process as continuous, in terms of keeping necessary information at the front of their minds.

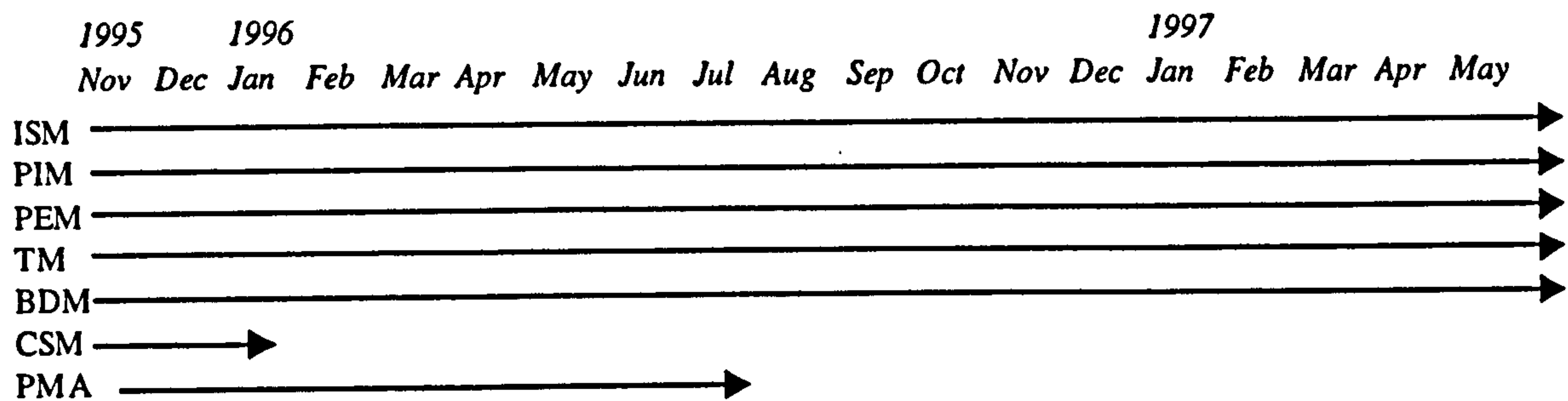


Figure 8-4: Involvement Of Core Design Team Members Over Time

Figure 8-4 shows the involvement of core design team members over time. The initial design team composition represented all the main areas of business across the organisation. The individuals chosen to represent each area were informed and positive about change. But after two months, the marketing representative on the team left the company and the marketing division did not provide a replacement. Following his departure, the work of the team suffered badly - there were often important design context questions which could not be answered by other team members and the design was significantly delayed as a result. The team also suffered from a lack of ownership by the Marketing group of the outputs of the design. Despite repeated lobbying by the IS Manager and others, this situation was not remedied as the Marketing Director did not view the initiative as a high organisational priority.

8.4 The Design Process

8.4.1 The Intended Process Of Design

The design approach was based directly upon the IS Manager's experience of IT-based design:

I did not have a model of the way to do it, but based my view on the traditional problem-solving model, of define a problem, analyse it, solve it. ... never mind what the current process is, identify shortcomings and identify what functions you need in a process. Then, with a clear view of the shortcomings and a clear view of functions needed, you design a new process. We took a sort of systems design approach - define the bits you want and put them together in a logical sequence. I guess behind that was an understanding of the components which made up a redesign process, but with doubts about the batting order of the bits.

The intended process model for the IS design project, supplied by the IS Manager, is given in Figure 8-5. That the IS Manager saw the core design problem as attaining an intersubjective understanding of the target design as part of distributed design activity is shown by his comment at our initial meeting:

I think a successful design project is one where all the members of the design team understand the problem in the same way, as early as possible in the project timescale. Sometimes, you get towards the end of the project and you plug the bits together and they all work perfectly; other times you get to the end of the project and two or three of them still don't have any idea what it's all about!

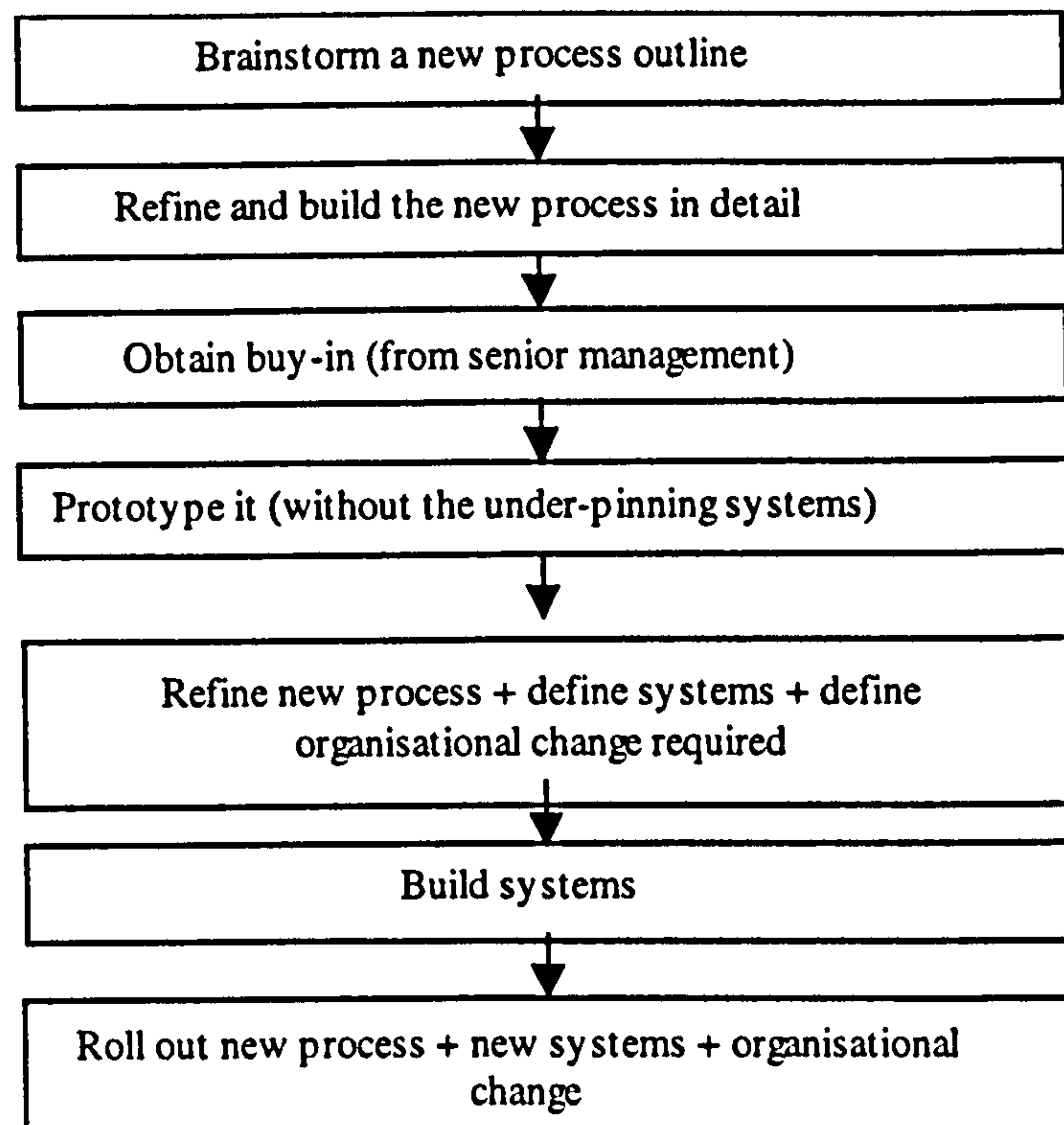


Figure 8-5: The Proposed Process Of Design

At the start of the project, there was some confusion as to what extent the processes modelled represented the new or the existing process. In a separate interview, the Process Improvement Manager conceived the design process as to model the existing process, obtain consensus across the group on what changes were required to the existing process, specification and decomposition of “clean sheet of paper” processes and specification of changes required to achieve the new process. The benefit, to the Process Improvement Manager, of specifying the new process first was “a number of startling flashes of the obvious when we started to do it, as people did not realise how complicated the process is until they see it.” The IS Manager obviously saw the process as informal, at least to start with:

Never mind what the current process is, identify its shortcomings and identify what functions you need in a process. Then, with a clear view of shortcomings and a clear view of functions needed, you design a new process. We took a sort of systems design approach - define the bits you want and put them together in a logical sequence.

As described in the antecedents to change section, a previous business improvement team, in which many of the existing team members had served, had acquired a basic understanding of the company’s core business processes. The target process for this design initiative: a business process to respond to customers’ Invitations To Tender (ITTs) - commonly referred to by company employees as the Tender response process - was chosen because it was relatively “stand-alone” (i.e. there were few inter-dependencies with other business processes). This lack of dependencies upon other business processes

was felt to be an important attribute for the first process chosen. This shows an awareness, on the part of the IS Manager and the Process Improvement Manager, who led the choice of process for this initiative, of the importance of reducing problem complexity for an uncertain design process. The design process was novel to the company, therefore they adopted a strategy of reducing problem complexity, to enable them to try and to modify the design process.

A major objective of the design process at its inception was to specify the “what” not the “how” of the process, to abstract the design process to a sufficient point that constraints which applied from the current process did not apply to the new, target process. The IS Manager stressed that the approach to be taken was incremental, not the “throw it all away and start again” approach, advocated by Hammer (1990). The design process was to build on what was good about the organisation, improving on what was not so good:

I'm totally sold on this idea that has come out from business process re-engineering as a concept - I'm totally sold on the idea that what we used to do was automate what existed and we mustn't do that - we must say what is the best way of doing something and automate that. I wouldn't say that it was really ever us because I can think of systems that we developed that at same time change the process quite substantially. But I think that happened rather than got designed into it. And what I'm really sold on is the idea that, if you start out from a process perspective as we're trying to do here and say OK let's put everything aside, blank sheet of paper, what is the process and then build out from that, that we will actually end up with a good result. The problem is, that I haven't found anybody who can tell you the way to do that! I've been on a course about business process re-engineering and I've read several books on it and they all seem to take a huge general leap from this stage which is 'define existing process and say what's wrong with it' and 'sell everybody the new process'. And a structured approach to generating a new process is something that I haven't found and if it exists then I'd be interested to know about it.

For the discussions which follow, it is necessary to clarify some terminology. The design was managed by a process of *decomposition*: a top-level design model (shown in Figure 8-7) was produced: this model was referred to by the team, and will be referred to here, as the “*level-1 flowchart*”, as this diagram represented a high-level flow of activity. The decomposition of the design proceeded as the level-1 flowchart was broken down into sub-processes: this model was referred to as a set of “*level-2 flowcharts*”, an example of which is shown in Figure 8-9. The further breakdown of these sub-processes, into sub-sub-processes and beyond is referred to as “*lower level decomposition*”. At lower levels of detail, the design was expressed in words: a written “*process specification*”, which defined, for each sub-process shown in the level-2 flowchart, its objectives, owner, inputs (i.e. information-flows into the sub-process), process (i.e. the activities encompassed by the sub-process) and outputs.

8.5 Episodes Of Design

The discussion in this section presents some perspectives on the processes of design, analysed with respect to the focus of activity during the design process. These periods, or process 'episodes' are shown by sequence and duration in Figure 8-6.

Although each episode was reasonably clearly distinguishable from other episodes, they were, of course, not so clearly delineated as it would seem from the presentation here. Many of the episodes overlapped slightly, with the gradual emergence of a new episode during the previous episode and with episodes sometimes occurring in parallel, as indicated in the diagram.

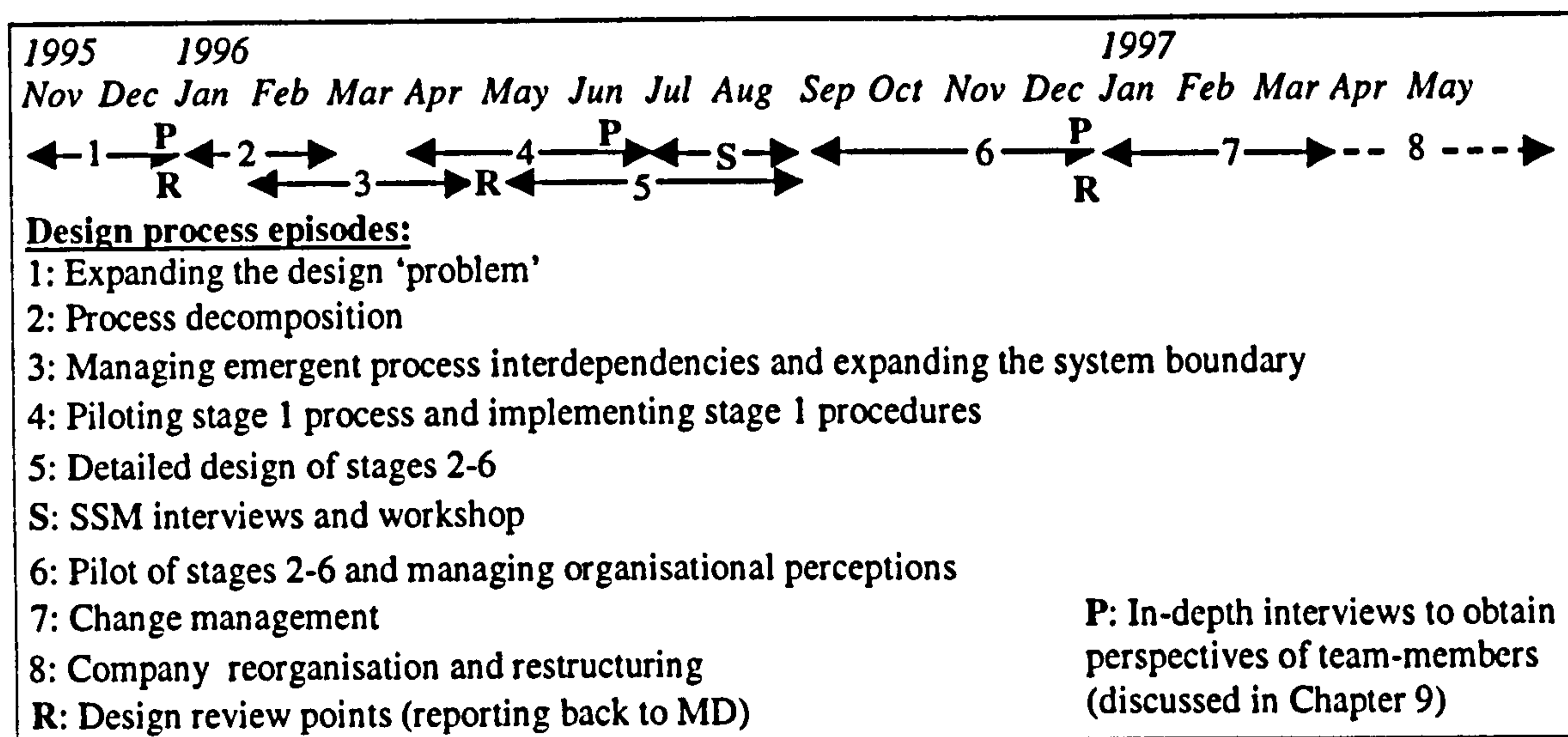


Figure 8-6: Duration And Sequence of Episodes During the Design Process

The main issues of each episode, in terms of stated and observed design objectives for that episode, hermeneutically-derived target system objectives, the main representational methods used during that episode, the dominant metaphors and 'stories' of the design team and the research issues which were observed during that episode are summarised in Table 8-1. A full discussion of the episodes of design at FTEL follows the summary table. Membership of the core project team and abbreviations used for each person in the dialogue extracts below are given here:

ISM	The IS Manager	<i>responsible for directing team</i>
PIM	Process Improvement & Change Control Manager	<i>responsible for facilitating team</i>
PEM	Assistant Project Manager, Engineering	<i>responsible for assessing and specifying new product requirements</i>
TM	Tender Manager	<i>responsible for responding to customer tenders</i>
BDM	Business Development Manager (Operations)	<i>responsible for developing new business</i>
CSM	Customer Solutions Manager, Marketing Group	<i>responsible for matching product to customer requirements (left the company in January 1996)</i>
PMA	Project Management Accountant, Finance Group	<i>responsible for dealing with financial aspects of bid responses and for business planning (left in July 1996).</i>

Table 8-1: Episodes Of Design At FTFL: A Summary

Episode	Stated design objective	Observed design objective(s)	Target System Goal(s)	Representational Method	Metaphors & Stories	Issues
0: Antecedents To The Process Of Design	business process redesign: 'quick wins'	re-ordering existing processes for efficiency gains	more effective	Unstructured (Post-It Notes): existing process definition and synthesis	Brainstorming	Team cohesiveness Lack of method focus
1: Expanding The Design 'Problem'	incremental business process redesign (defined vaguely)	define target system process in outline; experiment with and determine a suitable design process	improved system control and efficiency: formalise with scope for individual initiative	High-level process definition (Level-1 flowchart); Flowchart decomposition (Level-2 flowchart)	'Quick Wins' "hammering out how it will work" "feet on the ground" avoiding "this big snake that goes through the organisation" the "virtual team"	Capturing design output; understanding system purpose; recording different levels of decomposition; extent of system formalisation; determining completeness of design
2: Process Decomposition	functional specification of process	Abstraction of internal sub-process design from examples & scenarios; understanding information flows at process interface	Improved process effectiveness: obtaining a wider process 'vision'	Level-2 flowchart refinements; Written functional sub-process specifications, defining inputs, outputs & process	starting from a "blank sheet of paper" the "spectre of organisation" "working backwards" (to top-down process decomposition) "the organisation needs to understand what the issues are and why it's doing things" "a massive explosion"	achieving team commitment to design process abstracting target system processes capturing and recording learning about the target system <i>setting the design agenda</i> recording different levels of decomposition
3: Managing Emergent Process Interdependencies	External visibility: 'quick wins' through improved process efficiency	Abstraction of external and internal sub-process design from examples & scenarios; Political management of system boundary redefinition	Improved, coherent information support for the new system; Improved antecedent conditions for system (customer intelligence)	Level-2 flowchart refinements; Written functional sub-process specs. [Use of externally-generated material Understanding process through analysis/discussion of company documents]	'quick wins' a "grunge job" hive of bees: "ideas buzzing around" an "Aunt Sally" the "spectre of organisation" a "vision" of the system "complicating the system" "spreading out into other areas" a "common vision" of system "blinding flash of inspiration"	the tedium of functional specification <i>representing information flows at the system boundary</i> defining system scope <i>redefining the system boundary</i> <i>maintaining external visibility</i>

Table 8-1 (continued): Episodes Of Design At FTEL: A Summary

Episode	Explicit design objective	Observed design objective	Target System Goal(s)	Representational Method	Metaphors & Stories	Issues
4: Piloting Stage 1 Process	Obtain design feedback through piloting the designed process	To understand the new system better by using an exploratory prototype	Improved process efficiencies and effectiveness	Limited observation of new system in action; Verbal reports to design team	<p>“obtaining buy-in”</p> <p>“breaking into” the new process technical ‘bulletin board’ the “paperless office”</p> <p>IT as “support function”</p> <p>“a stick they can be beaten over the head with”</p> <p>“recover success from disaster”</p> <p>“business as usual”</p> <p>“it’s courage in our hands time”</p>	<p><i>the need to obtain design feedback</i></p> <p><i>‘invisible’ design of the supporting information technology</i></p> <p>planning the pilot study for minimal organisational disruption</p> <p>operationalisation of the new stage 1 process</p> <p>concentration upon detail rather than design</p> <p>understanding the target system</p>
5: Detailed design of stages 2-6	‘Completion’ of target system design	Design abstraction: deriving procedural ‘rules’ for new sub-processes from examples & scenarios based on existing processes	<p><i>Explicitly:</i></p> <p>“measurable” work process improvements (i.e. efficiency gains).</p> <p><i>Implicitly:</i></p> <p>increased process effectiveness</p>	Level-2 flowcharts; Written functional sub-process specifications	<p>“hear a whisper” [of a business opportunity]</p> <p>the target work-system as “an opportunity for people to apply their professionalism”</p> <p>“the big arrow/little arrow concept”</p> <p>the “data library” concept</p> <p>“the whole thing is converging”</p>	<p>planning short-term goals</p> <p>the tension between IT system formalisation and scope for individual ‘professionalism’</p> <p>a shift in system paradigm</p> <p>external visibility: effectiveness vs. efficiency</p> <p>representational issues of design</p> <p>defining system problems and objectives</p>
6: Pilot of stages 2-6 and Managing Organisational Perceptions	External visibility (success)	Trying to assess improvements resulting from new system	Measurable improvements to organisational performance	Written list of issues	<p>“we need to get it together”</p> <p>“the assessments we have are qualitative and subjective”</p> <p>“running around like a headless chicken”; “we should be visible”</p> <p>“stock-taking” (of design process)</p>	<p>tangible versus intangible design achievements</p> <p>understanding system purpose</p> <p>reviewing the design process</p>
7: Change Management	Organisational ‘learning’ about new system	Defining training and change programme; political lobbying	Support of operational work processes and ‘professional skills’	Flowcharts, written functional specs., training notes, IT system	<p>“a common vision of the process objectives across the company”</p> <p>“ownership” of the process</p> <p>“train the troops”</p>	<p><i>the need for continual sponsorship of design</i></p> <p>reconceptualising design through defining system organisation</p> <p>change as education</p> <p>the ‘invisible’ development of IT</p>

8.5.1 Episode 1: Expanding The Design ‘Problem’

Defining The Design ‘Problem’

The initial phase of the design process concentrated upon fast definition of the problem (the process description) and then problem decomposition (defining sub-processes). This episode lasted for approximately six weeks.

The first two meetings of the design team were brainstorming sessions, where an unstructured list of activities required in the new target-process was generated and arranged into a series of six stages which formed the basis of the new process. The six, top-level process stages, shown in Figure 8-7, remained the same throughout the whole of the design project, even though the project is only now drawing to an end after almost two years.

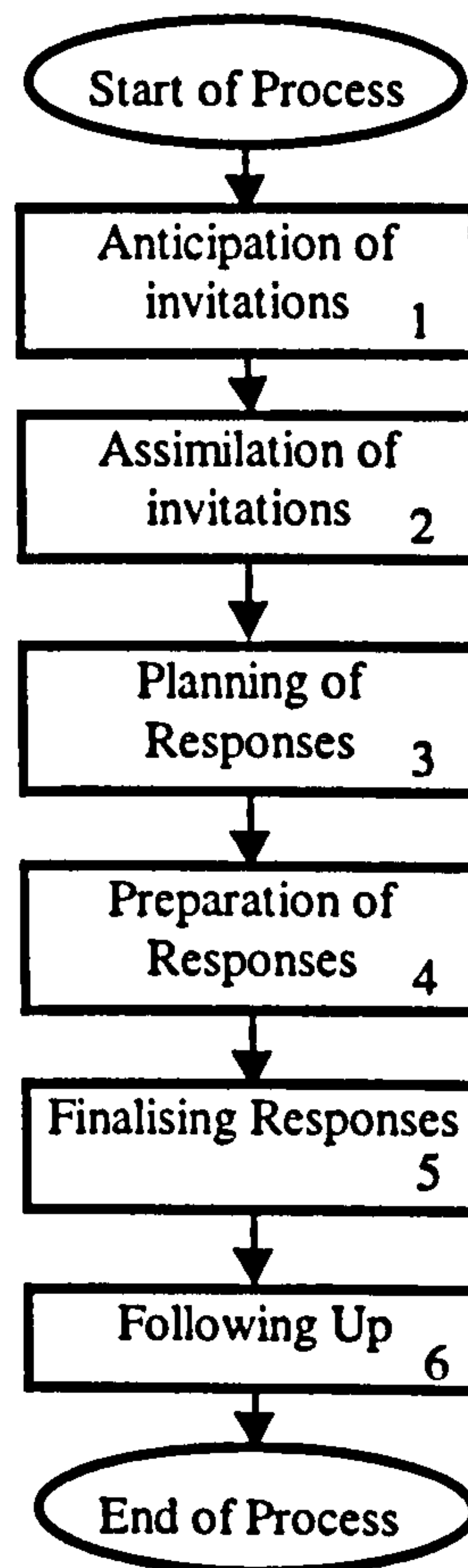


Figure 8-7: Overview Of The Designed Tender Response Process

The search for a “structured” approach to generating a new process (mentioned by the IS Manager in the comment quoted above) is typical of the traditional approach to IT design: the search for a structured methodology with which to control the process, discussed in Chapter 2. That the design project was conceived of as a decomposition of business processes as the basis for IT design is shown by the comments of the IS Manager, who

also had a much wider vision than is reported in the literature about the need for an organisational change process following IT system implementation:

Where we're going over the remainder of this phase between now and Christmas is to say, having said what must be in the process, to go through this further detail of hammering out how it will work and at the same time identify ways in which we will make it slicker, quicker, more effective, less expensive and so on. We're going to park those issues and then we're going to explore them in greater detail and come up with specifications for the underpinning IT that's going to help accelerate and control the process and finally make a board presentation which says this is what we're trying to achieve: this is the new process that we've designed, it's better because so and so. The actions that we need to take to deliver it are these, and that means investing in this, training in that and developing IT to do this.

Capturing Design Output

A major design issue for this episode was how to capture the output of the design process. The representation method chosen was the use of process flowcharts (these are commonly used in documenting computer programs: a simple example is given in Figure 8-9), where rectangular boxes represent a work-process and diamond-shaped boxes represent a decision. Arrows between the boxes represent the sequence of processes. The role of the IS Manager at this point appeared to be interpreting and capturing the design suggested by other team members; it was clear that he was uncomfortable with this role, especially in his dependence upon others for a judgement of how the design was progressing:

Normally, I'm clever about where we are going but this is the dilemma of the IT man - you have to sit back and try to understand it and let the others get on with the discussion. I'm far from clear at the moment [whether we have enough to go on].

The design team spent the next few meetings after the six-stage, top-level processes had been defined attempting to decompose the six stages of the top-level process into sub-processes. They did this at first by splitting the team into two sub-groups of 3-4 members, each facilitated by one of the two leading members of the design team (the IS Manager and the Process Improvement Manager). The sub-groups took a stage each of the top-level process, defining a set of sub-processes which they felt filled the requirements of the top-level process stage, from their own experience of the overall Tender response process. The whole team reconvened and criticised each sub-group's design, until they felt they had successfully defined a complete stage of the process.

Recording Different Levels Of Decomposition

In understanding the existing way of doing things, a great deal of information was explored which was at too detailed a level for the top-level analysis which was being performed. This factor also concerned design team members, who had no mechanism for recording such information. The following discussion from an early design meeting reflects designers' concern about capturing the information required to make a decision,

when this level of design decomposition involved only the specification that a decision stage took place:

ISM: I suppose, again, there's got to be an "advise customer" around here

PEM: yes, either way

ISM: either way is it?

PEM: I think so, I think you tell them if you're not going to bid as well as if you are, don't you? You tell them why -- the usual sort of massaging stuff. [pauses] The snag with this little bit of process, which is fairly fundamental, in my experience is that you really almost need to complete the entire exercise before you can do a bid/no-bid because you don't have sufficient information until you've actually completed everything else, so these meetings tend to be put off.

CSM: that's right

PEM: that's possibly outside... I mean you're looking for an ideal way of doing it, really. I think we need to just recognise that the information is at best sketchy during this period.

Understanding The Target System Purpose

A great deal of time appeared to be spent in understanding the purpose of the target system, in the context of wider company order management processes. Frequent discussions of high-level process purpose were observed in each meeting attended, for example:

CSM: It's worth reading that, because it gives you an idea of how it should be done. At the moment, we're trying to influence the decision that says whether or not we actually go for this, aren't we?

PEM: no, we shouldn't be trying to influence the decision, we should be...

ISM: ... working out how we're going to take the decision

PEM: ... providing sufficient information, in clear and simple terms, to enable the decision makers to reach the correct decision. The amount of influence you put in there is very, very risky ... I think the decision should be taken by the decision makers.

CSM: yes but it does beg the question whether engineering choose what the customer gets.

PEM: basically, it's the knowledge they're using, but engineering are anticipating, they're back up here (he gestures at the diagram) and I think they've got it wrong. I don't think engineering should do that.

CSM: see, that should be driven by -- this square, this is where we actually put some power into the new process, by saying -- you could actually pull out one issue that blows away nearly all the others, like that one there. What we would do is, we would actually end up making a recommendation that this is probably one of the most fundamental problems. At the moment we have no account management to drive it.

By now, the intended design process - to define what existed - had been implicitly replaced by the IS Manager's concept of how business process redesign should proceed: the definition of new business processes, to replace the existing ones. But team members were still engaged in an intense process of understanding how the organisation functioned, with respect to customer order management: new processes could not be defined without fully understanding existing processes and their deficiencies. The design team were aware of the conflict and had some difficulty in managing it:

PEM: Well there's company cashflow.

CSM: I think that's going to be a bit of an under-the-radar guide though, isn't it? I mean ... I'm not sure that something that shows eight hundred K positive, we'd worry about bidding (*he laughs*).

PEM: Are we trying to reflect the reality or the ideal? Because no matter how hard we try, you won't be able to remove the current cash position in the company out of the decision making process. Just to scope our ideas ... [*directed to the IS Manager*]

ISM: No, you won't.

PEM: even though we feel perhaps it should. So should we reflect what is actually going to happen and acknowledge that and record that or just go for an ideal scenario?

ISM: Oh no, it has to be feet on the ground. It has to be something we can operate.

CSM: This, I think, will be part of the overt organisation, but that will be probably part of the covert organisation. That will not be the sort of thing that is on the surface

PEM: That's right. That decision will be made in the decision box but that information will only appear in the decision box directly. It may come in on it from a different route, it wouldn't be collected by the bid team.

At the end of the initial six-week period, the project team presented their findings to the company's senior management, seeking permission to continue with what the IS Manager described as "filling in underneath the process". As part of their presentation to the board, the design team defined, for the first time, the goal of their design process: to formalise the process in order to make its participants easier for the manager of the process to control.

Definition Of The Design 'Problem'

There was constant tension during the design process, between the need to formalise target process outputs, to achieve control over the quality and timescales of Tender responses, and the informal culture of the company which led the team to agree that what they were trying to do was not to describe mandatory processes for the organisation ("this big snake that goes through the organisation"), but to provide direction and support for those people engaged in this process. The process of design was represented by the design team as one of moving from an uncontrolled, parallel business process to a more centrally controlled, serial process, which called upon external expertise as and when required by the process.

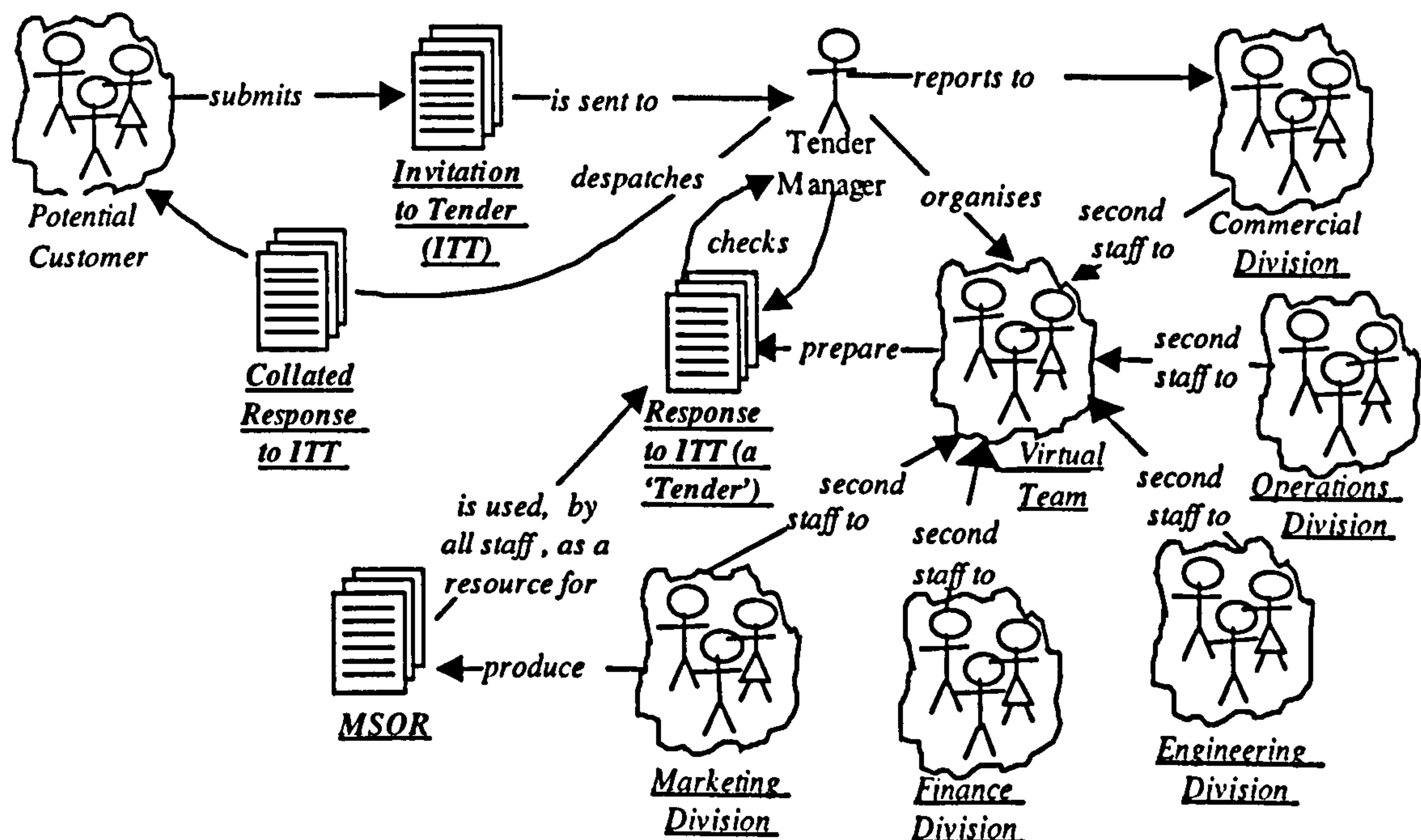


Figure 8-8: A Rich Picture Of The New (Intended) Tender Response Process

The proposed process, instead of being performed by a disparate collection of individuals, who were assigned on an ad hoc basis, would be performed by a 'virtual team' - i.e. a temporary project team, who shared information via IT, the membership of which was planned in advance of the arrival of the customer's invitation to Tender. The new process is illustrated in the rich picture in Figure 8-8. It is interesting that the design team did not attempt to define what the problems were with the current process, but let these problems emerge from the process of design. The chosen design 'problem' - that of securing resources for the process of Tender response - was a pressing one for the Tender Manager, but this was not the only serious problem that he faced (an analysis of the main problems of the current process and the interrelated nature of these problems, derived from interviews with the design team, can be seen in Appendix 4). The need to define a core design problem seemed to arise from the need to report the objective of design to the Managing Director; the team did not appear to understand the process sufficiently, at this point, to be able to define more complex objectives and had been content to operate without explicit design objectives being defined.

Determining Completeness Of Design

The design team received permission to proceed with the design and they reconvened after the Christmas break to start detailed process decomposition. The IS Manager was confident that the team had successfully defined the required process sufficiently for the target system to be defined as a set of work procedures and underlying IT:

I'm not convinced that this [the designed process flowchart] is not enough [to satisfy the needs of the design] - that plus the information which is passed at each point.

While the IS Manager was satisfied with the current state of the design, the rest of the design team were not. The team felt that there were outstanding issues, at more detailed decomposition levels, which had not been adequately recorded. As the design documentation (a high-level process flowchart) did not provide a means of capturing such issues, the group decided to list them for future action. The IS Manager felt that capturing these issues was a waste of time and did not refer the design process back to them:

The group decided to compile a list of issues: an analysis of the major items that we thought were related to getting from the process today to that [new] process. Having done this bit here [the top-level model], let us brainstorm what issues comply with this statement that we're going to have to think about this a lot more and really needs major actions but there will be benefits in doing so. Then we chewed around each one and came up with that piece of paper - although how valuable that piece of paper is I remain to be convinced. The group decided it would be valuable to analyse it by actions, benefits, barriers and costs. The fact that we've not been back to that piece of paper since might endorse my personal views. So events may well have overtaken that document.

8.5.2 Episode 2: Process Decomposition

Achieving Team Commitment To Design Process

The group had presented the top-level process design to senior management, and had obtained approval to proceed to a further phase of “much more detailed filling in underneath that process” and then to prototype the new process on a real customer Invitation to Tender. Following this permission, the group split into three parts to investigate how different stages of the process should be decomposed. The Customer Solutions Manager took stages 1,2 & 3, which were the smaller process stages, concerned with liaison with customer and product managers and Tender response initiation; The Project Engineering Manager and the Project Management Accountant took stage 4; the Tender response preparation (“which is the big one”); the current Tender Manager and the Business Development Manager took on stages 5 & 6, which were to do with despatching and following up the Tender response. After two weeks of detailed design work, the IS Manager felt that the project was progressing well and to schedule: “I think it’s fair to say now that for the most part we’re now well on down that route of filling in the detail underneath.” But there were still some problems with team availability and commitment to the process, due to the pressures of their functional roles in the company, according to the IS Manager:

I banged my head against a brick wall as far as getting the level of commitment that I would like to see from people. ... that would manifest itself in three ways. One, even better attendance at meetings. Because whilst this team is more committed than the last lot, it is still rare that we get a full house at the meetings. Secondly, turning up on time for the meeting, ... it really does get depressing. And the third is for things to happen between meetings, in the way that they aren’t. You’re clearly asking whether they are and they aren’t. People agree to take action between meetings and they never get done. The project is parked in the background again. ...

The other thing is that I’d really like to see a bit more sharing, with colleagues and managers by the team. The thing I keep taking the opportunity to drum into them is that we are looking to them to represent their peers and their gaffers and that implies that they should be using them as sounding boards for the ideas and thinking that they’d bring to the meeting and that which they take away. But it remains patently clear to me that that isn’t happening. I wish I could find a way of precipitating that.

The importance of political networking in the design of organisational information systems is clear from this: the IS Manager saw the successful adoption of an in-house information system depending at least as much on political acceptance as upon effective design.

Abstracting Target System Processes: ‘The Spectre Of Organisation’

The major design issue encountered at this stage was the difficulty of target system abstraction: separating *what* needed to be done (the designed system of work-processes) from *how* things were done in the target system (work-process mechanisms). The

flowchart diagrams used as the representational method by the project team could not capture the constraints imposed by the current organisation:

ISM: I wonder whether we've wandered off on that point ...

CSM: but how are we going to inject it into this, because it's no good writing up a process that the organisation can't deliver.

PEM: Well it's too early really isn't it, we know we don't really need to put in engineering contacts with the customer because there won't be any at this stage. It's too early. It's still fundamental, though.

In an analysis of design meetings during this episode of design, it became apparent that team members conceptualised a process's sub-components by discussing examples of how things were done now, comparing examples, to derive general rules of abstraction, then abstracting the process definition, iterating between the abstract and the concrete to provide and validate their common model of the process. All team members (including the IS Manager) found the process of abstraction from the concrete to the abstract very difficult at times. The IS Manager referred to this as "the spectre of organisation", saying:

I've had this constant battle with the team throughout the period, saying never mind the organisation, think process, we'll sort out who does it later. [The marketing representative] has been the most difficult to persuade to park the organisation at the side. His view has been, well this happens here and marketing do it; this happens here and operations do it. Or here is a big box which is marketing and we don't need to bother what happens inside there at this stage. Yes we do!

The process of abstracting work-tasks without linking them to organisational constraints was difficult because the design representation offered no means of capturing organisational constraints, as they were realised by the design team. This is, once again, the problem of decomposition: that many different levels of decomposition are involved in design at the same time, yet design processes only record considerations at the current level. The design team (including the IS Manager, at times) compensated for this by designing 'organisation' (i.e. concrete, as distinct from abstract, 'pure' process-definitions) into the abstract work-processes of the design, as illustrated by the following comment from the Customer Solutions Manager:

The thing I had a real problem with, on this, was the 2.3 box that says we're not rejecting it, pass to the next part of the process, the one with six groups of people, or there are six functions and I thought that in itself would need to be described in some way: how do you do it? I thought, this is prior to the bid decision isn't it, this is basically trying to say can we create a temporary bid team to actually do enough work to give us an indication at the bid/no-bid stage itself of how good our chances are of getting this business. I was really saying in the process that we would use e-mail to ask each manager of marketing and finance and manufacturing to allocate someone temporarily to this bid team.

Capturing And Recording Learning About The Target System

While the flowchart representations of target system processes supported the shared learning and model-construction required for an effective design excellently, they did nothing to provide the design team with a way of capturing and recording their learning. Team members suffered great anxiety over capturing information-flows and, at first,

responded by creating alternative representations of the target system. Different team members used different representational methods for their part of the design, according to their background and training. For example, the Project Engineering Manager used information-flow diagrams, while the Customer Solutions Manager described activities by the mechanisms used to record and support their outputs. This difference in representation continued for several weeks, until the IS Manager standardised the representational methods, but there were still difference between team-members in understanding what the design representation actually represented and how. When they tried to standardise on flowcharts, it was obvious that their concepts of what a process flowchart represented were radically different. The IS Manager requested that team members produce a flowchart which showed how a stage of the design would work in detail: four different types of diagram were produced.

The Customer Solutions Manager defined his design for the early stages of the target system process in terms of events which triggered the activation of a sub-process, organisational responsibilities for the sub-process, information to be captured during the sub-process and activities to be performed to capture that information. He argued that the design team should be concentrating upon how the target system worked as well as what the processes were, supporting his case with the illustration of the underlying IT. One needed to understand how a process was performed in order to understand what information was required by the person performing it and just what IT support was required. He argued that one would not discover gaps in provision until the system was in operation, unless the specific tasks to be done as part of each process were understood. The team was now feeling comfortable enough, in working together, for work to be divided on an ad hoc, voluntary basis and the chief issue was to manage the complexity of the design. The IS Manager described the position towards the end of this episode:

Where we really wanted to be, before the launch meeting, was also that we had done a fair bit of work on stage 4. Because you'll recall from earlier meetings that we saw quick passes through stage 4 as being fundamental parts of stages 1 and 2. This sort of sub-routine argument. So, the Project Engineering Manager -- on so much a voluntary basis that he turned up with the bulk of this work out of the blue -- turned up to one meeting with a "well, I happened to have a bit of spare time, guys, so here's a start of stage 4" and that was maybe 60% of what exists. He came back to a subsequent meeting with the rest and we are now working our way through it. I missed the part of the conversation where we discussed this flowchart, but there have been several iterations of that in the last three weeks, as people have grappled with getting a picture that (a) is a flowchart and (b) reflects the complexity of what happens in there.

It was during this episode that the Customer Solutions Manager left the company. This had two immediate impacts upon the design project: the team lost its representation from and with the marketing division and the team lost one of the most visionary of its designers. Many if the ideas which had been championed by the Customer Solutions

Manager were now left to succeed or fail through their being remembered by individuals, rather than recorded. The Customer Solutions Manager did leave behind a document, describing the design of the first two stages of the target system, but there were radical differences in the way in which he had conceptualised the system and the way in which the IS Manager wished to standardise the design documentation and important issues were retained or lost in the translation, according to whether other team members had understood them and were willing to raise them when the appropriate level of design decomposition occurred.

The Customer Solutions Manager had championed two “big ideas” with which the design team appeared to concur: (a) that the new system succeeded only if the people involved in the process of preparing a Tender response understood clearly what the customer wanted and (b) that the new system would only succeed if participants took individual responsibility for the quality of their work. The IS Manager could relate the first idea to his conceptualisation of what the supporting IT would provide (functions which he described as a computer-based ‘bulletin board’) and so championed this idea, in its initial form, at later stages of the design. But the second idea was initially rejected by the team, as the Customer Solutions Manager’s suggested mechanism would lead to unacceptable levels of formality and delays in the target system; the issue survived only in the form adopted by the Tender Manager, of using the supporting IT to track individual deliverables. The wider concept that the Customer Solutions Manager had espoused - of initiating an ‘internal customer’ culture, where individuals were responsible to the next person in the system workflow for the quality of their work - was lost in translation. This was mainly because of the way in which it was expressed in the form of a work-mechanism, the rationale for which was explained verbally rather than recorded for access when the design process reached a sufficiently detailed level of decomposition.

Recording Different Levels Of Decomposition

The Project Engineering Manager had produced a data-flow diagram to represent information flows in the main stage of the target system (stage 4), which formed the basis for discussion in at least two design meetings, although it was later abandoned and a process flowchart produced. He described the process of design as follows:

You normally work it the other way round [to the top-down, decomposition approach]. You say ‘what am I asked for’, ‘how am I going to do it’, ‘who do I need to do it’ and ‘what [information] do I need in to me to achieve it’? We did actually start to do this, right at the very end, we had [the marketing representative]’s picture of the actual tender and we said what do we need to achieve this and we started to work back, but it was getting very, very -- the procedure started to expand. He was going to do it in the form of a plan actually, well you need this before you can do this, and you need that before you can do that, but we never actually achieved that. ... We need to understand the nitty-gritty, to a degree, to generate the top level. We work backwards but we record forwards.

An important issue, therefore was how the “nitty-gritty” - the detail of design - could be captured when available representational methods only captured high-level design aspects. It is clear that design was taking place at many different levels of decomposition at once and design team members adopted a variety of representational methods to capture issues at a multiplicity of levels. When the representational method was standardised, to use process flowcharts, a huge amount of information was lost in translating the design, as this method did not represent multiple levels of decomposition and the formal decomposition approach which is applied to process flowcharting representations (decomposing each sub-process separately, one ‘level’ of decomposition at a time) did not permit capture of the synergies and interdependencies between sub-processes, which occurred at many levels simultaneously. Capture and representation of the target design was characterised by the lack of a mechanism to adequately record relevant information at multiple levels of decomposition at the same time. There was a mismatch between “working backwards” and “recording forwards”.

There is, of course, a trade-off: the sheer quantity of information generated in design discussions, coupled with the sparse understanding of the design problem at this point made the identification of what information was relevant very difficult. The central issue became discrimination between the significant and the insignificant (Turner, 1987). In his original conception of the procedure, the Process Improvement Manager had recognised the issue of information overload, but had commented that this problem would be removed by accepting that not all information needed to be captured:

First of all you get a massive explosion and there isn't a piece of paper in the company big enough to put it all on! So then you start to break it down into individual modules and the detail explodes - you get to a point where you just can't handle the sheer volume of detail if you go down too low. But by the time you have got down to this stage 2, you have got 80% of the effectivity out of the process: people can see where the holes are, see where the duplication is and start to understand the process. Because the other thing, apart from being very complicated, people had different perceptions of how the process was working and through this process people - would say oh no, it doesn't work like that, oh yes it does, oh no it doesn't - and you had to reach a consensus on how the process actually worked because it looked different from different parts of the company.

The benefits from this perspective, of the integrative approach to design were individual learning about the target system and achieving a shared vision. However, there was a third element missing from this approach, which was the capture of design constraints and individual and team insight. In many instances, insights were lost which might have improved the eventual design because individuals did not record the insight and the events which triggered it were not reproduced later in the design process, when a relevant level of problem-decomposition was appropriate.

Setting The Design Agenda

The IS Manager and the Process Improvement Manager jointly controlled the agenda for meetings, meeting before each design meeting to discuss which issues to pursue and how.

The IS Manager described their joint role in leading the design as follows:

If I'm not there, he will do a lot of the facilitating. Theoretically my role is leader and his role his facilitator. I happen to be a very facilitative leader, in my view, whether a leader should be a facilitator or not is a matter of debate. [The Quality Director] thinks they should be the same person. Before each meeting, Peter and I get our heads together and say: what are we going to achieve in this meeting? We map the meeting out inasmuch as we are able, we talk about the sort of problems that we've highlighted this morning, we talk about [the Tender Manager's] agenda, for example, we talk about [the Project Engineering Manager's] natural propensity for whipping off at tangents with enormous enthusiasm and not letting anyone else get a word in edgeways until the whole meeting has dived down with him! And my willingness to let that happen up to a point, until it gets to a natural burn out, before killing it off because I think it demotivates the team if I kill things off too soon.

We don't make any decisions to do with the process design outside of the meetings. What we do is make decisions on the process of design. So the decisions to get the group to split into two for this meeting was made by Peter and I outside of the meeting and we did a double act inside a meeting to make it happen. I said how are we going to organise ourselves to get this work done, we've got a lot to do in the next few months, tax? And Peter, after one or two people had said there thing, said well one thing we might consider of course, chaps, is to split into two. And everybody cracked it.

Two examples may give an insight into how individual team members influenced the design agenda:

U In his presentation of an initial design for stages 1 and 2 of the target system process, the Customer Solutions Manager suggested that all participants should use email as a communication mechanism, to ensure individual decisions were formally recorded:

Because at the moment, I know from experience that quite a lot of bid decisions are all done on flavours and gut feels and reading entrails - it needs to be more formal and I think the most important thing is it needs to be written down so everyone can understand how the decision was reached, not just on that one day but in the future as well. So people can then assess at the end of the bid - did it actually turn out the way we thought it would?

The email mechanism was rejected, partly because it was felt to make the system too remote for the informal interaction which was part of the company's current culture, but also because the IS Manager felt that they should not be defining mechanisms at this stage of the design process. In the course of discussing this suggestion, however, the current Tender Manager raised another aspect of this issue, which was not captured and appeared to form no part of later design discussions:

PEM: You lock them in a room until they come out with some solutions?

TM: Sometimes better, sometimes worse, but yes - they get on with it.

PEM: So a lot of it's down to the amount of time you've got available?

TM: That's right - that's the bid constraint. I think it's time available and getting people together.

That's trouble. The times I've got everyone that I've invited, I'd say you could count on one hand. There's always somebody who can't make it.

The issue of ensuring individual commitment was obviously a core one to the success of the target system design and formed the basis of a large part of the IT support for this

system. However, the means by which such commitment should be managed explicitly by target system management appeared to be predetermined: this issue was not noted by the IS Manager or the Process Improvement Manager for later discussion, nor was it again discussed by the design team in my presence.

⊞ The following interchange took place at an early design meeting:

ISM: so much of what has come up here, I see as material for checklists, to underpin the key boxes, which at the end of the day, are those (points to the flowchart)

CSM: In trying to get the organisation to adapt to this, it needs to understand what the issues are and why it's doing things and a diagram like that is going to show them why; showing them where the information is moving is showing them where it is deficient and why one little issue buried in the middle - understanding what the customer really wants - has a tremendous impact on the whole decision.

ISM: I think that diagram there (the information flow diagram on the whiteboard) is one that we would very much like to see come out at the Board presentation. That summarises much of the message that is emerging from this team.

But the information-flow diagram was not reproduced and the knowledge generated was limited to a single team member, as the Customer Solutions Manager left the company shortly afterwards. Although this knowledge obviously helped that team member to understand the design, it did not form part of the shared vision which the design manager was attempting to achieve, nor was the information used at later stages of the design, when the detailed system process specification took place.

It appeared that the inclusion or exclusion of design issues depended upon individuals' ability to recognise them as important to the design in general and to remember them for long enough to champion them and to convince others of their importance, when a relevant context arose, in design meetings. Sometimes, issues resurfaced at lower levels of decomposition when a team members suddenly realised the importance of a point made by another team member, earlier in the design process. This was related to the fact that individuals were conceptualising the design at multiple levels of decomposition, but capturing only a single level at any one time, so the person who determined how the design should be represented effectively determined the scope for the design.

8.5.3 Episode 3: Managing Emergent System Process Interdependencies

Following a short period of process decomposition, it began to be apparent that there were major interdependencies between the designed process and other, external business processes. As the target process had been selected for its 'stand-alone' nature, it took some while for the design team to change their perspective on process interdependencies. Coupled with that was a psychological problem: the designed system boundary had been defined along departmental boundaries, so interactions with other business processes were conceived as political, rather than design issues. When interdependencies between

this process and other business processes forced the expansion of the system boundary to consider parts of other business processes which had been considered external to the designed process, the expansion took place at an implicit, rather than at an explicit level.

The Tedium Of Functional Specification

Initially, the team were still designing for “quick wins”. Led in this perception by the IS Manager, the team saw the design process as a fast, task-oriented activity of system process decomposition and specification, with a “pilot study” of the designed process planned for March 1996. The team attempted to deal with process uncertainty by trying different approaches to design. The stage 2 process was “designed by committee” (in the words of the IS Manager, who thought that this had led to a poor design). The next approach was for one member of the team to design a paper prototype for other team members to use as a starting point in their discussions. The IS Manager, who described this as an “Aunt Sally”¹, saw this as a *much* more effective approach to design.

Process decomposition was performed by transforming the flowchart diagram for each stage of the target system into a set of process specifications, which defined the objectives, owner, inputs, process and outputs of each sub-process. The IS Manager did not perceive that much ‘design’ (i.e. creative conceptualisation) was happening at this stage. When asked if any flashes of inspiration had occurred during the previous few weeks, he replied:

No - just the opposite. I think what the team is engaged in is a real “grunge job” of grinding a way through the documentation and clarification of all the ideas that have been buzzing around. I think all the thinking through has been done to a certain level and the discipline of documenting it is highlighting some of the bits we haven’t thought through fully and therefore we are having to think through fully and other than that it’s a fairly uninspiring job. What we’re doing is not really the sort of activity which is likely to stimulate any blinding flashes of light -- it’s the wrong part of the project.

From this comment, it can be seen that the IS Manager perceived the design as reasonably concrete: that team members shared a common design model and so completion of the design would be a straightforward, if boring, process of functional decomposition.

Representing Information Flows At The System Boundary

But the process was not as straightforward a matter of “filling in the detail” as the IS Manager believed. The flowcharts, for which the detail was being specified, were continually changed as a result of this specification and it became clear that the design team had not fully understood the objectives or the information requirements of the target system stages. Towards the end of the project, several team-members reflected that the

¹ A fairground term, referring to a sideshow where a rag doll is knocked down with wooden balls.

team should have spent more time determining design objectives and what these meant for the design, before trying to specify the design sub-processes in such detail.

During this episode, which lasted for approximately four weeks, the team appeared to operate at two, distinct levels of design. At the explicit level, they were trying to avoid the IS Manager's 'spectre of organisation', by defining system process interfaces in terms of *information flows*, into and out of the process. But the team had no method for doing this, other than representing information flows as an 'interface' to the process flowchart and so the information flows were not defined in terms of sources, content and use, but more in terms of *'we need this document, which is produced somewhere external to our process [unspecified], to contain this sort of information'*.

On an implicit level, the team were increasingly becoming aware that the 'interface' worked in both directions and that the target system was constrained by other work processes over which they had no control. The IS Manager suggested that the team use a hexagon symbol in the process flowcharts, to indicate an interface to another process. But the addition of interfaces to process flowcharts only served to confuse the core issue of design at this stage even more. The level-2 flowchart for stage 1 of the new system process, shown in Figure 8-9, illustrates how the design changed as the team realised the significance of information-flows at the system boundary.

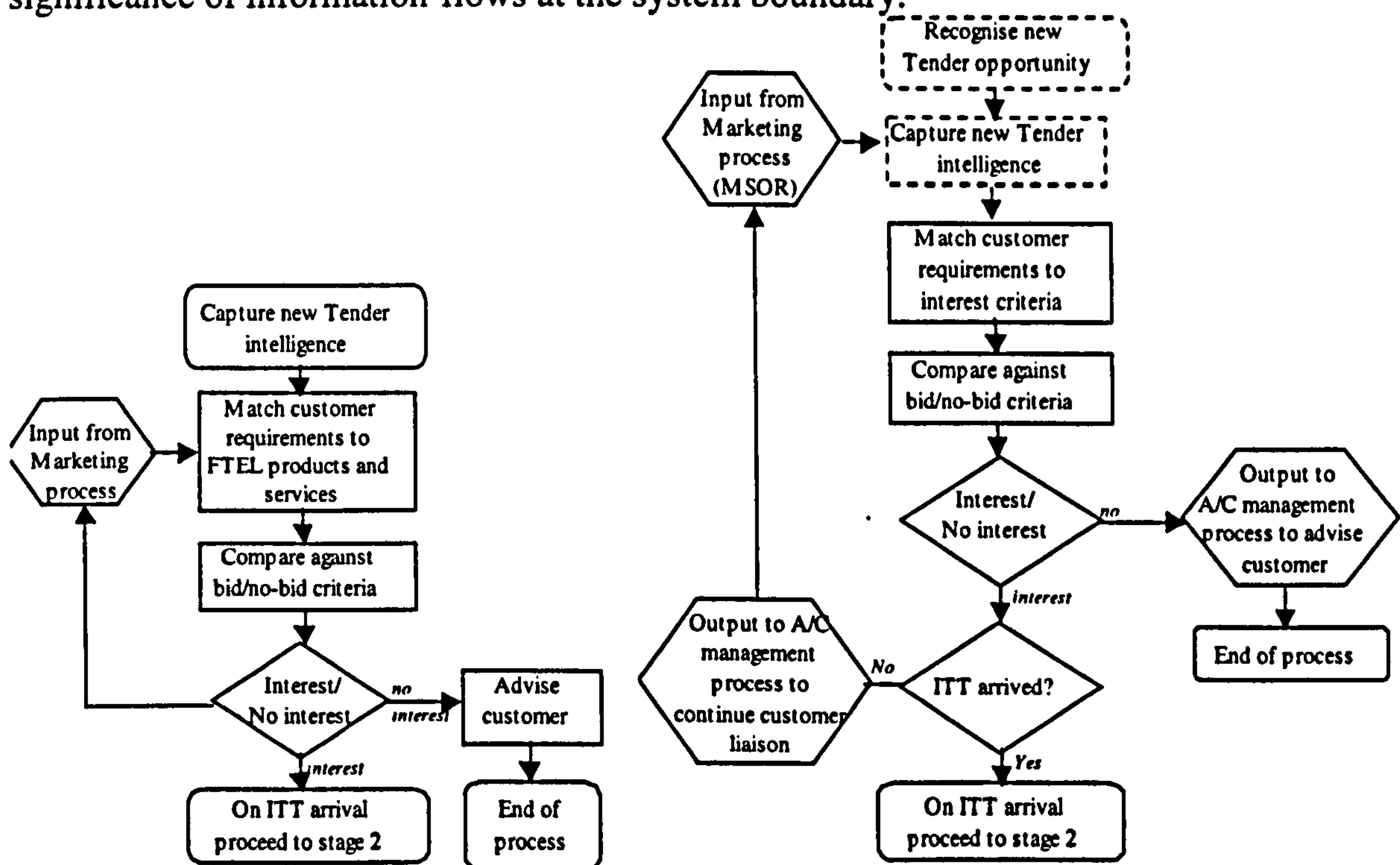


Figure 8-9: The Initial Stage 1 Process Design Flowchart Compared To A Later Design

There was significant confusion over the designed system boundary: the first two sub-processes shown in the revised design (shown enclosed in dotted lines in Figure 8-9) were

not performed by actors participating in the designed system processes, but by actors external to the explicit system boundary. While the design made the interfaces with some external functions explicit, by using the hexagonal 'interface' symbol, other external activities were included in the design of this process, even though the lack of control which the manager of the process was able to exert over these activities caused great problems for the successful operation of the process. *The design team did not sufficiently understand the detailed objectives of the existing process to be able to define the information-flows required by the new process and they had no representational methods to explore the information flows and so learn about external processes.* To design a new system, the team had to be able to abstract from the existing work-processes, as they had in episodes one and two of the design project: to define the objectives of the existing system and then to reconceptualise the system in ways that would meet those objectives better. But the design scope: the set of organisational activities - the system boundary - which it was legitimate to explore for the purposes of design was artificially constrained to that concerned with responding to Tenders and so the team could not understand their process's interactions with other processes which, conceptually, lay within their system boundary (i.e. had to be performed for the process transformation to take place) but politically, lay outside of it.

Defining System Scope: Domain-Specific Expertise, Mental Models And System 'Vision'

It is at this point that the role of expertise became significant in the design process. There was a struggle for definition of the target system between the Tender Manager, who was the only member of the design team who thoroughly understood the existing process (but much of his understanding was implicit: he was unable to articulate the workings of the existing process because he was too closely involved in the process to reflect on its workings fully) and the Project Engineering Manager, who was peripherally involved with the process and who had acquired an "informed outsider's point of view". The Project Engineering Manager was "intellectually excited by the design process" (according to the IS Manager), to the extent that he was prepared to spend a great deal of additional effort in acquiring the application-domain knowledge and expertise necessary for him to conceptualise the process, in all its complexity. The Tender Manager defined the system in a much narrower way than the Project Engineering Manager, as he was concerned with the day-to-day workings of the system, whereas the Project Engineering Manager was more concerned with an 'ideal vision' of the needs of the business as a whole.

Other members of the team appeared to be too busy with their functional company roles to be able to spare the time which was necessary to understand the design in a sufficient level of detail, according to the IS Manager:

I think everyone was more than happy with the Project Engineering Manager doing the bulk of the work (laughing). In the same way that I did the 'Aunt Sally' to stage 1, the Project Engineering Manager has done an 'Aunt Sally' to stage 4 -- and it is seen that way, I think. I think it's certainly easier for an individual to do that, than the first draft of stage 2 which was done by committee. I missed that work but my view is that the quality of the 'Aunt Sally' has been better for stages one and four than it has been for stage two which was done by committee.

Confusion over system definitions and the difference between the Tender Manager's grounding in the detailed work-activities of the existing process and the Project Engineering Manager's 'vision' of a new process is illustrated by this extract from a design meeting from this episode:

TM: But this is where I'm perhaps losing track a little bit - this section 4. To me, section 4 has been made so complicated now I've lost track of what we are supposed to be doing. ...

PEM: ... It's not that complicated really...

TM: ... The discussion we had on Tuesday - I couldn't see what relevance it had got to do with Tendering, which I think I said at the time. We should be concentrating on Tenders, not all this other part. It should be done well in front of when we get a Tender. To me, that bit should be in a box saying is an MSOR available? yes/no. If not, go away and get it. As far as I'm concerned the Tender has got nothing to do with MSORs. That's how it's generated.

PEM: That's where I'd disagree ... the Tender will feed into there as hard requirements...

TM: ... No

PEM: ... and it will invoke all this stuff. You've got to. Because what we do at the moment is, the Tender comes in, straight into here. These guys doing this have got no idea what we really want to offer, so systems group sit there and say oh this is what we think the customer wants.

TM: I'm not saying the way we do it is right ...

PEM: It's got to come through this ...

TM: ... yes, but that should be done well in advance of any Tender.

PEM: Oh, ideally- but it might not. As you say, some Tenders come in and we don't know what's going on. But this will be like an amorphous mass - there will be all sorts of intelligence coming in from all around the business and the customers. But it should be quite easy to knock that up when you get an ITT.

TM: I'm not saying it can't be done. I just think you're getting far too wound up with this, as far as Tendering's served. To me, as far as the process is concerned, the question is: is an MSOR available? Yes/No. If it is you get on it, if not, we go back and get it. As far as Tendering's concerned, how we do that is a separate process altogether and I think an awful lot needs to go on.

PEM: Well we discussed this and decided that we couldn't ignore it, because it was fundamental to the ...

TM: ... well that was why I was saying earlier - as I only took half of it I didn't agree with you because I wasn't party to the other discussions. That's an area that I think we need to go into more because I think you're complicating the system too much.

PEM: it's so fundamental that you can't escape from it.

TM: It needs doing, but I'm not sure whether this is the right vehicle for doing it.

PEM: Yes, but you're saying that you go ask if you've got an MSOR yes or no. What happens when the answer's no? The decision is stopped.

TM: No it isn't, you go away and get one. But that's part of another process.

Reading this dialogue, it becomes clear that there is confusion over the designed system boundary, which arises from two different perceptions of the *scope* of the design. The Tender Manager is arguing from a position where he views the design scope as optimising existing work processes (which he manages) and the Project Engineering

Manager is arguing from a position where he views the design scope as redefining work processes, moving the system boundary as necessary to one which encompasses work currently performed by people external to the Tender response manager's departmental area of responsibility. In particular, this discussion centred on the need for activities external to the Tender Manager's current area of responsibility to take place. The Tender Manager could not conceive of the system as other than his current area of responsibility ("but that's part of another process"), whereas the Project Engineering Manager conceived the problem situation as systemic, encompassing many different departmental concerns.

Confusion over the system boundary continued over the next few weeks. The system design, from this point, on began to be more centred around the existing process because the design team were dependent upon the Tender Manager's knowledge of the application domain, in defining what information was required by the processes of the new system. The IS Manager was aware of the constraints of defining the new process around the existing process, but was unable to overcome these, because of the increasing complexity encountered in defining the information requirements of the target system. The Project Engineering Manager often challenged the Tender Manager's 'mental model' of the new system with wider conceptualisations of how the process could work, but was invariably forced to compromise through the Tender Manager's recourse to the detail of existing information-flows. Such an example follows, where team members are discussing what causes a particular sub-process to occur. On closer inspection of the existing system processes, it transpired that the Tender manager or other staff used information from many different sources, other than the MSOR document and often had to perform extra work, to compensate for information about the product or manufacturing capacity not being available. The information-flows required proved complex and very difficult to specify.

TM: I would have said this commences with the delivery of the ITT rather than the MSOR.

PIM: you've got a problem there because...

PEM:... (interrupts) definitely not. Because you invoke this for pass 1, during the preparation of the business plan, then issue an MSOR.

PIM: ... it depends where you believe this started, it starts in about three or four different places.

TM: put 'or' then, or 'and/or' ...

PIM: yes OK. Because you've got "concludes with the completion of the draft documentation"

TM: if you ignore the ITT, why are we bothering with the draft responses and all the rest of it?

PEM: you don't. You don't, you miss them out. If they're not appropriate, you just cut straight through it. This is -- like the diagram, this is the instructions we are giving -- it's all-encompassing.

This is why we were discussing procedures the other day. I mean you're absolutely right ...

TM: ... yes, but we keep spreading out into other areas, we're supposed to be looking at tender preparation. I know we want to do these things, but remember that tenders are still in there.

PEM: it's tender preparation (stresses the last word). That's what it says at the top, that's what it's called -- not only dealing with the tender, but preparing the tender.

... [they debate about whether the ITT or the MSOR document contains the required information] ...
 PEM: just take it out, say “as detailed in the tender plan.” Because it’s the tender plan that triggers this.
 TM: I would agree with that.
 PIM: OK, compromise.

The Tender Manager’s complaint that “we keep spreading out into other areas” is significant: he is unable to conceptualise how the process could work, because he is so closely involved with how it does work. As the team defined the processes in more detail, they became more dependent upon the Tender Manager’s knowledge of the information contained in various company documents and he was able to influence the design to a greater extent.

Redefining The System Boundary

The team began to realise that the process was more dependent upon information generated outside the process (through other business processes) than they had thought at first. At first, they attempted to combat this dependency by inviting people from these external business processes, to explain how their processes worked, from which the team attempted to generate a plan to influence those processes. It was at this point that the IS Manager achieved a “blinding flash of inspiration”. He was able to conceptualise, for the first time, the new system in terms of the core business processes engaged in by the company.

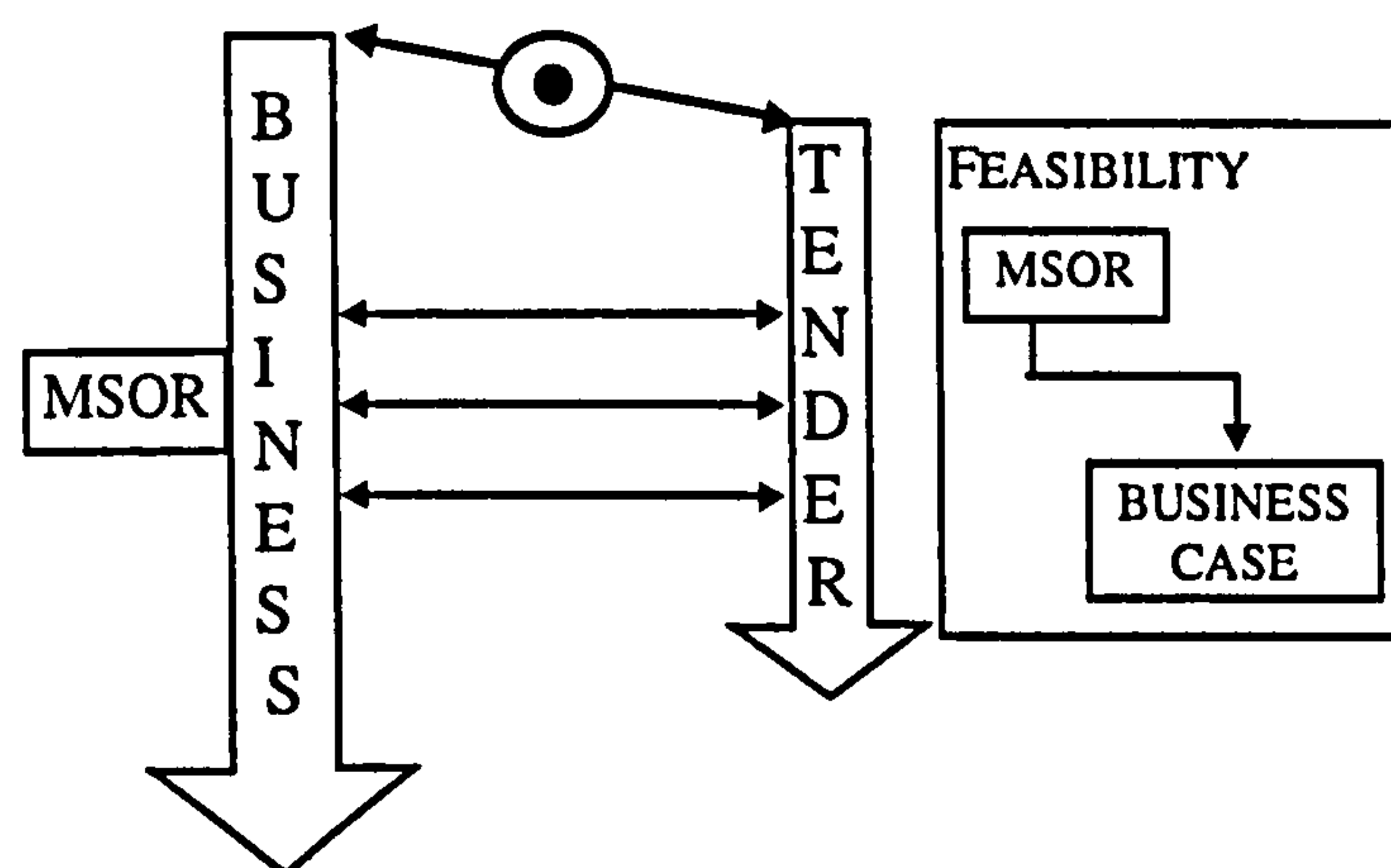


Figure 8-10: IS Manager’s Representation Of Relationship Between Target System Process And Wider Business Processes

The concentration upon information-flows and documents was replaced by a much wider perspective of how the company stored and used information and how that storage and use might be improved. He communicated this perception to the team with the words “I do not believe there is a common vision of what we’re looking at, in this room”, then drew the diagram given in Figure 8-10. Effectively, what the IS Manager was doing by producing this diagram (which was refined over subsequent meetings) was expanding the scope of the design by extending the system boundary, to consider work-processes which

were external to the departmental boundary along which the Tender response process had previously been defined. Prior to this point, the target system had been perceived as stand-alone and information-flows were seen as “interfaces” to the process. Now, the team were able to conceptualise information-flows as being produced by specific, external processes, rather than consisting of unrelated pieces of data, which had to be tracked down, in the nature of a detective novel. They were able to discern where, in the organisation, required information should be generated and at what point in the business process. However, this shift in design ‘paradigm’ - that the target system was no longer conceived as ‘stand-alone’, but as closely interrelated with wider business processes and therefore as part of a wider system of information-flows through the business - required careful political management, as discussed below.

At the next meeting, the team widened their definition of what information was required for this process. Rather than concentrating upon specific information-types, the team began to explore the production and ownership of information throughout the business. This led one of the team to suggest examination of a new document, the business planning, control and review document, which presented a ‘business case’ for specific products. The following meeting was spent by the team in attempting to jointly construct a model of how business planning should happen within the company, working from their own knowledge of company procedures and from the business planning document distributed at the end of the previous meeting and what their information requirements were, from the business planning process. An example discussion will illustrate this:

ISM: So - did all this documentation give us any illumination?

PIM: the only illumination that occurred to me is that we’re not following it!

ISM: [laughs] I agree

PMA: You should ... If they’re not following it, sometimes it’s for a good reason. [slightly defensively] You have to look at what needs to be done and say “does this documentation help what needs to be done?”

PIM: In the format for a statement of requirements, it does go through a number of categories, doesn’t it? Statement of key parameters, technology, methodology, dimensions etc.

PMA: this is relatively recent as well, this one’s 08-94

PIM: how relevant are any of those, do you think?

ISM: what, the headings?

PIM: mmm - the top-line structure. Does it come anywhere near?

ISM: well, a lot of what’s in here is relevant, isn’t it?

PIM: yes [pauses expectantly] ...

ISM: I would have said there was a reasonable degree of overlap with the sample MSOR that we have - in terms of content - the structure is substantially different

TM: the last four sections of the sample MSOR - I believe it’s the last four - it seems to stop with the technical side, rather than going to installation, packaging and so on

PMA: that’s true

TM: it just seems to stop with the technical side of it and the costs

ISM: [interrupts] I would say there’s less that’s in here that isn’t in the sample

TM: yes

ISM: than is in the sample and ain’t in here

TM: yes - I'll have a first stab at it if you like, I think it's just down to enhancing, isn't it, for what we want it to do ...

PMA: I think you have to ask, probably, everybody who uses the MSOR, whether it satisfies their requirements

TM: don't forget, we're only looking at what we want out of it - if they want something else, they'll add it in as well.

ISM: yes

TM: so we're not going to ask does it suit Fred Bloggs as an MSOR, it's does it suit us? If it doesn't suit him, he will get other bits put in.

PMA: what do you want from it? [*to the Tender Manager*]

TM: well it's one of those things we've discussed over the last X number of weeks, isn't it? You've told most of us what - what're you asking me for? [*laughter*]

... [brief exchanges concerning specific, individual information requirements] ...

ISM: were you proposing then that we'd already defined what we need out of an MSOR?

TM: I don't think we finally defined it - I mean we've gone through all sorts of pretty pictures and things, haven't we, but I don't think we've ever yet gone through that and said right, this is what we want and the rest of it isn't so, no I don't think we've actually finally pinned it down.

ISM: right - so what you were saying was, it's all the things we've talked about, but we haven't pulled it together into a nice package?

TM: yes - well we have to compare it against this to say that's included and that isn't.

ISM: but do we feel we would maybe be ready to pull it into a nice package?

TM: well I hope so.

Maintaining External Visibility

It can be seen that other team members were aware of the Tender Manager's dominance, in being able to define what information was required and were trying to open this up to debate. However, the need for some concrete definitions of what information was required overrode the concern with whether such information was provided by a single team-member, as the project had now been running for five months and the 'quick wins' were not materialising. In the same way that a primary objective of Governments is to stay in power, a primary objective of design teams must be to continue their task until they have completed the design. The team needed external visibility, in terms of achievement. They decided to pilot the early stage of the new system, to obtain this visibility in the eyes of senior management and to confirm to themselves that they had understood the needs of this part of the new system.

8.5.4 Episode 4: Piloting And Operationalising Stage 1 Process

The Need To Obtain Design Feedback

The role of feedback in design is seldom discussed as an issue, in the literature. In Norman's (1988) model of design, there are feedback loops from the system image to the user, but the lack of feedback from the user to the designer, or from the system image to the designer is not even discussed. Yet feedback is an important part of design. It is interesting that the IS Manager chose the term 'pilot study' to describe their prototyping, as a pilot study is usually the penultimate stage of an implementation process, employed when the technology or process to be implemented is sufficiently well-defined for it to be tried out in an operational context. It will be seen from the discussion here that the

designed system of work-processes was far from well-defined and what the team were actually engaged in was exploratory or experimental prototyping, particularly in respect of the IT support for the new information system. Floyd (1984) describes exploratory/experimental prototyping as a means of gaining both domain knowledge and experience about a particular problem. The team were using prototyping for two purposes:

1. To permit the team to observe the designed system of work processes in an operational context, to see where it was deficient.
2. To permit the team to fill in gaps in their understanding of what information was required by the people performing the work, so that required IT support for the process could be fully specified.

Arranging the pilot study proved problematic, because of the need to find an imminent customer Invitation To Tender (ITT), which was known about sufficiently in advance for the design team to be able to manage the expectations of the 'virtual team' who would be involved and to provide process documentation and IT support before the event. The Tender chosen for the pilot study also needed to be considered 'typical' by the design team - an objective which was hampered by the widespread perception among team members that there was no such thing as a typical Tender.

Eventually, the team found a suitable ITT for which to pilot the first stage of the new system. The main innovations of the new stage 1 process were an intelligence-gathering activity, to ensure that the company had sufficient time to complete product development and configuration before receiving the ITT and a 'loop' of activities around which the process decision-makers circled, recording what intelligence was available so that a decision about whether to formally bid for the Tender could be made very quickly once the ITT was received. A meeting with the senior management and other representatives from the Commercial and Marketing Divisions of the company (who were the primary people involved in this stage of the Tender preparation process) was called, to obtain political "buy in" to the pilot study - i.e. commitment to follow the prescribed procedures. This was obtained and the pilot study commenced.

The 'Invisible' Design Of The Supporting Information Technology

There was some debate about how to "break into" the stage 1 process, for the purposes of piloting the process, to simulate the collection of information which would normally come from the intelligence-gathering activities, but which had not been performed in that way as the process had not been instigated when intelligence for this Tender had been obtained. It was decided that the IS Manager's group of technical system developers

would provide a very basic IT support system for the process, which permitted the known required information to be stored electronically and provided a set of information storage facilities. A technical developer was assigned to the project and the team debated what information would have been stored on the IT system by this point, if the intelligence-gathering activities had been recorded as planned. The IS Manager described the impact of the IT support system as follows:

The essential system will combine things that are mandatory, like -- an obvious example is that, out of stage 1.2, it says record the opportunity. So there will be a screen on the database on which the opportunity is recorded and that recording process will be used as a trigger to advise other people automatically of the opportunity: people that need to know about it. So whereas in the old days somebody might write a memo to say "I had an interesting meeting the other day, you guys might like to know about this" and then put six copies of that memo in the internal post, the information will be quicker to put in, because it's in a more structured format, and will be quicker to distribute, because it goes through internal systems. So there is mandatory IT making things more efficient. But equally, there is more constructed information and the IT facilities should be there to enable constructed information to be recorded and shared, in a more voluntary manner. I hesitate to use the term, but I use the term bulletin board. We might not use do it in that way, but it will be a bulletin board substitute. So we say "OK guy's if you've got anything valuable to share with the rest of the team, stuff it in the bulletin board". So it then becomes voluntary, doesn't it, it's not mandatory to put your thoughts in the bulletin board, but it's bloody useful if you do!

[Interviewer asked about the extent of automation in the system.] It depends how automatable a process is: the estimation function is probably highly automatable. One would expect to get a reasonable amount of automation in it. But the whole thing about this process is that, at the end of the day, every need is different. Therefore that commodity, human discretion, has to be used at a multiplicity of points down the process. Therefore, you can't make it like a sausage machine. Probably, or you're alternating at the end of the day is movement of data and the flow of information.

What is interesting, is that neither at this point in the design process or later, did anyone in the design team feel the need to discuss the *form* that the IT system would take (how it would be implemented in detail). In initial discussions, the IS Manager had indicated that he saw the application of an intranet system - an IT system which supports communications, and information storage and dissemination within the company, using a World Wide Web browser - as one way in which the IT system might take form. The team appeared to perceive that all decisions concerning the form of the technical system were none of their concern, even though there was concern that people might not use the new system and the use of World Wide Web browser technology was unfamiliar to the team members. ***But in defining the IT system, the IS Manager was enabled to impose decisions about the way in which information was structured and also which information was significant to the process and which was not.*** For example, in several design meetings, the information required to notify 'virtual team' members engaged in Tender response of a new opportunity was determined, with the Tender Manager defining a 'Tender Opportunity Notice' - a form which was filled in as information became available. A core part of this form was a scoring system, which he used to determine the

attractiveness or otherwise of the expected business to the company. This was an informal assessment, used to communicate an estimate of the attractiveness verbally to the decision-makers who determined if the company would Tender for the business or not. There was some debate between the IS Manager and the Tender Manager about whether the scoring system added to the value of the information in the form, for people other than the Tender Manager: the Tender Manager felt strongly that the scoring helped him to administer the process. But when defining the IT-based documentation, the following discussion took place:

TM: Can I just pick up on interest bid/no-bid criteria? We need to issue this to people before we start the meeting [an activity in the new system process].

ISM: I did produce a document for this but did not bring it back to the meeting - I can't find it now. I left the scoring out - we agreed it was not relevant didn't we?

TM: I'd like to leave the scoring in, to build up a picture of how accurate we are, but I'm not too concerned at this point. We could introduce it at a later stage.

The Tender scoring was removed from the form and not reinstated when the information system was introduced into operation.

Unfamiliarity with the technology may have been part of the team's reluctance to debate IT system form. Team members other than the IS Manager felt unqualified to comment on the technology, as they did not understand it. There is evidence that the Customer Solutions Manager did understand this technology and made suggestions about how it was implemented in detail, but after he left, there appeared to be little understanding of how the technology would work. The IS Manager attempted to overcome this problem by giving a demonstration of how the new IT system would work. Only one team member, the Project Engineering Manager, attended. The IS Manager then suggested that the design team use the company intranet system (which performed many of the functions of the target IT system) for the purposes of disseminating project documentation. This was more successful in introducing team members, but they still showed little understanding of the impact which the technology would have upon company ways of working. For example, the following conversation occurred at the end of a meeting during this episode of the design:

BDM: I can't put a hard page break in an HTML document on the [prototype target IT] system, using the company templates.

ISM: You're not supposed to. Why do you want to put a hard page break into the document?

BDM: So I can print a copy for my boss.

ISM: You don't print it out, to send it to him. You email him, to tell him it's on the system and give him the URL [the location of the document in the IT system]. It's called the paperless office!

BDM: [laughing] Well it takes some getting used to ...

The stage 1 pilot started at the point when the IS Manager had his flash of inspiration concerning the relationship between the Tender response process and other business processes and ran in parallel with the continuing design process. This new understanding

permitted the pilot study to be interpreted in a novel way, with the IS Manager reconceptualising problems in the decision-making processes of the new system:

ISM: You've made me realise that we need to explore this larger process [the product lifecycle process]. What the pilot is highlighting is that the convergence between the two processes is not recognised by the business and that informal decisions in each are undermining the formal decision-making of the other.

The IT system design took place invisibly, with respect to the process design team. The initial IT developer attended a single design meeting (at which he did not speak), then did not attend any more. The initial developer was soon pulled off the project, to perform higher-priority IT development work and a succession of different developers were employed on the project, to perform specific tasks. It proved difficult to trace who was working on the project at any time and it was not possible to obtain interviews with them, apart from a single interview with the initial IT developer. There was constant tension during the design process, between the need to formalise process outputs, to achieve control over the quality and timescales of Tender responses, and the informal culture of the company which led the team to agree that what they were trying to do was not to describe mandatory processes for the organisation ("this big snake that goes through the organisation"), but to provide direction and support for those people engaged in this process. This was reflected in the implicit nature of the IT system: while it was presented as an information dissemination system, the IT developer responsible for initial design of the IT voiced the following concerns:

Now the one problem that I can envisage already is that there's a great reluctance in our user-base to use Oracle. They see it as quite unwieldy and they see it as old technology, because it's character-based. Because we've had a sudden influx of externals and more modern systems, with new systems, they like them to be intuitive and mouse-based if possible. ... The main priority is to get an efficient system introduced within the company. One that everybody wants to use. That's one of the problems we've faced, with systems we've put together, Oracle has been the only tool that we've had to design systems, and there is a great reluctance for it to be used.

The other thing is at people do seem to view it as a stick they can be beaten over the head with, so maybe some of the reluctance [to use existing IT systems] is down to that. I suppose we could get that with this system, if somebody promises to do something by a certain date and the system says that they haven't done that, then maybe they'll be reluctant to use it again. [Interviewer queries if this system will be able to pin down individual responsibility for actions?] Yes, it will. A full library of what happened on the system, even messages informing them that they haven't done certain things, will be available to anyone. We've got all this, proven and working, it's just the environment in which it exists at the moment.

These were critical issues about the impact of the IT system upon working practices, yet these were not discussed by the design team, as far as I am aware. While the form of the IT implementation did not appear to be open to wide debate, the information requirements of the new system were the subject of regular discussions. In this way, a great deal of the IT system was defined implicitly, but always with the IS Manager able to exert final control over the IT system specification and therefore over the information supplied to

system participants. Issues such as the clarification of detailed information flows at the system boundary - which the team had spent a great deal of time upon, but so far been unable to resolve in detail - were now assigned as IT-specific issues. The IS Manager agreed to refer these “support function” elements to an IT developer and to “involve the team as and when required.” However, it was not observed that the team was involved, or sought involvement in this area, following this point. Perhaps the team felt that it did not matter that they did not understand the technology involved, if they had control over the form in which information was presented. For example, the design team decided to use checklists, to avoid the “big snake” of over-formalisation of work procedures; they defined the content of the checklists and perhaps felt that they had discussed the process sufficiently for it to be well understood how the IT would support that process, without their being involved in assessing the form that that IT-system would take.

Planning The Pilot Study For Minimal Organisational Disruption

One of the main problems with the target system surfaced in the preparation for the pilot study: the lack of reliable customer intelligence concerning expected Invitations to Tender (ITTs). After several false starts for a pilot study, the team found a Tender which was likely to be attractive to the company and which they were assured would certainly be issued. But continued uncertainty about the likelihood of this ITT being issued led the team to constantly redefine the short-term goals of the design process, as they could not prototype the process as they had wished. This is demonstrated in this extract from a design meeting:

ISM: We need to make our objective that we have piloted stage 1 sufficiently well to go back and share our results with the guvnor [the Managing Director]...

PIM: One advantage is that we're doing this [*circles finger around main loop of stage 1 flowchart*] - is this typical [*to the Tender Manager*]?

TM: Probably is ... the fact that we have been delayed in obtaining a formal decision on the Tender does not affect things, we are going ahead with this anyway.

ISM: So we can afford to wait until later before we decide whether to go through another Tender for stages 2 to 6. We'd also consider whether there is sufficient disconnect in this process for us to measure the effectiveness of stage 1 and to make recommendations for stage 1. We can recommend the opportunity form and the opportunity database without piloting the rest of the process.

[rest of team agrees]

PMA: Our process is being adopted anyway, as 'business as usual' [he cites specific change instance]

ISM: So the principles we have been trying to advocate of getting decisions made earlier and information more explicit are happening anyway as a result of our process. It's something to think about - do we recommend stage 1 as a separate process and make recommendations separately before moving on?

PIM: It may be more realistic to break it up into chunks and deal with each separately. It will be more effective to launch our stage 1 while it is fresh in people's minds through the pilot - it will be an iterative loop and we'll have to refine our process.

TM: We could run several pilots in tandem.

In the event, the customer did not issue the expected ITT and the team was not able to use this Tender to observe and partially prototype the other stages of the process, as they had intended. In an email received from the IS Manager at this point, the position was stated emphatically:

There WILL be a meeting on Friday. We will spend the first hour with a 'guest' who knows the Business Planning Process (i.e. the big long arrow that we put beside our short arrow) backwards to discuss the interfaces and related issues. And the second hour doing an Exit Review of the Pilot Trial because We heard on Tuesday that our customer will not be issuing the expected papers after all and that particular opportunity is at the end of the line. Talk about an unwanted kick in the

Anyway, we spent our Tuesday meeting reeling and recovering from that news, planning the presentation to the MD on May 1, and deciding how to recover success from disaster.

By now, the design team had realised that their process was part of a much bigger business process and the IS Manager's diagram had been redrawn as shown in Figure 8-11. The Tender response process (shown as the 'ITT process' in the diagram) was now conceptualised, not in terms of its use of information, but in terms of its relationship to other core business processes. This was represented by the use of the metaphor "the big arrow/little arrow concept" which was soon adopted by the whole design team. However, it was politically unacceptable to re-define the target system boundary, as this could only be done by senior management, so the design team attempted to compromise.

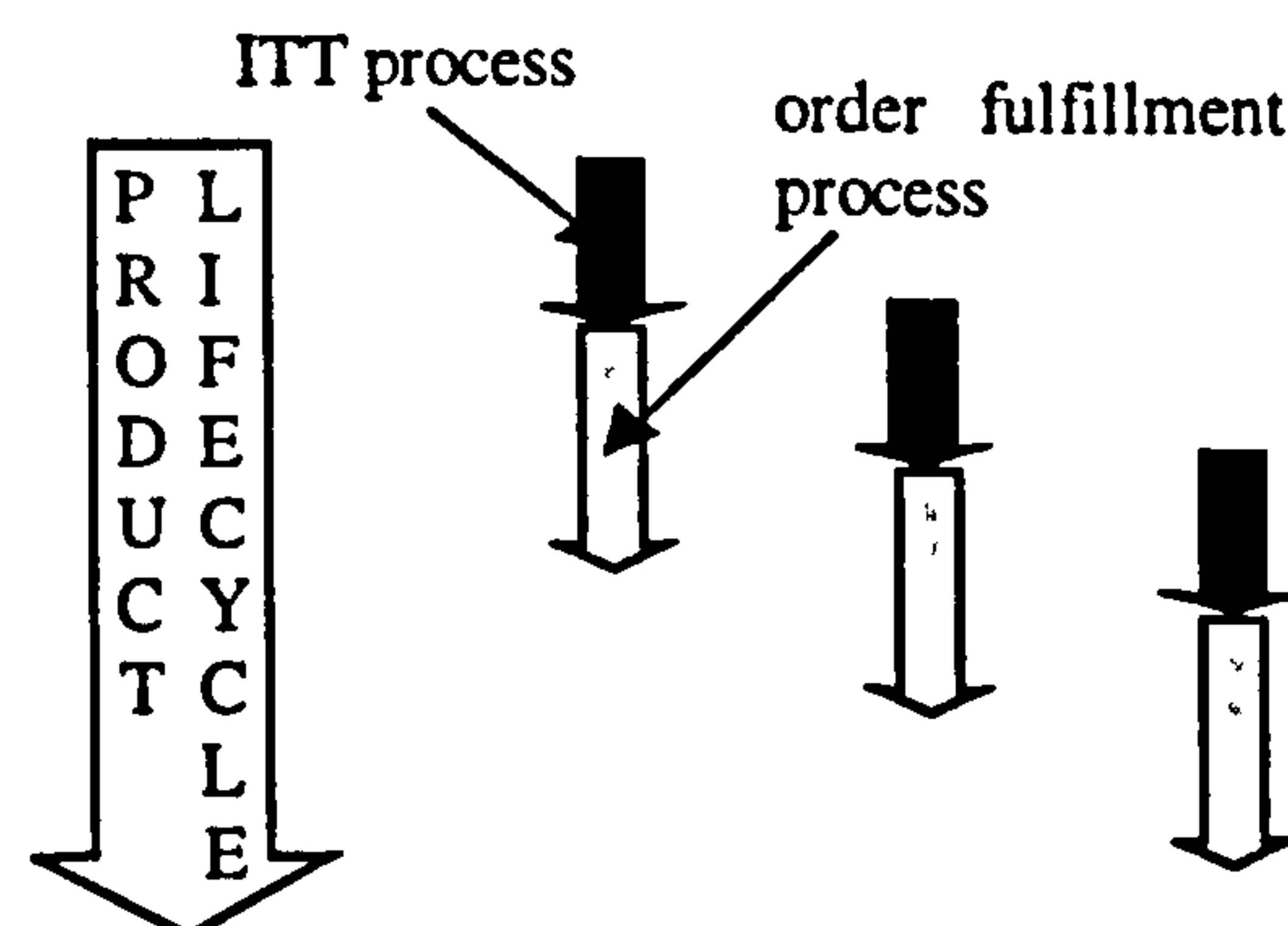


Figure 8-11: A Later Representation Of The Relationship Between The Target System Process And Other Business Processes

Pilot Review And Operationalising Stage 1 procedures.

The pilot study eventually took place and the team were reasonably satisfied with the results, feeling that they had a much better idea of how their new process might work, now it had been tried in practice. But there were continuing differences in conceptualisation of how stage 1 processes will work, even after the pilot study:

PIM: Are we going to impose an organisation for this, or do it through consultation

ISM: It'll have to be consultation, etc.

BDM: the only problem is that we don't have any Sales people: it's mainly marketing guys who are involved.

ISM: [challenging] Is it?

BDM: Yes. [elucidates why].

... the team examine the flowchart, puzzling over how it works ...

ISM: To my mind, the only person who can fill in an Opportunity Assessment Form is the Product Line Manager.

PIM: So if [the Tender manager] got a Tender and the Product Line Manager had not heard about it, you've got a problem, haven't you?

ISM: I don't think so [he describes the process as he understands it]

This stimulates a general discussion of how the [marketing] customer support and order management function and the [engineering] product design and manufacture function interface with each other, in the company.

The issues raised by this extract of dialogue from the design meeting are:

- even following the pilot, the team still did not have a shared understanding of the way in which the process worked in detail; and
- the team did not have a shared understanding of the relationship of their designed system with other organisational business processes.

The operationalisation of the stage 1 process, which had now been prototyped, was seen as “stage 1 can now go into business as usual”, which the IS Manager defined as being implemented as part of the day to day operation of the business and being adopted by the people who do the work for the process. The IS Manager described this as “a two stage thing: getting in a manual process and then improving it” - i.e. when the IT support system was complete. There was some debate about the need for external visibility once again, in the team's decision to (as the Project Engineering Manager put it) “do a piecemeal introduction of some parts of the process.” The operationalisation of a single stage was prompted by two factors:

1. The stage 1 process had been specified to a greater extent than the other stages, as the process had been prototyped and the team felt that they had a need to be seen, by external actors, particularly senior management, as making some progress in the design
2. There had been some adoption of parts of the stage 1 process, as the ‘pilot study’ had demonstrated its usefulness to people involved in Tender response. The team wished that people involved in Tender response should adopt the whole of the process and not just parts of it.

It was therefore decided to operationalise the stage 1 process informally, ahead of the other stages, and this became a major priority of the team's effort. This was achieved through introducing new working procedures, with the Tender Manager training people “as and when I need it”. But the issue of how the piloted stage of the new system should be organised caused political tensions. There was a discrepancy between where most team members felt the new process should properly reside (Marketing Division) and where the Tender Manager would be prepared to reside (Commercial Division), which was not helped by the continuing absence of a marketing representative on the team.

Concerning this reorganisation of the existing processes, the Process Improvement Manager commented "It's courage in our hands time!" The issue remained unresolvable and was deferred until late in the project, when other organisational issues were dealt with.

The Problem Of "Design By Committee": Concentration Upon Detail Rather Than Design

It was at this point that problems in what the IS Manager referred to as "design by committee" made itself apparent in the process. The Project Engineering Manager expressed his dissatisfaction with the design process:

PIM: How about we spend half an hour on the implementation of stage 1? To see which are the issues we can be getting on with, between now and the next meeting and the ones that we can't, then we can reflect on them. Then spend the main body of the meeting continuing with stage 4?

PEM: I don't have any philosophy on 'let's go away and reflect on it' - that means let's park it. [Laughing] Let's be honest about it, guys. How much reflection do you do when you're not in this room?

ISM: Well I fundamentally disagree with that point. [Also laughing] I don't think I want to commit time in the meeting to debating that one!

PEM: We seem to be struggling, to be honest, lately. I mean, I'm struggling with waning keenness. It just seems we'll go to the meeting, we'll talk about the weather and we'll do a little bit of this and we say we'll go away and think about stuff, then we'll come back to the next meeting and we'll do much the same. One thing I did notice, that I wasn't terribly keen on at the time, was that I think when we split up into small groups to do things, I think that we got more done. Because there was less sort of human interaction and more getting on with the task - less process, more task, for whatever reason. And I think there may be some mileage in doing that again.

ISM: Yes. Well I support that. I think we need to get things done. I think if we don't get on and do these tasks - which need doing - to say we've tidied up stage 1 and we can move on, then things are going to overtake us again. Because this pilot trial that will take off in June is, I think, going to be fairly demanding. I believe there's a lot to be done between now and when that Tender comes through the door. We certainly need to plan for and get some training seminars off the ground. We need to finalise the documentation and get some work started on the 'database' that's going to underpin it. ...

PEM: ... [interrupts] We say we need a project plan to achieve good turnaround of Tenders. How about us having a project plan, as to what we're going to achieve? Put down our deliverables and then decide how we're going to achieve them? OK, it's all in the process. But perhaps it's the little bit of process that we're missing? We don't appear to have fixed goals. At one time we had, you know, we'd got to see Tim, so we'd got to do this stuff. And we'd say 'Phew, we'd better get on with it and cut through all the garbage.' But at the moment, it's a bit open-ended isn't it? So perhaps, if we did have all the things listed that we needed to do, and address some way of achieving it, it might focus things a bit. Certainly, it would help my enthusiasm.

BDM: I think you're right, to a degree. When we'd got the five stages to attack: we identified what the stages were and now we've started to break them down and get really into it, it was fairly goal-oriented and I think you're probably right, to a degree, we've lost that initial enthusiasm.

PEM: But what about the way of achieving it? Is it realistic to put down the things that we need to do and plan it in, or is it a bit optimistic that we can actually do that?

ISM: I think in terms of generating a project plan, there are some difficulties in sizing the tasks and that might put some limitations on how perfect a plan we can come up with. But certainly, we can identify the tasks, we can give them and we can put some due dates against them.

PEM: That's right, with some goals. Goals are what we need, I think.

ISM: So what we need is a lightbulb [talking about inspiration]. ... [pauses] ...

ISM: But I agree that breaking down into smaller groups was more effective.

PEM: Well, going over stage 4 is a bit risky in a way, because you have the small group do stage 4, then you bring it back into the big group and spend all the time going over it again. What we tend to do is just look at the detail: to say 'I don't like this word there and that's OK'. It's not overly productive. But at least you've got the basic outline put down, by the small group.

This interchange was about more than the need for short-term goals. The Project Engineering Manager was making a point that agreed with a much earlier observation by the IS Manager: that design which involved the whole group tended to be “design by committee”: the design concentrated upon the detail of the process, rather than generating process inspiration or understanding. The team had no feasible method for testing and constructing joint models; throughout the whole of the design process, this tended to be performed by one or two ‘experts’, or a subgroup which tried to understand the problem by a process of argumentation: explaining to each other and disputing how a process would work overall. This was only felt to be feasible with a very small group: two to three people. With a larger group, the lack of detailed understanding which most team members had of the overall process and its interactions with other business processes manifested itself in individuals feeling unable to engage in argumentation, when there were others present (in particular the Tender Manager) who understood the process better than they did, so the team concentrated upon the detail rather than the design. In the large group (the core team of six), system design tended to default to the Tender Manager defining what happened in existing processes. In a smaller group, conversations came down to dialogues between two people and individuals felt more prepared to “argue the toss” and so more design was achieved.

Understanding The Target System

Despite the call for design in subgroups, the team was feeling that they had not made much progress in the last few weeks and appeared extremely demotivated. A problem at this point was the level of detail involved in validating functional specifications for the sub-processes. This was an extremely tedious task at times and the lack of support for constructing mental models of the target system provided by the representational mechanism - written specifications, rather than diagrams - contributed to a general feeling that the team did not understand the detail of the process and that the process of doing so was unrewarding.

The continuing lack of a Marketing representative also contributed to this lack of understanding, as the interrelatedness of the target system with marketing processes was becoming apparent, yet the Marketing Director continued to view this as a low priority. The IS Manager determined to find another customer invitation to Tender which the team could use as a pilot for the remainder of the design.

8.5.5 Episode 5: Detailed Information System Design

Planning Short-Term Goals

This stage ran in parallel with the operationalisation of stage 1 of the target system, for the first few weeks. At the start of this stage, the IS Manager expressed the state of the design as that the top-level flowchart was approximately 90% complete, but “at a more detailed level” only 20-30% of the design had been done so far. By this he was referring to the functional specifications which the team had adopted as the representational method for the design at lower levels of decomposition (the IS Manager had suggested this approach and as the team had no alternative to suggest, they agreed).

The process for this stage largely ran in parallel with the operationalisation of the stage 1 process of the target system. The IS Manager represented the tasks required to complete the system design in a whiteboard diagram as shown in Figure 8-12.

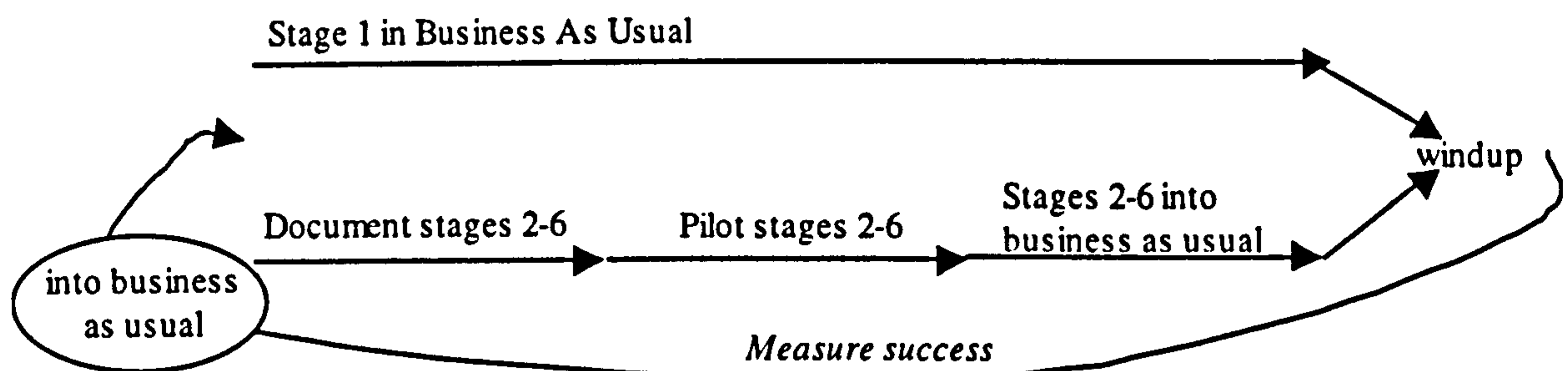


Figure 8-12: IS Manager's Model Of Tasks Required To Complete Design

At this stage, the team were actively engaged in seeking another expected customer Invitation To Tender which could form the basis for their ‘pilot study’ of stages 2 to 6 of the target system design. By now, the purpose of the pilot study had changes, from one of validating the design to one of elucidating the design (i.e. by now, the ‘pilot study’ was no longer intended to pilot the system, but to provide exploratory prototyping of the system): there was a change in perspective about the ability or indeed the requirement for the team to specify the process in detail the pilot study. The Process Improvement Manager commented on the design process as follows:

One of the things we learned from stage 1 is that we don't have to understand it - we understand it in detail through piloting it.

Because of the use of the term ‘pilot study’, this mechanism was described as exploratory prototyping and trying-out a completed design at the same time. There was concern within the team about the latter purpose, when the design was still very vague and unlikely to be completed within the short timescale involved until the expected pilot ITT arrived. This was reflected by the Process Improvement Manager, who was “concerned that we need to rattle through stages 2 to 6 in only two to three weeks”. It was suggested

that the team take another subset of the design to 'pilot', but the issue was not resolved. The IS Manager still spoke of the pilot study as "testing the design."

Design Of The Supporting Information Technology: The Tension Between System Formalisation And Scope For Individual 'Professionalism'

The IS group were now planning to try out some of the IT concepts which they [the IS Manager and technical developers] had decided to use as the basis for this system. This was based upon IT tools already in use in some sections of the company: FrameMaker, a desktop publishing package, which permitted 'document management' - the management of limited access to certain documents and the ability to change only those sections originated by the individual concerned - and a shared Oracle database of Tender documents and information, using a World Wide Web browser interface.

The new IT support function was by now referred to as (initially) "data warehousing", then (when the IS Manager objected that that term had specific meaning in the IT field as connected with the capture and presentation of business transaction data) as "the data Library for the Tender response process". The intention was to provide a repository of relevant information, which could be accessed by all those involved in the preparation of Tender responses, as and when required. A central design problem for the team at this point in the design was defining exactly what information was required and the 'data library' concept ignored the issue of who would provide and maintain the data.

The issue of how the new IT system would be used and who would enter the library data finally arose by chance at a design meeting. This reflection arose as the result of a question from the Business Development Manager, who was being briefed about the design progress prior to an imminent presentation to the MD, to report progress. He asked if the new system would be part of another IT system, which provided a contacts database for Marketing staff and, when the IS Manager commented that the major problem with the contacts database was that it was not updated frequently enough, responded that there was no reason for Marketing staff to update the database, as it had not been designed to support any of the functions which they performed as part of their day-to-day work. He then went on to reflect what functions the new IT system, for the Tender response process (the target system) would support and what incentives *that* system would provide to potential users:

BDM: So what will make people use this new database, that's going to be for tender opportunities? What would make Keith or Brian, say, start entering "I've just spoken to a guy about baked potato machines and are we going to be interested in this? Or I've just spoken to a guy who's going to put closed circuit TV through the Channel tunnel, I wonder if that's the sort of thing we want to get into?", rather than saying "hey Paul, I've just had a chat with this guy and are we interested in ...".
ISM: well, that's a good question, isn't it?! (he laughs)

PIM: currently [the Tender Manager]'s driving the process, isn't he? To get some visibility of what tenders are coming along, [the Tender Manager]'s driving the process by saying "will you tell me what opportunities you've had in the last month?" Because [the Tender Manager] has a need to have that visibility. What we are saying is that that information we would like to be available on a central repository. Which doesn't answer your question: what going to make them do it?

ISM: Yes -- you having said what you've said, I think I see a routine where it's like monthly reports. Nobody thinks about anything until the monthly report is due and if everybody knows that the tender opportunities report is produced monthly and goes in front of Tim [the MD] and Tim will expect to see all the Tender opportunities in there and kick ass if he doesn't, then everybody will put their information in on the night before the end of period.

PMA: it's a management things rather than a systems thing.

BDM: Yes.

ISM: That's a good point, that is. [*Reflecting on why people would use the system - he makes a note of the issue.*]

It is obvious from this dialogue that the IT system at this time was conceptualised as a system to provide information to those planning activity for the Tender response process, rather than a system to enable people to exchange marketing intelligence.

The inputs to the system were problematic, because the system provided no benefit to those whose work it would be to enter data into it: only to the recipient(s) of that data.

It is interesting that the response of the IS Manager to this dilemma was to impose information reporting rules, which relied upon the displeasure of senior management as a sanction, rather than to reconceptualise the new system in terms of what benefit it could provide to its users. Partly, this conceptualisation was constrained by the artificial system boundary which was still explicitly defined as corresponding with the organisational boundary enclosing the Tender response function and did not extend to those inputting the data. But also, it reflects the role of IT in the company, which was perceived as contingent support to fragmented work-functions, rather than being perceived as an integrated system of information provision.

An emergent issue which arose during this period was the differing user-profiles of actors involved in the new system of work and IT support. In particular, there was the problem that senior management were unlikely to use an IT-based system of recording information. A statement from the IS Manager highlighted this as "a weakness in the flowchart, as it doesn't allow for 'never mind stage 2 [of the process], there's a strategic decision from the highest level that we're bidding for this business'." There was also some discussion of how the system would work when senior management were directly involved in the process, as they would "probably not use the [IT] system, even to read documents."

The extent to which the new work-system would be formalised remained almost deliberately vague. The team presented their progress to the MD in the middle of this period and he was concerned that they were over-formalising the process. The IS Manager's response to this was:

We have given people a checklist of things to consider, but I do not want to remove people's opportunity to apply their professionalism.

However, as discussed above, when it came to ensuring that people entered relevant customer intelligence on the system, the IS Manager was cynical about the extent to which people's 'professionalism' would ensure that they entered relevant data on the IT system and was only too happy to ensure that company sanctions were used to enforce data entry. In this sense, the IT system was now seen as supporting people's skills in the preparation of Tender responses and therefore *requiring scope for autonomy in the way that its information was used*, but requiring people's conformance in the collection of customer intelligence and therefore *constraining autonomy in the way that its information was collected*.

A Shift In System Paradigm

The system boundary now began to expand at an *implicit* level, although it was still referred to *explicitly* as corresponding with the organisational boundary enclosing the Tender response function. This expansion was referred to, by team members as "the little arrow/big arrow concept", reflecting the IS Manager's drawing of the Tender response process in relation to wider business processes (see Figure 8-11). But the shift in design paradigm, which resulted from the implicit system boundary shift required careful political management. Perceiving the process as closely interrelated with wider business processes meant that a wider range of external actors were closely involved in 'buy-in' to team decisions. That one of these actors was the Marketing Director, who had still not provided a representative for the design team, was particularly problematic, as it meant that the team had no-one to explain how marketing processes worked, in their detailed analysis of interfacing processes and that there was no-one to lobby on their behalf with the Marketing Director: pressure and agreement must be sought indirectly, via the reporting structure (the MD), rather than directly, via a member of the team. This had political implications for the team, as reflected in this extract from a design meeting of the time:

ISM: We've proved out our stage 1 in its own right. But in doing so and in running through the pilot trial, we highlighted grey areas or whatever we want to call it, where our stage 1 integrates with the wider processes of the business. And have found it necessary to take the lid off that can of worms, in looking at it in greater detail - [he pauses to think].

PIM: And one of the worms in that can, was a statement of requirements. Which is the thing that we need at this point in our process.

PMA: The reason we picked on that is that we thought that those things weren't being done as effectively as they could be. So there was confusion leading into the Tender Manager, or the engineers who responded to this. I think it has improved, but it certainly hasn't happened in the past. It's a difficult subject to talk about.

The above dialogue reflects the new design-team paradigm, which saw the target system as part of a wider system of information-flows throughout the business. But this paradigm contrasted sharply with the way in which information provision had been conceptualised previously: as small-scale, contingency provision of database support for individual work-processes. The IS Manager began to expand his vision (which had been forming since before the design project) of a company-wide 'intranet' (internal world-wide web) system of information. But this wider vision was still limited to local information provision for specific processes: the issues of incentives for data entry and why and how it would be used were still missing from his conceptualisation of IT within the company, as discussed above.

That the implicit system boundary was being extended to 'external' business processes, was demonstrated by the IS Manager, who was now willing to forget "the spectre of organisation" and initiated discussion of the organisation of 'external' but related business processes in design meetings:

TM: The important thing is that it should be done properly. Who it resides with should not be a significant factor.

ISM: Yes and no. My task is to recommend efficient structures. There are some inefficiencies:

1. An apparent lack of logic between an extremely small and not that broadly skilled engineering group and a massive duplication between that and the customer engineering group. The Project Engineering Managers might as well do the lot.

2. A dichotomy between the way we manage product and the way we manage service.

There are three steps in the chain up here [refers to a diagram drawn earlier on whiteboard]:

Customer → Commercial [Tender Management] → Customer Services → Product Line Manager
Ask why and Marketing says this guy [the Customer Services Manager] has got a level of independence. But you [*the Tender Manager*] have a level of independence too: we don't need both of you. We should define what we think it should be, even if we take a couple of giants on, in the process.

The IS Manager is suggesting here that they recommend to the MD that an organisational function external to the Tender response process be abolished and that the Tender Manager take over this role in the organisation. This quote demonstrated the IS Manager's awareness of the constraints of the existing work organisation, external to the process, and his willingness to consider them as legitimate objects of design.

The design project also had a wider effect on the rest of the business, from this point on: it played an important role in forming external actors' conceptualisations of wider business processes than they had previously held. Following an invited speaker's address to the meeting and the questions which followed, the IS Manager commented:

I am absolutely convinced that, at one or two points, we had effectively made a couple of points to him that had immediately registered as holes in his thinking and then he gave us answers and pretended it was as it was. When it occurred to him that an MSOR only dealt with this stream [the two "little arrows" of the Tender response/order fulfilment processes, shown in Figure 8-11] and not this [the "big arrow" of the product lifecycle], you could almost see him thinking 'Oh bother, well that's something I hadn't thought about! Well -- it's like this, isn't it ...?' "

Gradual changes in the organisation in turn affected the way in which the design project was run. The Process Improvement Manager commented:

My total thinking is starting to change now, about how we would launch this. I thought it would look something a big bang approach, where we would say 'Hey guys, this is the new process, look at this!' But it's actually dribbling in. People are picking things up and saying 'Ooh, I'm going to go with that one.' It's not as I expected it would happen.

The IS Manager added:

That's what is happening in reality. These debates we are having with people are modifying their thinking and they're going away and then, bit by bit, everything that we are building [conceptually] is happening out there. The whole thing is converging. Our thinking is going to a point - that we haven't quite defined yet. What's happening downstairs [Marketing and Engineering divisions] is about six weeks behind it, but now they're following us.

This example demonstrates the way in which the system boundary was expanded by the actions of the team. The designed process affected and was, in turn, affected by, external business processes. In the above example, challenging an external process representative as to the extent to which the work-system in which he was involved supported the whole of the business and not just specific parts of it, he redefined the purpose of his work-system as providing customer intelligence to the business, in addition to its other functions. This, in turn, permitted the design team to rely upon customer intelligence information, the provision of which was fundamental to their system design (and part of the implicit design), but the provision of which lay outside their explicit system boundary. This is illustrated in the rich picture, in Figure 8-13, where the solid heavy line represents the explicit system boundary and the dotted heavy line the implicit system boundary.

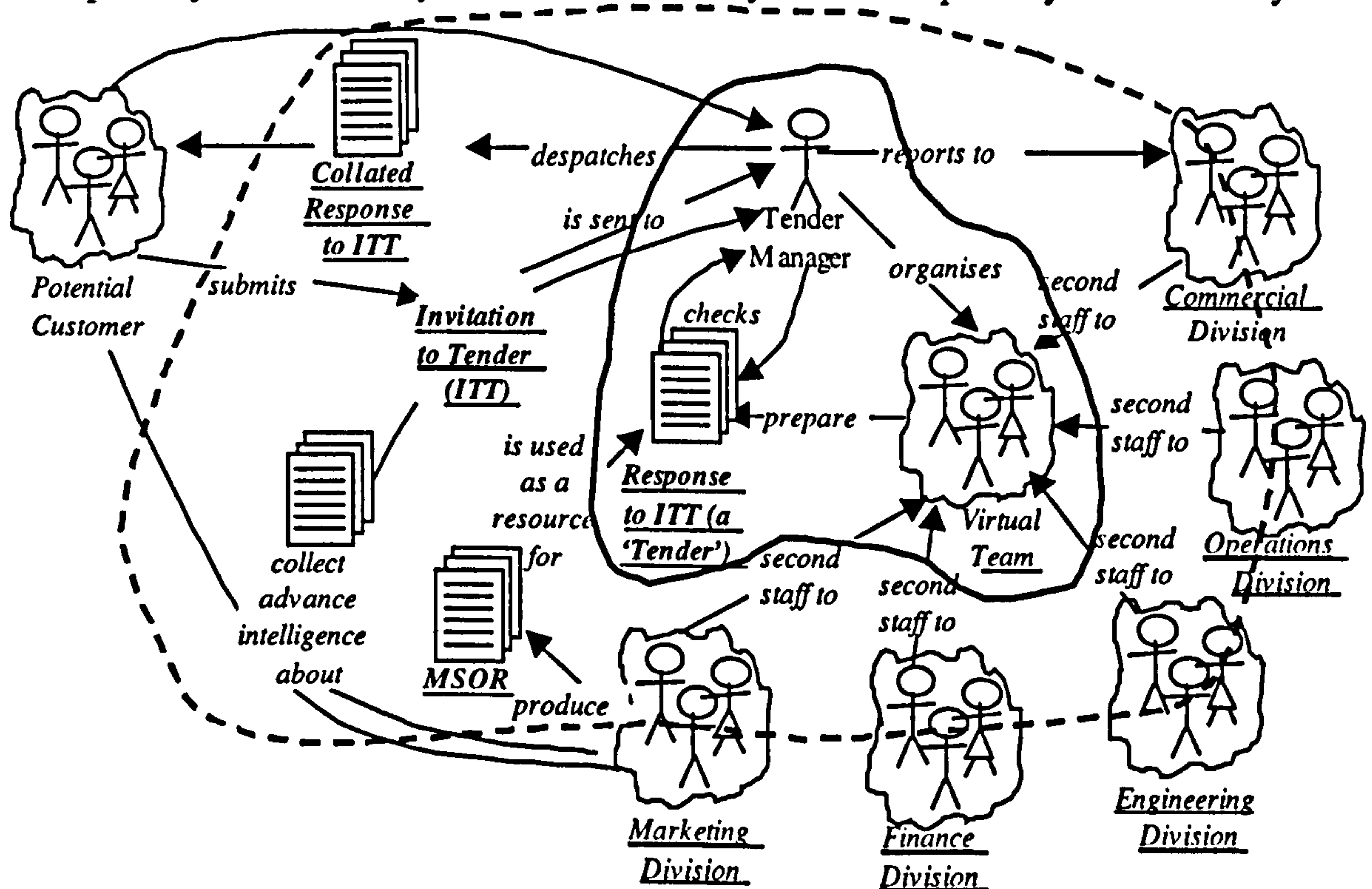


Figure 8-13: A Rich Picture Of The Explicit And Implicit System Boundaries

What is interesting here is the extent to which the long-term objectives of the design project were redefined as the design paradigm changed and the design team perceived the design as increasingly complex. From the initial “big bang” implementation, conceived when the target system was seen as “stand alone”, the implementation was now perceived as incremental organisational change - a perception which reflected the team’s ability (or inability) to manage the increased complexity of the target system.

External Visibility: Effectiveness Vs. Efficiency

One of the most pressing issues of the project as a whole was to ensure continuing external visibility of the design team’s “success”, particularly in the light of the political problems at the interface with the Marketing function, which were discussed above. This was overcome, to some extent, by maintaining a high profile for the project, through frequent presentations of progress to the MD. But this meant that a great deal of design time (two to three meetings per presentation) was spent in determining how best to present the outcomes of the design progress. While the design process itself was largely concentrating upon business *effectiveness*, this was demonstrated in intangible benefits, which could be qualitatively assessed, but not quantified. However, ‘progress’ was defined as quantifiable benefits - i.e. *efficiency* gains. The team therefore spent a great deal of time attempting to fudge the transformation of intangible, effectiveness benefits, such as the quality and consistency of the new work-system output, the increased awareness of ITT arrival (which meant that resource planning and allocation was far less problematic than it had been) and increased levels of commitment to the process of preparing Tender responses, as demonstrated in this quote from the Process Improvement Manager:

Well, [the Tender Manager] said we always hit our target. The question is: how much grief do we have on the way there? ... A measure of success is how much do we reduce the number of unannounced Tenders.

The extended duration of the project, over its estimated duration, began to cause problems. From the six months which had been estimated by the IS Manager early in the project, for completion of change management, the project had been running for a year, by the end of this period and change management had still to be started. As discussed earlier, improvements to this and to other business processes had been occurring as a direct consequence of external actors’ contact with this design process, but such improvements were difficult to ascribe directly to the process. Halfway through this period, the IS Manager began to feel under immense pressure to produce quantifiable benefits; this affected the morale of the team and also led to a feeling that the design was “not going anywhere”.

Representational Issues Of The Design Process

The uncertainty over progress was compounded by the lack of a suitable customer's invitation to Tender (ITT) for which to pilot stages 2 to 6 of the system process. The team had started this period by expecting to move fairly rapidly into a pilot study, which would enable them to clarify their understandings of the system processes and information flows. But it did not prove feasible to use the expected ITT as their pilot study, firstly because of the on/off nature of the ITT issue and also because of the failure of customer intelligence to give sufficient warning of expected ITT's, which was required for the IS Manager to set up the prototype information system with the product and customer-specific documents required. The team were therefore reliant upon sample company documents to supplement their understanding of external processes; this was an extremely inefficient mechanism for providing the team with joint models of the system interfaces. By now, the detailed definition of information-flows for the system design was viewed as appropriate to the technical function, rather than the process design team. This appeared to be largely a matter of pragmatism on the part of the IS Manager, as the core design team appeared unable to define detailed information flows. This was largely a consequence of the representational mechanism used: the team were unable to conceptualise information-flows when these were presented in a disjointed, written form (as inputs and outputs, in detailed functional specifications for sub-processes) and when many sources or sinks of information did not appear in the system documentation at all, because they were external to the process. However, the design team still spent many meetings debating the provenance of different types of information, in order to understand the work-processes required for the system.

The design process still lacked a mechanism for recording information which was relevant to issues other than that being discussed at a particular point. This became critical when the team started to explore information-flows at their previous process boundary in detail. They could not conceptualise where information had been generated or for what purpose and the same issues and debates about information provenance were revisited again and again in multiple design meetings. The mechanism used to represent the design was that of a written functional process specification, which did little to permit the design team to build effective mental models of the target system. They became more and more dependent upon the expertise of the Tender Manager in describing existing process mechanisms. But much of the Tender Manager's knowledge was implicit and it proved difficult for him to conceptualise the process as a whole through the medium of a written functional specification. The team was therefore reduced to quibbling about

detail, rather than the form and interactions of the target system and the design proceeded very slowly indeed. This would not have mattered had the pilot study been imminent, as the IS Manager expected, because the team could have clarified their understandings of the process through observation and interaction with the prototype system users. But the pilot study was deferred over a long period of time, while the customer decided what type of product it required and the summer holidays intervened. This made the management of external visibility even more critical.

The SSM Workshop: Defining System Problems And Objectives

It was during this episode that I conducted a series of interviews and a facilitated workshop, using Soft Systems Methodology (SSM) tools, to explore the problems and objectives of the target system design situation. The design team appeared demotivated during this period, particularly the IS Manager, who felt that pressures originating from external (to the explicit system boundary) problems, so the interviews and the workshop appeared a possible way to explore and surface some of the implicit design objectives more explicitly for the team.

Two cause and effect diagrams were produced as a result of these sessions and presented to the team for validation. Although no substantive changes were suggested to these diagrams by team members, the feedback received indicated that the team found them helpful and representative of the problem situation. These diagrams are given in Appendix 4. It is accepted that they will be incomplete, as they are based upon single interviews with individuals, operating under time constraints. But the cause and effect diagram which represents the order capture processes (of which the target system was a part) clearly illustrates the circular and reinforcing nature of the organisational problems faced in this design initiative. This circularity was confirmed by members of the design team at a late point in the design, but the team had no method for representing such problem causality at the time when it was being investigated. Additionally, there are many issues contained in the cause and effect models which surfaced frequently at design meetings yet were not dealt with satisfactorily as they were 'soft' issues (concerning organisational, people, or political aspects of the design), rather than 'hard' issues (concerning tasks or technology). While individual members of the team indicated that they found the soft issues of critical importance to the success of the design, the culture of the design team was such that objectives which would lead to measurable efficiency gains were considered more legitimate than effectiveness objectives, despite the IS Manager's statement that he had adopted a "business innovation" approach to address issues of process effectiveness. Objectives concerned with system effectiveness were often

considered to be “political” issues by the IS Manager, who noted such issues, but took the view that these were best resolved outside of the design meetings. This strategy avoided conflict, but it also meant that the design process lacked clear objectives, as the organisational issues which needed to be resolved for successful implementation of the new system - and for the design team to understand how it would operate within the organisation - were declared outside the scope of design by the IS Manager. In the words of the Project Engineering Manager:

We're becoming demotivated because of the lack of clear objectives. There's an over-concentration on the process: we need a short, sharp session on the process to settle some of these things. We need to sit back and say what the team needs to achieve, by when and why. At the moment, everything is done by consensus - this is desperate, as the most vociferous people drive things through.

8.5.6 Episode 6: Pilot Of Stages 2-6 And Managing Organisational Perceptions

Tangible Versus Intangible Design Achievements

The design was completed to a level of satisfaction that left something to be desired among the team, who felt that they had completed the process specifications to the best of their ability, as they still did not feel that they had a complete understanding of the system processes and interactions. It was noticeable that, in design discussions of this period, the design team referred to the level-2 flowcharts to clarify process system design issues, not to the process specification documents which had formed so large a part of their output. When the pilot study eventually took place, it appeared to happen very rapidly and without warning. The design team had not met regularly for some weeks, as the winning of an important order had drawn off effort to other, operational tasks. The pilot study eventually took place in late September; the IS Manager described it thus:

The Tender came at a disastrous time. The Tender Manager was left holding the baby.

The team met next in early October, to discuss IT support for the project. The Tender Manager had not, at that point, managed to discuss the pilot study with the participants and so was unable to throw much light on how it had proceeded, except to disclose a major flaw in the process. The company had not won the business Tendered for in the pilot study because the decision had been made upon price alone. This information had not been available to the team preparing the Tender response. The carefully-designed system processes, which assessed a “winning strategy” for the business to be tendered for had been relatively valueless in the face of late discovery of this information, which occurred when the Tender response was reviewed by senior management. The virtual bid team had had to rewrite the response in a very short space of time, a job they felt that they had done badly. This made external visibility extremely problematic, in terms of the limited ‘success’ of the pilot study. It did, however, permit the team to modify the design,

adding an extra process loop to permit planned review of the Tender response before it was despatched.

As feedback from the participants in the pilot study was received, there was a general perception that the system had worked well, compared to existing work processes. But there remained a continual pressure on the team to quantify intangible benefits, which was largely driven from within the team. The need for demonstrable gains to senior management, in order to obtain approval for the continuation of the business improvement programme, led the IS Manager to ignore the very great gains in process effectiveness which had been achieved and to concentrate upon improved process efficiency. This proved extremely difficult to quantify, as the team had been concentrating on effectiveness during the design process (the 'ideal', "blank sheet of paper" design approach, rather than re-ordering what exists).

It is a sign of the high degree of team intersubjectivity at this point that team members did not question the IS Manager's 'hard' design goals, which were implicit in the search for process efficiency gains, but spent (at least!) two hours racking their brains for ways in which they could measure 'hard' process improvements. When I suggested some 'soft' process improvements that the team might include in their 'final' presentation to the MD (due at the end of December), the IS Manager leapt at the words and asked me to repeat them so that he could capture them; it had obviously not occurred to him or to other team members to present intangible benefits as design achievements, even though these had, by now, been substantial. The team had, by running pilot studies of the new system and by discussing the basis of the new system design with their colleagues and managers, gradually changed organisational perceptions of the importance of the new system in winning new business and the need for commitment and effectiveness on the part of participants. Resourcing of the new process was still problematic, but the organisation as a whole now appeared to understand the need for awareness of the customer requirements, advance planning of Tender response tasks, commitment to the process and consistency of output. In addition to this, the provision of task outlines and IT system support was felt to be helpful, although these areas needed more work. A particular issue now was to present the process as a success, with measurable benefits: the team decided to use it as the basis for two additional 'pilot' tenders so that they could report to the MD that it was being used operationally.

Understanding System Purpose

An interesting aspect of design at this point is that the team were still debating the *purpose* of the new system of work and IT support at this late stage. For example, the

Project Engineering Manager advocated that guidelines be set for consistency of response output, to give participants in the process an idea of what was expected in terms of the form of their output. The Tender Manager contested this suggestion strongly, arguing that “everyone has their own style”. It was resolved that the issue of consistency was an important one and that the team would prepare an outline set of guidelines, but that this set would be minimal, to permit individuals to use their own judgement. This type of discussion was not unusual and fundamental changes were made to the level-2 flowcharts during this period, as lower-level decomposition activity forced a realisation that the high-level design was inappropriate.

Reviewing The Design Process

The feeling of the design team was that the design had progressed to specifying the detail of the target system (functional specifications for the sub-processes) at too early a stage, before the purpose or information flows of the design were well-understood. In addition, many “inspirational” details of the design had been lost because the team had no mechanism for capturing them at higher levels of decomposition. The following extract from the SSM modelling feedback session, held at this point in the design, illustrates this:

TM: we should have spent a lot more meetings deciding what is the objective, what are we trying to achieve, how are we going to achieve it, rather than getting into the nitty-gritty of the design. It's quite clear, we should have spent far more time preparing for it, rather than writing the words.

PEM: you need to modify that (a diagram of a suggested evolutionary design process). Obviously, you get your objectives, as you understand them you build up your picture of it, but you need a mechanism for updating it -- capturing it and updating it. The amount of stuff that we've lost, to be honest, is absolutely appalling. A lot of really good work, good thoughts, ideas and problems [*emphasises word*] even. There are stacks and stacks of issues: the worst ones are the ones we can't think about [remember]!

I always feel there's some room for formalising these things with a list of actions or some brief minutes, just to go over at the next meeting. Because you often forget where you've got to, even from one meeting to the next, never mind once part. How you control things months apart, I don't know, from one week to the next is bad enough!

TM: I remember things that I've said, in the specification and three or four weeks later, I've said 'I can't exactly remember what I meant by that'! Even within yourself you forget what things mean - never mind between a design team.

PEM: we dug out some of our [issue] lists and we crossed half of them off because we couldn't remember what they meant! One of the big problems we have is measurables: we have to look at measures of success.

ISM: I personally believe that's we do need a bit more stock taking for the process design.

It is clear from these comments that the team as a whole (including the IS Manager) believed that the decompositional approach adopted for the design had not provided the design stimulation and capture mechanisms required. It was suggested to the team that an evolutionary approach might be more effective, with short-term objectives set then re-examined at the start of each cycle, to cope with changing objectives as the team learned about the application domain, but also to permit periodic, explicit re-examination and

surfacing of objectives. Team members felt that this would be helpful, but that the problem of capturing elements at different levels of decomposition remained unresolved. I also suggested that, as the team had obviously learned so much from the 'pilot' studies, more frequent prototyping might be built into the design process. The IS Manager concurred, but highlighted the problems of running 'pilot' studies when potential participants were under immense pressure from a business which was rapidly changing and which was in a period of rapid growth.

8.5.7 Episode 7: Change Management

The Need For Continuing Sponsorship Of Design

The IS Manager had, for some time, been ambivalent about the process of organisational change management which would be required for implementation of the new information system. In an interchange which took place in a 'post-mortem' of the second pilot study, the following interchange took place:

ISM: What about this 'winning strategy' stuff - was that useful?

PEM: I'm not sure that was discussed

TM: We did discuss it at various times but it was not important in the process. I think it's a learning curve by managers to understand the importance of this.

ISM: So what is required is to instigate a common vision of the process objectives across the company through our training programme, so they become business as usual.

The concept beneath the intention to "instigate a common vision" was revealed by the frequent use of the phrase "train the troops", initiated by the IS Manager and quickly adopted by the team as a whole. The disadvantage of not being able to expand the system boundary explicitly became apparent to the whole team at this point: neither the company's senior management or those participating in the work of the new information system perceived that the new system design should have influence over the work-processes which preceded it and upon the outputs of which it relied. As there was no-one to champion necessary changes to what was perceived as an external, unrelated system of activity, the changes did not take place and the new system was left largely dependent upon vague hints and individual awareness on the part of the marketing staff who were to provide the customer intelligence required. The IS Manager responded by telling the design team that "education is the key". But it was obvious, from the IS Manager's reactions to the difficulties of implementing the design work procedures, that he had expected adoption of the new system to be relatively unproblematic: that "external" issues would be addressed once the design team had received senior management approval for the new procedures.

In the event, there was a great deal of resistance to the new system, both from those directly affected, in having to change their working procedures when they were already

under immense pressure of work, and from those marketing staff who were responsible for setting the antecedent conditions for the new system to operate successfully (by providing timely and relevant customer information). The IS Manager confided:

There are so many cultural issues. I don't know whether it's cultural to this place, or whether it's cultural on a world-wide basis or what. But at the end of the day, the massive problem is not defining the improvement - you can come up with an improvement quite quickly - it's making it happen! I can think of a number of things that I've been involved in recently, where it's occurred to me that the world never changes and people never get any more flexible. You can tell them "you will do it this improved way" and all they do is argue. It's so frustrating, taking people with you. If you do try and simplify - if you do try and design on a more superficial level, the risk is that that just erodes your chance of actually making it happen.

It is clear from this reflection that the design process was still perceived, by the IS Manager as one of functional design, where adoption depended upon an objective assessment of the advantages of the new system, rather than a subjective negotiation of interests. The business was in a period of rapid expansion and under-resourcing, so the management of change proceeded with those processes which lay between the explicit and the implicit system boundary remaining unchanged. The Project Engineering Manager summarised this position as follows:

I've asked the manager involved to summarise how the [new] process has run but he's not interested at the moment because he's running around like a headless chicken.

Towards the end of this period, the position was becoming intolerable for the IS Manager, who required visible design outcomes in order to continue with the programme of business information system design which he intended for the future. He sought the sponsorship of the Managing Director more explicitly and reported back to the design team:

There is going to be a meeting, to follow up the discussion which took place in the boardroom [following the team's last presentation of their design], to ensure that our process is adopted PDQ.

The need for championship was made so urgent because it had not remained constant throughout the design process. For a long period of time (during episodes 4 to 6), the Managing Director had perceived the design process as unproductive, because the "quick wins" promised had not occurred and because the organisation had no way of assessing increased effectiveness. Sponsorship had been lukewarm during the period when the team was unable to obtain a replacement for the marketing representative on the design team. This had severely constrained the team's ability to apply positive pressure for change in the work-processes outside of their explicit system boundary (directly, through internal marketing group sponsorship) and they had to resort to negative pressure for change, through external pressure on the marketing division, from the Managing Director.

Change As Education

The IS Manager saw the management of change, ultimately as a culture change, which could only be achieved through a programme of education, taking place within the company. The new system would not be adopted because it was superior, or because of sanctions - given the informal work processes which the company usually adopted - but because the participants understood the need for formalisation and accepted that need as a requirement of improved corporate competitiveness. The main action of his planned change programme was therefore a series of training seminars, both in aspects of the process and use of the (by now more or less complete) IT system.

Reconceptualising Design Through Defining System Organisation

The team now started to address a significant issue which they had deferred for some time: what type of skills were required to manage each sub-process and where they would reside in the organisation. They termed this the “clarification of process responsibilities and ownerships”. While the team could make recommendations concerning this, it was made clear that ultimate decision-making about organisational responsibility would lie with senior management.

What is clear from an analysis of the meetings of this episode is the high level of conceptual design which was still being performed at this stage - the design team were still redefining the process. In discussing who should be involved at different points, it became clear that there were different routes through the process and that some sub-processes of the process would have to be redefined, as illustrated in the following meeting dialogue:

PIM: It begs the question, should they be involved? We know they're not at the moment, because MSS do their own marketing, but should this be part of the mainstream?

TM: I hesitate to go back to redesigning the flowchart but ...

ISM: It looks to me as if it [a sub-process] doesn't exist if there's no product element in the Tender.

This was a fairly radical design reconception, made at a time when the design was thought of as “complete”; this dialogue sheds light upon the decompositional aspects of the design. Organisational responsibility was seen as a very detailed level of decomposition, yet it was only by considering this level that much higher levels of the design became clear.

'Invisible' IT System Development

Discussion of the IT system requirements had been scheduled for several meetings which I attended, but had not taken place as the team had other priorities, such as discussing the lessons learned from the pilot study. By the start of January, 1997, events had overtaken this discussion: the IT system had been developed “as a background task” by the IS

development group and its introduction and use was viewed as unproblematic. By now, the Netscape World Wide Web browser application was in common use throughout the company and its use as the basis for the new IT system to support the Tender response work system was seen as “business as usual” by the design team.

8.5.8 The Final Phase: Company Restructuring and Reorganisation

This phase occurred after I had ceased involvement with the project: what is reported here is based upon a brief progress update from the IS Manager. The changes following my involvement with the project had revolved around what the IS Manager had described as “political wrangles”. Eventually, a “cross-party agreement” to adopt the new process had been achieved, and the team were now working intensively on a review of the process documentation and an educational package, especially for marketing staff, who were most closely involved in the preconditions for the system to operate successfully.

The representation issue arose even in the brief discussion in which the IS Manager described changes which had happened since the study. The IS Manager referred to the flowcharts having changed significantly, showing that even he, as an IT specialist, conceptualised the system through the diagrammatic representations produced, rather than the process specification documents which had formed so large a part of the design team’s output. The operationalisation of the new system had also provided the joint understanding of the new work-processes which the team had previously lacked: the adoption of the process into “business as usual” had revealed lots of gaps and the team was engaged in design clarification, where the design had altered significantly.

The other element of the changes since my involvement was a company restructuring, which had led to two new administrative departments in the company. There were “lots of new people wanting buy-in” and more senior people now getting involved in the design process: the IS Manager saw further design changes as inevitable because of the increased stakeholder involvement.

8.6 Summary Of Findings

Findings from this analysis are explored in more detail in the next two chapters, with further analysis centred on the issues raised by this analysis. Issues identified above were summarised, to produce an overview which is presented here using the three levels of the Curtis et al. (1988) model of the IS design context: individual, group and organisation.

8.6.1 Issues At The Level Of The Individual

The analysis given here has identified two core issues at the individual level:

1. Individuals analysed design requirements at multiple levels of decomposition at once, but representational methods only captured a single level.
2. Individuals framed system requirements and problems in terms of examples or analogies from existing organisational mechanisms; they were incapable of abstraction without reference to “the spectre of organisation”.

8.6.2 Issues At The Level Of The Group

The analysis given here has identified four core issues at the group level:

1. Design discussions took place at multiple levels of decomposition, having slightly higher levels in initial meetings (those which might be described as understanding the design) and slightly lower levels in later meetings (those which might be described as clarifying the design), but the range of issues did not decrease as time went by: at initial stages, very low levels of decomposition were encompassed in design discussions and at later stages, very high levels were still encompassed.
2. Negotiated design outcomes depended upon the changing influence of various individuals within the design team. Individuals’ ability to affect the design depended on the extent to which they could manage meaning for other group members, which depended upon the value attached to different types of knowledge at different points in the design process and the knowledge and/or recognised expertise.
3. Even though the group was attempting a new method of design and had with no common socio-cultural background, the ‘investment in form’ (Star, 1992) of existing, normative IS design practice drove the way in which the design was conducted and represented.
4. Goals were not explicitly defined or agreed and were continually emerging from a process of negotiation and design argumentation. Abstractions were explained by individuals to the group and either accepted or rejected on the basis of individual influence, which was managed by perceptions of the legitimacy of a particular contribution with respect to the implicit system boundary held intersubjectively by the design team at that time.

8.6.3 Issues At The Level Of Organisation

The analysis given here has identified five core issues at the organisation level:

1. At the organisational level, political negotiation becomes critical. Design is constrained by political influences, particularly as they affect acceptable definitions of the system boundary. This constraint on the scope of design fundamentally affected the design team’s definition of problems and thus their ability to achieve an optimal, or even satisficing design.

2. The legitimacy of design-goals was constrained by politically-limited definitions of the system boundary. Many design-goals were held implicitly because it was politically unacceptable for them to be held explicitly, yet these goals were fundamental to the success or otherwise of the designed system. Different people defined the scope of the system (what lay within the legitimate system boundary) for the rest of the team at any one time: their ability to do so depended upon different types of influence which were exercised at different points in the project.
3. Design goals were emergent: their emergence was stimulated by the process of learning and argumentation which took place both at a group and organisational/political level. This caused problems for the group with respect to political and organisational management of progress reporting; as goals were emergent, progress assessment depended upon a subjective understanding of the design, yet external visibility depended upon objective presentation of firm design goals. This led to the intangible benefits of the design (the goals of which were concerned with system effectiveness) being subsumed to the tangible benefits of the system (the goals of which were concerned with system efficiency), as the latter were easier to quantify and thus to present to senior management.
4. The overall nature of the design project was reconceptualised as the design team became increasingly aware of the complex nature of organisational information system design. Initially, when the target information system was seen as “stand alone”, system implementation was planned as a “big bang”. As the design team increasingly viewed the target system as more and more complex and as they realised its interrelationships with other organisational systems, target system implementation was conceptualised as managing incremental organisational change and system delivery changed from proceduralisation of the target system to providing education and training for participants about the rationale underlying target system procedures.
5. The supporting IT system ‘disappeared’ from the information system design as decisions about the form and nature of the IT were increasingly seen as pertaining to the IS function, rather than the design team. This was not because the IS Manager excluded other design team members from decision-making about IT (in fact, he actively encouraged them to participate), but rather because the other design team members saw the design of the IT system as belonging to the technical domain..

9. A SOCIAL COGNITIVE ANALYSIS OF THE DESIGN PROCESS

9.1 Introduction

This chapter presents a social cognitive analysis of the processes of design, based upon a detailed analysis of meeting contributions, individual and group use of metaphor and the production of external representations. It examines design as the acquisition of intersubjectivity and the co-ordination of distributed cognition, concentrating upon the cognitive framing processes of individuals and the group, through interactions of the core design team.

9.2 Differences in Individual Mental Models

9.2.1 Method Of Analysis

Individual models of the design objectives, with respect to the product of design (the process of responding to customer Invitations To Tender) were analysed at three distinct points: at the start of the project (presented in Table 9-1 below), in the middle of the project (presented in Table 9-2) and towards the end of the project (presented in Table 9-3). The design-perspective interview points are shown as a 'P' in Figure 9-1.

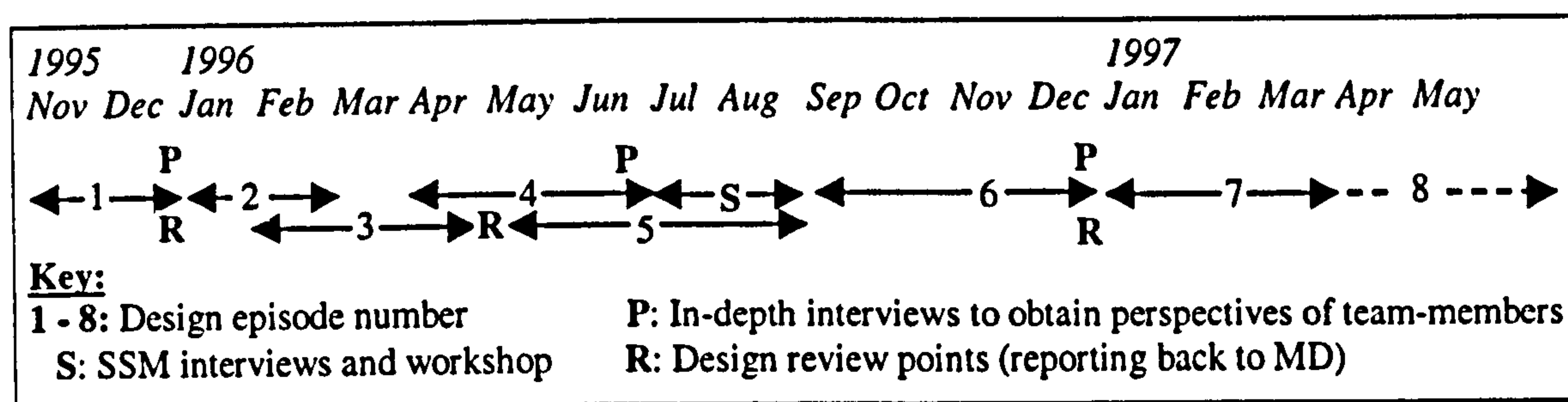


Figure 9-1: Duration And Sequence of Episodes During the Design Process

Information was obtained primarily from contemporary interviews with team members, supplemented with an analysis of tape-recorded design contributions where an individual's perspective was unclear from an interview. Where possible, actors' own words have been used to represent their objectives¹.

Target system objectives describe what each actor saw, at that time, as their objectives in terms of the product of design - i.e. *what* they were intending to achieve with the design. Design process objectives describe what each actor saw, at that time, as their objectives in

¹ In the tables below, the following key is used (the abbreviations represent individuals' job titles, as used in Chapter 8, the function in brackets here is the division to which the actor belongs):

PIM: Process Improvement Manager (Quality); IS: Information Systems Manager (IS);
 CSM: Customer Solutions Manager (Marketing); PEM: Project Engineering Manager (Eng.);
 PMA: Project Management Accountant (Finance); TM: Tender Manager¹ (Commercial);
 BDM: Business Development Manager (Operations)

terms of the process of design (the methods, approaches and interactions employed in design activities) - i.e. *how* they were intending to achieve the design.

This analysis of objectives articulated in individual interviews was compared with the content of individuals' contributions to design meetings at the period of the interview, to determine how their perspective affected their conceptualisation of the design problem.

9.2.2 Findings Of Analysis

The Early Stages Of Design

It can be seen from Table 9-1 that the initial design objectives held by different team members differed radically and were also substantially vague, with respect to the target system. While the current manager of the process (the Commercial division representative) was focussed upon the resolution of particular, organisational problems, other members of the team who were less directly involved with the existing processes of the target system were more concerned with wider business support and effectiveness.

Actors' definitions of target system objectives	Actors definitions of design process objectives
IS: Improved process <i>and</i> IT effectiveness through achieving 'Quick wins' ²	IS: <i>Structured</i> ³ , <i>incremental</i> : 'ideal' process decomposition and interface definitions; investigate business process design approach to IS provision
PIM: "Looking at ways to work smarter and harder" - cutting down bureaucracy	PIM: <i>Semi-radical</i> : Understanding existing processes to obtain a 'vision' of problems and required change for "quick win" gains
CSM: Improving effectiveness of wider customer-interface and support function	CSM: <i>Radical</i> : reconceptualisation of business processes with organisational change
PEM: Improving efficiency and effectiveness of business processes, especially in advance warning and preparation	PEM: <i>Semi-radical</i> : improved process effectiveness, grounded in current practice
BDM: Improved process efficiency & effectiveness	BDM: <i>Semi-radical</i> : some reorganisation and improved IT support
PMA: Devolving decision-making away from the centre of the organisation; creation of cross-functional 'virtual teams' to deploy individuals' skills effectively	PMA: <i>Radical</i> : organisational and system definition
TM: Resolve operational problems	TM: <i>Incremental</i> : efficiency improvements

Table 9-1: Perspectives At The Start Of The Project

This emphasis appeared to affect the individual's concept of *what design should be*: the "higher level" the target system design objectives held by the individual, the more radical were the design process objectives held by that individual. A study of design contributions by individuals shows that, while individuals with a radical perspective of the design process conceptualised the design 'problem' in terms of system interactions:

² Improving resource management, timescale management, response presentation, etc.

³ At this point, the IS Manager was extremely task-oriented with respect to the design, seeing it as a straightforward process of requirements definition and decomposition.

attempting to understand the purpose of the target system in supporting the business, those individuals with less radical perspectives conceptualised the design 'problem' as solving particular problems with the existing process, even though these conceptualisations might be at a similarly high level of detail as those of more radical scope. To give an example of this, the Marketing representative on the team, who had a radical perspective of design process objectives, conceptualised the target system thus:

What we need to do is decide at what threshold our understanding of the problem is sufficient that we can make a decision. And say we said - I don't mean anything by this, but say 66 percent - we can either make decisions very early or very late and everything in between, based on how rapidly we can understand the problem. And then I would say that that it's worth being mindful of the classic Pareto chart: that you rank all your problems and you tackle the big ones first. And I would say that if we want to improve this process in order to achieve a better understanding of our requirements so we can make a decision on that, we should identify what these top influences are on the decision.

The Tender Manager, who had a much more incremental perspective of design objectives, conceptualised the target system thus:

We should all be starting at that point [the start of the process, in a diagrammatic model of the design]. How much they do at that point and how much they do later will vary, but all those activities should be being done in parallel. You might not be able to do everything at that point, but you should be able to do something. People may not be able to get on with all of this stuff, but they should be able to make a start on it. We shouldn't be sat there waiting until that [a process output] comes in before you start.

These differences in perception led to some debates about the purpose of the target system which were caused by different perspectives of what function it filled, for example:

TM: These [information flows] are not part of the process; these are just inputs to the process.

CSM: Yes, but we need these pieces of information to put the Tender together, so producing them is part of the process.

TM: No it's not. Mike doesn't produce these costings; Geoff does. It's not part of the estimating process, its part of the product engineering process, so this is nothing to do with us.

CSM: But if we need this information to produce the Tender, then it is part of our process.

TM: No, I disagree. This is nothing to do with tendering. The output from this is: this is the price we're going to charge the customer. That's the output. There are lots of inputs to make that decision. But the process is still getting the information, doing your juggling with the figures and coming up with the answer.

This conflict arose because the two team members were conceptualising the target system scope in different ways, according to how radical their perspective of the design objective was. These conceptualisations led to very different perceptions of their respective contributions, to quote a fellow team-member:

[The Marketing representative] comes at it from a reasonably broad experience in industry. How the hell he packs his understanding of the way business ticks in his young head, I have no idea - how he's got all of this experience - you know, he's such a fresh-faced lad, he astounds you every time he opens his mouth with all his pearls of wisdom. So, I mean, he has been mind-blowing, and I've constantly underestimated his capacity to contribute, but he's very much, I've seen him very much as a pragmatist, speaking from experience and a practical understanding of the way things tick, with a very high degree of vision.

... I expected [the Tender Manager] to be a lot more open minded and demonstrate a lot more vision than he has. He has turned out through this exercise to be extremely protective of the status quo ... and I think, really, the only conflicts that come out within the team and I think this was well evidenced on Friday, as I think there were only one or two serious conflicts on Friday, were because of Vic's protectivism. And whereas he has always argued for better systems and improvements to the process, and vehemently argued that he is a man alone doing this Tender work and he ought to get more support from all directions, he seems to be pedalling backwards from that at about 300 miles an hour in the course of this project!

The Marketing representative conceived of the process of a design as a radical, "nothing is sacred" process of work- and information reorganisation, so the boundary which he conceptualised as pertaining to the target system was much wider in scope than that of the Tender Manager, who conceptualised his system boundary as limited to the existing organisational functions. This led to debate and conflict within the team over how the new system would be modelled and a perception of the Tender Manager as "lacking vision", where in fact he was merely operating from a different perspective of design objectives from the individual who made that comment. Flor & Hutchins (1991) argue that a diversity of perceptions is necessary for a wide number of design alternatives to be considered; this was observed to apply to both the target system objectives and the objectives pertaining to the process of design. Because of this diversity of perspectives, debate took place about appropriate methods and representations of design, which were helpful and constructive at this stage of the process.

Individuals were very well aware that they held different mental models of both the target system and the design objectives, to the extent that managing conflict in dialogues was an explicit part of design meeting interactions - team members often prefaced contributions with comments such as "I know [name] won't agree with me, but ..." or "I understand where you're coming from, but I don't agree with you because ...". While my perception of these debates was that they were generally good-humoured and led to richer conceptualisations of the target system, the IS Manager saw the mediation of different perspectives as one of the most problematic issues in the management of organisational information system design and initially rejected the idea of using SSM to model multiple perspectives of the design as:

The big problem is, everyone's got their own ideas about what it should do and how it should work. What we need is to agree on a common vision as early as possible, not to complicate things with even more disagreements. You tell me how you can get seven people around a table to agree on what they're doing, if they're all drawing different pictures of what they want to get out of it.

The Middle Stages Of Design

By the middle of the project (Table 9-2), individuals' objectives for the target system appeared to have converged somewhat. In particular, team members' objectives for the target system now centred upon system effectiveness, rather than system efficiency -

possibly because the high-level process design in which they had engaged gave them an overview of how the target system supported and interacted with the business as a whole (as was the intention). Individual conceptions of an appropriate focus for the design process also appeared to be converging, with the exception of the IS Manager, who, as the person responsible to the Board for design progress, articulated process objectives centred around achieving external visibility, rather than effective design of the target system.

Actors' definitions of target system objectives	Actors definitions of design process objectives
<p>IS: Process effectiveness and efficiency: solve problems with current process through process redefinition and formalisation⁴ of work procedures</p> <p>PIM: Radical change to improve process effectiveness⁵</p> <p>PEM: Improvements to fundamental business operations ("including soft, political and people issues")</p> <p>BDM: Process efficiency: solve problems with current process through process formalisation⁶</p> <p>PMA: To win business by widening the strategic focus of participants</p> <p>TM: Widen ownership of Tender response process to the "business as a whole"⁷</p>	<p>IS: <i>Structured, incremental</i>: Overcome difficulties establishing a common vision; speed up design; establish external design teams to address "interface" problems.</p> <p>PIM: <i>Radical</i>: Fundamental redesign for long-term process effectiveness (as distinct from 'quick wins')⁸</p> <p>PEM: <i>Radical</i>: Recognising wider organisational problems of process and "recommending ways of implementing change"</p> <p>BDM: <i>Semi-radical</i>: Putting the "theoretical" ideas generated in the group into practice with a real Tender</p> <p>PMA: <i>Radical</i>: Achieve a wider scope of design by involving a "wider constituency within the company"</p> <p>TM: <i>Semi-radical</i>: Specification of formalised procedures to enforce improved participation & commitment</p>

Table 9-2: Perspectives In The Middle Of The Project (Start of Episode 5)

The Quality and Engineering function representatives on the team had by now been converted to a radical perspective on the objectives of the design process, while the Commercial representative (the existing Tender process manager) had been converted to a semi-radical perspective. The team was, by now, displaying high levels of

⁴ Problems mentioned include: adequate resourcing, consistency of process output, adequate preparation time, improved communication between participants, base response on business strategy, improve cost estimation.

⁵ Objectives mentioned include: provide innovative customer solutions; differentiate responses from those of competitors; improve quality of process output.

⁶ Problems mentioned include: participants' lack of commitment to process, vagueness of task definitions, lack of adequate warning for preparatory work, inaccurate cost-estimation, cost of Tender response process not accounted for in decisions whether to Tender for business. In the detailed models which this person produced, it was obvious that he had a vision of improved cross-functional effectiveness, although this was not articulated.

⁷ Issues mentioned here included wider ownership of the process, increased commitment on the part of participants to responding to Invitations to Tender, and more formalised distribution and co-ordination of labour during the Tender response process.

⁸ An issue here was the feeling that essential redesign work could not happen with the lack of commitment which accompanied the "expectation that BPR can be done part-time".

intersubjectivity, with team members (constructively) finishing sentences for each other and explaining concepts in much shorter phrases, needing fewer examples to illustrate points. There were of course still disagreements between team members, but these tended to be about the information required by the system or the processes by which such information was generated externally to the explicit system boundary, rather than about the purpose and nature of the system.

Overtly, the IS Manager adopted an incremental perspective, yet this conflicted with the semi-radical (and sometimes radical) position taken by the IS Manager in design meetings, where he conceptualised the target system in relation to functions which lay outside of the system boundary, for example:

But surely, marketing has got to make a formal statement to engineering of the sort of features it requires in the new generation of product? Because otherwise, if you're two years down the lifespan of a product ... if we've had a product in the field for two years and we in our process see a new tender coming, there'll be no point in turning to the Marketing statement of requirements if it's two years out of date.

It would appear that there were fundamental conflicts between what the IS Manager conceived of as the purpose of design (redefinition of the process, using a "blank sheet of paper") and what he conceived of as suitable methods for design (requirements specification and decomposition). To use the analogy of human-computer interaction, his conceptual model of design and his task-action model of design were very loosely coupled (see Chapter 3 for a discussion of conceptual models and coupling). This meant that, while he implicitly recognised the need for a wider design scope, inviting representatives from external (to the target system boundary) business systems to explain how these systems worked and conceptualising the target system in terms of information-flows produced externally to his explicit system boundary, he was unable to redefine the system boundary explicitly. The decompositional task-action mapping model adopted meant that the high-level design requirements had been determined at the start of the design process and were "agreed" (and therefore, by implication, frozen). This task-action mapping model was reinforced by external, political pressures upon the project, to deliver "quick wins". But the radical conceptual model of design which he had adopted - design as business process reconceptualisation - meant that he must constantly question these design requirements, reconceptualising the system boundary dynamically, as his understanding of the target system emerged from the process of design investigation. So a significant factor in understanding the role of mental models in design must be the realisation that individuals may hold *multiple* mental models of a design, for different purposes, and that these models may cause internal conflict.

Latter Stages Of Project

Towards the end of the project, it was observed that design team members were much more radical about design objectives and feasible organisational change than they had been previously. This may have been due to a process of reflection triggered by pulling together the design into a coherent set of work-procedures and information specifications, or it may have been due to a spirit of bravado engendered by the IS Manager's dictum that this was an appropriate point for the team to tackle "the spectre of organisation". (The Process Improvement Manager described this stage as "it's courage in our hands time").

Actors' definitions of target system objectives	Actors definitions of design process objectives
<p>IS: "At the end of the day, the best we can hope for is 80% success." Incremental reorganisation and change.</p> <p>PIM: "The business is continually shifting and moving, therefore our processes have to follow suit".</p> <p>PEM: Reorganisation of work and the effective use of organisational information to provide measurable gains in effectiveness.</p> <p>BDM: Effective IT and business support systems</p> <p>TM: Formalisation of procedures to increase participant accountability for scheduling and quality of output</p>	<p>IS: <i>Semi-radical</i>: Cultural change: "taking people with you" - through training and dissemination of design.</p> <p>PIM: <i>Radical</i>: "We have a lot more confidence about who should own what at this stage"</p> <p>PEM: <i>Radical</i>: You need a mechanism for capturing and updating the design model as you go along.⁹</p> <p>BDM: <i>Semi-radical</i>: Design process delegating issues to wider business groups, for them to expedite change.</p> <p>TM: <i>Radical</i>: We should have spent more time deciding objectives, rather than getting into the nitty-gritty ("writing the words")</p>

Table 9-3: Perspectives Towards End Of Project (Start of Episode 7)

There were two overriding concerns voiced towards the end of the design project, which appeared to be shared by all the team members: that insufficient time had been spent on investigating and understanding the target system and its relationship with other business systems and that better tools were required to capture the richness of a design, in terms of design rationale and detailed information at multiple levels of decomposition. There was a widely-held belief among team members that they still did not, individually, understand the basis for the design as a whole. While individual objectives with respect to the processes of design appeared to have converged towards the end of the design project,

⁹ His comments were: "some people are task-driven and some are process-driven. Inevitably, the people who are task-driven dominate the discussion, so lots of issues get lost because there is no mechanism to explore them. ... The people who are task- or process-driven change, depending on the issue and whether it concerns them ... You need to modify that (the design model). Obviously, you get your objectives, as you understand them you build up your picture of it, but you need a mechanism for updating it -- capturing it and updating it. The amount of stuff that we've lost, to be honest, is absolutely appalling. A lot of really good work, good thoughts, ideas and problems (emphasises word) even. There are stacks and stacks of issues: the worst ones are the ones we can't think about [remember]!"

perspectives with respect to the target system appeared once more to have diverged. Team members placed differing emphases on different aspects of the target system. While the Process Improvement Manager emphasised the need to support dynamic processes, the Tender Manager re-emphasised the need for formalisation of work procedures (although his perception of design process objectives was *much* wider in scope than at the start of the project). While the Project Engineering Manager emphasised the effective use of information within the organisation through radical reorganisation, the IS Manager saw the key to change as incremental reorganisation and change (probably because he personally would have to supervise this change). Despite these differences, the team was able to function coherently, agreeing fairly major issues with little conflict and this suggests that differences in explicitly-held target system objectives were less significant, in achieving consensus about the design, than differences in perspectives on what the design process was intended to achieve.

9.2.3 Team Learning, Intersubjectivity And Distributed Cognition

Late in the design process, the team reflected on how design goals had emerged from their emergent understanding of the system and how difficult it was to capture this understanding at the time. A typical comment was:

Obviously, you get your objectives, as you understand them you build up your picture of it, but you need a mechanism for updating it -- capturing it and updating it. The amount of stuff that we've lost, to be honest, is absolutely appalling. A lot of really good work, good thoughts, ideas and *problems* even. There are stacks and stacks of issues: the worst ones are the ones we can't think about!

It is clear, from an analysis of the design meetings that goals were not explicitly defined or agreed and were continually emerging from a process of negotiation and design argumentation, even towards the end of the project. Clarification of the design at low levels of decomposition often instigated changes to the high-level design (the level-2 flowchart), as illustrated in the following extract from a design meeting, which was discussing a different part of the design to that amended:

PEM: So what we need is a short-form document to hack the MSOR [a Marketing document].

PIM: If it's product driven, won't it come through the Invitation to Tender document?

PEM: No, it will always come through the MSOR. This filtering process is appropriate to stage 4 as this process will be drawn upon from other routes and other processes.

TM: So what you want at the top of stage 4 (level-2 flowchart) is "strip and allocate MSOR".

Many goals appeared to be held implicitly, yet shared by several team members; they only surfaced when a goal held by a number of individuals was challenged by another team member. Through this process of argumentation, the team appeared to build sufficiently intersubjective models of the design for the design process to proceed, although team members did not feel that they had fully understood the design. There was a widely-held belief among team members, voiced during the SSM feedback workshop

and in interviews towards the end of the design project, which appeared to be shared by all the team members except the IS Manager: that they still did not, individually, understand the basis for the design as a whole. This did not, however, affect their ability to function as a design team: the levels of trust built up between team members enabled individuals to delegate decisions on parts of the design which they did not understand to other team members. This accords with Hutchins' (1990, 1991, 1995) concept of *distributed cognition*, where members of a group understand only part of a problem, but can co-operate in achieving a composite task. This is not to say that cognition was divided among the team members, more that it was 'stretched over' (Lave, 1988) the team, with individuals having some shared partial models held in common with one or more other team members, but not having a complete, shared mental model of the design. This aspect of behaviour was much more noticeable at this, late stage of design than at earlier stages, suggesting that an appreciable period of shared design is needed before a sufficiently high degree of trust is achieved for distributed design activity to take place.

The different perspectives that individual team members held extended to mental models of the processes of design as well as mental models of the target object system. In episode 2, it was observed that a request that team members brought along a flowchart representation of how they conceived the design elicited four different executions of what constituted a process flowchart, despite the team having used this method of representation for three months at this point. The four representations were clearly based upon individuals' use of representational methods in their functional work experience. The engineer produced a 'flowchart' which looked like a circuit-diagram, the accountant produced a diagram which looked like a list of issues, the Process Improvement Manager appeared to have drawn an organisation chart, which converged the branches into one output stream and the Tender Manager had started with an organisation chart then merged this with two, distinct process flowcharts to form a single diagram. While the design process was initially left unstructured by the IS Manager, to permit the emergence of new ways of designing organisational information systems, team members reflected that they needed training in the representational methods which were recommended by the IS Manager, as they did not understand the design models produced for some time. Team members initially had problems using a common representation and, even towards the end of the project, misunderstandings would arise from the way in which these models were interpreted. A very narrow range of alternatives were considered, as team members did not, at first, understand the basis of design sufficiently to suggest alternatives. This may have led the IS Manager into a false sense of security concerning the completeness

of the design: certainly he observed that the design was almost complete at the beginning of episode 2, when it was very far from being either complete or well-understood by other team members. But, as discussed in Chapter 7, the rest of the design team felt that there were outstanding issues which had not been adequately resolved and decided to list them for future action. The IS Manager felt that capturing these issues was a waste of time (as the design was almost complete) and did not refer the process back to the document, so this design information was effectively lost.

Star (1989) observed that different groups can successfully co-operate while employing different units of analysis, methods of aggregating data, and different abstractions of data, using “boundary objects” such as diagrammatic models, documents and representational artefacts to co-ordinate activity. In this case, the role of the external representations of the design appears to have changed with the course of the design, as the extent of intersubjectivity and distributed cognition increased with time. Initially, many different types of design representation were used, as the team’s focus was on constructing mental models of the target system. The role of external representations then changed as the IS Manager attempted to achieve his stated goal for the design process, of achieving a common understanding (intersubjectivity) between team members. Representations were standardised and a critical task for team members became learning to use the standard representational methods in a common way. Finally, the role of the design representation moved to being an external (to the team) communication mechanism. They were modified and constructed in such a way that they could be used as the basis for staff training and process management. The critical task of design now changed again to ensuring that these representations of the design were both correct and complete. The IS Manager reflected upon the inadequacy of the chosen representational mechanism (process flowcharts) to support required design activity, at a point about halfway through the design project, with the words “the reason we’re struggling because we’re trying to look at it in process terms whereas it’s really information flow that we’re trying to reflect round that feedback loop”. However, at this point, it appeared unrealistic to expect the team to learn another way of representing the design, given the political pressures on the team for a rapid closure to the design.

9.3 Framing Processes In Design

9.3.1 Method Of Analysis

The ethnographic analysis discussed in Chapter 7 identified five core issues of design framing, at the individual and group level, which are discussed here within the context of situated social cognition (*organisational issues are dealt with in Chapter 10*):

1. The design was framed at multiple levels of decomposition, while representational methods only captured a single level, from both an individual and group perspective.
2. System requirements and problems were framed in terms of examples or analogies from existing organisational mechanisms; team members appeared incapable of abstraction without reference to concrete mechanisms (the IS Manager's "spectre of organisation", described in Chapter 8).
3. Individuals' ability to affect the design depended on the extent to which they could manage meaning for other group members, which depended upon the value attached to different types of knowledge and/or expertise at different points in the design process.
4. Pre-existing normative IS design practice formed the ways in which the design was conducted and represented, even in a new group with no common socio-cultural background.
5. The articulation of particular, emergent design goals depended upon their perceived legitimacy, which was determined by the explicit system boundary.

To explore these issues further, transcripts of four design meetings were analysed in detail. Meeting A took place during episode 1, during the initial weeks of the project, meeting B took place during episode 3, when the project had been running for about three months, meeting C took place during episode 5, when the project had been running for about seven months and meeting D took place during episode 6, when the project had been running for about thirteen months and was drawing to a close (the project was terminating when research involvement ceased after eighteen months). The above meetings were chosen because of the high degree of design discussion which took place, in contrast to other meetings which were more concerned with design organisation or management issues, especially during the last three months of the project, when the team were primarily concerned with the logistics and politics of change management.

The analysis used to investigate the first issue followed the method used by Guindon (1990a, 1990b), where individuals' contributions to design discussions were coded according to the decomposition level of the design requirements discussed. A coding structure was devised to suit this design project (Guindon's detailed coding structure was

unsuitable for this analysis, as it related to software program design). Verbal contributions to design discussion were analysed according to five levels of decomposition (verbal contributions related to administrative or social issues were omitted from this analysis):

5. Top-level design (level-1 flowchart, or overall goal/purpose of system)
4. Second-level design (level-2 flowchart, or sub-goal or specific problem for resolution)
3. High-level detail (functional specification or type of information required)
2. Mid-level detail (process mechanisms or specifics of information flows)
1. Low-level detail (specifics of organisation or detailed information description/example)

The analysis used to investigate the second issue examined individual and composite contributions to design discussions with respect to how design concepts were abstracted. Cognitive maps (Eden et al., 1983) were constructed for design concepts, along different threads (sets of discussion contributions referring to a single design topic), with contributions from different individuals being modelled together. Grounded theory analysis was also applied to transcript data, as discussed in Chapter 5.

The analysis used to investigate the third issue examined instances in the meeting transcripts where contributions to a design discussion were responded to by another team member in a way which indicated that they were judged to be illegitimate, using grounded theory analysis. The grounds for rejection were analysed and are discussed below.

9.3.2 Issue 1: Design Occurs At Multiple Levels Of Decomposition

Table 9-4 presents a summary of the analysis of decompositional levels of verbal design contributions at the four meetings analysed. Samples from the four meetings are represented graphically in Appendix 5. Verbal design contributions tended to average at a reasonably high level of decomposition, regardless of the purpose of the meeting or the episode of the design for which the analysis was made (the average contribution was at level 3.3, using the coding scale shown). It is clear that the design was not conceptualised at the level intended for discussion in each meeting, but at multiple levels of decomposition at the same time, with designers considering many high-level issues, even when the design was relatively advanced.

Meeting	Episode of design	Purpose of meeting	Intended level of decomposition	Average level of decomposition
A	1	overall system purpose & functions	5	3.28
B	3	detailed design of stage 1	3	3.05
C	5	detailed design of stages 2-6	3	2.75
D	6	implementation of stages 2-6	1 - 2	2.82

Table 9-4: Summary of Meeting Analysis By Contribution Decomposition-Level

There were some changes in emphasis (i.e. the average level of decomposition) as the design proceeded: design discussions took place at multiple levels of decomposition, but centred around slightly lower levels, with slightly fewer very high level issues as time went by. But design discussions had a much wider-ranging, exploratory nature than the waterfall model of design would lead one to expect. Design contributions were made at all levels of decomposition, with rapid and wide swings between levels. This would indicate that both the construction and maintenance of mental models of a system context need wide ranges of information, at all stages of the design process.

Design took place at multiple levels of decomposition at both group and individual level. An interesting finding from the analysis was that design discussions tended to proceed in a particular pattern: an individual would appear to be “sparked off” by another comment to make a design contribution - not necessarily on the same topic. Whichever level of decomposition this contribution was at, individuals tended to respond at the same level, as if the initial contribution formed the mode of thinking for that topic. If other individuals agreed with the first contribution, additional contributions to a design topic tended to remain at the same level of decomposition. If others disagreed, lower levels of decomposition were employed, in providing examples to refute the initial argument. Higher levels of decomposition were employed only when an individual attempted to sum up the team’s position on a topic. Sometimes summing up contributions appeared to be for the purposes of testing whether an individual’s understanding of the design topic under discussion was shared by other team members; at other times summing up behaviour appeared to be for the purpose of eliciting further information on the topic. Very high level contributions tended to be made primarily for the purposes of management: to pull the team back to the main topic when they had digressed, or to prevent conflict or discussion of topics which the IS Manager considered inappropriate (such as the organisation of system functions). While the above patterns of behaviour were observed in almost all contributions, it was not judged appropriate to take statistics of such contributions, due to the exploratory design nature of the sample meetings chosen. Other meetings, which concentrated more on administrative or political issues might have shown different patterns of contribution.

9.3.3 Issue 2: How A Design Model Is Abstracted

Several team members reflected that design which involved the whole group tended to be “design by committee”: the design concentrated upon the detail of the process, rather than generating process inspiration or understanding. They reflected that the team worked best if their joint models were based upon a design *prototype* which was produced, on behalf

of the team, by a an individual or a sub-group of ‘experts’: team members prepared to invest time in investigating and understanding a subsystem in order to produce an initial design model. The IS Manager referred to this type of prototype as an “Aunt Sally”¹⁰: the subsystem ‘experts’ would explain their design to the other team members, who would then debate and dispute how the subsystem should work. With a larger group, individuals felt unable to engage in design argumentation when there were others present who understood the process better than they did, so system design tended to default to the Tender Manager defining what happened in existing processes. In a sub-group of two or three, even when the Tender Manager was present, conversations often turned into dialogues between two people, with individuals more prepared to participate in argumentation, so more design was achieved. Mathiassen and Stage (1992) distinguish between the analytical mode of expression in IS design, which acts to reduce complexity in the design and the experimental mode, which acts to reduce uncertainty. The production of an “Aunt Sally” was experimental, in that it involved the production of an exemplar, but it was also analytical, in that the exemplar gave design team members a concrete model of a proposed design against which they could compare their own mental model of the design, which they were unable to express or to conceptualise without this means. The role of this exemplar was not to reduce uncertainty, but to provide a concrete specific from which individuals could abstract generalisations of the design, possibly increasing uncertainty with respect to the design.

It was noticeable that individuals did not abstract system concepts and functions in a way which was divorced from the context of the design, but based their abstractions firmly on what was done now, using examples and analogies from other areas of the business where their understanding of existing system processes was insufficient to act as the basis for abstraction, as illustrated in the following, typical contribution to a design discussion:

Design Contribution	Level of decomposition
<p>The process can take from an hour to several days. Depends again on the length and the size of the Tender. I mean, if it's a fairly simple one, it might be just a phone call - one I had the other day was just for contract manufacture, from Norway. I gave the papers to Malcolm, had a quick chat: are you interested in this and he said no, it's no good, I couldn't cope with this, I couldn't do that and I put a formal recommendation in, saying that we can't do it, because of this and that. I recommended no-bid - accepted, done. You see that you don't need a bid meeting for that. So it depends. But otherwise, as Gavin says, you need a meeting for more formal decisions ...</p>	<p>Level 3: defines inputs to system process (basis of decision concerning resourcing) Level 4: process mechanism, described with respect to example to define conditions Level 5: organisation of system function Level 4: process mechanism, described with respect to example to define conditions Level 3: defines process transformation Level 3: defines process transformation</p>

¹⁰ A fairground term, referring to a sideshow where a rag doll is knocked down with wooden balls.

As illustrated by the above example, there was a huge amount of information which could not be captured by the design representation mechanism (at this point, a level-2 flowchart). This information described the rationale for the design, at much lower levels of decomposition than that captured by the representational mechanism. In the SSM feedback workshop, individuals commented that they only remembered design details which made sense to them in terms of what they already understood of the design. A team member described this process, in an early design meeting, as “working backward but recording forward”. It can be seen from this dialogue that individuals needed to start from an understanding of the goals and nature of a system component, for which they needed a comprehensive “bottom up” investigation of that component, before they could engage in design decomposition of the component: the “top-down” design. This interchange was about more than the need for short-term goals. Some of the design rationale discussed in design meetings was retained by team members, but only if it fitted into an individual’s existing mental model of the process; otherwise it was lost. Discrimination between the significant and the insignificant (Turner, 1987) was a critical activity of design: this was enabled by the extent to which an individual had been enabled to construct a sufficiently wide-ranging mental model of the design when particular information was discussed. The core problem of design thus becomes one of complicating individuals’ models of a design, rather than one of reducing them, which is the focus of the decompositional (waterfall) model on which this project was based.

Lave & Wenger (1991) argue that abstraction is meaningless in the sense that knowledge can exist outside of the sociocultural context to which it pertains. Design team members were unable to abstract “pure” business processes without visualising them in the sociocultural context of the existing organisation. They were then very easily able to criticise that context and to re-define business processes, but the IS Manager’s insistence that “the spectre of organisation” was kept out of all design discussions constrained individuals’ ability to abstract a design, as in the following example:

Design Contribution	Classification
CSM: let’s talk about technical account management. What other assessments are we making on the fit on tactical match? That comes down to the quality of the product.	Change of topic Exploration of design sub-goal through request for info. on system mechanisms
PEM: well, OK, what it does, there’s also existing, it’s not just the projects we have it’s what functional blocks within those products will fit, like a particular interface we already have, so we don’t take much time to do that...	Response with mental model of respondent explained through system mechanisms
CSM: so it’s reuse	Clarification of sub-goal
PEM: yes	Validation of sub-goal
CSM: reuse versus?	Request for further clarification

PEM: yes: reuse of the technology or whatever. And also clear knowledge of what we can -- what economically we can ...	Further elaboration of nature of sub-goal
CSM: ... technical decision making	Clarification of sub-sub-goal
PEM: yes technical decision making.	Validation of sub-sub-goal
CSM: who would make those assessments? Engineering?	Request for further clarification, based on organisation of existing process
PEM: it should be, yes, including	Response
CSM: under whose guidance?	Request for further clarification, based on organisation of existing process
PEM: John Woodcot	Response
CSM: you're going to go to a bid/no-bid meeting and we need to harness the request	Query of mechanism, based on summary of sub-sub-process of system
PEM: oh, right, how do we collect it in this decision process? That would have to be done by product manager.	Definition of system sub-sub-process, based on organisation of existing process
IS: we did say that we would keep organisation issues to one side	Design discussion judged illegitimate
PEM: OK so somebody with local engineering expertise.	Modification of definition to abstract mechanism
CSM: I was just trying to make sure it was engineering, an engineering function. So we're going to look at the technology we've got and the ability to deliver new technology, that's an engineering function, the clarity of the customer request, that I think would be best left to everyone's reading of the ITT	Justification of need to explore organisation in order to abstract basis of design.

Individuals conceptualised problems and their solution together, by framing design 'problems' in terms of the required organisational mechanisms and structures, then testing their mental model of this pairing against a real example or scenario. There was an explicit recognition of this in the team's acceptance that they would better understand the design 'problem' once they had observed a 'pilot' study of their prototype system design. Thus problem and solution are intertwined and inseparable: they are framed by a process which takes place through a continual iteration between the concrete and the abstract until the individual is satisfied that they have a working model of the situation.

In summary, design framing, in terms of conceptualisation and abstraction was found to be situated in the organisational context of design: individual designers were unable to conceptualise system components without reference to existing organisational mechanisms and organisational structures. Where references to organisation were made to explore system purpose, they were seen as legitimate, where they were made to define a system component, they were not, as the social 'rules' of the team, driven by the IS Manager, required team members to abstract design concepts from the concrete organisational conceptualisations used. These abstractions were then legitimate objects for group validation. This framing mechanism is shown in Figure 9-2.

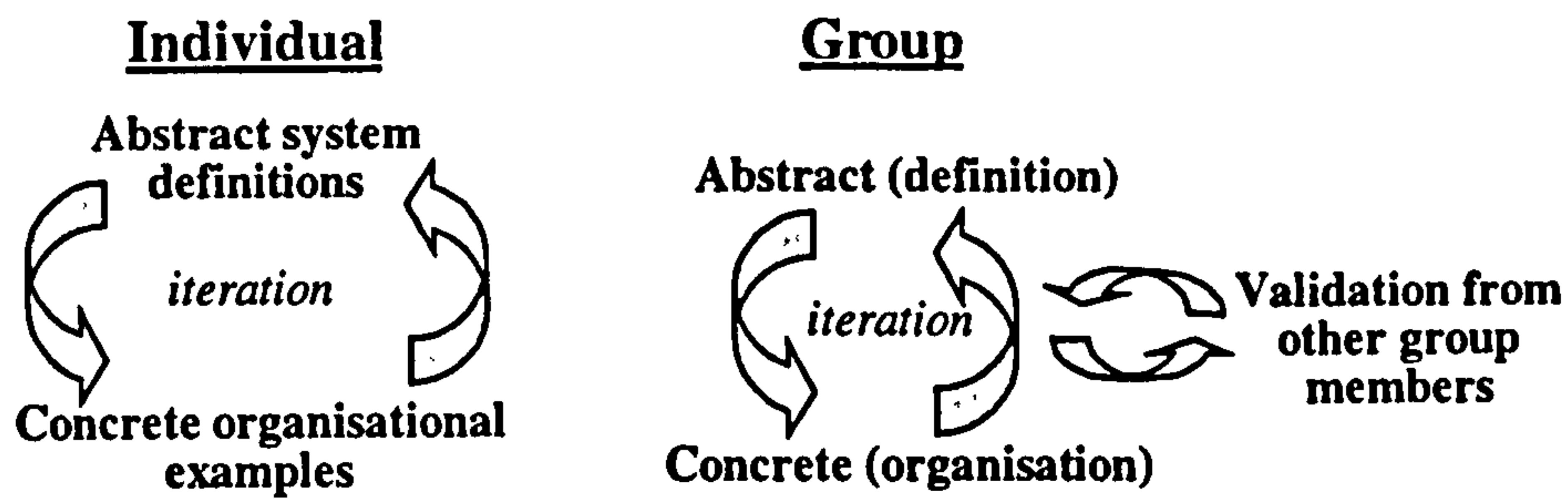


Figure 9-2: Design Framing At Individual And Group Levels Of Analysis

9.3.4 Issue 3: Managing Meaning Through Possession Of Knowledge Or Expertise

The legitimacy of design contributions tended to reside in the form of their presentation, rather than in their content, as in the following example:

Design Contribution	Classification
PEM: We need to continue dialogue with the customer, even if we are interested in pursuing the tender	Argued rationale for change to design:
TM: so we have a contact customer box in both the no-interest and the interest outputs from that decision box?	Translation of rationale to representation in external design model.
IS: No -- I believe that the extra box that we're talking about needs to go in there [into the feedback loop]. because, in terms of the flow, until the ITT arrives we go round in a circle. And really what we're saying is that while we're waiting for the ITT, the account management process continues dialogue with the customer -- that account management process might result in some changes of the MSOR, which feeds back through this loop	Redefinition of translation of rationale to representation in external design model, based upon example from the organisation of the existing system translated in terms of information requirement of system component.
TM: so your left hand one is your interest-line?	Referral to information-flows of existing system, to understand abstract concept
IS: Yes -- and you only break out of that loop once the ITT arrives and you carry on to stage 2.	Confirmation of model based on information-flows of existing system.
PEM: so you're saying that as part of this process, we don't talk to the customer, we just feed the information back?	Query concerning mechanisms of new system.
TM: we shouldn't be talking to the customer, at this stage, anyway.	Rationale based on mechanisms of existing system
PEM: so how does that work?	Query re: effect upon design model
IS and TM. (jointly): you change the interest line to this feedback loop here and put this extra box that we're talking about here. We're interested in talking to the customer about this ...	Translation of rationale to representation in external design model
PEM: but who tells him that?	Query re: organisation of new system
IS and TM. (together): the account manager.	Response re: organisation of new system
PEM: so that's going into the account manager process?	Query re: effect upon design model
Dave and TM: yes.	Response re: effect upon design model
PEM: so this (the "interest" output from the decision box) also goes into account management? And into marketing, directly?	Validation sought for mental model of information-flows in process.
IS: no, I think there's a feedback loop that goes into account management and then into marketing.	Modification of model of information flows.
TM: yes, that's right.	Validation of modified model
PEM: well, to be honest, marketing are going to be part of this so they're going to get it directly anyway, aren't they?	Attempt to understand model via organisation of new system.
IS: in reality the reason we're struggling because we're trying to look at it in process terms whereas it's really information flow that we're trying to reflect round that feedback loop.	Comment on the inadequacy of the external representation in use (a level-2 process flowchart)

The issues here appears to be the definition of legitimacy, with respect to ways of framing the design and the dynamic way in which different types of knowledge influenced the design at various points in the process. It was observed that *all* team members referred to the organisation of functions, either within the designed system, or using analogous examples from other areas of the organisation to describe system mechanisms. The *legitimacy* of these concretisations tended to reside in the context of their presentation. If contributions were made in the process of defining a system component, as in the previous example, they were judged illegitimate. If contributions were made in the process of exploring the purpose of a system component, they were judged legitimate. In the meeting extract reproduced above, two different exercises of influence upon the design may be observed. The first was that exercised by the IS Manager, in defining how a concept translated to the explicit model of design, as he had expertise in creating such models which was valued by other team members. The second was the influence exercised by the Tender Manager, who was able to define the new system in terms of how existing processes worked and so influenced the team's perception of the design rationale. The need for an understanding of system mechanisms and organisation, discussed above, meant that those individuals who possessed such an understanding - or who were motivated to achieve an understanding of the existing system of work - were disproportionately powerful in defining conceptual models of the design. A framework for the analysis of the management of meaning, which takes as its starting point the Markus & Bjorn-Andersen (1987) framework of power exercise, is presented in Figure 9-3, as the Markus & Bjorn-Andersen framework proved too centred in the specifics of IT development to provide insight into the context of organisational IS design.

		<i>Basis of influence</i>	
		<i>Issues of fact</i>	<i>Issues of value</i>
<i>Scope of influence</i>	<i>Design goals</i>	Framing	Conceptual
	<i>Design process</i>	Interpretive	Symbolic

Figure 9-3: A Framework For The Management Of Meaning In Design

This framework examines influence in design, through the an analysis of the way in which knowledge is valued and interpreted for others:

- *framing influence* may be exerted in defining the meaning of ('framing') specific design goals for other actors, based upon factual knowledge to which other people do

not have access (for example, by stating that there must be a meeting to decide whether to proceed with the Tender - no-one can argue with that position unless they are aware of instances when a meeting was not required, which is unlikely if they are not involved in the current process);

- *interpretive influence* may be exerted by an individual who interprets the actual process of design for other actors (for example, with the statement “we’re not getting anywhere: we need to define clearer objectives”);
- *conceptual influence* may be exerted in shaping others’ values and concepts of design goals, based upon specialist expertise (for example, in defining that the design is intended to achieve ‘quick wins’);
- *symbolic influence* may be exerted by shaping the meaning of the design process for others (for example, in defining appropriate design roles for individuals, or appropriate representational mechanisms).

The different types of influence are rooted in different bases of power. For example, the shaping of values would normally be expected to be consequent upon the possession of specialist expertise, so conceptual influence would depend upon acknowledged expertise in the context or domain in which the design is situated, whereas symbolic expertise would depend upon acknowledged expertise in design in general. Framing and interpretive influence would be consequent upon possession of factual understanding. Framing influence would depend upon experience of the object of design (or a similar object from which an analogy could be drawn), whereas interpretive influence would depend upon others’ recognition of a superior analysis of a situation of which they themselves might have experience.

As observed in Chapter 7, there was a ‘power struggle’ between the Tender Manager, whose understanding of the design was grounded in a deep understanding of the current process mechanisms and the Project Engineering Manager, who was motivated to achieve an in-depth understanding of the existing system in relation to other business processes through intellectual curiosity. This was resolved through the exercise of *framing influence* by the Tender Manager, who framed the specifics of the design for other team members by basing his suggestions upon knowledge of how the *current* process worked. Such knowledge was valued because the design model and the information requirements of the new system were too poorly understood by members of the design team for the Tender Manager’s rationale to be challenged, except by the Project Engineering Manager, whose attempt to exercise conceptual influence proved weak when confronted with the Tender Manager’s basis in issues of fact. This was not the only dynamic in the ways in which

design meanings were managed for the design team. The IS Manager and other team members engaged in disputes over the form of design representations. The IS Manager was able to resolve these by exerting symbolic influence over other actors, in defining the meaning of design. He was able to do this because of his acknowledged expertise in the design of IT systems. Similarly, when the IS Manager and the Project Engineering Manager adopted rival forms of design model representation, the IS Manager was able to exert symbolic influence, in calling upon his expertise of assessing design representation methods for particular purposes, whereas, the Project Engineering Manager was able only to exert conceptual influence, in arguing that his method of representation was suitable for this specific context.

Episode	Overall Design Approach	Dominant Forms Of Knowledge (Content)
1	Ad hoc (high-level decomposition, plus high-level abstraction)	General representational methods for design; Organisation's competitive environment; Customer requirements of order-capture/business tendering; How the organisation works (high-level view) Problems with current organisation of work.
2	Process decomposition and abstraction from scenarios	Business and marketing knowledge; How the organisation works (high-level view) Problems with current organisation of work; Representational methods for IT design; General representational methods for design.
3	High-level decomposition, plus information-flow definition	Representational methods for IT design; System interface with external business processes Information requirements of external business processes; Problems with current organisation of work; Detailed understanding of current Tender process; How the organisation works (high-level view).
4	Information-flow definition, plus experimental prototyping	How the organisation works (high-level view); Customer requirements of order-capture/business tendering; IT system information storage architecture; Current organisation of work within explicit system boundary; Detailed understanding of target system design model.
5	Functional decomposition	Customer requirements of order-capture/business tendering; System interface with external business processes (info. reqs.); Detailed understanding of target system design model; Understanding of target system information architecture; Current organisation of work within explicit system boundary; Current mechanisms for recording information;
6	Experimental prototyping, plus functional decomposition	Current measures of system effectiveness; Current organisation of work within explicit system boundary; Current mechanisms for recording information; Detailed understanding of target system design model; Understanding of target system information architecture; How the organisation works (detailed view).
7	Allocating organisational responsibility, plus defining change programme (selling design to the organisation).	Detailed understanding of target system design model; Understanding of target system information architecture; Understanding of how target system should be implemented; System interface with external business processes; How the organisation works (detailed view).

Table 9-5: Dominant Form Of Knowledge Vs. Design Approach, For Each Design Episode

Different forms of knowledge were valued at different points in the design process. The dominant forms of knowledge (in terms of what types of knowledge were most valued and deemed appropriate to the process by the design team) and the overall methodological approach taken to design, for each design episode identified in Chapter 8, are summarised in Table 9-5. It was observed that the dominant forms of knowledge became more based in issues of fact and less in issues of value as the design proceeded. On the one hand, issues of value had been resolved as the team stabilised and their interests became aligned (see Chapter 10). But also, the methods used for design required more detailed, fact-based knowledge as they became more grounded in the low-level, functional decomposition approach which is commonly employed for IT design, following the exertion of symbolic influence over the design process by the IS Manager. All of the above (and other) disputes were managed by actors mobilising a body of opinion about their case by managing the meaning of either design goals or the design process. At early stages of the design process, issues of value played a larger role in conflicts over the goals or processes of design. At later stages, issues of fact played a larger role, as the design process became more based upon functional decomposition, which required detailed understanding of a design, the complexity of which had been insufficiently explored for team members to possess this understanding, except where it could be based upon a knowledge of existing processes. It was observed that, in lieu of clear mental models of the target design, the team trusted issues of fact, based upon the way in which the existing system of work functioned more than issues of values, concerning the way in which the new system should work.

9.3.5 Issue 4: The Influence Of IT Design Practice

A second element of situatedness was the way in which design framing was situated in the sociocultural context of the design team. Lave & Wenger (1991) refer to “legitimate peripheral participation”, through which ‘apprentices’ to professional practice become respected practitioners through learning the sociocultural rules of the professional group to which they aspire to belong. One of the reasons for selecting this project to study was that there was no existing, professional group practising this type of design in this organisation, so it was possible to observe design practice in an environment unformed by the sociocultural norms of existing practice. However, this turned out to be a vain aspiration. The existing professional practice of the IS development function drove practice in this design team, as the IS Manager was able to exert conceptual power over the processes and standards of design, as he was the only member of the team with extensive design experience. While many different methods of conceptualising the design

and representational mechanisms were legitimate at first within the design team, as the IS Manager became more comfortable with the new approach to system design and more established as the leader of the design team, he determined procedural standards for design, based upon existing IT design approaches used in the company. The inadequacy of decompositional design representations is shown in this dialogue concerning the IS Manager's request that team members use "structured" (i.e. decompositional) written system representations:

IS: I would feel a lot more comfortable with a little more structure in the text against each box. If, in each box, if it said: owner, input, process, outputs, rather than a more ad hoc, textual, "this is what happens here" then I would feel that it was a bit more usable into the long term.

PEM: you normally work it the other way round. You say 'what am I asked for', 'how am I going to do it', 'who do I need to do it' and 'what do I need in to me to achieve it'?

The use of "structured" external representations of the design constrained the effectiveness of the design process: process-based external representations of the design were unable to capture the complex models of information-flows which required to be understood and the early adoption of written functional specifications to represent the design did not permit the diagrammatic visualisation necessary for the team to construct more complicated mental models of the design. Towards the end of the project, team members reflected that they should have spent more time understanding how the system should work and less time "writing the words".

The dominance of the IS Manager's perspective was reflected in the design team's use of metaphors. Phrases such as "the virtual team", "starting from a blank sheet of paper", "quick wins", "business as usual", "the big arrow/little arrow concept", "stock-taking" and "train the troops", were all metaphors which were observed to originate with the IS Manager, but which were rapidly adopted by the team as a whole. Such metaphors tended to define the *purpose* of the design process at any point in time and are an instance of leadership as the "management of meaning" observed by Smircich and Morgan (1982). Using the framework from Figure 9-3, the IS Manager was able to exert symbolic power over team members, through his ability to determine management policy concerning the values of the team. This ability was supported by the collusion of the Process Improvement Manager in managing the team according to an agenda pre-determined before each design meeting.

9.3.6 Issue 5: The Emergent Design Boundary

One of the issues which emerged as critical in the analysis of Chapter 7 was the emergent nature, not only of goals and system problems, but of an appropriate boundary to the target object system. Initially, the target system was selected for an exploration of the

“business process design” approach to organisational IS implementation, as it was considered to be relatively “stand alone” in nature. As the design proceeded, it emerged that the design ‘problem’ was of the “wicked problem” type (Rittel, 1972; Rittel & Webber, 1973), where multiple, often competing problem definitions are involved and many design problems are interrelated. This type of design ‘problem’ has no clear stopping point and many, alternative solutions, depending upon which aspects of the ‘problem’ are defined as objects of the design. The emergent nature of the design boundary - control of the scope of the design - therefore became the critical management issue for the design team as a whole.

It is clear that, while the IS Manager controlled the explicit definition of what was a legitimate object for inclusion in the design, team members held different conceptualisations of the system design boundary, with different people implicitly defining the scope of the design at different points in the design process. Initially, the design boundary was “agreed” - i.e. no-one objected to the IS Manager’s definition - and was published to the company as a whole. In the early stages of design, several individual team members attempted to expand the boundary to include other functions, which they saw as relevant to the success of the target system, yet this was done at an implicit level. For example, the Customer Solutions Manager argued that control over and specification of the gathering of intelligence by Marketing was critical to the successful running of the target system: this conceptualisation of the system boundary was adopted and internalised at an implicit level by the design team and figured large in the final design. Yet the system boundary remained unchanged: it included no Marketing functions. The management of these processes was somehow to be achieved through the specification of certain information requirements which were to be supplied by Marketing. In fact, the Customer Solutions Manager himself was criticised at one point by another team member for taking too limited a view of what lay within the system boundary:

His view has been, well this happens here and marketing do it; this happens here and operations do it. Or here is a big box which is marketing and we don’t need to bother what happens inside there at this stage. Yes we do!

This behaviour (which was replicated in other instances) suggests that there are two purposes of a system design boundary, one of which is explicit - to ensure political visibility and adoption of the ultimate IS by the organisation - and one of which is implicit - to bound the scope of the system design. While the explicit system boundary is shared, implicit system boundaries may differ radically. The team appeared to suffer from a great deal of confusion, in attempting to reconcile their implicit system boundaries with the explicit boundary and yet did not appear to consider it feasible to change the explicit

boundary, even when they clearly agreed that the latter was inadequate for the purposes of the design. This may have been because of the innovative nature and the high visibility of this design project, which meant that the team was highly motivated to be seen to succeed. This almost certainly meant that changes to the design scope and goals, once published and accepted by senior management, were not politically acceptable. The dual and emergent nature of the design boundary appeared to be a critical issue of this study.

9.4 Summary

9.4.1 Differences In Perspective, Intersubjectivity And Distributed Cognition

While individual objectives with respect to the processes of design appeared to have converged towards the end of the design project, perspectives with respect to the target system appeared have diverged with increased understanding of the design 'problem', with team members placing differing emphases on different aspects of the target system. But despite radical differences in perspective of the design product, the team was able to function coherently, agreeing fairly major issues with little conflict and this suggests that differences in explicitly-held target system objectives were less significant in achieving consensus about the design, than differences in perspectives on what the design process was intended to achieve.

Design goals were not explicitly defined or agreed and were continually emerging from a process of negotiation and design argumentation. Many design goals appeared to be held implicitly, yet shared by several team members; they only surfaced when a goal held by a number of individuals was challenged by another team member. The team appeared to build sufficiently intersubjective models of the design for the design process to proceed, although team members did not feel that they had fully understood the design. The key element in agreeing the design appeared to be the degree of trust built up between team members, which enabled individuals to delegate decisions on parts of the design which they did not understand to other team members - an example of distributed cognition (Hutchins, 1990). This aspect of behaviour was much more noticeable at late stages of design than at earlier stages, suggesting that an appreciable period of shared design is needed before a sufficiently high degree of trust is achieved for distributed design cognition to take place.

The role played by external representations of the design appears to have changed with the course of the design. Initially, many different types of design representation were used, as the team's focus was on constructing mental models of the target system. Representations were then standardised and a critical task for team members became

learning to use the representational methods to achieve an intersubjective understanding of the design. Finally, the role of the design representation moved to being an external (to the team) communication mechanism, to act as the basis for staff training and process management., with the focus on ensuring that these representations of the design were correct and complete.

9.4.2 The Framing Of Design

The multiple levels of decomposition at which design contributions were made constitute a replication of Guindon's (1990a, 1990b) experimental findings from the protocol analysis of design reflections of single designers. However, these findings have been made in the organisational context of a group of designers working in concert. If one looks at changes over the project lifecycle as a whole, there is some evidence that the decompositional, waterfall model applies in terms of the focus of the design, as represented by the average level of decomposition. But this focus may have been influenced by the IS Manager's model of how the design process would work (which he continued to maintain throughout the project), as he managed the agenda of the design meetings according to the waterfall model. Additionally, the exception to declining decompositional foci was the initial period of design, when much wider ranging discussions, in terms of the decompositional level, were observed than at later periods. The design process had no mechanism for capturing requirements and part-solutions and multiple levels of decomposition, which caused many issues to be revisited, as individuals attempted to recall or investigate the rationale behind a previous design decision.

Design framing, in terms of conceptualisation and abstraction was found to be situated in the organisational context of design: individual designers were unable to conceptualise system components without reference to existing organisational mechanisms and organisational structures. Where references to organisation were made to explore system purpose, they were seen as legitimate, where they were made to define a system component, they were not, as the social 'rules' of the team, driven by the IS Manager, required team members to abstract design concepts from the concrete organisational conceptualisations used. These abstractions were then legitimate objects for group validation.

Different types of influence became significant at different points in the design process, depending upon the knowledge and expertise of individuals and whether issues of value or issues of fact were most significant at that point in the design. At early stages of the design process, issues of value predominated, as the form of both the design process and

of suitable design goals were debated and resolved. At later stages, issues of fact concerning the existing organisation of work and information predominated, as the design approach, which was based upon existing IT design methods, did not recognise the existence of emergent design goals. This reflects the way in which 'traditional' IS design is situated in existing organisational structures and mechanisms.

9.4.3 The Role Of Existing, Normative IS Design Practices.

The situated nature of the design team, in the context of existing IT design practice within the company, constrained design effectiveness as the wider, more complicated system conceptualisation required - the construction of complex mental models which encompassed system processes, information-flows and rationales - were not supported by the formalised, structured representational mechanisms used to support IT design. A range of diagrammatic techniques were required to enable continuing construction and elucidation of designers' mental models, but the grounding of the design process in the values and approaches used in IT design, based upon the reductionist waterfall model, meant that such representations were not judged to be legitimate. The group design values were managed by the IS Manager, who was able to exert symbolic power to "manage meaning" within the team, as far as the target system was concerned.

9.4.4 The Legitimacy Of Emergent Design Goals.

The behaviour of design team members in attempting to control processes outside of their agreed system boundary suggests that there are two purposes of a system design boundary, one of which is explicit - to ensure political visibility and adoption of the ultimate IS by the organisation - and one of which is implicit - to bound the scope of the system design. These aspects are explored further in the next chapter.

The emergent nature of the design boundary must be seen as a critical issue for future research. The design literature (e.g. Ball & Ormerod, 1995; Maclean et al., 1990; Malhotra et al., 1980; Schön, 1983; Turner, 1987) has recognised that design goals are emergent and has considered the implications of this, in terms of rejecting the waterfall (decompositional) model as the basis for organisational IS design. But a recognition that the system boundary is also emergent means that not only design goals but also the overall system definition must be seen as dynamic. Design support tools must reflect this changing nature of the *scope* as well as of the detailed goals and problems of design.

The next chapter examines the mechanisms by which design goals and scope are established.

10. A GENEALOGICAL ANALYSIS OF THE DESIGN PROCESS

10.1 Introduction

This chapter presents a contextual and political perspective of the design initiative, drawing upon some elements of actor-network theory to analyse the design process as the evolution of situated learning, to address research questions 7 and 11:

7. *How do differing perspectives on the nature of problem-definition and analysis/investigation affect organisational actors approaches to information system design processes.*

11. *To what extent is design scope constrained by political considerations and what role do explicit models of the design play in extending and obtaining consensus on the scope of a design?*

10.1.1 Method Of Analysis

This analysis is grounded in Lave's (1988, 1991; Lave & Wenger, 1991) concepts of situated learning. An individual becomes a member of a community of practice through *legitimate peripheral participation*: "a person's intentions to learn are engaged and the meaning of learning is configured through the process of becoming a full participant in a sociocultural practice" (Lave & Wenger, 1991). Knowledge is thus situated in the context and practices of the social group; the nature of problem-definition and the legitimacy of certain types of problem-translation are defined by the socio-cultural norms of that group. The production and translation of socio-cultural norms through the alignment of diverse interests during the processes of design over the period of the longitudinal study, is analysed using some elements of actor-network theory (Latour, 1987). Actor-network theory recognises the relationship between human and non-human mechanisms in the construction of social reality. Designers *inscribe* their interests into technical artefacts (Akrich, 1992). Technical artefacts, "facts" and "knowledge" may be seen as the end product of many processes of *translation* which occur over time as actors offer new interpretations of others' interests and channel people in different directions to serve their own interest (Latour, 1987).

The unit of analysis here is the **local** actor-network perpetuated by the process of design: the way in which the local actor-network was formed and re-formed by the interests of other actors within the organisation and the role played by outputs of the design process, in particular the IT system produced to support the work system and written representations of the design, produced during the design process. The analysis draws upon only part of Latour's (1987) original concept of the actor-network, as it ignores the

wider social and business environment of the design initiative: it was not possible to gain access to these, external processes. But the concepts of actor-network theory are of particular use in examining the processes of the local design-team because they enable an examination of how *non-human actors* - for example documents, technical systems, design representations and design-team membership - represented the interests of human actors and how interests were *translated* over time. The "emergence" of the design is thus exposed as socially-constructed, explaining the mechanism by which different forms of design knowledge, identified in chapter 9 (Table 9-5), dominated the process at different points in the design.

10.1.2 Limitations Of The Analysis

A limitation of actor-network theory is its concentration upon intentionality. Given the analysis of translations, it is easy to perceive the whole world as planned and intentional, whereas structuration theory permits unintended as well as intended consequences (Orlikowski, 1992). With this awareness, I attempted to examine each translation thought to be significant for the intention, as well as the embodiment of interests, permitting unintended outcomes to surface. Translations were many and frequent; the translations presented here have been produced through a subjective process of selection. This weakens the analysis from the perspective of actor-network theory in the sense intended by Latour (1987), making it more akin to the diffusion model of technology which he presents than the evolution model (i.e. stages of evolution are omitted). But the intention was to explain the (subjectively and in retrospect) *significant* links between translations: to tell a story of how the design evolved in the context of this particular design team.

Another constraint on the study was the central role played by the IS Manager, not only in running the project, but in acting as a primary source of information to this research. I am aware that much of the analysis here is centred upon the actions and interests of the IS Manager and have tried to analyse as wide a range of interests as possible in this analysis. In a way, this concentration is justified by the role which the IS Manager played in framing meaning within the design process for other actors involved in this process: this is discussed further in the summary section, below. Given a lack of research access to many organisational processes external to the design team, this analysis has concentrated upon the evolution of the design through the mobilisation of interests viewed from within the design-team. I have tried to be as wide-ranging as possible in the translations which I have considered. During the study, I collected all documents and models which were distributed, recorded all design representations and every communication, formal or informal. Selection of translations was made by determining their significance to the

study once a reasonable period for reflection had occurred, when the researcher had been able to distance herself from identification with the team's perceptions of meaning.

10.1.3 Perspectives Of Design

Perceived complexity and uncertainty with respect to the product of design, is mapped in Figure 10-1 for each of the design episodes identified in chapter 8 (position (0) identifies the antecedent conditions), using the framework developed in Chapter 4 to follow the changing ways in which the design 'problem' is perceived. The discussion below explains the basis of these movements and interprets how this changing perception of the design *product* affected the *process* of design.

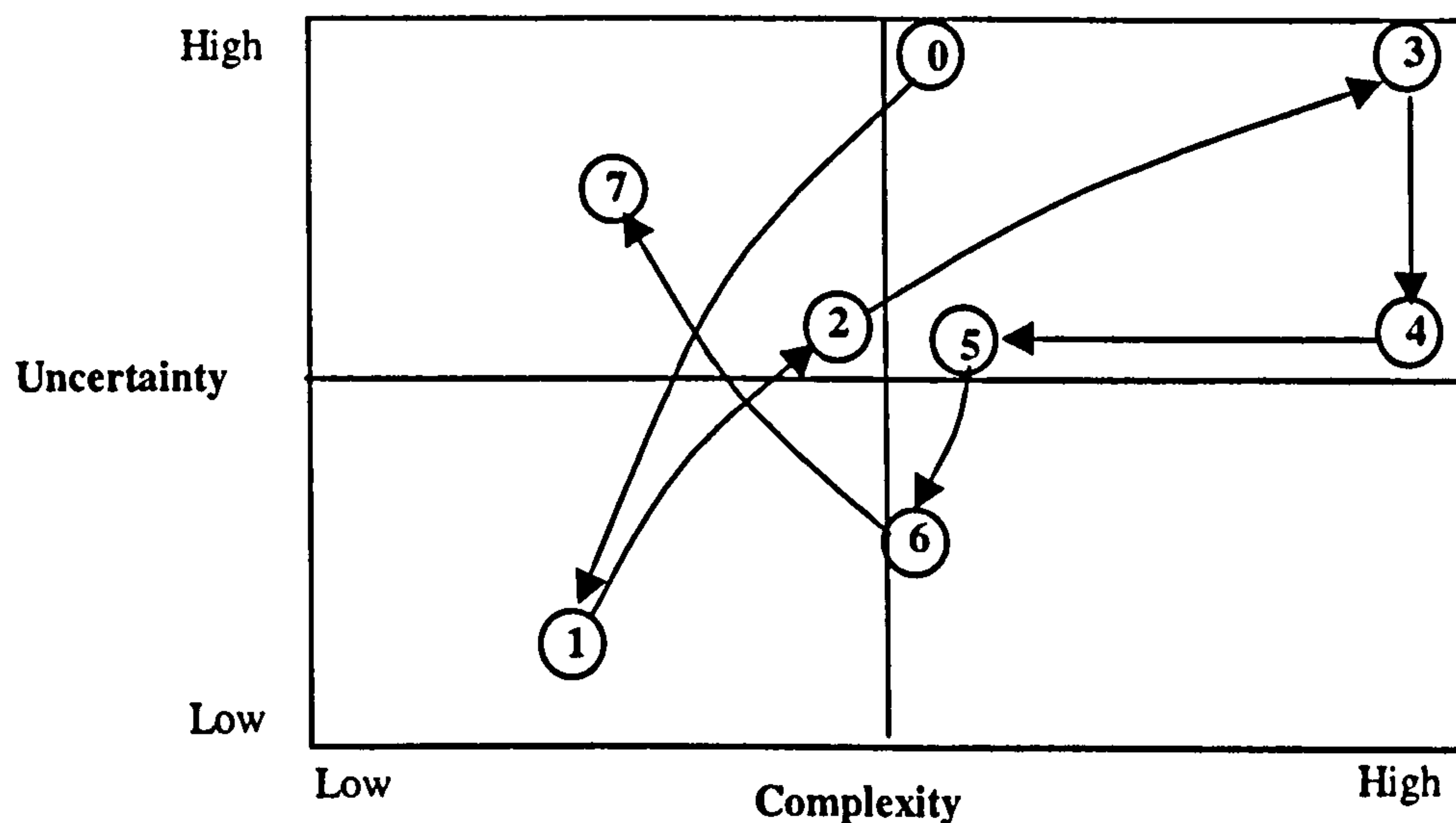


Figure 10-1: FTEL Design Process Mapped To Complexity/Uncertainty Dimensions

High uncertainty, coupled with high levels of complexity in the perceived problem indicate a 'wicked problem' (Rittel, 1972). A designer will tend to move the problem into one of the other quartiles of the matrix by applying a reductionist design approach, aimed at reducing either problem uncertainty or problem complexity, in order to make the design problem more manageable. As discussed in Chapter 4, an effective design process (one which permits periodic consideration of the wider context of the design, in the light of emerging understandings of design objectives) will need the design 'problem' moved back again to the top-right quartile periodically, to 'complicate' designers perspectives. But this complication is not without its attendant confusion and designers are liable to react by trying to move the design to one of the other quartiles, as quickly as possible. Latour (1991) comments that any Actor-Network narrative should account for "the progressive passage from the microscopic to the macroscopic" - i.e. to account for the social structures which influence the course of local history. To attempt this, Figure 10-2 illustrates the political trajectory of the FTEL design project. The relative success and

failure of a project is determined by the degree of control exerted by that project over the local and global networks (Law & Callon, 1992; Lea et al., 1995). The positionings are, of course, subjective: they represent my interpretation of the design team's perception of local (i.e. design team) mobilisation and global (i.e. external stakeholder) attachment for each of the episodes identified in chapter 7; position (0) identifies antecedent conditions. A position in the top-right quadrant represents a "solid, indispensable project"; a position in the bottom-left quadrant represents a "weak, disaggregating project" (Law & Callon, 1992).

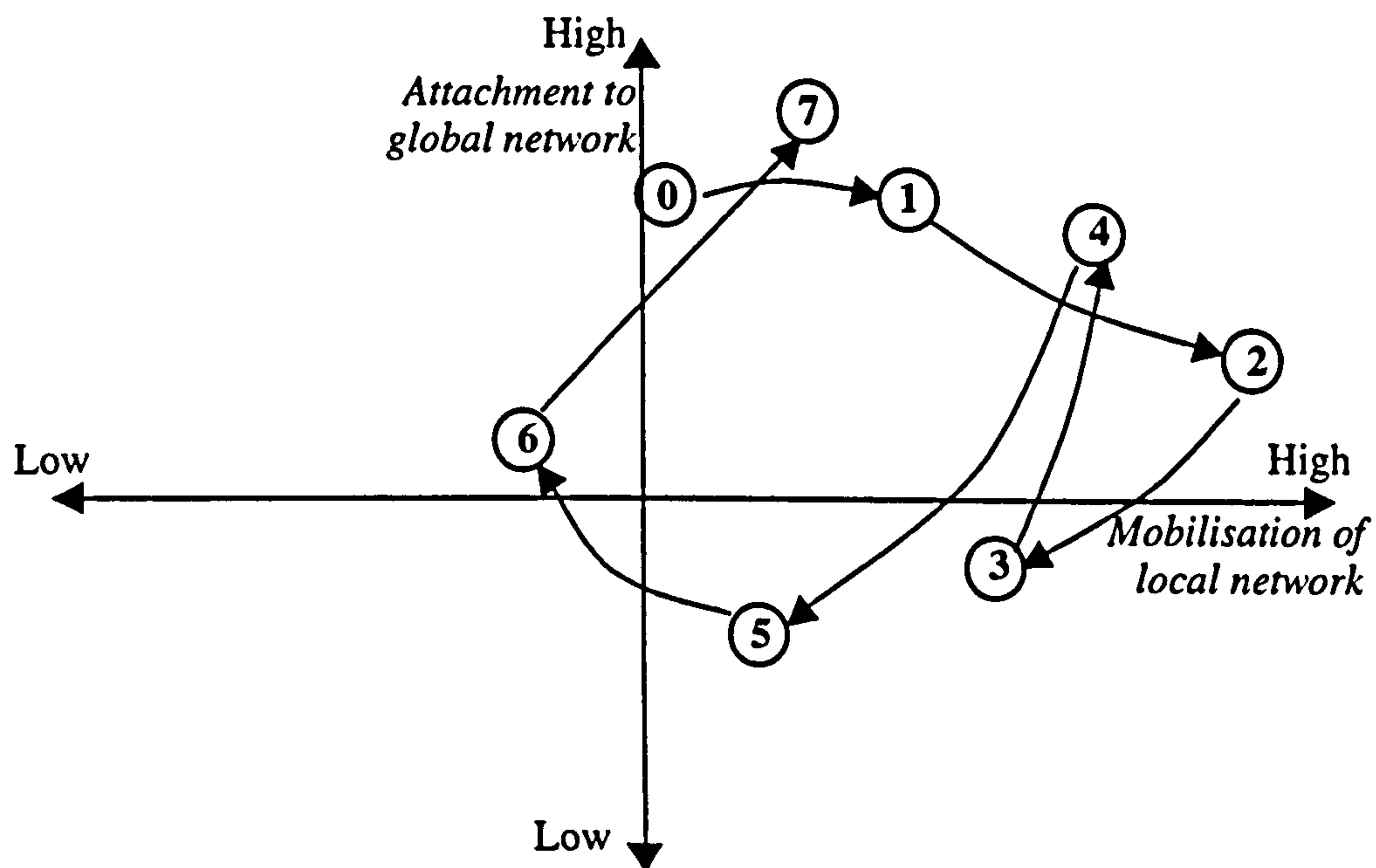


Figure 10-2: Political Trajectory Of The FTEL Design Project

10.2 A Genealogical Analysis Of The Design Process

10.2.1 Antecedent Conditions To Project

Constitution Of The Design Team

The team was mobilised by the IS Manager, who had been involved in a previous initiative of "business process redesign" (discussed in Chapter 8) and had retained three of the team members from that team for a new initiative to design an organisational information system to support the processes of responding to customer invitations to Tender (ITTs) for new business. He, personally selected "appropriate" people to constitute the new design team and defined the scope of the new information system: he viewed the system of work-processes and IT-based information to support the processes of responding to ITTs as relatively "stand-alone" and therefore easy to design, which permitted the exploration of new approaches to design. The complexity of the design 'problem' as perceived by members of the design team was reduced by this definition of

the system as stand-alone, as this statement defined a clear system boundary, which coincided with the boundary for this function in the current organisational structure, but at this point in the design, the team had only a vague idea of what they were designing, or how, so the design problem was perceived as relatively uncertain. This perception is represented by point (0) in Figure 10-1.

The initial design network is shown in Figure 10-3, where dotted lines indicate reporting structures and solid lines indicate membership of the design team, which was centred on the IS Manager. It can be seen how the IS Manager intentionally sought to constitute a network to every part of the organisation: by his selection of influential team members, he had indirect access to every member of the company board.

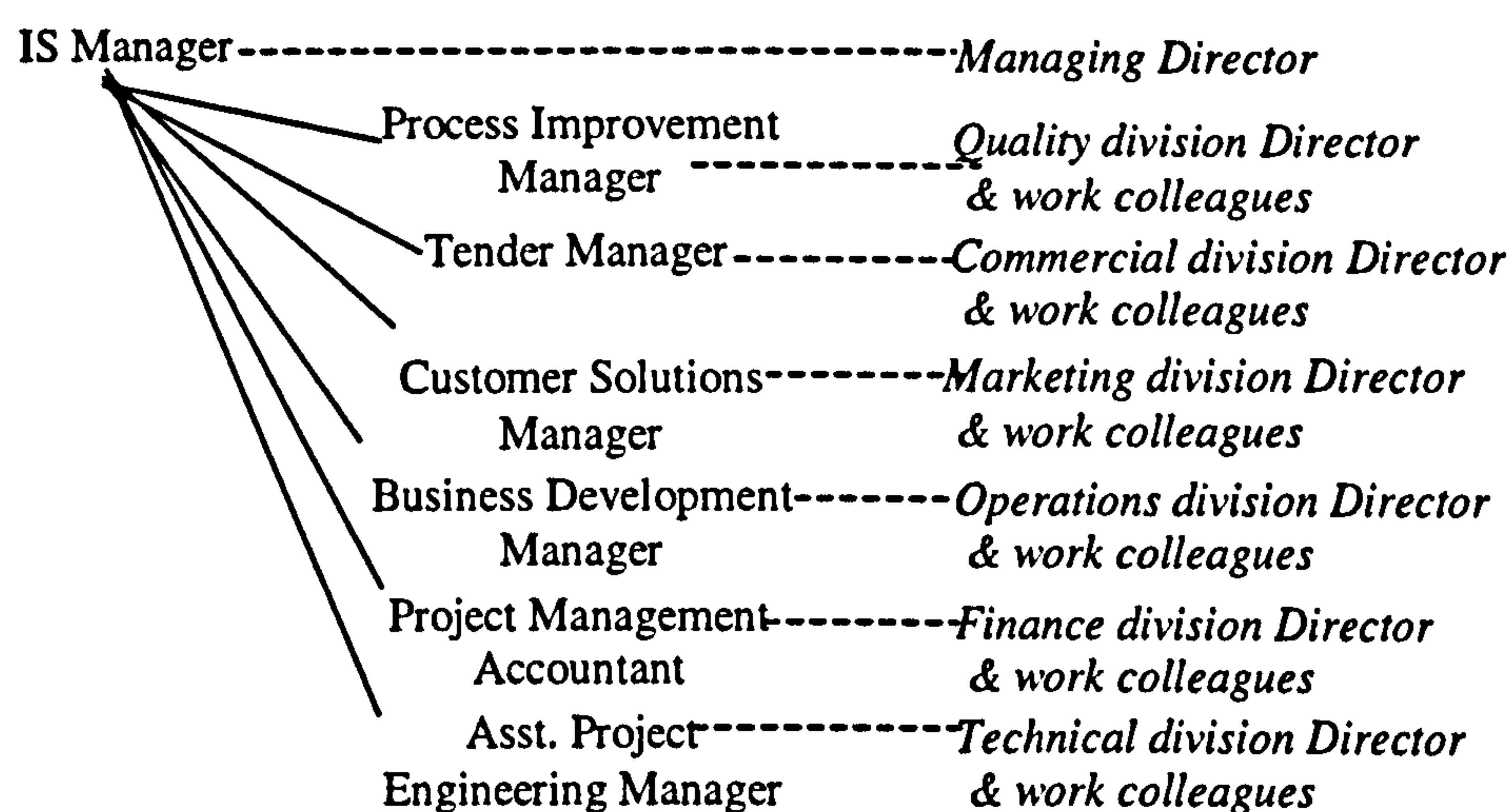


Figure 10-3: The Design Network At The Start Of Project

That the IS Manager was aware of the importance of the design network is shown by his statement (given in Chapter 8) that “we are looking to them [design team members] to represent their peers and their gaffers and that implies that they should be using them as sounding boards for the ideas and thinking that they’d bring to the meeting and that which they take away”. Mobilisation of the global network (the network of external stakeholders and influential decision-makers within the organisation) was high and beneficial to the design at this point, but mobilisation of the local network (the design-team) was relatively neutral. The IS Manager saw his main task at the start of the project as mobilising the local network, by “achieving a common vision” within the team.

10.2.2 Episode 1: Expanding The Design ‘Problem’

It was shown in Chapter 8 that the initial design objectives held by different team members differed radically and were also substantially vague. The first task of the IS Manager was to engage team members in a coherent (intersubjective) design process by enabling the team to bond and to forge common perspectives of the design objectives. The IS Manager expected this to be relatively easy, as he perceived the design problem as

relatively certain and relatively bounded (Figure 10-1). He issued a memo to organisational managers, defining the design (target system) objectives, in terms of “quick wins” for the organisation; this served both as a common focus for the design team and also served as a secondary network-strengthening mechanism, as shown in Figure 10-4 (where the double lines indicate network connections enabled through a non-human actor, in this case the statement of design objectives, and the arrow indicates influence to achieve the adoption of that person’s interests). Through this mechanism, he was able to change the meaning of the design project for organisational managers, as the statement of objectives embodied his personal objectives for the project, which now “represented” the project to the company as a whole, and was able to reduce the complexity of the design problem, as perceived by the design team (point (1) in Figure 10-1).

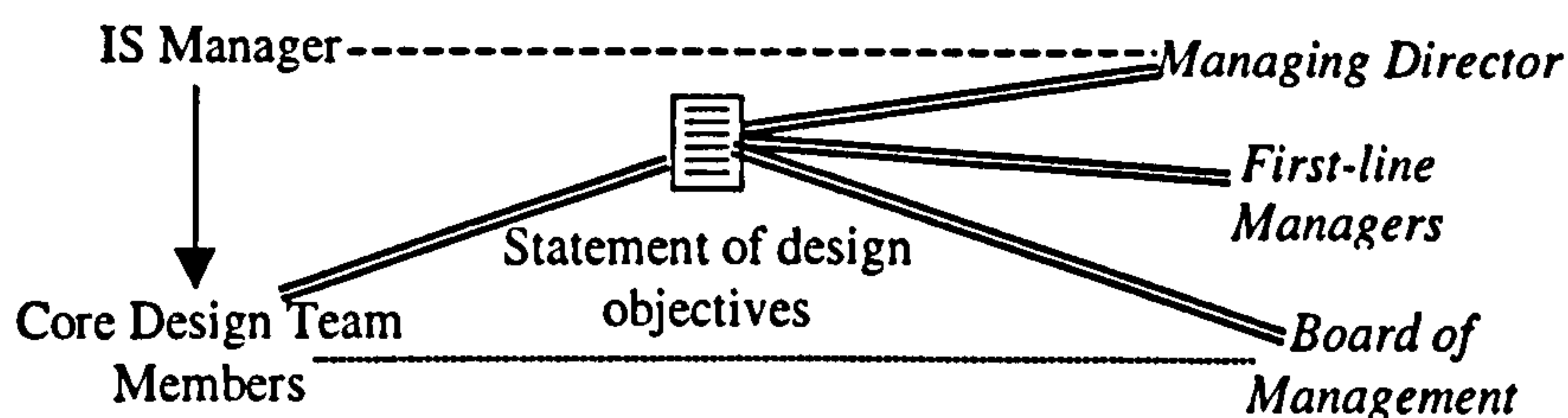


Figure 10-4: Effect Of The Statement Of Design Objectives

The IS and Quality representatives jointly led the design team, so their perspectives (as discussed in Chapter 8) might be expected to be similar. They were, to some extent, in that they both saw the design process as one in which the novel business process redesign approach to information system design might be tried out. But the IS Manager had an interest which centred upon the detail of the design: the information flows and process specifications which would form the basis for a new, integrated, work-support information system, whereas the Quality function representative had a broader interest which centred upon design team members achieving a ‘vision’ of business processes: how they interrelated, how problems arose, where there was duplication of effort and where essential tasks were not being performed. The two perspectives, therefore were antagonistic to each other (although the two actors did not realise this and spoke as if they shared a common interest): the IS Manager wished to narrow the process, through decomposition while the Quality representative wished to widen the process, through integration with other business processes. The role of expertise now becomes significant: based upon the influence framework developed in Chapter 9 (shown in Figure 9.4), the IS Manager was able to exert symbolic influence over the process of design, as he had prior experience of a wide range of design processes and so could define the *meaning* of design, for the sociocultural context of the design group as “starting with a blank sheet of paper”. Whereas the Process Improvement Manager saw the process as resolving areas of

inefficiency and ineffectiveness in the existing process, the IS Manager saw this as unnecessary (as his perception of the system was that it was relatively simple and relatively certain - point (1) in Figure 10-1), so he was able to replace the Process Improvement Manager's concept of design as *problem investigation* with his own approach to system design, which he described as:

Never mind what current process is, identify shortcomings and identify what functions you need in a process. Then, with a clear view of shortcomings and a clear view of functions needed, you design a new process.

The shortcomings of this approach are those of the "traditional" approach to problem-solving (which was how this was described by the IS Manager), which was discussed in Chapter 7. The problem is taken as given and unitary in nature, when it can be seen that organisational design problems are complex and interrelated with other problem-systems. In this case, from individuals' statement of their perceptions of design objectives, it is clear that the design problem was very far from being either unitary in nature, or well-understood.

Towards the end of this episode, the design team prepared a joint presentation to the Managing Director and the Board (senior management). The team had derived a top-level model for the design, which defined the target system as consisting of six, sequential top-level processes (or "stages") and their presentation concentrated upon a single design 'problem' which was a subset of the multiple objectives published initially by the IS Manager: to formalise the work-process, in order to make its participants easier for the manager of the process to control. Their model of the design problem is given in Figure 10-5. The model of objectives was based upon the interests of the Tender Manager, who had an urgent problem with resourcing the current process, as he was competing for (human) resources against other, functional managers and his position in the organisation was not sufficiently senior to command resources when required.

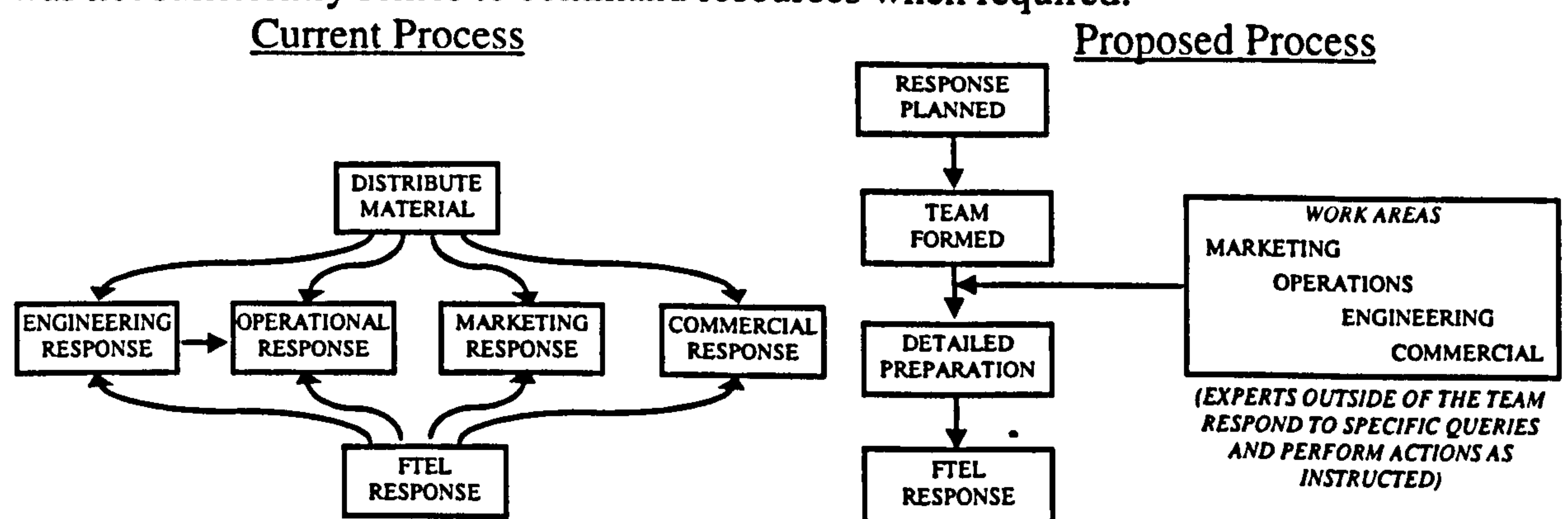


Figure 10-5: The Team's Published Model Of The Design Objective

This model envisaged the creation of a "virtual team", whose work would be co-ordinated and controlled by information technology. In this way, a secondary, potential actor-

network (indicated by dotted, double lines in the diagram) was created, through which the design team influenced the actions of users of the eventual, designed information system. This concept is illustrated in Figure 10-6.

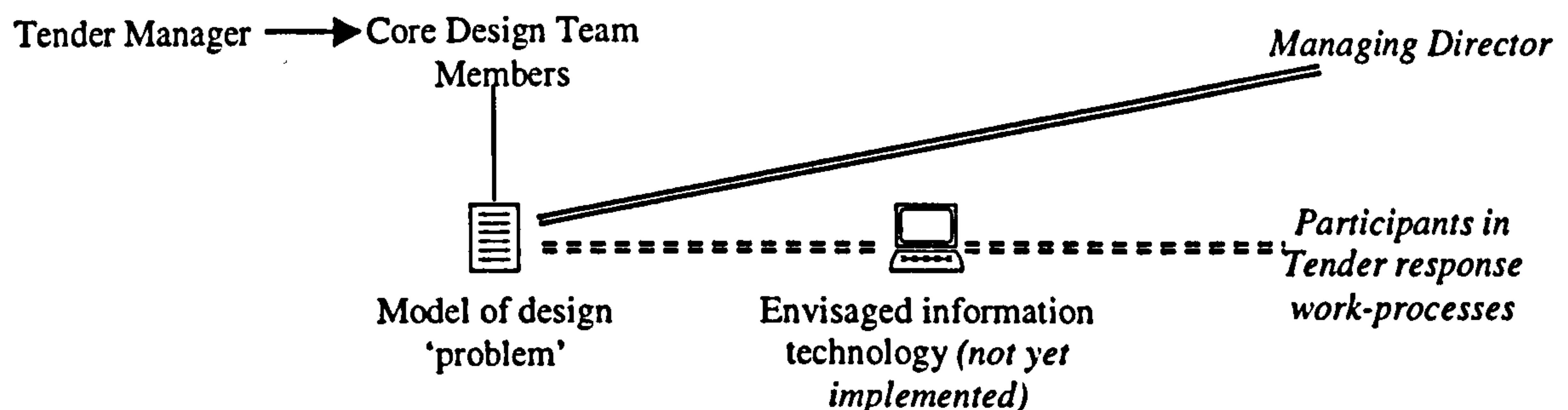


Figure 10-6: Direct And Indirect Actor-Networks Established By The Model Of The Design 'Problem'

By accepting such simplified models, the team further constrained the design process, by formalising the short-term design goals of the team and by raising in the Managing Director and the Board the expectation that the design would be relatively simple and thus result in “quick wins”. This changed the meaning, for external stakeholders, of the long-term design objectives, which were simplified and reduced from the initial “external” objectives of addressing inefficiencies and ineffectiveness in the current system of work. It was clear, from an analysis of the meeting in which the presentation was prepared, that the design team did not understand the target system sufficiently well to be able to design more complex objectives and so was susceptible to the one person who did have the expertise to define the design ‘problem’: the manager of the current system.

In bounding the process of design and in colluding with further bounding of the target system, the IS Manager acted to reduce complexity and uncertainty with respect to design, but in doing so he constrained both the scope of the design and the ability of the design team and external stakeholders, such as the Managing Director, to conceptualise the problem situation in sufficient complexity. While the IS Manager saw this phase of design as “a period of rapid system decomposition”, what was required was design-problem expansion and investigation, rather than problem decomposition. By inscribing his interest in achieving a common perspective between team members into the social arrangement which bounded the problem early in the process - using the intermediaries of the statement of system objectives and the presentation to the Managing Director - the IS Manager ensured of the actor-network which constituted the design project - this proved counter-productive at later stages of the project. In actor-network theory terms, the IS Manager concentrated upon aligning team members’ and external stakeholders’ interests with his own as early as possible in the design project, as he saw the central problem of

design as “achieving and maintaining a shared vision”. In fact, given the complex and interrelated nature of the multiple design ‘problems’ which required investigation, the core design problem was achieving a sufficient diversity and definition of perspectives and the IS Manager would have done better to leave individuals’ interests more loosely aligned until the problem context had been sufficiently investigated.

10.2.3 Episode 2: Process Decomposition

The core task of this phase, as seen by the IS Manager was the further decomposition of the six-stage, top-level process model. The IS Manager had an interest in removing political or structural issues from the design, as he foresaw these design issues resulting in conflict and competition at board level, with himself caught in the middle. This was one of the main attractions of the “business process redesign” approach to information system design: the ‘recipe’ provided in the manual from the executive training course which he had attended prescribed objective redefinition of work-processes, followed by allocation of organisational responsibilities. However, team members found difficulty in working at this level of abstraction: as noted in the previous chapter, design team members were unable to abstract “pure” business processes without visualising them by reference to the existing organisation. In actor-network terms, the IS Manager attempted to align his interests with those of senior management, in avoiding conflict, through the translation mechanism of defining design procedures: the “scope” of the design process. But in defining the scope of the design process, he constrained the effectiveness of the design process.

The role of external representations in design was discussed in Chapter 7. Research evidence shows that the representation used for a problem fundamentally affects individuals conceptualisation of the nature of that problem (Simon, 1988). There was some debate during episodes 1 and 2 about the representational mechanism to be used for models of the design. Initially, the IS Manager had suggested computer-program process flowcharts in lieu of a better suggestion, as he was familiar with these and as they represented “the flow of activities, which help me to see the flow of information”. The design team had not had any other suggestions and so this mechanism was adopted. But this mechanism proved ineffective for capturing the detail of the design - as observed in Chapter 7, individuals do not conceptualise a design at one level of decomposition, but at many levels at the same time. Individuals began to use a variety of modelling techniques: “plans” (a list of activities required, with interdependencies shown), information-flow diagrams, and others. The flowchart representation also confused team members as it represented flows of activity, whereas what was concerning them at this point were the

complex information requirements of the target system. Other design team members' felt their interest lay in learning how the information-flows affected process interdependencies, but the IS Manager's main interest was in decomposing the design, rather than in exploring it, as his perception of the design process was still as a simple problem decomposition. The IS Manager suggested and achieved a standardisation of modelling techniques: other forms of model were not captured in their original form, but were "translated" to flowchart representations. Because of this translation process, a great deal of information was captured and many issues had to be revisited at lower levels of design decomposition, because the rationale behind the design had not been captured at the time when design decisions were made and the higher-level model recorded. In actor-network terms, the IS Manager translated his own interests, in using a representational method which he understood and with which he felt comfortable and in removing the potential for misunderstandings about the design model under discussion which arose through the use of different representational mechanisms. He aligned team members' interests with his own as he was the only member of the team with extensive design experience, so he was able to exert symbolic influence (see the framework in Figure 9.4) over other members of the design team, in defining the *nature* of design in that sociocultural context as "we should all be able to understand these diagrams without a lot of hard work", subsuming the application domain learning aspect of the process to the design recording aspect. But in doing so, he constrained the effectiveness of the design process, by losing the richness, detail and variety of the representations used by other design team members.

Towards the end of this episode, the attachment of the global network to the project was waning, as the design did not appear to be producing the expected "quick wins" for senior management. The extended network of contacts shown in Figure 10-3 was not proving as effective as the IS Manager had expected. He expressed his frustration at team members' unwillingness to "share" design issues with colleagues and managers and to feed back issues which affected the design. Team members were enjoying the intellectual challenge of the design process, so the mobilisation of the local network was increasing as the global attachment decreased, as shown in Figure 10-2. But they were under high pressure from their functional work-roles and were becoming increasingly confused by the increasing complexity perceived in the target system. It was during this episode that the marketing representative on the team left the company. This severely impacted the actor network of the design team, as shown in Figure 10-7: the team's input from and influence upon the Marketing division was now indirect, via the Managing Director or Marketing

staff, through the organisational structure of the company (dotted lines indicate organisational reporting structures; solid lines indicate the design-team's direct network).

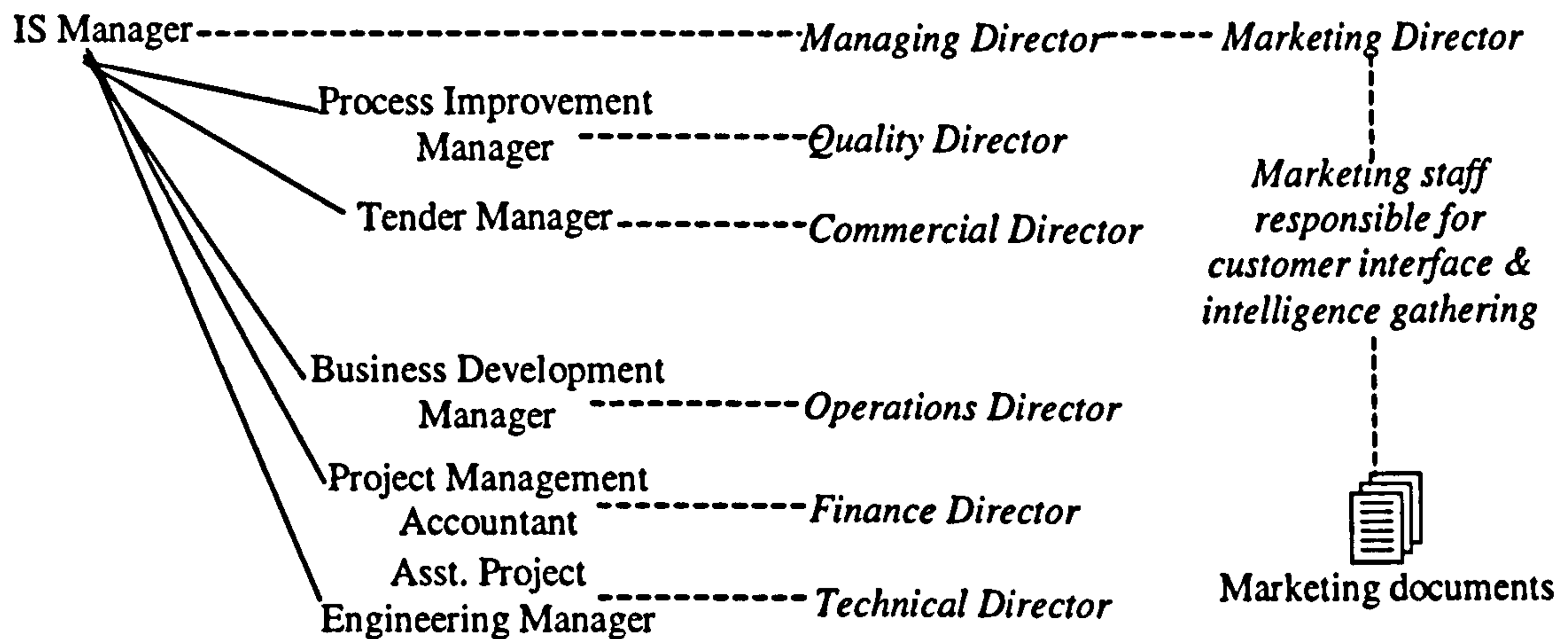


Figure 10-7: Local and Global Actor-Networks Following Departure Of Marketing Representative

This created a severe problem for the design process. Emerging interdependencies between the target system and marketing work-processes were becoming apparent as the team understood that critical information requirements of their process could only be supplied by documents produced as outputs from Marketing Division (which were, of course available via informal contact with Marketing staff, but not amenable to influence in this way).

Design problem-definition became more uncertain: the explicit system design boundary increasingly did not match the implicit system boundary implied by their analyses of required information-flows and the truncated nature of their direct actor-network cut the design team off from detailed information concerning the wider, implicit system of activity (which included Marketing activities) at the very time when they realised their dependence upon this information for a successful design.

10.2.4 Episode 3: Managing Emergent Process Interdependencies

The lack of a Marketing representative was beginning to have repercussions, in terms of the team's ability to investigate and influence appropriate systems of human activity within the organisation. It was at this point in the design that the 'wicked problem' (Rittel, 1972) nature of organisational information systems became critical. Figure 10-8 illustrates the explicit system boundary for the design - the acknowledged area of influence for the design project - versus the implicit system boundary - the main organisational systems of human activity which were interrelated with that under design. For effective design of the Tender response system, it was necessary for the design team to understand and to integrate into the design, those interrelated systems of activity which

lay outside the explicit system boundary. Because of the wide-ranging network of influence established with the design team, this was possible for all but those systems of activity which lay within the Marketing division. The only access which the team had to the Marketing systems of activity was to the documents produced as output from these systems. The team spent many hours attempting to understand, at second hand, actual and potential information-flows within the company, based on these documents.

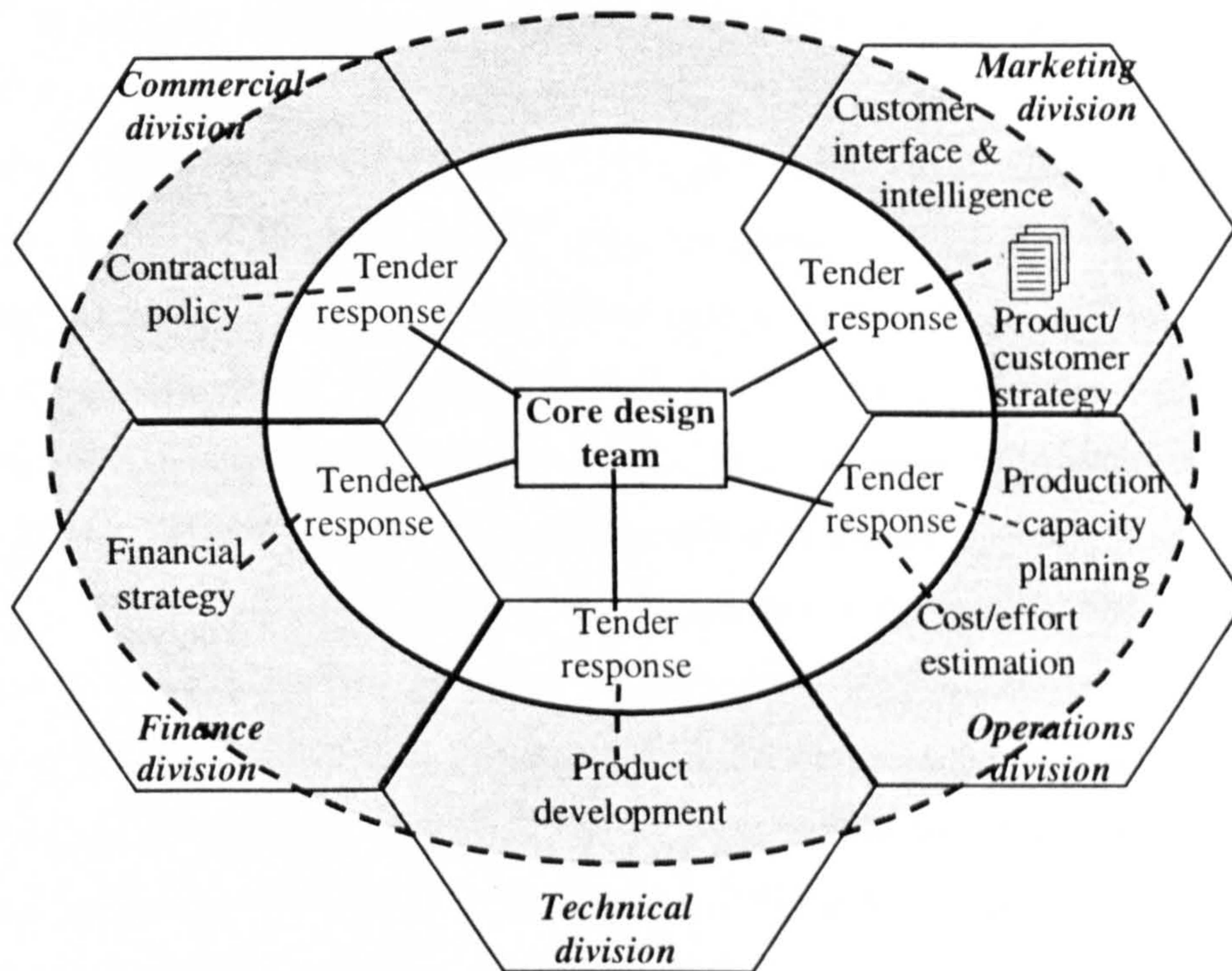


Figure 10-8: Explicit System Boundary (Solid Line) Vs. Implicit System Boundary (Dotted Line)

The impact of the expanding nature of the implicit system boundary (shown as the grey area, in Figure 10-8) was emergent and slow to be realised. There was a great deal of confusion within the team, as they wrestled with activities which lay outside of their explicit system boundary, seeing these as “interfaces” to the design, but at the same time, attempting to exert influence over these “interfaces”, in order to achieve satisfactory operation of their designed information system. The IS Manager eventually came up with a conceptual resolution to this confusion. He originated the “big-arrow/little-arrow” analogy, where the wider business-planning systems were seen as a “big arrow”, representing a product lifecycle. Two, smaller lifecycles were identified: the “little arrows” of the Tender response system of activity and of the order fulfilment system of activity. These systems were seen as interrelated, with information and activity interdependencies. In this way, without extending the explicit system boundary, the IS Manager made the implicit system boundary explicit to the team, but at an informal level. This is another instance of the “management of meaning” (Smircich and Morgan, 1982),

discussed in Chapter 8, through which the IS Manager defined the purpose and scope of the design for the rest of the team.

The design team established an “informal” area of influence, where the actor network was extended by agreeing incremental, informal changes to systems of work outside the explicit system boundary. **There were therefore *two* systems of work being designed by the project design team.** One was the formal design, which lay inside the explicit system boundary; this design was documented and subject to formal, planned organisational change. The other was the informal design, in the “grey area” between the explicit and implicit system boundary; this design was not documented and depended upon the goodwill of the functional managers involved.

Both perceived design complexity and uncertainty as to the nature of the design problem were now extremely high (see Figure 10-1). It was also recognised that local network mobilisation (of the design team) had dropped a little, as motivation decreased with an increasing perception of problem complexity, and that global network attachment was declining (and had become negative for the first time), as the project was failing to deliver the promised “quick wins” (see Figure 10-2). An interesting element in this analysis is that the initial, document-enabled actor-network influence on the global network established through the statement of design objectives (Figure 10-4) was proving more powerful than the direct actor-network access which the team enjoyed to senior management, through the reporting structure. This indicates the role which expectations play in the design process: a primary focus of the direct actor-network was to manage the expectations raised by the indirect network which had preceded it. It was decided to ‘pilot’ (prototype) the stage 1 sub-system, as this was reasonably complete, to achieve increased global visibility of the team’s achievements; this had the secondary effect of providing a focus around which the design team could be mobilised.

10.2.5 Episode 4: Piloting Stage 1 Process

The stated intention of this sub-system prototyping was to reduce uncertainty, with respect to the design problem (see Figure 10-1); this was achieved and the morale of the team was raised immensely as a result. The successful conclusion of the pilot study also ensured external visibility of the team’s achievements and the global network attachment also increased (see Figure 10-2).

One element which was subjected to less visibility was the nature of the IT system which was to support the organisational system of activity being ‘designed’ by the team. The design of the supporting IT was also within the remit of the team and the nature of the system: what types of information should be delivered and the technology to be used to

support information delivery was open to frequent debate. But the implementation of the system: the form which this technology would take and the way in which it would be used, was not discussed to any great extent. The IS Manager was able to exert conceptual influence (see the framework in Figure 9.4), in defining how and why IT should be of use in supporting the new system of activity. This was possible because of the symbolic influence of the IS Manager, in shaping the meaning of technology in this context: he could decide what technology was appropriate and also **which information was significant in the context of the new technology and which was not**, without reference to the other members of the design team. This is not to say that this influence had adverse consequences for the users of the new system - this research saw no evidence of that - but that the design team, while engaged in decisions concerning the nature of information required by the designed system and how that information should be used, saw no problem in delegating the technology-based interpretation of these requirements to the IS Manager and his technical staff. In this way, the IS function staff bypassed the system design team, in establishing an alternative network of influence; this is illustrated in Figure 10-9

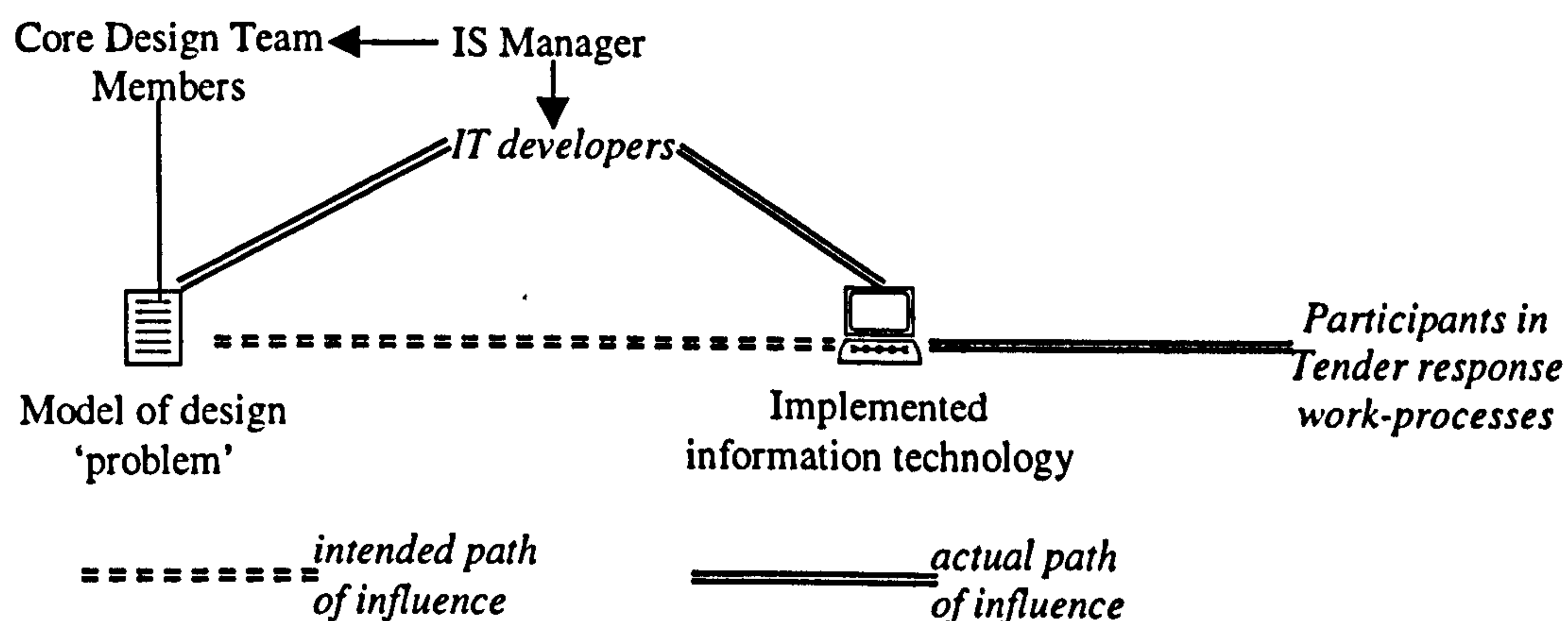


Figure 10-9: Direct And Indirect Actor-Networks In Technology Implementation

10.2.6 Episode 5: Detailed Design Of Stages 2-6

As the team progressed towards lower levels of decomposition in the design, too much information was produced by the processes of design for this to be captured on a flowchart. Additionally, there was increasing external pressure to bring the design to a conclusion. The IS Manager responded to this by reducing the complexity of the problem through the introduction of written, functional process-specifications (of the type used for computer program documentation), as the “standard” method of representing the design. He was motivated in this by a variety of objectives: he saw functional specification as a fast method of defining what people knew already about a design, without wasting time on what they wanted to know; he wished the design representations to serve as the basis

for work-procedure training and management; he did not understand the thinking behind some of the representations used and so wanted to standardise on one that he did understand; and he wanted to achieve a “common vision” (intersubjective understanding) among team members, to expedite the design.

There was a small amount of resistance to this standardisation on the part of one or two of the design team who had conceptualised their contributions to the design in a richer way than this recording mechanism permitted, but the IS Manager’s desire for a “common vision” of the design was adopted because of his greater experience in managing design projects. The use of this standard served to align the design team’s interests with the IS Manager’s: meaning within the team was managed to the extent that achieving a “common vision” was valued more highly than achieving an effective design. This perception was helped by the global pressures on the project team: global attachment to the design project was once more slipping into a negative perception, as functional managers disassociated themselves with the lack of progress displayed by the design team and local mobilisation was decreasing as team members became demotivated (Figure 10-2). Team motivation was not helped by the “legalistic” emphasis of the functional specification representations used as the basis for design (to quote one of the team members). Although the written process specifications enabled standardisation of the detail captured, they did not provide a mechanism to inspire or capture learning, design rationale or creative thought. It was observed that team members favoured a variety of visual mechanisms for this purpose and still used these on occasions, although they obviously felt constrained by the need to translate these into functional specifications, as they lost the richness of understanding. This was summarised by several team members late in the process, who commented that they found it difficult to remember, from meeting to meeting, what the functional process specification wording meant. But the pressure on the design team from the global network overrode all other concerns. It was proving increasingly difficult to attach global network support, to the extent that, when interviewed concerning design objectives, the IS Manager defined eleven objectives, two of which were concerned with attaching the global network more effectively, two of which were concerned with issues within the formal system boundary and *seven* of which were concerned with mobilising global support for changes required to the grey area between the formal and the extended, informal system boundaries. The majority of objectives articulated by the other team members were also concerned with mobilising global support for this grey area. (Team members’ objectives at this point are given in Appendix 4).

10.2.7 Episode 6: Pilot Of Stages 2-6 and Managing Organisational Perceptions

During episode 6, the IS Manager's strategy with respect to the design was aimed at reducing uncertainty with respect to the design problem. Another pilot study was scheduled, not so much to test the design, but to investigate the problem context further. The team were quite explicit in this aim - the Process Improvement Manager commented "we don't have to understand it - we understand it in detail through piloting it."

While the IS Manager attempted to increase global network attachment by publicising the imminence of the 'pilot' study - increasing global confidence by giving the impression that the team were confident enough in their design to pilot it - the team became demotivated still further. A typical comment in team design meetings during this design episode was "let's get on with this - I'm getting fed up and I just want to get the design finished". The pilot study became a mechanism for managing internal expectations as well: the team did not have to worry that design complexity was high, as this would be solved by the increased understanding which resulted from the pilot study. The activities which the team engaged in were thus aimed at documenting the new system, rather than designing it - for which the written specification representation was admirably suited. As a consequence of this management of internal meaning with respect to design objectives, the IS Manager lost the "common vision" which he was trying to achieve - the team depended more upon distributed cognition (as discussed in Chapter 8), as intersubjective understanding was proving difficult given the complexity of the design 'problem'. So, by aligning team members' interests in support of "completing" the design documentation, to reduce design uncertainty, to increase global attachment through visible indications of progress and to mobilise the local network through reducing the problem complexity (by subsuming investigative design to 'defining' - and thus reducing - problem definition, as discussed in Chapter 7), the IS Manager reduced design uncertainty at the expense of a wider-ranging design solution. At this point, as discussed in Chapters 8 and 9, the Tender Manager was able to influence design decisions disproportionately, as he could exercise framing influence (see the framework in Figure 9.4) in arguing for a course of action based upon his knowledge of existing system mechanisms and processes, without providing other team members with the evidence to make their own decisions. The design began to converge once more on incremental improvements within the formal system boundary, as team members became demotivated in trying to understand interrelated systems of activity throughout the wider system boundary. Design meetings became less frequent and less well attended throughout this period, as team members used the excuse of their functional work or holidays to absent themselves from the design process. When

the pilot study did occur, team members appeared unconcerned and the Tender manager was described as having been “left holding the baby”.

10.2.8 Episode 7: Change Management

A major problem with the, by now, negative local network mobilisation was that the team did not pay much attention to the pilot study and so it did not provide the opportunity for learning which had been intended. This was partly due to the study having been repeatedly deferred, as the low global network attachment meant that it was given far lower priority than other, functional activities and so it was difficult for the IS Manager to find a suitable customer Invitation To Tender upon which to prototype the designed system. This had the consequence that, following the pilot study, the team had difficulty in deciding what, if anything had been learned from the study, or even whether it had succeeded in its stated aim of making the process of responding to an Invitation To Tender more effective.

A major problem for the team at this point was the need to attach the global network to a greater extent. Team members felt personally liable for the project’s success or failure - the high profile of the initiative and the large amount of time which it had taken meant that individuals felt their credibility in the company depended upon the project being seen as a success, as well as identifying with the team objectives through local network attachment. This caused the local network to mobilise again: team members spent several meetings attempting to define benefits which had resulted from the project and built a much more intersubjective vision of the design through this process, for a presentation to the Managing Director and senior company management.

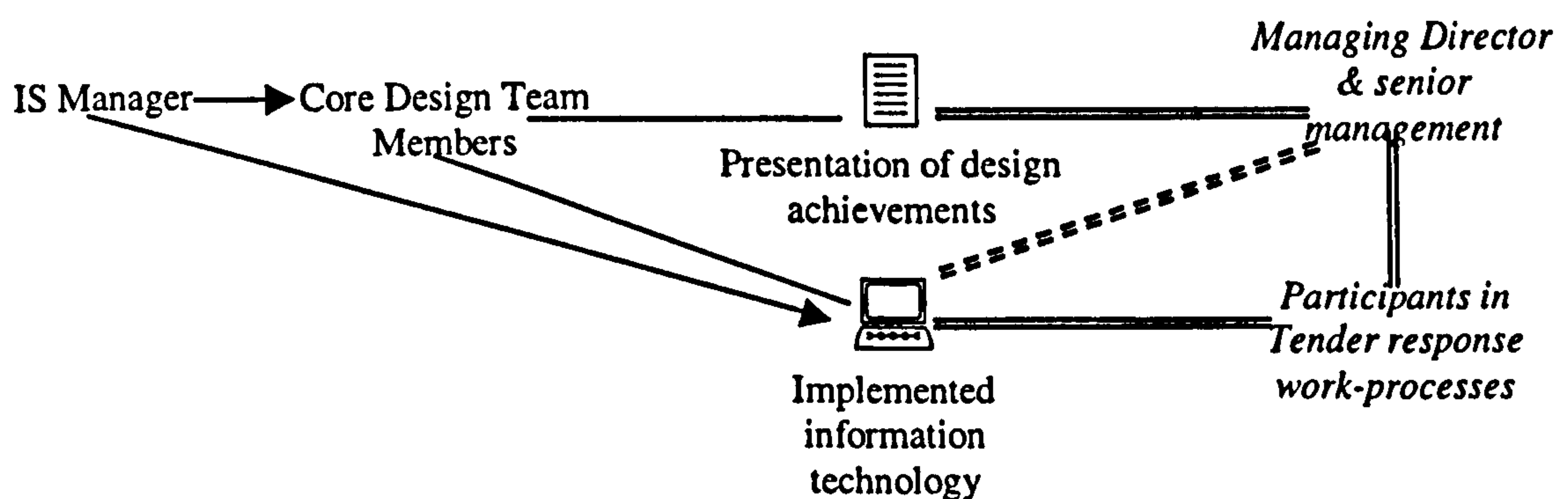


Figure 10-10: The Attempt To Attach The Global Network Through a Definition Of Design Benefits

The resulting actor-network is shown in Figure 10-10, where the double lines indicate network connections enabled through a non-human actor, the arrow indicates influence to achieve the adoption of that person’s interests and the dotted, double lines indicate potential influence (as the Managing Director was considered highly unlikely to use the

IT support system). An issue of interest was how the global network attachment was constrained by the initial statement of objectives: benefits were couched in terms of quantifiable efficiency gains (which could be considered “wins”, if not quick) rather than intangible, effectiveness gains.

The IS Manager also sought to attach the wider global network, through a program of training: several design meetings were spent in discussions of how to “train the troops”. The wider, informal global network which the team was able to mobilise through its constituency (Figure 10-7). An exception was still the Marketing division, whose Director appeared to have instructed them not to become involved with the design initiative. One of the critical tasks towards the end of the project was exerting indirect influence upon the Marketing Director, via the informal actor-network constituted by organisational reporting structures (both the Marketing Director and the IS Manager reported to the Managing Director).

Returning to the invisibility of the IT system, information requirements for this system had been discussed from time to time in design meetings, but the team continued to consider it the responsibility of the IS Manager to translate these requirements into a suitable form - so much so that, when he proposed a demonstration of the technology which would act as the basis for the new system, only one team member turned up. The impression was given that team members were daunted by having to deal with a technology which they did not understand and felt confident that the IS Manager represented their interests in implementing the technology. It was clear that team members did not understand the way in which the technology would be used - as illustrated by the confusion over the “paperless office” concept, discussed in Chapter 8. By episode 7 of the design, the basis of the future IT system appeared to have been implemented with little input from the design team and its use had become “business as usual”. It is significant, that the interests embodied by this system, illustrated in Figure 10-6 and Figure 10-9, were not questioned by the team, as the IS Manager isolated them from issues of values in not ensuring that they were familiar with the technological alternatives. It is possible to read too much into this, actor-network perspective; the IS Manager’s intentions do not appear to have been to exclude other interests, it is simply that he did not perceive that other team members could have an interest in the form which the system took. Learning about technological alternatives was not seen as a legitimate activity of design. Given the lack of learning about technology which took place, it is not surprising that non-technical team members were happier to leave decisions as to the form of the technology to IT professionals. This finding reinforces the finding of the

survey, reported in Chapter 6: the form of technology is considered to be the domain of IT professionals, irrespective of its potential impact upon work systems and even when users and other organisational stakeholders are involved in IT system specification.

10.2.9 End of project

By the end of the project (which occurred after this research study had ceased regular contact with the project), the team had achieved a high degree of global network attachment and a reasonable degree of local network mobilisation once more. Although design problem complexity had been reduced by the strategies described above, design problem uncertainty was extremely high as successful operation of the target system was so dependent upon changes in other systems of activity in the Marketing division. The critical task facing the design team appeared to be to lobby senior management for changes to Marketing systems.

I was not present when the reorganisation occurred, but I gather that this lobbying, combined with a general perception that the company might lose potential business, triggered a radical reorganisation of the company's structures. The company was now described as "more responsive and effective" and a 'business improvement programme', based upon the design project approach described above, is to continue, so the strategy of continuing global network attachment obviously succeeded to a high degree.

The IS Manager recognised that representational methods did not support the activities of design and has been searching for a computer-based, representational tool to capture richer amounts of design rationale and detail, at multiple decompositional levels. The team, on the whole, were fairly positive about the design process, with the reflection that they should have spent more time investigating the design requirements and less time trying to capture them in writing.

10.3 Summary

Table 10-1 summarises the translations discussed above. It is noteworthy that in many of these translations, meaning is framed by a single actor, for other actors whose interests are represented or appropriated. In particular, the IS Manager was able to exert influence over the processes of design, not by exerting 'position power' (Pettigrew, 1973), but largely by **managing meaning** for other actors in the process (Smircich & Morgan, 1982). In Table 10-1, the key to the 'actor' column is:

ISM - IS Manager, *IS Dept.* - technical developers working under the IS Manager,
TM - Tender Manager, *Team* - members of the core design team, acting in concert.

Actor	Interests	Translation	Inscription/Mediation
ISM	attaching global network to project	achieving cross-departmental representation	selection of broad membership for design team
ISM	achieving "quick wins", reducing complex and multiple objectives of team members to manageable, brief set of objectives and attaching global network to design project	publication of statement of objectives to senior management	document circulation
ISM	ISM: fast, controllable design process PIM: investigating design problems	definition of design process 'stages'	defining design procedures
TM	Resolve structural constraints on resourcing current process	definition of design objectives	publishing a model of design 'problem'
ISM	exclude political & structural design issues from discussion	definition of design scope	standardising design procedures
Team	capture design requirements and context in as rich a way as possible	multiple design representations	drawing models of design
ISM	representations of design which are familiar and easy to translate to computer programs	flowchart representations of design	standardising design procedures
ISM	define of Marketing division work procedures, in the absence of a replacement Marketing design team representative	specification of Marketing information-flows	translation of Marketing process output documents
ISM	control over work processes in multiple structural domains, external to explicit system boundary	information outputs imposed on external systems of work	specification of two systems: explicit and implicit processes
ISM	control over Marketing division work procedures, after departure of Marketing design team representative	specification of Marketing process outputs	redefinition of MSOR (document produced as output by Marketing)
ISM	Reattach global network and mobilise local network more strongly	trial implementation of design so far	Stage 1 process pilot study
IS Dept.	Standardisation of target system work procedures	enforced conformance	supporting IT system
ISM	Fast, controllable design process, using reusable representation; reduction of design 'problem' to recording what is known about design	written, functional specifications	standardising design procedures
ISM	Reattach global network by maintaining external visibility	design documentation	'completion' of design
TM	Increase personal control over definition of target system tasks and work procedures	target design model representation	defining processes based on issues of fact (current work procedures)
Team	Mobilise global network through publicising design achievements	representation of design benefits	presentation to Managing Director & senior mgt.
ISM	Mobilise global network through demonstrable changes	IT system	feedback from participants in target system to senior management
ISM	Mobilise global network through education	training materials	training workshops aimed at wider company membership
ISM/ Team	Achieve changes to work-processes and information-provision which take place outside the explicit target system boundary	work-process and information requirements definitions	lobbying senior management and MD for change

Table 10-1: Significant Translations Of The Design Process At FTEL

The genealogical analysis has demonstrated the ways in which different and, on the face of it, incompatible elements of the 'web' of computing and information system (Kling &

Scacchi, 1982) were joined in practice. It also demonstrates how normative mechanisms may be established for recording a design and may continue to be used even when they are patently inadequate, in the context of a community of social practice. Star (1992) argues that 'investment in form' - the intersection of practice and distributed knowledge - may be extremely difficult to change in practice. The above analysis is a *prima facie* example of "the ways in which people pragmatically use and commit to particular forms and conventions; as time goes on, the commitment to the form itself may overshadow the pragmatics of particular contingencies" (ibid., page 406). It also demonstrates how management control interests may be embodied in non-human artefacts, such as standards, documents and IT systems.

The above analysis illustrates the tension between the need to attach the global network (to maintain positive external visibility) and the need to mobilise the local network (to achieve a coherent design). The needs of the global network were dominated by an early requirement for closure of the design and a strategy of problem reduction/simplification, while the needs of the local network were dominated by a requirement to investigate the problem context in detail, which required a strategy of problem complication. An understanding of this dialectic was implicit in the behaviour of the design team; the above narrative shows how the needs of the global network tended to dominate, leading to an early over-reduction of the design, with the consequence that the design was poorly understood by team members. This resulted in weak or negative local mobilisation at times, with the consequence that some critical design tasks, such as observation of the second pilot study were neglected and the team became over-dependent upon the application-domain knowledge of the current Tender Manager, who was able to influence the design by arguing from a definition of knowledge (Markus & Bjorn-Andersen's, 1987, 'issues of fact') that other team members did not have sufficient grounding to debate. In the end, team members' interests were aligned pragmatically behind the need for global network attachment and the design was 'completed' even though individual team members felt their understanding of the design was far from complete or adequate for closure.

This analysis has shown how the translation of interests, through social arrangements and technical artefacts was achieved in the construction of a network of system design practice. The next chapter pulls together the ethnographic analysis, the social cognitive analysis and this, genealogical analysis, to synthesise the findings from the longitudinal field study of situated design.

11. SYNTHESIS FROM ANALYSES OF THE LONGITUDINAL FIELD STUDY

11.1 Introduction

Five research questions (questions 7 to 11 from Chapter 7) were addressed by the second iteration of the research. The findings from the three analyses of the longitudinal field study are synthesised in this chapter to provide some answers to these questions. It should be borne in mind that this synthesis presents an interpretive perspective of a single field study. Whilst some generalisation may be tempting, generalisation is inappropriate in this context.

11.2 How do differing perspectives on the nature of problem-definition and analysis/investigation affect organisational actors' approaches to information system design processes?

The differing perspectives which actors held on the nature of the design process (discussed in Chapter 9), led them to different conceptions of the legitimacy of various issues in the design. For example, the IS Manager held the perception that the process of design should be structured and incremental, based upon the perspective that the design 'problem' was relatively well-defined, whereas the Customer Solutions Manager saw the design process as a radical reconceptualisation of business processes, based upon the perspective that the design 'problem' was interrelated with much wider, far-reaching problems within the business. In the event, the IS Manager's perspective prevailed because he was able to exert conceptual power over the symbolic meaning of information system design in the context of a new team, who had little previous experience of such design. However, events proved the Customer Solutions Manager's perspective to be more appropriate for the problem context: the decompositional design approach chosen by the IS Manager proved inadequate for the investigation of the 'wicked' problem of organisational information system design.

The IS Manager was increasingly aware of the mismatch between his perspective of the design 'problem' and the emergent nature of the problem situation, but was unable to find a solution by changing the design approach, given the external pressures for closure which had been formed by his statement of design objectives and benefits, circulated to senior management at the start of the project. To change his perspective publicly would have meant public admission that he had misunderstood the nature of the design problem. It is notable that, while the IS Manager articulated the objectives of the new information system as supporting existing work-skills and initiative in a flexible manner, i.e. the system was conceptualised upon a 'Japanese' model of the organisation, which allows

elasticity for continuous definition and redefinition of sub-tasks within a general framework (Egidi et al., 1992), the methodological design approach chosen was based upon a Tayloristic model of the organisation, in which the division of labour in the organisation is managed prescriptively and hierarchically (ibid.). The design approach involved the recursive decomposition of work-functions, to define a set of prescriptive procedures for the system. In the absence of suitable alternative tools and methods for what the organisation saw as a totally new way of designing information systems, the IS Manager based his approach on the 'structured' approach to design, as this was the only approach of which he had experience. In applying the methods of IT development to organisational IS design, he inherited the constraints of traditional systems design: limited 'problem' investigation, a failure to appreciate fully the multiple and interrelated nature of the design 'problem', and the inability to account adequately or in full for design progress or for effectiveness benefits accruing from the design. Many, significant design achievements lay outside the very limited system boundary recognised by the 'structured' approach to design which was adopted. As a consequence, the measurement of design progress and achievement was performed far too simplistically for this type of 'wicked' design problem and so the team were unable to manage global network attachment to the project, as it appeared to be achieving very little, when in fact it had achieved a great deal. It is clear from the previous analyses that individuals were aware that they held radically different perspectives on the design 'problem' to other team members and that they saw the process of design as one of argumentation, exploration and negotiation, to achieve consensus on these perspectives. In the early stages of the design process, debate as to the purpose and processes of the design was permissible, as the IS Manager, in conjunction with other team members, explored the nature of the new 'business' design process which he was championing within the company. But the 'investment in form' which already prevailed in the IT development function overrode these explorations, when coupled with pressure from the global network of influential actors within the organisation to achieve closure for the design. As Star (1992) asserts: "in the face of plasticity and situated cognition, forms and bureaucracies and structures of action may persist." The established, normative methods of design in the company were applied to this process, in lieu of available methods to support the exploration of more complex problem situations. This was not all due to the perception of the problem as well-defined (although this did play a large part), but also due to the non-availability of alternatives within the experience or understanding of design team members. In the IS Manager's comment that "a structured approach to generating a new process is something I haven't found and if it exists then I'd

be interested to know about it”, there was an implicit recognition that available methods for design are inadequate, yet this recognition was still embedded in the perception that, for a method to be acceptable, it must be ‘structured’ (which presupposes a well-structured problem definition). There was a fundamental conflict between the way in which the IS Manager saw the organisation as a social system of innovative people, with unique skills, who required supporting in their work and the way in which he characterised design as ‘problem-setting’ (Lanzara, 1983), seeking design consensus at a very early stage and constraining design exploration to achieve a ‘common vision’ of the design. The first perspective sees the organisation via the ‘organism’ metaphor (Morgan, 1986), the second the sees the organisation via the ‘brain’ metaphor. Whereas the IS Manager in this study was relatively informed and aware, in applying a social ‘web’ metaphor (Kling & Scacchi, 1982) to the organisation, he saw this web as static and so applied methods which were unable to cope with the dynamic and emergent nature of design goals and solutions.

11.3 How are individuals’ different mental models manifested in design and are individuals aware that they hold different models from other individuals?

The analysis of Chapter 9 illustrates the wide extent of divergence between individuals’ perspectives, both of the target system and of design process objectives. Individuals were aware that they held different mental models of both the target system and the design objectives, to the extent that managing conflict was an explicit part of design meeting interactions and the IS Manager saw the mediation of different perspectives as one of the most problematic issues in the management of organisational information system design. Individual perspectives of process objectives did appear to converge over the period of the study, but not to the extent that one could say there existed a “common vision” of the design. However, the team appeared more in agreement about design objectives and there was less overt conflict in design meetings. Individual perspectives of the target system were still fairly divergent and were fairly ill-defined even towards the end of the project. It appeared to be more important for the design team to agree on design objectives than for them to agree on the design model: team members appeared to be able to function using a mental model of the design which was distributed among them, rather than shared completely between them. This would suggest that intersubjectivity is critical in defining design objectives, but distributed cognition is more important in achieving an adequate, detailed model of the design.

The alignment of interests played a significant role in this project, as the IS Manager engaged in the 'management of meaning' (Smircich & Morgan, 1982) from a very early stage in the design process. In appropriating and representing other design team members' models of the design, the IS Manager fulfilled his need for a 'common vision', which formed the basis for the formal models of the design. But in retrospect, the process suffered from too early an adoption of a 'common vision' which was sub-optimal, incomplete and ill-understood by the majority of the design team. It would have been better, from the perspective of achieving an effective design, to use design approaches and methods which *complicated* team members' mental models of the design, permitting them to construct a richer picture of the design and to investigate alternative conceptions at an earlier stage in the design process (*c.f.* the 'double-loop learning concept of Argyris & Schön, 1978; the argument for complicating the thinking of managers to disturb familiar interpretive structures in Boland et al., 1994; or the advocacy of 'semi-confusing' information systems, which supply information to support diversity, uncertainty and change signals in decision-making, by Hedberg & Jönsson, 1987). In the event, the investigation of alternative conceptions of the design occurred at late stages of the design, when an individual's implicit mental model of the design was challenged by a detailed, explicit description of the design (i.e. in the detailed, functional process specifications). In many cases, the formal model was completely revised by a single individual's perspective at a fairly late stage of the design, requiring major changes to other, interdependent design components. The frequent, radical changes to the design at late stages in the project meant that design team members were unable to achieve a stable mental model of the design and the IS Manager, under political pressure to achieve closure of the design, became extremely negative about the team's capacity to complete the design effectively.

11.4 What are the processes by which designers frame design models and what tools or methods are appropriate in supporting the construction of mental models by designers?

Design discussions had a much wider-ranging, exploratory nature than the waterfall model of design would lead one to expect: design contributions were made at all levels of decomposition, with rapid and wide swings between levels. This would indicate that both the construction and maintenance of mental models of a system context need wide ranges of information, in terms of the level of decomposition and that mental models of the design do not remain fixed. Design discussions tended to proceed in a particular pattern: an individual would appear to be "sparked off" by another comment to make a design contribution - not necessarily on the same topic, but at the same level of decomposition, as

if the initial contribution formed the *mode of thinking* for that topic. If other individuals agreed with the first contribution, additional contributions to a design topic tended to remain at the same level of decomposition. If others disagreed, lower levels of decomposition were employed, in providing examples to refute the initial argument. Higher levels of decomposition were employed only when an individual attempted to sum up the team's position on a topic and very high level contributions tended to be made primarily for the purposes of design-process management.

Individuals did not abstract system concepts and functions in a way which was divorced from the context of the design, but based their abstractions firmly on concrete examples: how existing processes/activities worked, using analogies from other areas of the business where their understanding of existing system processes was insufficient to act as the basis for abstraction. Design team members needed to start from an understanding of the goals and nature of a system component, for which they needed a comprehensive "bottom up" investigation of that component, before they could engage in design decomposition of the component: the "top-down" design. The rationale for the design model was only retained by an individual if it fitted with their existing mental model of the process; otherwise it was lost. Discrimination between the significant and the insignificant (Turner, 1987) was a critical activity of design: this was enabled by the extent to which an individual had been enabled to construct a sufficiently wide-ranging mental model of the design when particular information was discussed. The critical management activity appears to be one of *periodically* complicating individuals' models of a design, rather than reducing them to achieve a 'common vision'.

Representations of the design produced by individuals were based on modelling techniques of which they had experience from their work background. For example, the Process Improvement Manager produced a "flowchart" which looked like an organisation-chart, whereas the Project Engineering Manager produced a "flowchart" which looked like a circuit diagram. Team members initially had problems using a common representation and, even towards the end of the project, misunderstandings would arise from the way in which these models were interpreted. Flor & Hutchins (1991) observe that too great a degree of intersubjectivity leads to too narrow a range of design alternatives considered; it was observed here that too *small* a degree of intersubjectivity led to a very narrow range of alternatives being considered, as team members did not, at first, understand the basis of design sufficiently to suggest alternatives. This led the IS Manager into a false sense of security concerning the completeness of the design: he concluded that the design was

almost complete at the beginning of episode 2, when it was very far from being either complete or well-understood by other team members.

Intersubjectivity was also important in constructing a design component: this was achieved most effectively when an individual designed a subsystem in isolation from the team, then presented his 'vision' of the subsystem design - a prototype design model - to other team members, who would debate and criticise it, to define a common representation of the design (the "Aunt Sally" discussed in Chapter 9). Team members would use the initial model as a conceptual exemplar, against which they could compare and articulate their own, implicitly-held models of the design. Without this type of concrete exemplar, team members appeared to be unable to abstract a design: such attempts were referred to as "design by committee" and subsystems designed in this way were later discarded in favour of ones produced using the "Aunt Sally" method.

The observation made by Lave & Wenger (1991), that abstraction is meaningless in the sense that knowledge can exist outside of the sociocultural context to which it pertains, was supported by the findings of this study. Design team members were unable to abstract "pure" business processes without visualising them in the sociocultural context of the existing organisation: its structures and political systems of activity. Because of this, the IS Manager's insistence that "the spectre of organisation" was kept out of all design discussions (based upon a theoretical model of business process redesign which he had been exposed to in the context of a short management course - e.g. Davenport, 1993) constrained individuals' ability to abstract a design. The observed design framing mechanism was modelled in Chapter 9, this model is reproduced in Figure 11-1. Design may be seen in the context of moving from the general to the specific (problem decomposition), but this process does not take place in isolation. It is preceded by the process of problem abstraction: moving from the specific to the general.

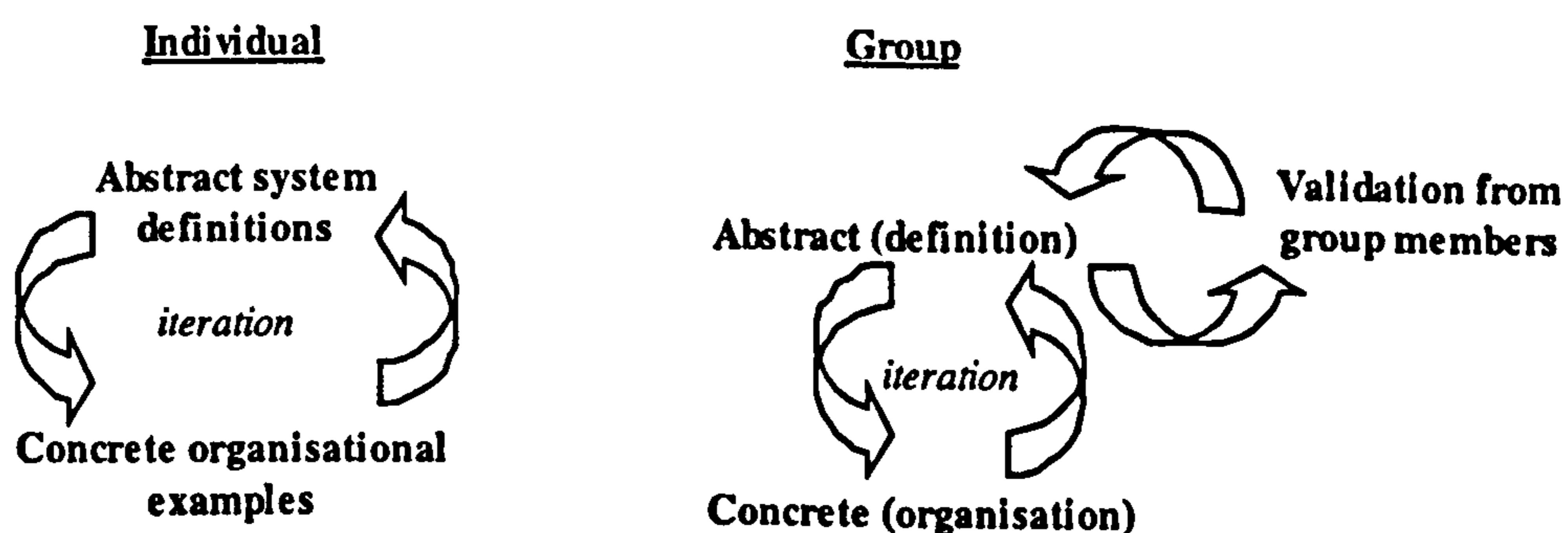


Figure 11-1: Design Framing At Individual And Group Levels Of Analysis

Exemplar-abstraction cycles may be seen to occur through the multiple perceptions of the design team: there is not a single, shared abstraction of a problem situation, but multiple abstractions, which need to be managed to provide an intersubjective understanding of the

design problem before the team can attempt to define a design solution. Two major weaknesses of most design methods and approaches are:

- (a) that they assume a single, uncontested problem definition
- (b) that they assume that the design-team understands the problem definition and the basis for decision-making in the same way.

Design *goals* were not explicitly defined or agreed, except in the broadest terms, but emerged from the process of design. Many design goals appeared to be held implicitly and only emerged when they conflicted with explicit design goals, which led to fundamental changes in the design model at a very late stage, when implementation issues were being discussed. One would infer from this that the separation of process and “organisation” (i.e. structures and responsibilities) was counter-productive, because of the inability of individuals to abstract design components without reference to concrete exemplars and analogies. Methods to support effective design might therefore support the surfacing of designers' assumptional frameworks by the use of scenarios, analogies and concrete exemplars of the design.

While the team might reach ‘agreement’ about a design model, it is clear (and explicit, from designers’ comments in this study) that team members rarely understood the design model in the same way. Tools to support explicit surfacing and challenging of implicit design assumptions were needed, to enable design team members to test their understanding of a design model at as early a point in the design as possible. It was noticeable from this study that multiple representational methods contributed to this, questioning and surfacing process, while standardisation of representational methods constrained it.

11.5 How do members of a design group engage in a ‘community of social practice’?

Different types of knowledge became significant at different points within the design process, depending upon the type of design approach employed at that point and the targets of the process. The framework presented in Chapter 9 and reproduced in Figure 11-2 was used to analyse how different types of influence were significant in design processes. It was observed that different types of influence became significant at different points in the design process, depending upon the knowledge and expertise of individuals and whether issues of value or issues of fact were most significant at that point in the design.

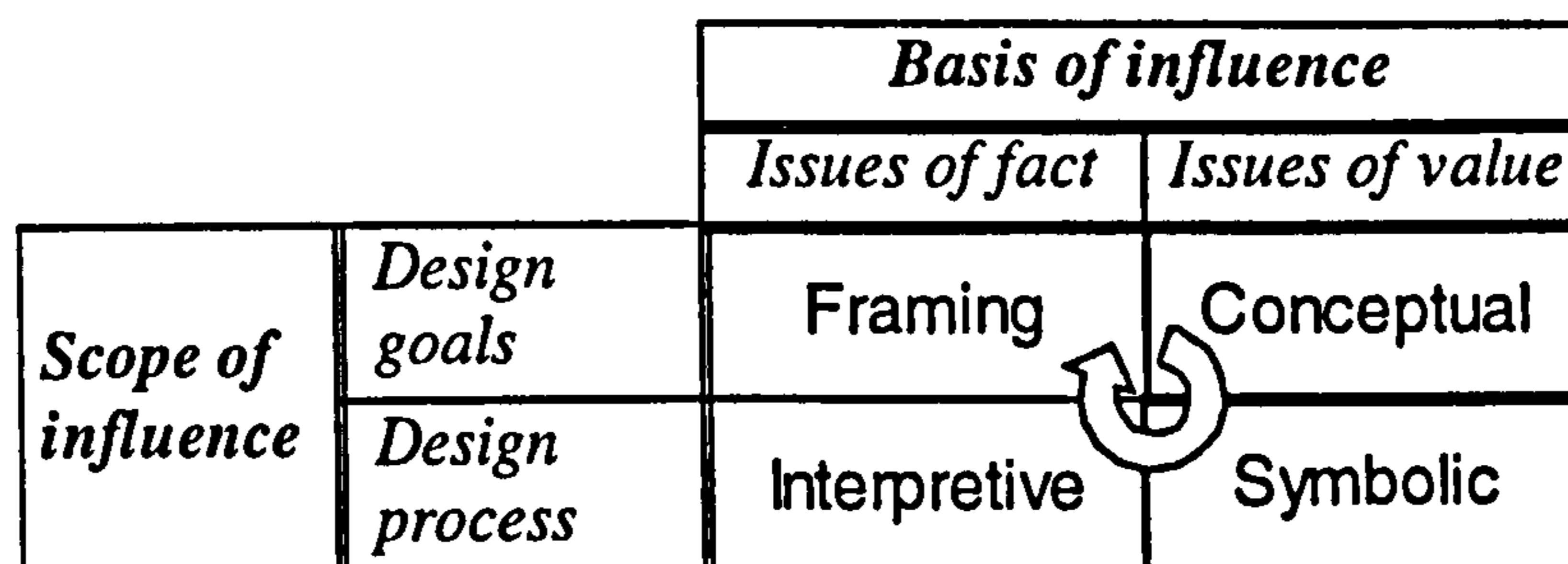


Figure 11-2: A Framework For The Management Of Meaning In Design

At early stages of the design process, issues of value predominated, as the form of first appropriate design goals and then suitable design approaches were debated and resolved. This stage was succeeded by one where issues of fact took over, as the IS Manager attempted to expedite the process by 'interpreting' the design process for other team members, based upon existing IT design practice in the organisation. At later stages of the design process, issues of fact concerning the existing organisation of work and information predominated, as the design approach, which was based upon existing IT design methods, did not recognise the existence of emergent design goals. This reflects the way in which 'traditional' IS design is situated in *existing* organisational structures and mechanisms, rather than supporting emergent understandings and objectives in design. As this was a novel design initiative for this company, one would expect that the sociocultural practices of the group would gradually evolve, as members of the group coalesced as a working community. This was true to some extent as, at the start of the project, design practice was a loose conjunction of representational methods and argumentation which individuals brought with them from their respective backgrounds. Design framing, in terms of conceptualisation and abstraction, was found to be situated in the organisational *context* of design: individual design team members were unable to conceptualise system components without reference to existing organisational mechanisms and organisational structures. Where references to organisation were made to explore system purpose, they were seen as legitimate; where they were made to define a system component, they were not, as the social 'rules' of the team, driven by the IS Manager's preconception of 'abstract' business process design, required team members to abstract design concepts in isolation from concrete organisational structures. These abstractions were then legitimate objects for group validation. But as individuals required to understand abstract processes in the context of concrete examples and analogies, there arose a sequence of carefully-moderated conventions, in which some statements involving structure (which were prefaced by a comment indicating that the individual was exploring the design purpose or function) were judged legitimate, whereas other statements

involving structure (which appeared to define how the target design should be structured within the organisation) were judged illegitimate.

The mode of practice was experimental and individuals were flexible in attempting to understand and integrate each others' perspectives and approaches to problem conceptualisation. Initially, when the design appeared to be progressing well, the IS Manager was keen to expose himself to ideas concerning the practice of design from other team members. Different representations arose, but it is clear from an analysis of meeting discussions that the IS Manager was looking for the Tayloristic "one best way" of doing things (Taylor, 1947). In the absence of a single method which proved superior (in terms of delivering consensus, which he perceived as the legitimate output of design), he reverted to the traditional IS development methods with which he was familiar. Pressure for conformity arose, not from inside the group, but as a response to political pressure from the global network, to deliver the expected "quick wins". Partly in response to these pressures and partly because of his preconceived expectations of design, the IS Manager, as the leader of the project, exerted normative pressure to standardise design processes and representations. *The dominant paradigm of IS design practice in the organisation - the technical, IT development paradigm overrode attempts by individual team members to innovate design practice* (for example the Project Engineering Manager, who persisted in using 'alternative' representational and modelling approaches, even after the IS Manager standardised the approach around the decompositional methods used for traditional IT system design).

Rosenbrock (1981) argues that human values disappear from the design agenda because IS design training is largely achieved through normative learning, which emphasises technical optimisation. This was true, to some extent, in this case: it was noted in chapter 8 that *implementation* issues (as distinct from information requirements) of the supporting IT system 'disappeared' from the information system design agenda as decisions about the form and nature of the IT were increasingly seen as pertaining to the IS function, rather than the design team. This was not because the IS Manager excluded other design team members from decision-making about IT (in fact, he actively encouraged them to participate), but rather because the other design team members saw the implementation of the IT system as belonging to the technical domain. The sociocultural value-system of the organisation filled the paradigmatic vacuum in which the team found themselves in this novel-design context, even when the IS Manager made active attempts to change this paradigm, with respect to role expectations. As a consequence, the IT system was designed with little attention to how or why it should be used. At a fairly late stage in the

information system design, it was realised that use of the IT system provided little benefit to participants in the system of human-activity and information-flows which constituted the information system, because the design of the IT system had been based upon the fallacious assumptions that users would want to use an IT-based system if one were provided. Decisions as to the form of the IT system had centred around a single, dominant information system requirement: to control work processes more tightly. Yet the resulting proceduralisation of the information system relied upon voluntary use of the IT system, in an organisational context where the dominant information system requirement had arisen because individuals neglected information recording due to the pressure of work. To some extent, compliance was ensured by an increased formalisation of work in the new information system, which would ensure some use of the IT system, but the neglect of how this would be used and how individuals would be motivated to use it was surprising, given the context of the design. *The scope of the design - the boundary of issues explored by the design team - appears to have been constrained by role expectations, which were not challenged by the novel, multi-domain approach to design adopted in this organisation.*

The picture here, then, is one of dominant organisational paradigms filling the vacuum exposed by innovative contexts of practice. Lave & Wenger (1991) speak of “legitimate peripheral participation”, in which novices become full participants in a community of social practice by becoming conversant with the sociocultural norms of the community, which they learn through emulatory practice within the community - i.e. learning by doing, or what Schön (1983) refers to as “reflection-in-action”. Individuals learn to ‘practice’ design through applying the rule-driven behaviour that they have observed in others to problems which confront them. Thus, it should come as no surprise that the dominant paradigms concerning design of this type of artefact (a computer-supported information system) should have prevailed in the novel design practice of this group when it was led by the manager most conversant with those paradigms, even though the initiative was intended to achieve outcomes different from the previous practice reported by that manager of “automating what’s there already”. Both design practice and design scope were constrained by these paradigms, because of the ‘investment in form’ (Star, 1992) which was embodied in the practice of IT design in this company. A critical issue for innovative IS design must therefore be to examine ways of preventing pre-existing paradigms of practice from prevailing - possibly by challenging the sociocultural norms with which design team members are familiar.

11.6 To what extent is design scope constrained by political considerations and what role do explicit models of the design play in extending and obtaining consensus on the scope of a design?

There was a continual tension between the need to attach the global, political network to the project (to maintain positive external visibility) and the need to mobilise the local network of the design team (to achieve an effective, coherent design). The needs of the global network were dominated by a desire for rapid closure of the design, while the needs of the local network were dominated by a desire to investigate and to understand the problem context. The strategy of problem reduction, which was required by the need for design closure, conflicted with the strategy of problem complication, which was required by the need for design exploration. An understanding of this dialectic was implicit in the behaviour of the design team, in the way in which an implicit system boundary co-existed with, but did not replace the explicit system boundary. The analysis in Chapter 10 illustrates how the needs of the global network tended to dominate, leading to an early over-reduction of the design, with the consequence that the design was poorly understood by team members. Because of team members' lack of design understanding, knowledge relating to issues of fact prevailed over knowledge relating to issues of values: knowledge concerning current ways of doing things was more valuable for rapid closure than knowledge concerning more effective ways of doing things. Team members' interests were aligned pragmatically behind the need for global network attachment and the design was 'completed' even though individual team members felt that their understanding of the design was far from complete or adequate for closure.

The 'management of meaning' (Smircich & Morgan, 1982) played a large part in this design process and was largely driven by the design project leader: the IS Manager. He was responsible for mobilising the design team around a 'common vision' centred upon his interests in maintaining external, political visibility for the product of the design - positively attaching the global network of senior management and organisational decision-makers to the project. In the same way that political parties are perceived as inadequate by the electorate if they air disagreements in public, this interest required that the team 'agree' upon a design and appear to be acting in common, even when disagreement and differences in perspective were required to explore and define design subsystems. This was due, in part, to the initial presentation of the design initiative as providing "quick wins" as part of a short, sharp "business process redesign" project; this approach presupposed that the design problem was reasonably unitary in nature and that it was well-understood, neither of which turned out to be the case. But even if this had not been so, the external, political visibility of the project was problematic in the design of this

organisational information system. The emergent nature of the design boundary and the indeterminate nature of design objects which lay within the “grey area” between the explicit and implicit system boundaries (discussed in Chapter 10 and illustrated in Figure 10.8) were critical problems in the effective management of this design project.

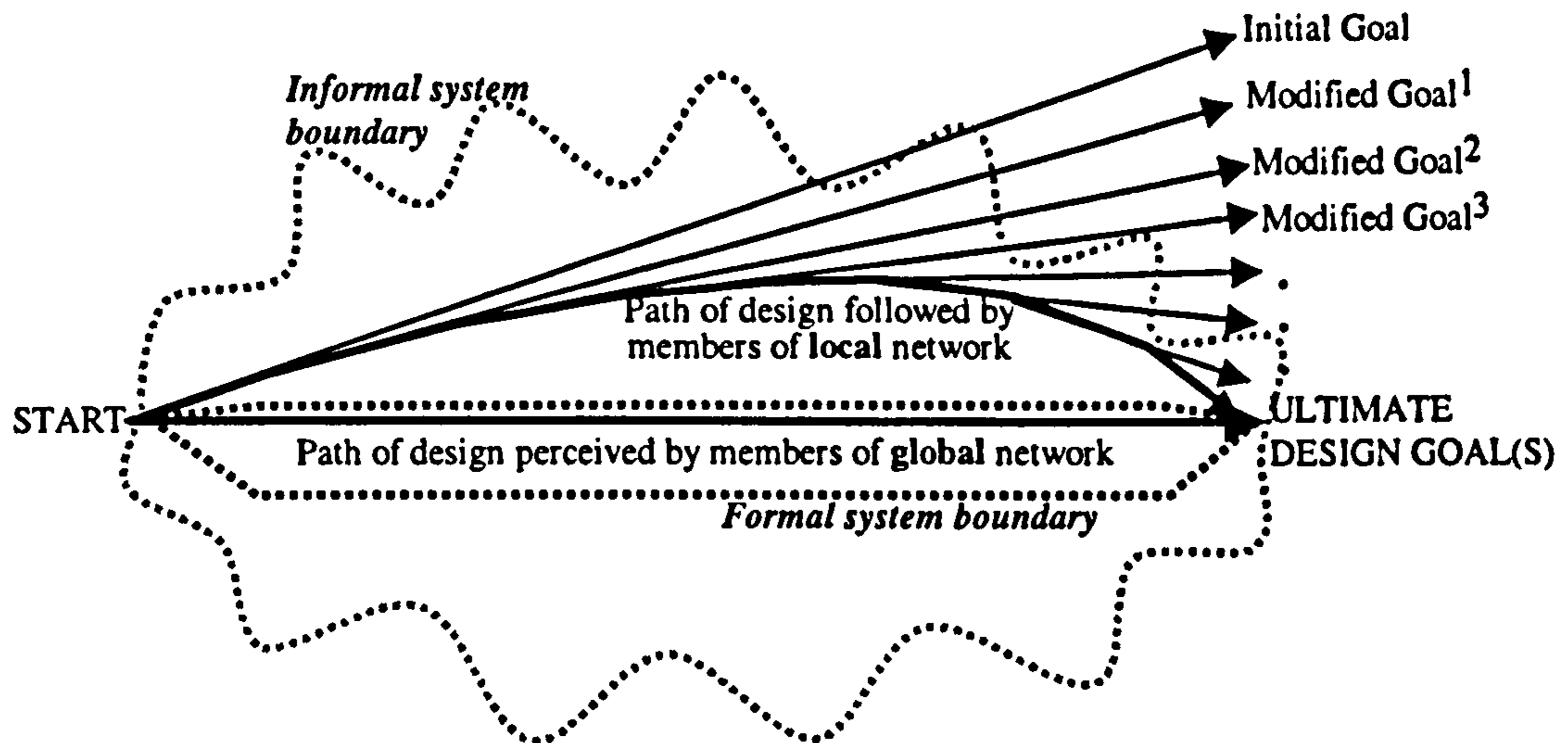


Figure 11-3: The Concept Of Emergent Design

Figure 11-3 illustrates the nature of the problem, which is associated with the existence of an informal information system (Land, 1992), which co-exists with the formal, designed information system. Designers cannot ‘analyse’ the information and social requirements of an information system, as its boundaries are not immediately apparent: they emerge through the processes of investigation, analysis and synthesis which constitute design. But the political success of the project depends upon positive attachment of actors in the global network of influential organisational decision-makers; these actors are only aware of the formal (published) system boundary and the explicit design route between the starting-point of design and the end-point. A major part of design was thus the management of external visibility for the products of design: the ‘management of meaning’, not just internally to the design team (although this does appear to be important), but externally, within the wider political networks of the organisation. The products of design needed to be assessed qualitatively, as well as quantitatively: benefits such as organisational learning, improved communication between groups of actors and increased organisational effectiveness required to be seen as legitimate outputs of design, as well as the formal information system and quantifiable benefits such as increased efficiency.

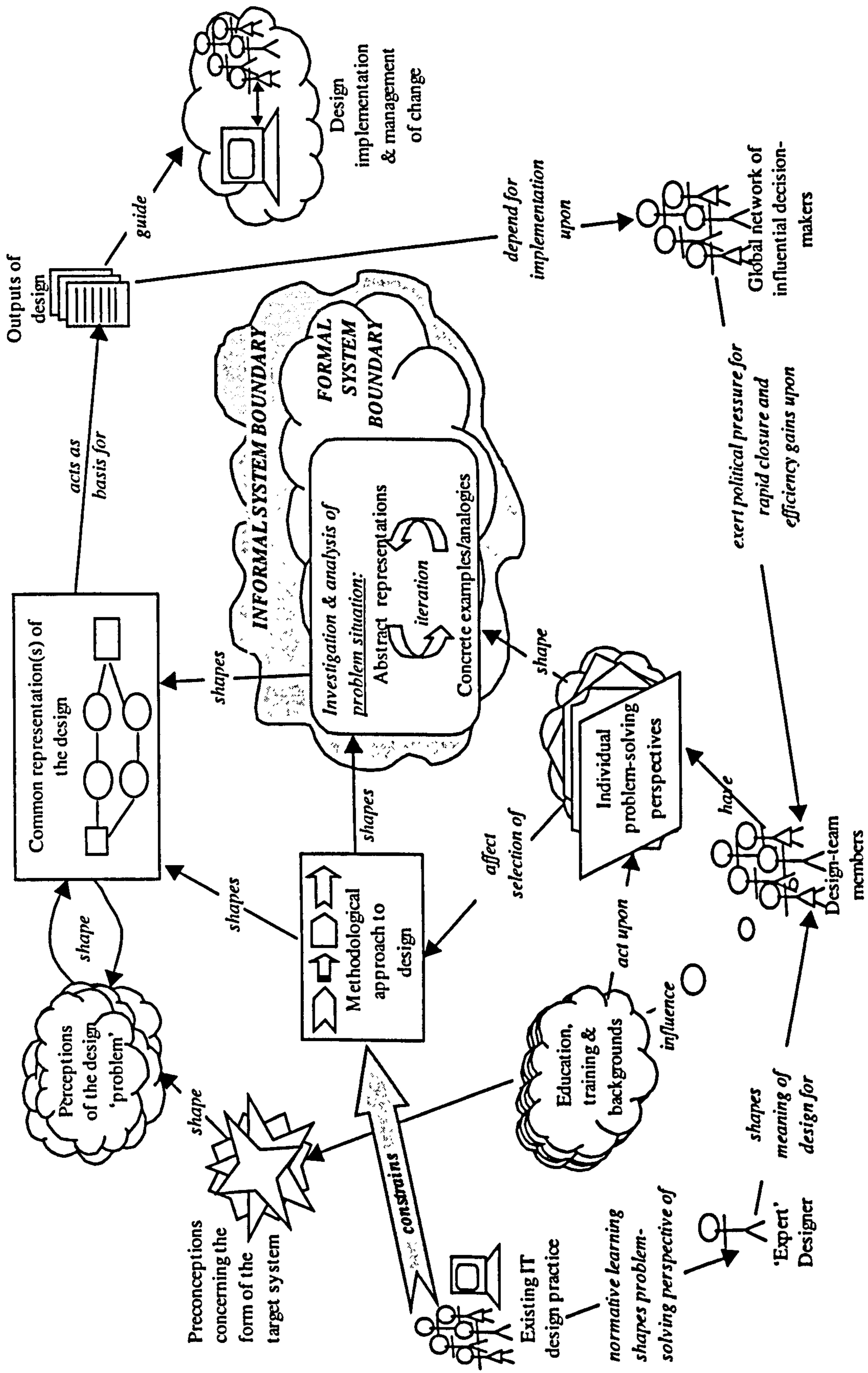


Figure 11-4: A Model Of The Organisational Information System Design Process

11.7 Summary: Managing The Design Process

The synthesis of design which is discussed in the previous sections is summarised in the model shown in Figure 11-4. In this model, the process of design is captured as a rich picture, based upon the findings of this study. It is, of course, an initial model and does not capture the richness of the findings discussed here: it is intended to summarise the main elements in a visual form. Further research is required to explore the extent to which these findings are generalisable and to validate and extend the model of organisational IS design.

The critical management issues which arise from this synthesis are:

1. There is a fundamental conflict between the requirement for effective organisational information system design and the senior management expectation that organisational IS design will provide rapid, efficiency benefits. The 'productivity paradox' is not new to the IS literature (for example, it is discussed by Brynjolfsson, 1993), but this study has exposed the interior of this perspective: how it affects the processes and outputs of an IS design project and the conflicting pressures to which the design team were exposed.
2. The investigation of work-processes and interrelated information systems in the grey area, lying between the formal and informal system boundary is critical to design effectiveness. The nature and extent of the informal system boundary emerges through the processes of investigation, analysis and synthesis which constitute design. But influential organisational decision-makers external to the design project are only aware of the formal (published) system boundary and the explicit design route between the starting-point of design and the end-point. A critical management activity is therefore the 'management of meaning', both internally, for the design team, and externally, within the wider political networks of the organisation. The outputs of design require stating in qualitative as well as quantitative terms.
3. The design approach must be suitable for the intended form of the target system. The paradox noted by Hedberg and Mumford (1975) - that while designers held a mental model of potential system users as self-motivating and autonomous, they implemented systems which supported a model of potential system users as non-autonomous and sources of error - may be partly explained by the findings of this study. While the IS Manager in this case based his conception of the target system on a 'Japanese' model of the organisation, he employed a design approach which was more appropriate to a Tayloristic model, involving recursive decomposition of work-functions to define a set of prescriptive procedures for the system. The existing 'investment in form' (Star,

- 1992) in IT design may prevail against an exploration of novel methods of design, especially when political pressures from the global network require design closure.
4. The role of 'expert' designers in shaping the meaning of design for other team members is central to the design initiative. The problem-solving perspective of the expert designer affects their concept of design, which in turn shapes the way in which they perceive appropriate design 'problems', roles and activities. The highly complex and uncertain nature of organisational information systems requires a perspective of design as situated, evolutionary learning, whereas problem-solving perspectives formed by normative IT design practice are likely to see the target system as static and so recommend design approaches which are unable to cope with the dynamic and emergent nature of design goals and solutions.
 5. The importance of achieving a 'common vision' in design may be overestimated. Designer teams appear to function effectively with a distributed mental model of the design, although a certain degree of intersubjectivity concerning the model appears to be necessary to avoid anxiety and confusion. In particular, too early an achievement of intersubjectivity appears to be harmful, leading to a false expectation that the design is almost complete and making further exploration of the design context difficult, as emergent goals and system boundary conceptualisations require this. A critical management activity appears to be that of periodically complicating the design, to ensure that emergent understandings are communicated and shared between design team members.

The synthesis in this chapter has summarised the main findings of the longitudinal field study of design performed as part of this research study. The next chapter summarises the findings of the research study as a whole, discussing the contribution to knowledge and implications of the findings for both researchers and practitioners.

12. CONTRIBUTION OF THE THESIS

12.1 Introduction

Organisational information system design is seen as the framing of systemic solutions to organisational problems; such activity may, but does not necessarily involve the development of information technology and is viewed as occurring at all stages of the life-cycle of an information system. Little is known about how the design of organisational information systems is approached in context: the literature does not tell us which methodological approaches to information system design prevail, or to what extent and how information system development methodologies are used. The strategic IS literature exhorts IS managers to consider organisational and business strategy fit when defining and implementing organisational information systems, yet the studies which indicate that such advice is ignored largely concentrate upon the development of computer-based technology in isolation from the design of organisational systems of human activity and do not indicate how widespread this approach might be. This thesis addressed these concerns by examining the mechanisms by which a user-centred methodological approach might be subverted by technical interests and by surveying methodological approaches to organisational information system development.

The literature on the processes of IS design has been concentrated upon experimental studies of individual computer-program design and has based design models upon an investigation of interior, cognitive processes. This perspective does not provide insight into the design of complex, organisational information systems, which involves the integration of skills and knowledge from multiple organisational domains. This thesis has exposed the interior nature of the processes of organisational information system design and the extent to which these are situated in their organisational context.

The objective of this chapter is to discuss the contribution of the thesis. The contribution is organised under the following headings: the interpretive research position and its implications for generalisability; implications for researchers; implications for educators; and implications for practitioners.

12.2 The Interpretive Research Position And Its Implications For Generalisability

The interpretivist research paradigm adopted by this thesis is described by Walsham (1993a) thus:

“Interpretive methods of research start from the position that our knowledge of reality, including the domain of human action, is a social construction by human actors and that this applies equally to researchers. Thus, there is no objective reality which can be discovered by researchers and replicated by others, in contrast to the assumptions of positivist science.” (Walsham, 1993a, page 5).

In the context of "no objective reality", generalisability of research findings could be viewed as an oxymoron. But it may be argued that data obtained in the course of *all* research, qualitative or quantitative, is subject to a double filter of selection and presentation: from those people whose views and opinions were sought in compiling the data, and from the perspectives and expectations of the researcher (Lee, 1991; Walsham, 1995). It may also be argued that human beings effectively balance the recognition that their perceptions are based upon individual experience with their need to apply generality to their interactions with the external world.

Any conflict between the claims of generalisability and the interpretivist position is mitigated by the ontological stance of internal realism - that "reality-for-us is an intersubjective, shared human cognitive apparatus", which is contrasted with external realism (the independent existence of reality) and subjective idealism (that reality is completely socially constructed) by Walsham (1995). Generalisability is viewed as being acquired through the accumulation of "shared" experience - i.e. through repeated interactions with the external world. From this position, the methodological problem which pertains to qualitative research is how the researcher may access and share the shared-reality of their subjects sufficiently to generalise from their interpretation of this sharing. If subjects' perception of reality is not shared, the researcher runs the risk of internalising and representing actors' espoused theories of their work, or discursive knowledge, rather than their theories-in-use, or practical knowledge (Argyris & Schön, 1978; Giddens, 1984).

As a consequence of this ontological position, this thesis argues that a deep understanding of the processes of design in an organisational context can only be obtained by sharing designers' experience of such processes, which requires qualitative research methods such as case study or the use of participant observation. While an exploratory survey was performed to obtain a perspective upon the "big picture" of IS development practice in the UK, the main emphasis of this research was upon the detailed processes of organisational IS design. Initial insights were obtained from the findings of the early case study, but most of the detailed contributions of this thesis arise from a single, participant observation study of IS design in its organisational context. The process of participant observation allowed the researcher to partake in the shared world of design, while the tape-recording of design meetings and the recording of contemporary, transient information (such as design representations and observations concerning the design context) permitted the emotional separation which is necessary for a rigorous analysis at a later point in time.

King (1997) addresses the generalisability of case studies (and by implication, other forms of interpretive research) thus:

" Case studies are useful when we want to see whether something is happening in at least one setting, or to understand deeply how it happens when it does happen in at least one setting. Some insights gathered from such studies will not be generalizable across other possible study sites without research aimed specifically at the question of generality. Comparative case research can help sort out whether a particular finding is present across multiple sites. ... to say that findings from case studies are "not generalizable" reveals nothing more than the inability of the person who says it to see the world from where her or she stands." (King, 1997)

The intention of this research was to "understand deeply how it [design] happens when it does happen in at least one setting" (ibid.). Walsham (1995) discusses four types of generalisation which may be obtained from IS case studies:

- ◆ development of concepts, e.g. "informate" (Zuboff, 1988)
- ◆ generation of theory, e.g. Orlikowski & Robey's (1991) theory of the organisational consequences of IT
- ◆ drawing of specific implications, e.g. Walsham & Waema (1994): the relationship between design and development and business strategy
- ◆ contribution of rich insight, e.g. Suchman's (1987) contrast of situated action with planned activity and its consequences for the design of organisational IT.

The deep understanding of design acquired through the studies which constituted this research have resulted in the main contribution of this thesis, which is to provide rich insights into IS design in an organisational context - insights which were missing from the IS literature. The contribution of this thesis also includes some generation of theory (the models constructed to explain the detailed mechanisms and context of design which are given in Figure 12-1, Figure 12-2, Figure 12-3, Figure 12-4 and Figure 12-5) and the drawing of specific implications, such as the relationship between problem-solving perspectives and the ability of a design-team to capture and frame a design, or the need for organisational design-teams to prioritise intersubjectivity with respect to design process objectives over intersubjectivity with respect to the products of design (both of which are discussed in detail below). Such theory and implications are, at best, tentative, as they are based upon the investigation of a single design context, yet may provide constructs for theory-generation or testing in future studies.

It is believed that many of the theories, implications and rich insights discussed below are generalisable to other contexts of organisational IS design and development. Such a belief is based partly upon comparison between the findings of the initial case study and the findings of the participant observation study, partly upon reference to the researcher's own previous, practical knowledge of IS development and partly upon a non-positivist epistemological position which believes that "facts" are socially constructed (Latour,

1987) and that facts and values are interrelated: both are involved in the production of scientific knowledge (Walsham, 1995).

Further studies are required to strengthen the position of these findings with respect to generalisability, in particular to investigate further the generalisability of the initial, theoretical models presented here. While recognising that such theory is at best tentative and that any claims to generalisability are weak, it is argued that the models contributed may provide a starting point for alternate conceptualisations of the processes of IS design in an organisational context, as current models are demonstrated to be inadequate.

12.3 Implications For Researchers

12.3.1 The Impact Of Methodologies Upon Organisational Information System Development

The survey findings present a recent perspective on current organisational practices in information system development (ISD). It would appear that approaches to information systems development are largely a-methodical, in terms of the coherent, prescriptive methods advocated by much of the ISD literature. Formal ISD methodologies do not seem to be used by the majority of IS development initiatives and are rarely used in full: tools and methods appear to be used only in part and on a fairly ad hoc basis. Those ISD methods and tools in use appear to be used more for reporting and management control purposes than to support the framing of the information system design; where framing tools are used, the focus of these appears to be directed towards shortening project timescales, as shown by the one-third of the sample who used Computer-Aided Software Engineering, Fourth-Generation Languages or Rapid Application Development approaches at some stage of their system development life-cycle. This finding would indicate that the large amount of effort invested in researching new ISD methodological approaches which include organisational factors in the framing of design may have little impact upon ISD practice and that alternative approaches, possibly involving the development of new management models of design, or the development of tools to support the framing processes of design might be more fruitful.

The perspective of senior IS managers was shown to be more sophisticated and complex - more oriented towards business and organisational drivers and aware of the contribution of user-involvement in design - than is reflected by the ISD literature, but there was still a dominance of technical/functional approaches to IS development during the system design phase of IS development projects. Future research into IS development might fruitfully investigate how those development activities which aid the synthesis of organisational IS design in its wider context might be legitimised and managed during the system design

and modelling stage, when the organisational focus of earlier stages is open to subversion by optimising technical considerations as to the form of the target system. Additionally, the low degree of user-participation in the overall change-process when information system technology development is outsourced is an issue which was raised by the survey findings and which has so far escaped research attention.

12.3.2 Managing Investment In Form In The Context Of Organisational Innovation

Although the finding of the survey was that IS development may be largely a-methodical, this does not mean that technical and organisational innovation are not guided by normative paradigms of design. On the contrary, a major problem observed in both the initial case study and the participant-observation study was the dominance of "investment in form" (Star, 1992). Perceived expertise in domains which were novel to other members of the design team, such as how to approach IS design, how a particular area of organisational activity functioned or how a new technology worked, enabled individuals to engage in the "management of meaning" (Smircich & Morgan, 1982) for other actors, to the extent that they were able to define work-practices and roles in the design process as well as defining concepts which lay within their domain of expertise. This enabled technologists to exclude user-representatives from decisions concerning the form and impact of technical system components, as user-representatives were "not qualified" to contribute meaningfully to such discussions.

This thesis presented a framework for the analysis of such meaning management, shown in Figure 12-1, developed from the "technical power" framework of Markus & Bjorn-Andersen (1987). This framework may prove useful in future studies of design, problem-solving and decision-making in organisations, as it supports the analysis of influence in terms of dominant forms of knowledge, permitting insight into the processes involved.

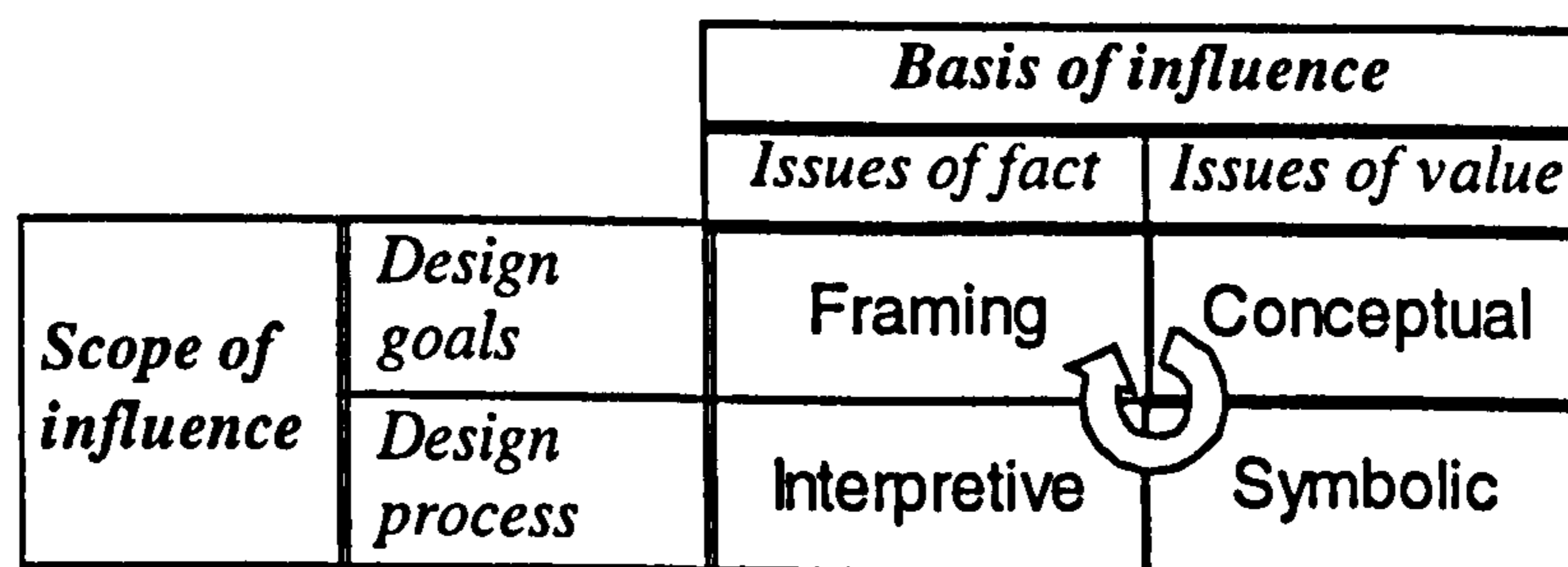


Figure 12-1: A Framework For The Management Of Meaning In Design

It was observed that the dominant forms of knowledge in design during the participant observation study progressed from (i) issues of value related to design goals, to (ii) issues of value related to the design process, to (iii) issues of fact related to the design process, to

(iv) issues of fact related to design goals. It has been suggested that effective information system design requires periodic "complication" of the accepted models by which people view the organisation (Hedberg & Jönsson, 1987; Boland et al., 1994). The observed design process ended at point (iv) as this initiative was constrained by external expectations of "quick wins": factual, concrete knowledge became disproportionately important to the design-team at later stages of the process as this enabled the rapid (if not the most effective) closure of design ambiguities. Future studies might investigate if periodic complication could be achieved by managing the process so that it repeats or varies the cycle of influence observed here. For example, appropriate design approaches for the next stage of activity might be periodically reviewed, changing the focus to issues of value if the design-initiative appears to be too centred upon issues of fact.

The role of the expert designer in facilitating effective design has been highlighted by Curtis et al. (1988), but little work has been done into the specific mechanisms by which existing structures of action persist in the face of emergent organisational knowledge or how the dominance of certain forms of expertise may be shifted. Basing design upon "expert" domain-knowledge leads to the reinforcement of single-loop learning (Argyris & Schon, 1978) in design and shapes expectations of organisational information systems for external stakeholders in the design, defining design outputs in terms of efficiency gains, rather than questioning organisational effectiveness. By periodically shifting the focus of design activity, it may be possible to complicate design perspectives (Argyris, 1987) and thus concentrate equally upon organisational effectiveness, through the exploration of alternative design objectives and process. This thesis has presented the basis for such a mechanism in detail - the management of meaning in design.

12.3.3 The Situated Nature of Design Activity

Design activity was observed to be situated in a local context: both goals and meaning were seen to be locally-derived. Design may be viewed as non-deterministic to the point that design objectives, even at high levels (e.g. definitions of organisation or information system strategy), are emergent rather than pre-definable. The "rational" perspective of design as problem-definition, analysis and synthesis, which underlies traditional models of IS development, is therefore inappropriate as the basis for action. This thesis suggests that a more integrated model of design is required to encompass evolutionary design activities, situated in the organisational context. Current models of the design process start with the pre-definition of a target system boundary and of high-level design goals, then describe design processes which enable actors to achieve these goals. This thesis argues that high-

level design goals and target system boundaries are evolutionary, context-specific and interrelated with emergent definitions of the design "problem".

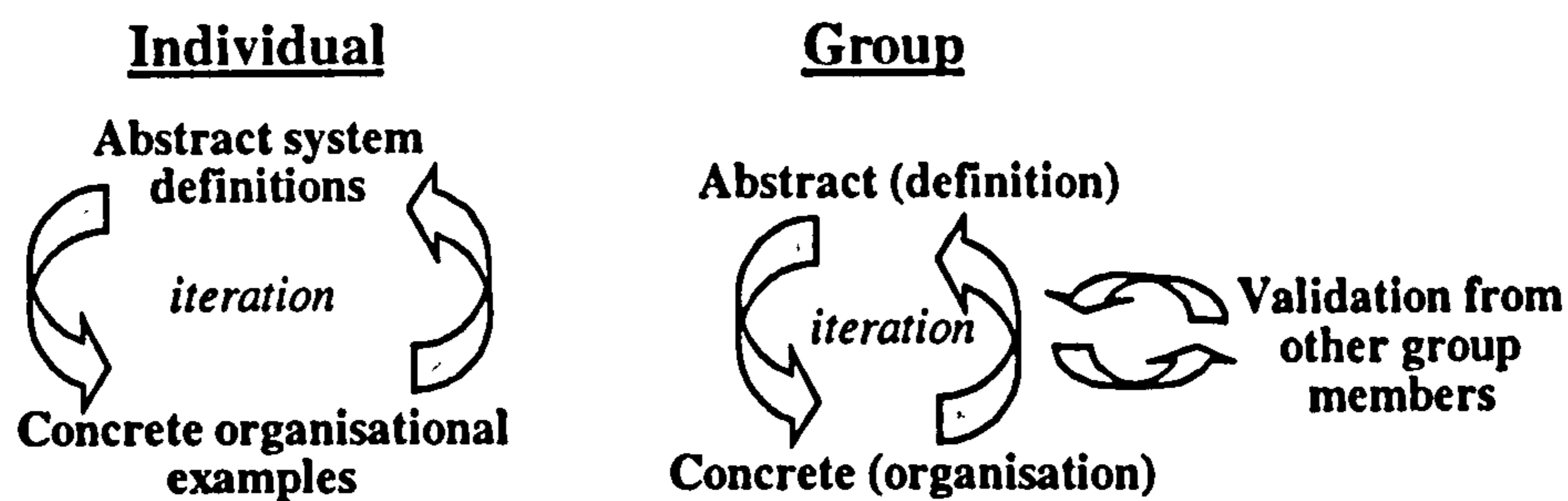


Figure 12-2: Design Framing At Individual And Group Levels Of Analysis

Figure 12-2 presents the observed model of design-framing. Goals and boundaries for design emerge from designers' interactions with the problem-situation throughout the design process - even at very late stages, when the design is thought to be complete - rather than being susceptible to definition early in the design process. Such interactions appear to consist of *abstraction* Δ *concretisation* cycles, where the designer continually analyses his/her understanding of design goals and requirements against existing organisational exemplars and analogies, then abstracts new goals and requirements from the analysis which are shared and validated against the other designers' constructs, using the same mechanism.

Design negotiation and argumentation appears to be mediated through use of situated exemplars rather than abstractions: this has implications for the design of IS design tools and framing methods, which currently concentrate upon capturing abstractions rather than specifics - i.e. they are "top-down" and linear, rather than "bottom up" and iterative in nature. There was a poor fit between the structured, decompositional design approach employed in the participant-observation study and the flexible, autonomous work-system envisaged as the outcome of design: this constrained the autonomy of tasks in the resulting information system. This, cyclical abstraction-decomposition model of design-framing has implications for the conduct of Business Process Redesign (BPR) approaches (e.g. Hammer, 1990; Davenport, 1993), which advocate the abstraction of high-level business processes in isolation from current practice. The rationale underlying BPR is that organisational processes may be defined from business process objectives, yet such objectives only emerge from interaction with current business processes. It follows BPR participants must *already* hold comprehensive mental models of current organisational practice from which to abstract "new" processes; this conclusion reveals the "obliterate" approach of Hammer (1990) as a chimera.

Further research is required to determine to what extent the cycles observed in the participant-observation study are universal, but the implication of this finding is that new approaches to design must manage the emergence of design objectives and recursive interactions with the design context, rather than relying upon more rational models of problem-solving and analysis in the context of organisational design.

12.3.4 The Distributed Nature of Design Activity

The target system model in the participant-observation study appeared to be distributed among design-team members, rather than held intersubjectively. Achieving intersubjectivity on objectives for the process of design (for example, the extent to which the design team should or could manage IT-related organisational change) appeared to be more significant to designers' perceptions of design completeness and success than achieving intersubjectivity on target system objectives (for example, the extent to which the designed information system would formalise work procedures in the organisation). This accords with Lave's (1991) suggestion that the process of socially shared cognition should not be seen as ending in the internalisation of knowledge by individuals, but as a process of becoming a member of a "community of sustained practice" and explains how the exploration of emergent design goals, discussed in the previous section, might be achieved. The implication of this finding is that achieving intersubjectivity on design process objectives enables a design-team to function effectively so that they may achieve consensus based upon a distributed model of the target system. The nature of the distributed model was that design understanding appeared to be "stretched over" (Lave, 1988) the team rather than divided between team members, with many areas of overlap in individuals' understanding of target system requirements and detailed design goals and shared areas of responsibility for design detail and coherence.

An implication of a distributed model of design is that the response to rational models of design and problem-solving - the reification of process through the application of prescriptive methods - is inappropriate for complex, multi-domain design and problem-solving. It might be hypothesised for future studies that an appropriate response to design-problem complexity is not division of labour (which follows from the rational model of information system design, where design requirements may be decomposed into separable parts) but shared responsibility for design which is mediated by achieving shared process objectives. This form of shared responsibility has coherence of action, trust and distributed cognition, rather than coherence of target system objectives and intersubjectivity, as its

goals. The assumed goal of design intersubjectivity may be unrealistic in innovative, complex design initiatives.

12.3.5 The Political Nature of Design Activity

There appears to be a fundamental conflict between the need for an effective design process to expose and explore organisational possibilities in design and the requirement of influential stakeholders for rapid gains in organisational efficiency (widely referred to in practice as "quick wins"). This finding raises the research issue of how design "progress" is assessed: if progress is reported entirely in terms of efficiency gains (the attainment of which is quantifiable), normative external perceptions of organisational information system design will exclude considerations of organisational effectiveness. In practice, this conflict appeared to form the basis for a dialectic where, in the short-term, organisational effectiveness was sacrificed to political expediency in achieving efficiency gains which, when reported, achieved additional time in which to explore longer-term effectiveness objectives. Future research into situated design might investigate how this conflict might be managed and how qualitative measures of effectiveness might be legitimised and assessed as part of a more organisational and business focus upon IS design.

12.3.6 Towards A Process Model For Organisational Information System Design

Four paradigms of organisational problem-solving were compared in the literature review; it was concluded that the fourth and newest paradigm - problem-solving as situated, distributed action - was most applicable to the processes of organisational information system design. Such design processes centre upon the construction of individual, shared and distributed mental models of the organisation, supported by learning, investigation and communication activities. Design is both constrained and mediated by the organisation's evolving political structures and pressures from the business environment. From the synthesised analyses of design activity, an "ideal" design process might be conceptualised as alternating cycles of:

- *opening up the design problem*: investigating and synthesising design goals, target system requirements and organisational possibilities; and
- *narrowing down potential solutions*: agreeing appropriate sets of design goals and target system requirements and determining appropriate actions for organisational and technological change.

From the perspective of current IS development practice (modelled upon the development of well-defined systems of technology), these two elements might be taken sequentially as an appropriate model for design activity, but viewed in the twin contexts of organisational

evolution and of the emergent individual and group learning discussed above, an ideal design process may be conceived of as more cyclical in nature, as illustrated in Figure 12-3. The right-hand cycle of the model (*narrowing down potential solutions*) represents those areas of activity which are visible and legitimate from the perspective of rational models of design, where the problem is viewed as given and design is viewed as the separate activities of formal problem-definition, analysis and solution. While the right-hand cycle is concerned with coherent group action for problem closure and decomposition, the left-hand cycle (*opening up the design problem*) is concerned with individual and distributed activity intended to explore and to complicate design possibilities. A contribution of this thesis has been to uncover the *implicit* activities of design, exposing to view the detailed activities of the left-hand cycle of this model and the cyclical and dialectic nature of the two halves of the design process.

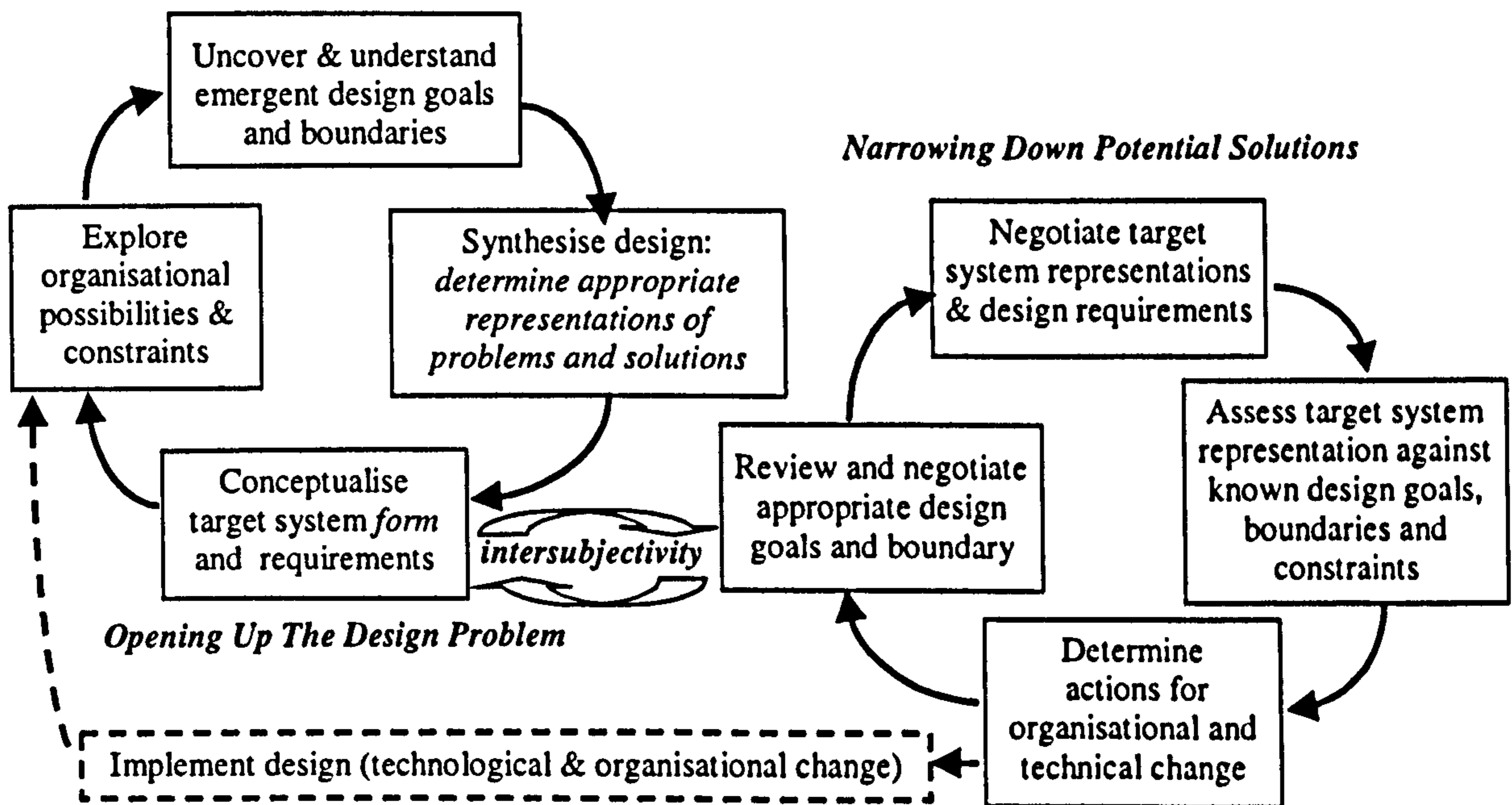


Figure 12-3: An "Ideal" Design Process

It is suggested that the attainment of sufficient intersubjectivity for design to proceed requires several iterations of the "opening up" loop to achieve individual synthesis to the extent that the implications of potential target system forms may be conceptualised. The individual may then (and will periodically) engage in the more visible, "narrowing down" processes, in order to achieve intersubjective representations of the design form and outputs and in order to test their individual conceptualisations against a group "model" of the design. The process will terminate when the majority of the design team feel that the distributed design model (obtained from the "narrowing down processes) matches their individual design model in sufficient detail *in those areas of the design which they have been able to conceptualise adequately* - i.e. in those areas of the design which they understand. The process objective of the "narrowing down" loop is therefore viewed as

satisficing, rather than as achieving complete intersubjectivity, in that it achieves a distributed model of the design.

This thesis has illuminated the situated nature of design processes and has demonstrated the interdependency of design problem-definition and solution in organisational IS design. It has also demonstrated the inadequacy of the dominant model of technology design (the "waterfall" model) in explaining organisational information system design. The model in Figure 12-3 is offered as an initial process model of design activity. An important research issue for the future is to investigate this model further with a view to deriving simple process models of design which are suitable for transfer into organisational IS design practice, to replace the waterfall model of design.

12.4 Implications For Educators

From the perspective of education, a core element of this research is how the skills involved in organisational information system design are taught and/or acquired. Lave's (1988) example of how individuals are unable to abstract maths skills which they are able to apply in specific contexts, such as the supermarket or weight-watchers groups, to a classroom environment is instructive if we are to teach design skills. This thesis has demonstrated that design skills are situated in the context of organisational problem investigation: designers continually cycle between concrete exemplars and abstractions in defining both design problems and solutions, which are validated with, and distributed between multiple design group members. A design 'problem' is dynamic and constituted of many, interrelated parts which are viewed in different ways by different design team members. Requirements for a design solution are explored in conjunction with conceptualisations of the design problem: designers' understandings of both evolve as a result of the process. When the situated nature of design is excluded, in order to derive a set of abstract processes, we are left with ISD "methodologies", which this thesis has shown are not used in full or in the manner intended. Yet IS managers continue to search for prescriptive methods by which design may be controlled. Two implications arise:

1. As design knowledge is situated in problem investigation and solution synthesis, design skills may only be acquired through situated practice - that is "learning through doing". Classroom teaching of design should therefore provide simulations of design environments, to supplement abstract discussions of conceptual models.
2. Educators might usefully manage the expectations of future IS managers by exposing the situated nature of innovative design activity to make explicit the failings of prescriptive ISD methods.

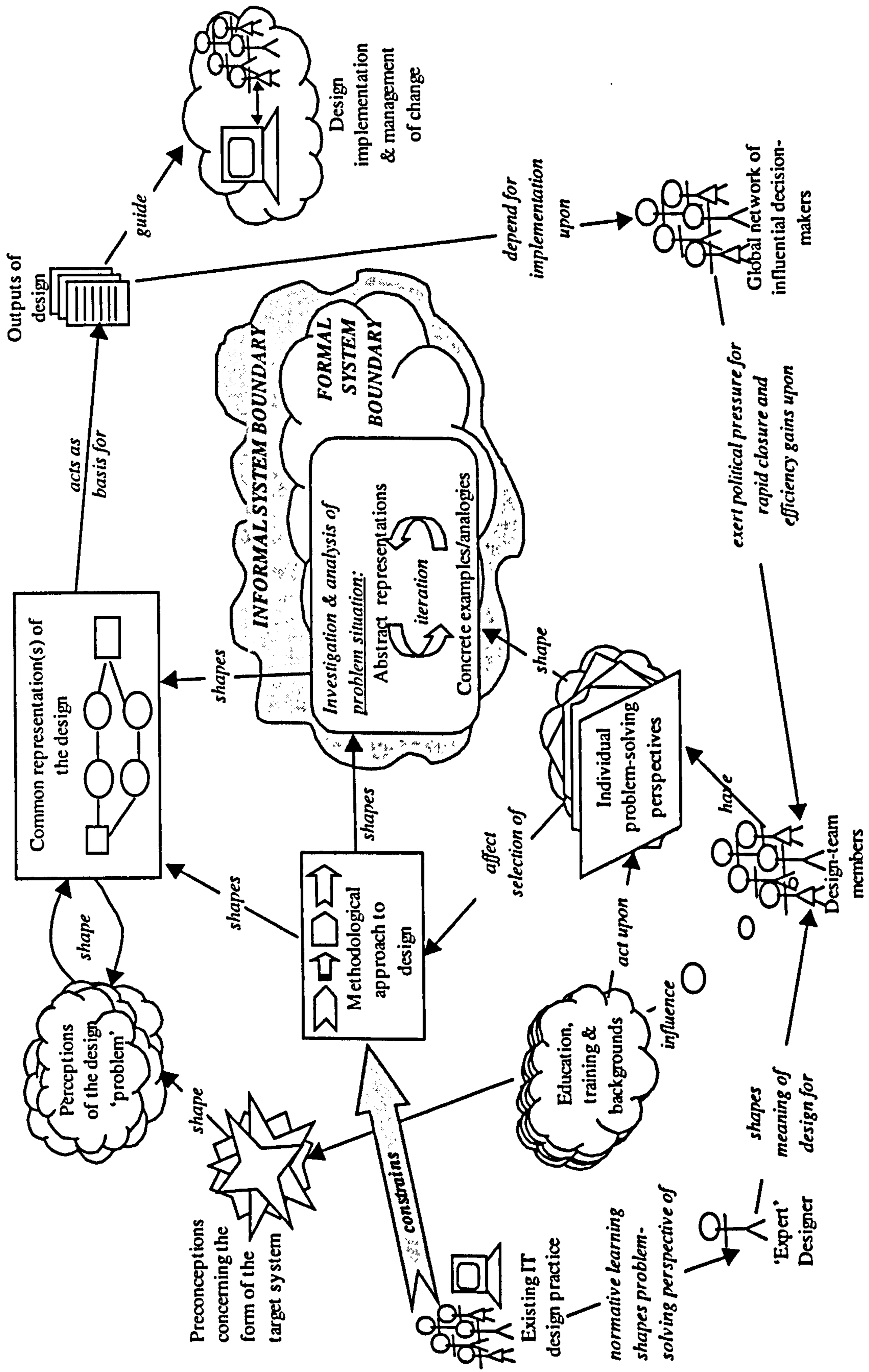


Figure 12-4: A Social Action Model Of The Organisational Information System Design Process

It is proposed by this thesis that the fairly simplistic models of design activity presented in most literature accounts of design could be replaced by a situated, social action model of design such as that synthesised in Chapter 11 and reproduced in Figure 12-4, which encompasses the research findings in respect of the situated nature of organisational IS design. In particular, this model highlights the following issues:

- ◆ The influence of existing IT design practice is not considered in MIS texts, yet it may be viewed as constraining in two ways: (i) it constrains the selection and application of methodological approaches to organisational IS design and (ii) through normative design practice, it shapes the problem-solving perspectives of "expert" designers, within the community of social practice constituted by the technical design domain of the organisation.
- ◆ "Experts" in design practice or in domain knowledge shape the meaning of design for other actors; this has implications for the selection and management of design-team members and the design process. Basing design upon "expert" domain-knowledge leads to the reinforcement of single-loop learning (Argyris & Schon, 1978) in design and shapes expectations of organisational information systems for external stakeholders in the design, defining design outputs in terms of efficiency gains, rather than questioning organisational effectiveness.
- ◆ Designers' education, training and work-backgrounds influence their individual problem-solving perspectives, which in turn shape the way in which they explore and conceptualise design problem situations and the way in which they conceptualise appropriate forms for the target information system. Preconceptions of appropriate forms of solution shape the way in which the design "problem" is defined, constraining (in conjunction with available design methods) design models and representations.
- ◆ Shared design representations arise from the communication and negotiation of individual perceptions of the design problem and from individual and group abstractions of target information system goals and scope. Such abstractions are situated in individual and group interaction with and learning about the problem situation and in the group's ability to understand and legitimise the emergent boundaries of the target system. System boundary legitimisation will depend upon the design team's *awareness* of divergence from the formal, agreed target system boundary and upon their political influence in managing the adoption of emergent system boundaries by influential organisational decision-makers.
- ◆ The design outcome, in terms of acceptance, legitimacy and the implementation of change is dependent upon the global network of influential decision-makers to which

the design team attaches itself. If global attachment of influential decision-makers is unsuccessful, political pressures for rapid, efficiency gains are likely to outweigh the team's need to investigate and interact with the problem-situation in sufficient detail for an effective design. But if the design team successfully manages external meanings of the design initiative, to the extent that the initiative is assessed by qualitative, effectiveness outcomes (which are, by their nature, longer-term than "quick-win" efficiency gains), then the design is likely to be wider in scope and less constrained by legitimacy problems arising from the emergent nature of design goals and boundaries.

Traditionally, educators have concentrated upon prescriptive models of analytical design to reify IS development processes. This thesis reveals design as situated, social interaction with the local environment, within a design "community" based upon a common vision of short term goals; learning-through-doing is viewed as more important in communicating this conceptualisation of design than the presentation of abstract process models.

12.5 Implications For Practitioners

The main contribution of this work for practitioners has been to expose the need to manage the socio-cultural nature of design and the need to legitimise the activities required for effective design exploration and complication, as well as those already recognised as necessary for design closure. The social-action model of Figure 12-4 is relevant to practitioners as the basis for managing IS design and development initiatives, although the observations of this thesis would indicate that such a model might not be immediately acceptable to them, given their grounding in 'rational' models of design. A better way to introduce such concepts might be to operationalise them in fragmented models and tools which support areas of design and thus to introduce them incrementally.

A second contribution of this thesis with respect to practice is the conceptualisation of design as *distributed* across a design-team, replacing the "common vision" perspective of design. If design and problem-solving processes are seen as distributed and emergent, then complete goal-intersubjectivity is not only inappropriate, it is not attainable: the current management focus upon shared vision may raise unrealistic expectations of intersubjectivity which lead to high levels of stress in cross-domain design-teams. The implications of this are discussed below.

12.5.1 The Emergent Nature of Design

Design may be viewed as a cyclical process of learning about a situation, then planning short-term, partial goals which emerge from the process of design. But the emergent and

distributed nature of high-level design goals and scope affects the perceived legitimacy of design problem-investigation. Design-team exploration and prescriptions for action within the "grey area" between the formal (published) and informal (emergent) target-system boundaries may not be perceived as legitimate by external stakeholders and organisational managers *or by design team members*. A critical management activity for organisational IS design might therefore be seen as periodic review of the design scope - design goals and target system boundaries - with the recognition that goals and boundaries are subject to change and such change needs to be managed both externally to and internally within a design team.

The definition of problem goals and objectives only causes contention if the socio-cultural norms of design-team members are not coherent. In the case study, it was demonstrated that cultural differences between psychologists who shared a formal, document-based culture of work and technologists who shared an informal, verbal culture, contributed to the mutual alienation of the two sub-groups during design and enabled the technologists to effectively exclude contributions from psychologists as "irrelevant". In the participant-observation study, it was observed that group cohesion, indicated by high levels of convergence regarding *process* objectives was more critical to perceptions of success than shared models of the design (i.e. convergence regarding the *product* of design). A "common vision" of process objectives, resolving the question of what constitutes cultural knowledge and how such knowledge is communicated and learned, is more important to successful design than a common vision of design goals.

12.5.2 Managing Design And Domain Expertise

The way in which the meaning of design is shaped by the influence of "experts" in design practice or in an application domain has implications for the selection of design-team members: managers could consider the selection of design-team members with expertise in a variety of design approaches and relevant organisational domains, to preclude the dominance of a single perspective. The findings of the participant-observation study demonstrated how differing forms of pre-existing knowledge dominated design negotiations at various points in the design process: it would seem that an effective design might best be achieved by managing the process so that it repeats or varies the cycle of influence observed in this study. This would 'complicate' designers' models, permitting consideration of design alternatives which might not otherwise be considered from the focus of a particular expert (achieving the objective of multi-domain design teams). Such

a variation might be achieved by periodically reviewing and questioning the goals or processes of the design project.

A related issue concerns the conceptual barriers which are erected by designers around the definition and exploration of technological opportunities. In the case study, two conceptual barriers were detected: a *visibility barrier*, removing technology development from the public gaze, and a *perceived relevance barrier*, which enabled the exclusion of non-technologists from discussion of the form of the (technological) information system as they lacked appropriate "qualifications" for contribution. In the participant observation study, these barriers were again detected, but in this case they appeared to be erected by the socio-cultural attitudes of non-technical design-team members, who saw their involvement in technology design as irrelevant to the design of organisational processes and information-flows. These barriers have significant consequences for the design of organisational information systems. They preclude cross-domain debate about the nature of and appropriate forms for technology, confining such decisions to technologists in isolation from other organisational interests. They also enable unintended consequences of a new information system - for example work-pacing or control - to go unrealised until the technology is delivered in an operational context. The lesson for multi-domain design initiatives is that the agreed design process should regularly review and debate the form and implementation of technical support for the information system. This activity should be viewed as relevant to *all* actors, technical and non-technical and presented in such a way that 'techno-speak' does not dominate the discussion, possibly by the introduction of technical system prototypes to enable situated learning.

12.5.3 The Nature Of The Design Process

From the perspective of the individual designer, the critical role played by domain investigation and learning activities is indicated: such activities are currently not considered legitimate, in the rational, decompositional models of design which dominate organisational IS design practice. Adopting a convergence model of individual design activity, which conflates analysis and synthesis and sees these activities as mediated by interaction with the organisational context of design, would contribute significantly towards an improvement in practice. ISD project plans should include activities to support application-domain exploration, cross-domain dialogues and learning, and the exploration of design process objectives to achieve a common socio-cultural perspective. Making such activity explicit might remove a great deal of the stress currently associated with 'padding'

IS development project plans to allow for "unplanned" activity which does not conform to the rational, decompositional model of design.

An operationalised model of group design activity might consider the nature of the design process, as illustrated by the findings of the longitudinal study, in planning and controlling the 'required' activities of design:

1. With the adoption of a convergence model of design, the critical problem of design moves from the definition of design goals, boundaries and requirements at the prescribed level of decomposition to one of distinguishing between significant and insignificant design information at multiple decompositional levels simultaneously. This problem was identified as central by practitioners in the participant-observation study, who felt that much "advance design" was repeated unnecessarily because previous design ideas, particularly in respect of lower levels of design decomposition (such as mechanisms for implementing the design) were not thought to be significant to the current focus of design and so were not recorded. Some method is required to capture high-level design requirements as they emerge from design debate *and* the rationale, scenarios and planned structures underlying them, even though such information may not be relevant to the current problem focus.

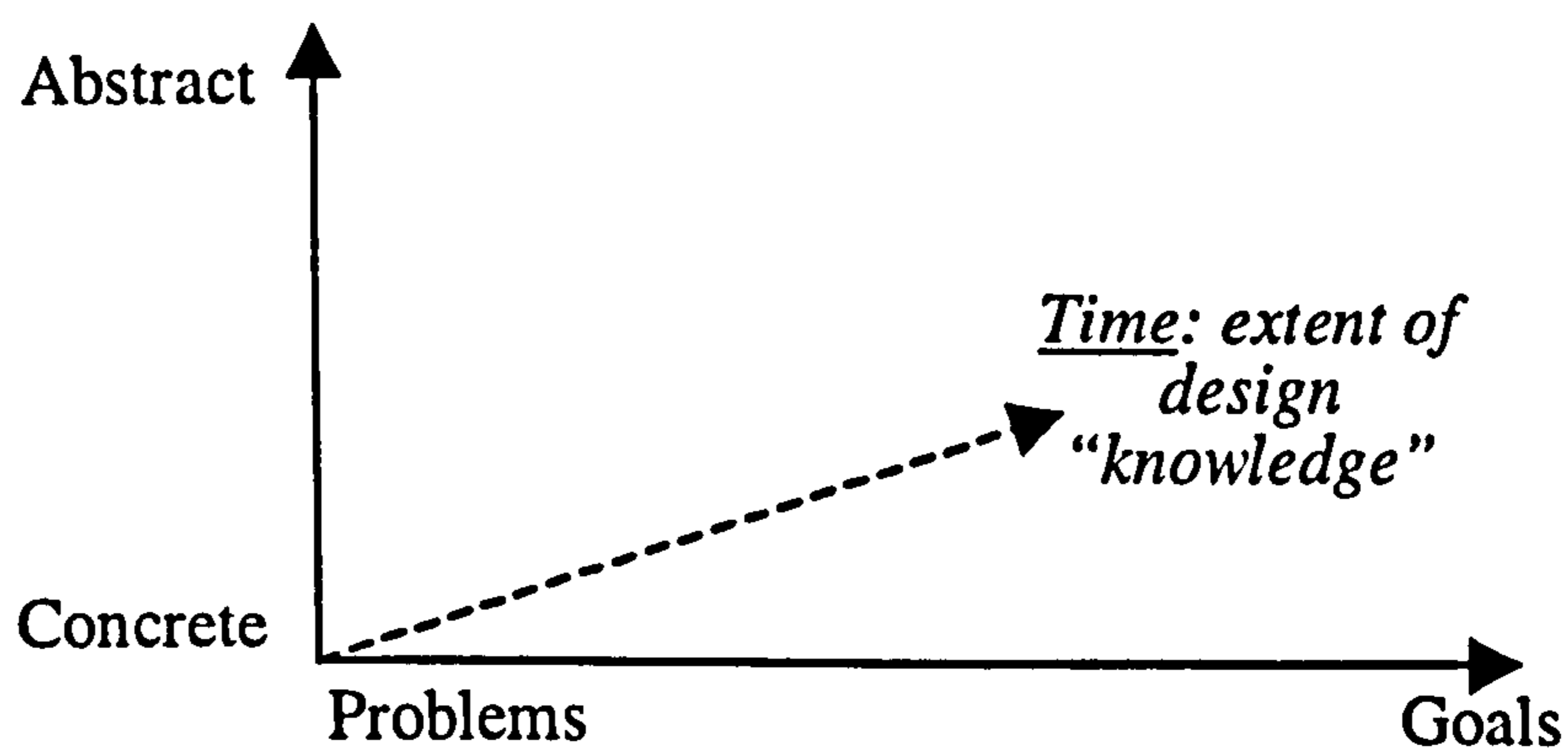


Figure 12-5: Multiple Dimensions Of Design Abstraction And Representation

The development of design support tools, paper-based or computer-based, to capture design information at multiple levels of abstraction is seen as central to the adoption of a convergence model of design by practitioners. Appropriate dimensions of design activity for such tools are suggested in Figure 12-5. An important issue in the application of such a model is information "forgetting" as well as information acquisition: design information needs to be reviewed periodically in the light of emergent design understanding.

2. Individuals can only conceptualise abstract design requirements, processes and concepts by basing them in examples and structures from a known organisational

context. If their design is to be effective, it must be considered legitimate for them to investigate and understand the local context in which the system is to be implemented; otherwise the design will be based upon inappropriate scenarios and assumptions. The use of local system (possibly paper) prototypes suggests itself here as a possible mechanism to stimulate scenarios of information system use.

3. The implication of recognising that a design team have a distributed (as distinct from shared) model of design is that different methods are required to support design synthesis. Practitioners in the participant observation study recognised that using an "Aunt Sally" approach to design (where one designer conceptualised an initial system component in detail, then explained his vision to the others, who used it as a starting point for their debate) was more effective than "design by committee". The explicit goal of most IS development methods is group intersubjectivity with respect to the target system (a "common vision"), but this goal needs to be recognised as unrealistic. To achieve *distributed vision* of the design, it needs to be recognised that all group members will not understand the design model in the same way, that understandings are often partial and that achieving levels of intersubjectivity with respect to what the team is trying to achieve may be critical in these conditions, as it permits designers to trust other group members to design a system component effectively, even when they, individually, do not fully understand the requirements or the nature of that component. A common vision of what the team is trying to do and how appears to be more important to effective design than a detailed, shared vision of what the designed system will achieve and how it will operate. This has the following consequences for method:
 - ◆ Individuals from different backgrounds will represent and interpret "shared" models of a design in different ways and may have difficulty understanding each others' representations. Time should be spent in achieving a common understanding the meaning of representations.
 - ◆ If trust (intersubjectivity with respect to process objectives) is achieved between design group members, then the group is able to reach "agreement" about a design model without necessarily all understanding it in the same way. This is the *expected* process of design, yet group members will have unrealistic expectations of shared understanding which need to be managed carefully.
 - ◆ Design goals do not need to be explicitly defined and agreed at the start of the design initiative: they will emerge from the process of design. Many will only be clarified towards the end of the design. Information system specifications and models should be

seen as interim plans, rather than as "frozen" design documents. This emergence needs careful management in respect of external stakeholders' perceptions of the target system, as these will necessarily be based upon published accounts of the design. An implication of this is that periodic design reviews should be planned into the project, at which time the published system specification should be seen as liable to radical change.

The perspective of senior IS managers has been demonstrated by this thesis to be more organisation-focussed than one would expect from the ISD literature, but the dominance of decompositional approaches to IS development practice would indicate that managers require alternative, simple models of design activity with which to manage IS development. Future challenges for the management of IS development appear to lie in the legitimisation and support of development activities to aid the synthesis of organisational IS design in its wider context and in the management of a specialised workforce who are currently rewarded for applying single-loop learning (the application of technical domain expertise) in conditions of rapid development life-cycles and business environment turbulence. IS managers might also pay attention to the extent to which users are involved in outsourced system development projects.

12.6 Conclusion

This thesis has exposed the emergent and distributed nature of design processes in multi-domain design teams and has questioned the focus on development methods which dominates the literature on the design and development of organisational information systems. The following findings were found to be of critical importance in understanding organisational IS design activity in multi-domain teams:

- ☛ Current management perspectives on the design of organisational information systems appear to be less technology-centred and more complex than represented by the ISD literature. But information system design and modelling is still viewed as a technical task, rather than as an activity which concerns multiple organisational domains.
- ☛ Because of the view that information system design is the concern of technologists, users or their representatives may not be considered qualified to comment on decisions which affect the form and impact of the technological system components.
- ☛ The *meaning* of design processes within a design-team is shaped by pre-existing "investment in form", represented by individual IT-design and application-domain expertise.
- ☛ There is a mismatch between "top-down" models of organisational IS design (such as those used in traditional approaches to IT design or in Business Process Redesign) and observed design abstraction processes.

- ☛ Mismatches between the structured, decompositional design approaches and the flexibility required in the support of autonomous work-systems may constrain the task autonomy of actors whose activity constitutes the target-system.
- ☛ Negotiated design outcomes are influenced by different types of knowledge at various stages. 'Complication' of the design by periodically changing the focus of the design process, for example from "how should we change" to "how should we approach the next period of design" is recommended.
- ☛ The distributed nature of group design has the effect that achieving a 'common vision' of the design process is more critical than achieving intersubjectivity with respect to product.
- ☛ Design is political: conflict between the exploration of organisational possibilities and influential stakeholders' expectations of efficiency benefits must be managed for the design process to succeed.
- ☛ Activity relating to the "grey area" between explicit system design goals and boundaries and emergent definitions of goals and boundaries needs to be legitimised, both internally and externally to the design-team for effective design.

A critical issue for future investigations of design and problem-solving in organisational contexts is the extent to which design goals and boundaries may be defined in advance of the analysis and synthesis of solutions. The early achievement of intersubjectively-held *process* objectives was demonstrated by this thesis to be critical in achieving the socio-cultural convergence required for successful design in multi-domain teams. Design goals and target system boundaries were shown to emerge from the processes of design and to be distributed between design-team members according to their domain-specific perspectives of appropriate products for the design. A cyclical, convergence model was suggested as a more appropriate guide for design activity than the decompositional model in current use.

It is suggested that the findings of this thesis have important implications beyond the design of organisational information systems; they may fundamentally affect how we perceive knowledge management and organisational innovation. Current models of organisational "learning" view intersubjectivity (with respect to information or knowledge content) as an appropriate, if problematic end. If organisational problem-investigation processes are seen as involving distributed and emergent knowledge, then such intersubjectivity is not only inappropriate, it is not attainable. The focus of organisational learning thus shifts from *sharing* organisational knowledge to *accessing* distributed organisational knowledge which is emergent and incomplete.

APPENDIX 1:

ADDITIONAL INFORMATION FOR INITIAL CASE STUDY

Interview Questions

1. What has been your involvement with the ISLE project?
2. When did you join the project?
3. Are you still involved with the project?
4. a) What did you see as the main project objectives at the start of the project
b) What do you see as the main project objectives now?
5. How do you perceive the ISLE project now, in terms of meeting initial objectives?
6. How was the project plan initially derived?
7. a) When did the plan first change (not necessarily officially) OR when did you first notice that the project was not proceeding according to the project plan?
b) How did things change? c) How did you feel about the change(s)?
8. a) When did you notice any problems with the project?
b) How did you feel about those problems?
c) Were those problems overcome? If so, what did you do about it? (How were they overcome?)
9. What were the project stages and progress-measures which you worked to:
a) at the start of the project; b) at the end?
10. Did people working on the project see the model given below as defining project processes or as an approach which would be nice if the progress-control measures dictated by any structured development methods used allowed?
11. What relation was there between the progress "milestones" of the project:
a) predicted when the project were initiated
b) actually used to determine progress?
12. Did project milestones dictate design/implementation methods, or did design/implementation methods dictate project milestones?
13. What were the main tasks involved in the project? Who was responsible for each of these tasks?
14. What mechanism determined task responsibility for tasks which were not clearly defined?
15. What conflict occurred between people from different disciplines? Was this conflict productive, or counter-productive? Did the development methods lead to a bias in conflict resolution and was this resolution constructive or destructive, in terms of the original project goals?
16. What evaluation methods were used at various stages of the project? Were these methods chosen to conform with the original process-model or to conform with structured development control milestones?
17. Do team-members perceive the ISLE project as successful in meeting:
a) original objectives? b) revised objectives?
18. How do staff from different disciplines evaluate "successful"?
19. Was the initial process model (as given in figure 1 below) received and perceived differently by people from different disciplines who were involved in the project?

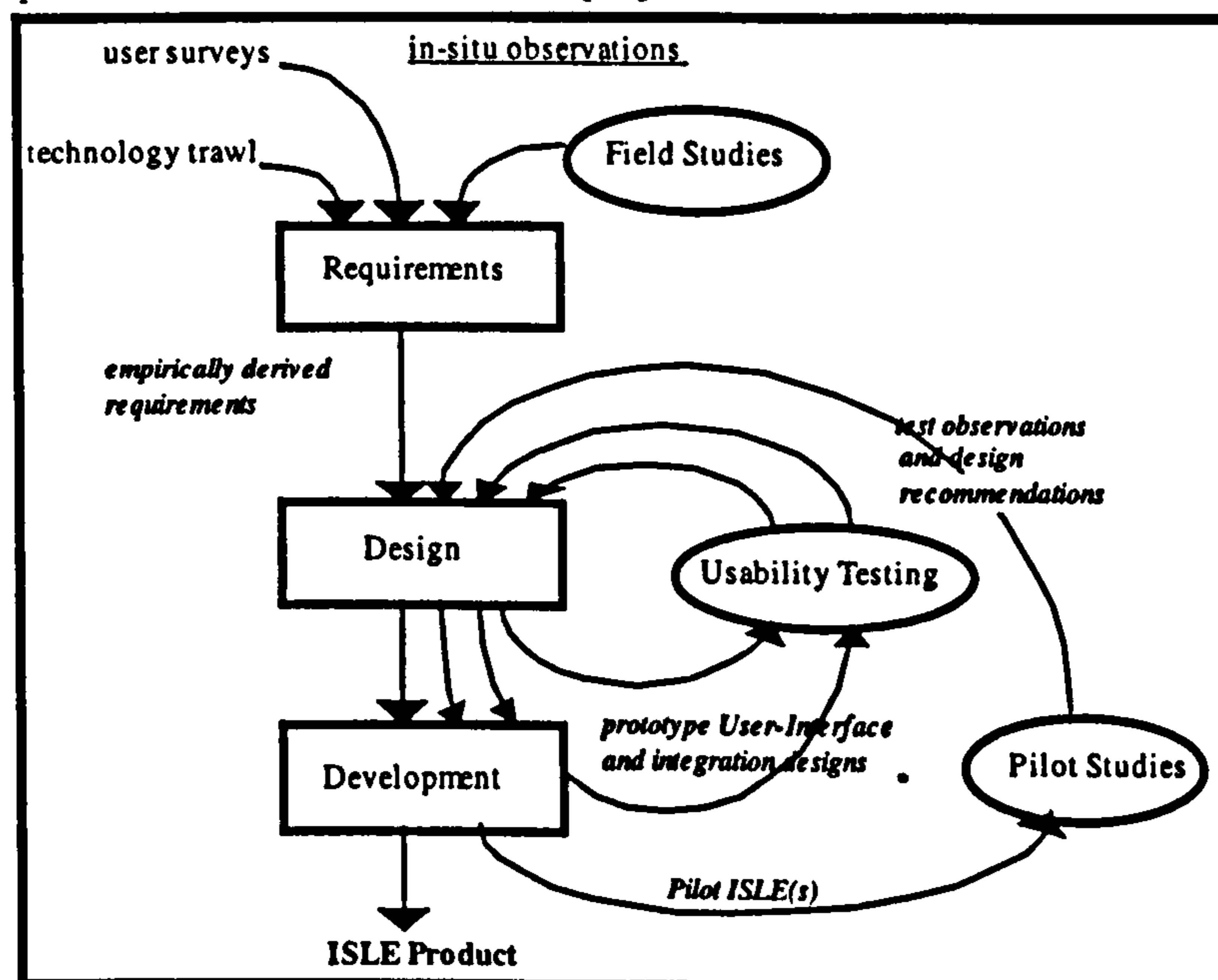


Figure A1-1: Intended Process Model For ISLE Project

APPENDIX 2:

SURVEY QUESTIONNAIRE AND CODING SCHEME

Survey Questionnaire

1. How would you describe the system architecture in your organisation? (Tick as many as apply).

- | | |
|---|-------------------------------|
| 1. Stand-alone PCs | 5. Client/server architecture |
| 2. Workstations - connected by a Local Area Network | 6. Mainframe - with PC links |
| 3. Workstations - connected by a Wide Area Network | 7. IT links to customers |
| 4. Minicomputer - with dumb terminals | 8. IT links to suppliers |

2. To what extent are the following true of your organisation?

	<i>False</i>				<i>True</i>		
Business functions can access applications from a network.	1	2	3	4	5	6	7
Business functions can extract data from central databases to use local applications.	1	2	3	4	5	6	7
Business functions have access to integrated office systems.	1	2	3	4	5	6	7

3. Think about the main IT development project as a whole. What did it most resemble?

- | | |
|---------------------------------|--|
| 1. A single, staged life-cycle. | 2. A set of evolutionary developments. |
|---------------------------------|--|

4. What was the duration of the main IT development project?

- | | |
|--------------|--------------|
| 1. < 1 year | 5. - 4 years |
| 2. - 2 years | 6. - 6 years |
| 3. - 3 years | 7. > 5 years |

5. Now think about the approach to system development during the main IT development project. How would you rate the following factors?

The overall emphasis was on:	<i>Exploiting technical opportunities</i>	1 2 3 4 5 6 7	<i>Supporting organisational changes</i>
The approach to system requirements definition stressed:	<i>Business requirements</i>	1 2 3 4 5 6 7	<i>Technical infrastructures</i>
The approach to system design and modelling stressed:	<i>Functional requirements decomposition</i>	1 2 3 4 5 6 7	<i>Modelling work processes</i>

6. Think of the methods and tools used in the main IT development project for project management and system development. What tools were used at each of the following 3 stages?

A. Requirements Analysis

Project Management	System Development
--------------------	--------------------

B. System Design

Project Management	System Development
--------------------	--------------------

C. Implementation

Project Management	System Development
--------------------	--------------------

7. Think about the approach to business needs definition. Which of the following mechanisms were used to match IS needs to business needs?

A. During system requirements analysis

1. Validation and sign-off of specifications by users
2. Participation of users at requirements “walk-throughs”
3. User-participation workshops
4. Interviews with users to elicit requirements
5. Joint design (using groups of users to design work processes)
6. Participation of users as development team members.

B. During system design

1. User validation and sign-off of design documents
2. User attendance at design “walk-throughs”
3. Use of experimental system prototypes (to try out ideas)
4. Use of evolutionary system prototypes (incorporated into system)
5. Formal user training in use of development tools.

C. During system implementation and testing

1. Provision of user-manuals
2. Provision of help-desk facilities to support user problems
3. Formal user training in use of the new systems
4. User workshops to discuss design changes
5. User-directed testing schedules
6. Modifications to system design to support business applications.

D. During ongoing operation of system

1. User manuals describing advanced system features
2. Formal advanced training in use of the system
3. Use of methods to help users re-design work processes
4. Modifications to system design to support business applications
5. User-support mechanisms for dissemination of information about the new system.

8. How were external consultants used and how helpful were they?

They carried out large parts of the change project	<i>Not at all</i>	1 2 3 4 5 6 7	<i>A great deal</i>
They performed some specific actions	<i>Not at all</i>	1 2 3 4 5 6 7	<i>A great deal</i>
They facilitated the work of people making the change	<i>Not at all</i>	1 2 3 4 5 6 7	<i>A great deal</i>
None were used	<input type="checkbox"/>		

9. Think about the overall change of which this project was a part. To what extent did the following factors get in the way of, or help the success of the change?

User consultation and involvement	<i>Really got in the way</i>	1 2 3 4 5 6 7	<i>Helped a great deal</i>
Approaches to planning and project management	<i>Really got in the way</i>	1 2 3 4 5 6 7	<i>Helped a great deal</i>

10. Think about the IT aspects of the change process. What do you feel . . .

- A. . . . you did well?
- B. . . . you should do differently next time?
- C. . . . are the aspects of a well-managed change process that you missed altogether?

Coding Scheme For Responses To Survey Questions

Questions 1 and 2

Data was coded using the scheme shown in Table A2-1, to determine the stage of growth of the organisation, with respect to IT. As stated above, this type of assessment is highly subjective; this was intended as a crude measure only, to ensure that organisations had sufficient levels of experience with IT to be included in the sample.

	3.1	3.2 (with score ≥ 5)
I Initiation	None	None
II Contagion	1	None
III Control	6 and/or 4	1
IV Integration	5, 2	1 and 2
V Data Admin.	3, 7, 8	1, 2 & 3
VI Maturity	N/A	N/A

Table A2-1: Coding Of Responses To Determine Organisation Stage Of Growth

Questions 3 and 4

This element of assessment proved problematic, in terms of the obvious degrees of interpretation which became apparent in the responses, when analysed with respect to other information given on the questionnaires, particularly with respect to the type of project and the comments with respect to the methods and tools used. The development life-cycle model element of the framework was eventually coded on the basis of a two-point scale (i.e. one of two extremes: 1 or 7 on a seven-point scale), with the timescale recorded but not used in the final analysis.

Question 5

The responses were coded according to their response along a number of Likert scales, rated from 1 to 7. For the first three factors, the coding method used was as follows:

Interpretation	Hard			Mean			Soft
overall emphasis	1	2	3	4	5	6	7
approach to reqs. definition	7	6	5	4	3	2	1
approach to system design	1	2	3	4	5	6	7

The interpretation of these three parts of question 3.5 gives a measure of the philosophical approach to software/system development. If an approach is "hard", it is concerned mainly with technical and functional priorities. If it is "soft", it is concerned most with business and organisational factors. As with all quantitative analysis of this type, the mean is expected to be halfway between the two, assuming a Gaussian distribution over the whole population.

Question 6

This question was phrased as an "open" question, so that it could be used in an exploratory manner. Responses were coded into appropriate classifications, as follows:

	<i>Main Approach To Project Management</i>	<i>Main Approach To System Development</i>
1	Resource/time mgt	Structured approach
2	Quality/risk mgt.	CASE
3	Document Validation	RAD/JAD
4	In-House Change control	DBMS
5	Informal	Acceptance test/change control
6		BPR
7		Informal
8		User-participation tools
9		Functional prototyping

Respondents provided sufficient information in this section for all in-house development responses to be classified into this scheme. Contracted-out development project respondents generally left this section blank.

Question 7

Each of these factors represent methods which may be used to involve system users at each phase of the development lifecycle. The methods which were applied by different companies therefore give a measure of their attitude to user-participation in development. Ranking these methods, using a scale where 1 = nominal user-participation to 5 or 6 = integrated user development participation, the elements can be coded as follows:

<i>Response-code</i>	<i>A. Requirements Analysis</i>	<i>B. Design</i>	<i>C. Implementation & Test</i>	<i>D. Operation</i>
1	1	1	1	1
2	3	2	2	3
3	4	3	3	5
4	2	4	6	4
5	5	5	4	2
6	6		5	

User-responses were measured against the highest score obtained on each part. The 5- or 6-point scales were adjusted to values corresponding to a 7-point scale, so that results could be compared with other elements of the conceptual framework.

Question 8

Responses to this question were combine with responses to other questions to ascertain whether the company had performed the main IT-system development in-house or had contracted out this function. With no exceptions, the respondents had made this perfectly clear, often with additional comments written on this part of the questionnaire.

Question 9

Responses to the first part of this question (the extent to which user-involvement and participation helped in the process of IT-related change) were used as an additional insight into the data obtained from question 7.

Responses to the second part (the extent to which approaches to planning and project management helped in the process of IT-related change) were used, in combination with a qualitative assessment of the project management methods and tools, to provide a measure of the extent of formality in the project management and control. Again, comments were often written on the questionnaire for this question; these were used in combination with other comments written in response to question 10 and elsewhere, to provide additional data for this assessment.

Question 10

This question was used as qualitative data, to provide an insight into the respondents' own perceptions of the project.

APPENDIX 3: LONGITUDINAL STUDY AT FTEL:
SCHEDULE OF DESIGN MEETINGS

The following table summarises the main research contacts: attendance at design meetings and workshops or special interviews, over the period of the study. Short interviews/review sessions with design-team members were conducted at the beginning or end of most design meetings attended: these are not shown separately here.

Date	Purpose
19/09/95	First research meeting with IS Manager
7-11-95	First meeting of design team (<i>prior to my involvement</i>).
14-11-95	Second meeting of design team (<i>prior to my involvement</i>)
17-11-95	<i>I was introduced to project.</i> (Second research meeting with IS Manager)
27/11/95	Design meeting: To specify outline flow-charts for Stages 2 and 3 of Tender Bid Process
01/12/95	Design meeting: To decompose process stage 4 (but participants decided they did not understand what was going on overall, so decided to re-examine overall process as a whole).
26/01/96	Design meeting: Gavin Ray - handover of design as leaving company
30/1/96 - 2/1/96	<i>Interviews with individual design team members to ascertain their perspectives on the process and objectives for the design.</i>
09/02/96	Design meeting: To finalise stages 1 & 2 then discuss how to run pilot study, using "live" tender.
16/02/96	Design meeting: To discuss new version of MSOR production DFD and to refine flowchart for stage 4
08/03/96	Design meeting: To discuss suitability of MSOR for Tender process use and to refine flowchart for stage 4 - main input from CB
12/03/96	Special Meeting: to agree tender observation process with Commercial representatives.
15/03/96	Design meeting: To discuss suitability of MSOR for Tender process use and to determine position with respect to Tender pilot study.
22/03/96	Design meeting: To understand Tender process interfaces with company's business planning processes and documentation produced by the latter.
29/03/96	Design meeting: To clarify operation of early stages of process for Tender pilot study.
02/04/96	Design meeting: To clarify current position with respect to design progress, for presentation to MD
19/04/96	Design meeting: Invited speaker from business planning group, to explain business planning processes.
26/04/96	Design meeting: Invited speaker, Director of Marketing, to clarify business case/business planning interfaces to Tender process.
07/05/96	Design meeting: To discuss: 1. Actions from presentation to MD; 2. The piloting of process stages 2-6; Organisation of training sessions for stage 1 process; IT feasibility.

- 31/05/96 Design meeting: To discuss stage 4 (started at Tuesday meeting of that week) and to re-examine actions required to make stage 1 “business as usual”.
- 4/06/96 - *SSM modelling sessions with individual design team members to ascertain their perspectives on the process and objectives for the design.*
- 6/06/96
- 07/06/96 Design meeting: To discuss stage 4 of process.
- 02/07/96 Design meeting: To discuss piloting of stages 2-6; complete stage 4 design and stage 5 design.
- 23/07/96 Design meeting: To review design work schedule and to discuss the pilot study logistics.
- 27/08/96 *I held a facilitated SSM Workshop, to review design boundaries and target system definitions and activities.*
- 16-10-96 Design meeting: to discuss IT system support in context of the second pilot study, which had just been completed.
- 07-11-96 Design meeting: to review success of the second pilot study.
- 21-11-96 Design meeting: to discuss presentation to MD.
- 05-12-96 *Workshop to present my insights from SSM interviews and workshop and to gain insights and feedback from design team concerning process and SSM models.*
- 19-12-96 Design meeting: to discuss design progress, actions for completion and presentation to MD.
- 16-01-97 Design meeting: to fill in gaps in design documentation.
- 27-03-97 Design meeting: to clarify and allocate organisational ownership of stage 4 processes.
- 30-03-97 *End of research involvement (Interview with IS Manager)*

Following the end of my research involvement, I spoke to the IS Manager by telephone and received the following news of the project:












There had been some “political wrangles” in the company, but cross-party agreement had now been obtained to get the process adopted officially. The team was working on a timetable for changes, a review of (external) process documentation and an “educational package” (training programme) for staff, especially marketing staff, from whom there had been most resistance to the new procedures. There were “lots of gaps being revealed in the process” by its use in operation. There had also been a major re-organisation in the company: the company now had two new administrative departments and a new marketing director. There were “lots of new people wanting buy-in”, with more senior people getting involved in the process definition, so process changes were inevitable at this point.

***APPENDIX 4: FTEL ACTION RESEARCH STUDY.
SSM ANALYSIS OF TEAM MEMBERS' PERSPECTIVES
OF DESIGN***

The following sections illustrate the SSM transformations defined/constructed by individual design team members during modelling interviews. The Weltanschauungen given below the transformations give team members own words, taken from tape-recordings of the interviews. Transformations given priority by individuals were decomposed, using SSM analysis and modelling methods (Checkland & Scholes, 1990); deriving these models helped the individual to clarify and modify their transformations. The decomposed models are not included here as they do not add substantially to this analysis (although they were used to feed back alternate perspectives to the team as a whole).

Where a transformation is numbered as a sub-model (e.g. 1, 1a, 1b etc.), this indicates that the initial, single perspective was broken down in the course of deriving the model into multiple perspectives which represent different Weltanschauungen.












The IS Manager

1	BPR process does not satisfy MD's timescale expectations		Process needs revised timescale
2	Many differences in perspective between team members		Shared vision of objectives and mechanisms for achieving objectives
3	Project scope is insufficient to fully achieve objectives of process		Those processes which interface with Tendering process are improved
4.	No formal process for Tender management		Formal process implemented
4a	Lack of ownership for providing effort to respond to tenders		Individual department heads assign effort for this on a planned basis
4b	Lack of planned resourcing for Tenders		Formally planned Tender resource allocation
4c	Individual authoring tools used to generate Tender response sections, so no consistency		Consistent 'look and feel' achieved for all sections of tender responses
4d	Insufficient warning of Tender arrival received		Know all about tender and how to approach it as soon as it arrives
4e	Poor information-flow between those responsible for Tender response preparation		High level of visibility and information exchange between members of response team
4f	Bid resources were far too mechanical (effort geared to responding not to winning Tender)		Responders understand at a deep level what customer requirement is and gear whole flavour of response to winning it
4g	Quality of cost estimates is poor (unnecessary levels of detail gone into)		Minimum endeavour is spent achieving maximum accuracy

The IS Manager was unusually negative when participating in the individual modelling session. Although he is an extremely positive person, at the time, he felt that the problems of the design team lay beyond their scope of action. Because of this, the transformations which he suggested tended to be issue-based (concentrating upon problems or issues for action), rather than primary-task transformations, concentrating upon system purpose (Checkland & Scholes, 1990). The IS Manager's priorities were transformations:

- 2 *"There are difficulties in establishing a common vision": this would "accelerate the process, make the design task easier and improve the quality of the outcome"*
- 3 *Because the process was "bound up in other business processes"*
- 4a & 4b *[Insufficient time to explore reasons for these fully]*

The Process Improvement Manager

1	Informal process for order-capture (could not cope with volume of work)		More formal process to cope with volume, with more planning & control
1b	Business position at start of business process redesign project, struggling to cope with volume of orders		Business has changed: volume is no longer the issue; quality and presentation of response is the issue.
2	No business process management		Business has changed in last 6 months - need to define new procedures and resources.
3	Customer has a problem which needs to be solved		Customer problem resolved
4	Expectation that BPR can be performed part-time		A number of people own the process of BPR full-time.
5	No clear, short-term BPR goals		Maintain short-term goals
6	BPR team go for short-term, quick wins on existing process		Long-term 'designed' process solution with agreed delivery date.
7	Ineffective business processes		Regularly-reviewed, effective, low-cost, high-quality business processes.
8	Customer requirements		Proposal for an innovative solution to customer requirements
9	Competitor offerings		Differentiated response from competitors
10	Need for well-presented response		Need is met






The Process Improvement Manager's priorities were transformations:

- 8 *As the company needs to differentiate itself from other companies*
- 9 *In order to ensure company survival through development of effective, long-term product strategies*
- 10 *To make the company's response more attractive in the customer's eyes, to win the business.*

The Process Improvement Manager also identified important problems with the design process in the following transformations:

- 4 *The company needs full commitment to business process reengineering for this to work; the company could save a lot of time, in the long term, by adopting this approach*
- 6 *"Many [defined] sub-processes are historic, rather than necessary to achieve the objectives of the process".*

The Business Development Manager

1	High degree of informality in tender process		More managed Tender process
2	Elements feeding into Tender process ill-defined		Documented, defined inputs to Tender process
3	Customer contact people do not notify Tender Manager of likely opportunities		Tenders do not take Tender Manager by surprise
4	High degree of informality in "current setup". There are lots of elements feeding into Tender arrival, these are not well-understood.		Better-controlled and defined marketing interface, with Tender Manager having full-knowledge of arriving Tenders and customer visit reports available.
5	FTEL cannot estimate product costs accurately for Tender responses		Accurate product costs can be estimated for Tender responses

6 Cost of process of Tendering is unknown



Cost of tendering is known and considered in decision whether to respond

The Business Development Manager's priorities were transformations:

- 1 as more explicit system control would relieve time constraints, and "bring resourcing issues into the open" - he conceptualised this as being controlled by a computer-based support system
- 2 as "there is no common point of reference within the company"; defining the system explicitly "would give people a better idea of what's going on"
- 5 because it takes too long to produce Tender cost estimates, as too much detail is used
- 6 the company needs a "more scientific" view of which tenders they ought to respond to; tenders are not prioritised against each other on the basis of the likely outcome and the effort/cost involved in responding to an invitation to tender.

The Business Development Manager's reflections on the process of design were:

- ◆ The use of flowchart diagrams was not well-understood, so there was "some learning" at the beginning of the design process.
- ◆ The large design group (six/seven people) meant that discussions were fragmented and argumentative. More subgroup activity (splitting groups into smaller, task-focussed groups of 2-3 people) could be productive.
- ◆ Design team members were over-constrained by time and the demands of their functional work.
- ◆ The team was "stuck, because we don't have a Tender to work on". The team depended too much on "theoretical ideas" about the target system, which they did not have the opportunity to put into practice.

The Tender Manager

1 Bid-process centred on Tender Manager's role



Bid process handled by business as a whole

2 Tender response relies upon a memo or informal arrangements between individuals



Regardless of type of Tender of which groups are involved, go through the same basic procedure to get output at the end of the day

3 People do not know what is expected of them



People prepare documentation in advance, when they first identify Tender opportunity

4 Tender arrives



Response to Tender despatched

5 Do not know/have:
*business case; *statement of customer requirements; *cost estimates; *product descriptions; *some technical information¹; *commercial agreements with Third-Party suppliers



Do have required information and agreements













The Tender Manager's priorities were transformations

- 1 An increased chance of success in winning the business would be achieved as a better Tender response would be submitted, with "less wasted time and effort",
- 2 Re-use of existing paperwork would save effort and mean that system actors "haven't got to reinvent the wheel each time",
- 3 System participants need to be aware of Tender opportunities: "to give them more time to consider and do the work when the Tender hits us".

The Tender Manager appeared to be very task-focussed, conceptualising the target system in terms of the detail of what was done now, rather than the purpose of the system and not appearing to have reflected upon the process of design, so his transformations and their associated Weltanschauungen were concerned with details of the existing process, rather than an overview of system problems. There were many implicit problems in his system definitions, which it took some time to explore.

¹ Mean-time between failures, power consumption, temperature ranges, etc.

The Project Engineering Manager

1	Takes an inordinate amount of time to respond to Tenders which was not allowed for in resource plans		Senior management acknowledge that servicing Tenders should affect business as normal
2	Tenders are unexpected		Some advance warning of and preparation for Tenders
3	Tender process is a limited, self-contained process which needs minor modification		There are much more fundamental business operation issues and concerns involved, including soft, political and people issues.
4	Engineering group drive content of Tender response		Marketing group drive content of Tender response (deliverables)
5	Recognition of a problem with existing processes		Report and recommendations for ways of implementing changes which BPR Team believe necessary
6	Boundaries ill-defined for BPR project		Boundaries are re-defined to address existing and proposed business interfaces
7	BPR Team do not have any knowledge of how Marketing front-end processes work or wish to operate		Expertise in this area is present in BPR Team, bringing automatic buy-in/sponsorship from this area of the business
8	Serious issues omitted from wider discussion in Team presentations (issues of people/politics)		Board is aware of serious issues and takes action.
9	Team may be suffering from a credibility problem due to non-delivery		Team delivers major business value
10	Departments are autonomous and defensive		Need project team mentalities rather than matrix arrangement
11	Piecemeal adoption of parts of 'designed' processes		Staged, formal adoption of complete process, properly monitored
12	No end point in sight for BPR team; could wander on for ever with decreasing motivation		Delivered, evaluated process tasks




The Project Engineering Manager's priorities were transformations:

12 *because he felt that team-members were demotivated by a lack of clear objectives, coupled with "an over-concentration on process" and that the method of defining objectives through team consensus in meetings meant that only the most vociferously stated objectives were adopted*

5 *"because the team think that existing ways of doing things are inefficient, over-departmental and slow, but a full feasibility study and understanding of the problems has not really been done"*.

The Project Engineering Manager appeared to take a systemic view to the design, conceptualising the target system as part of much larger systems of work and volunteering Weltanschauungen without being asked.

The Project Management Accountant

1	Narrow focus on getting business		Wider focus on getting business (new customers and/or new people and/or new technology specified
2	Narrow focus on tendering process design		Wider focus on all areas of business (see T1).
3	Serious weaknesses in existing, related business processes		Improved related process:, e.g. product costing

4	Inappropriate customer product specifications without understanding of customer requirements or wider needs		Proactive solution of telecommunications company problems (knowing how products are being used)
5	Unquestioning company organisation (frightened of changing the way in which things are done; just left a culture of job-losses, so no criticism of senior managers)		Confident, questioning organisation - BUT have to prove you have achieved something!
6	Narrow number and type of people involved in BPR team investigations		Wider constituency within the company
7	People not trained in new business procedures		People trained
8	Inaccurate information available on which to base marketing forecasts, with limited ability to influence how FTEL products are used in their market		Accurate and timely marketing information, focused on end-user of products.

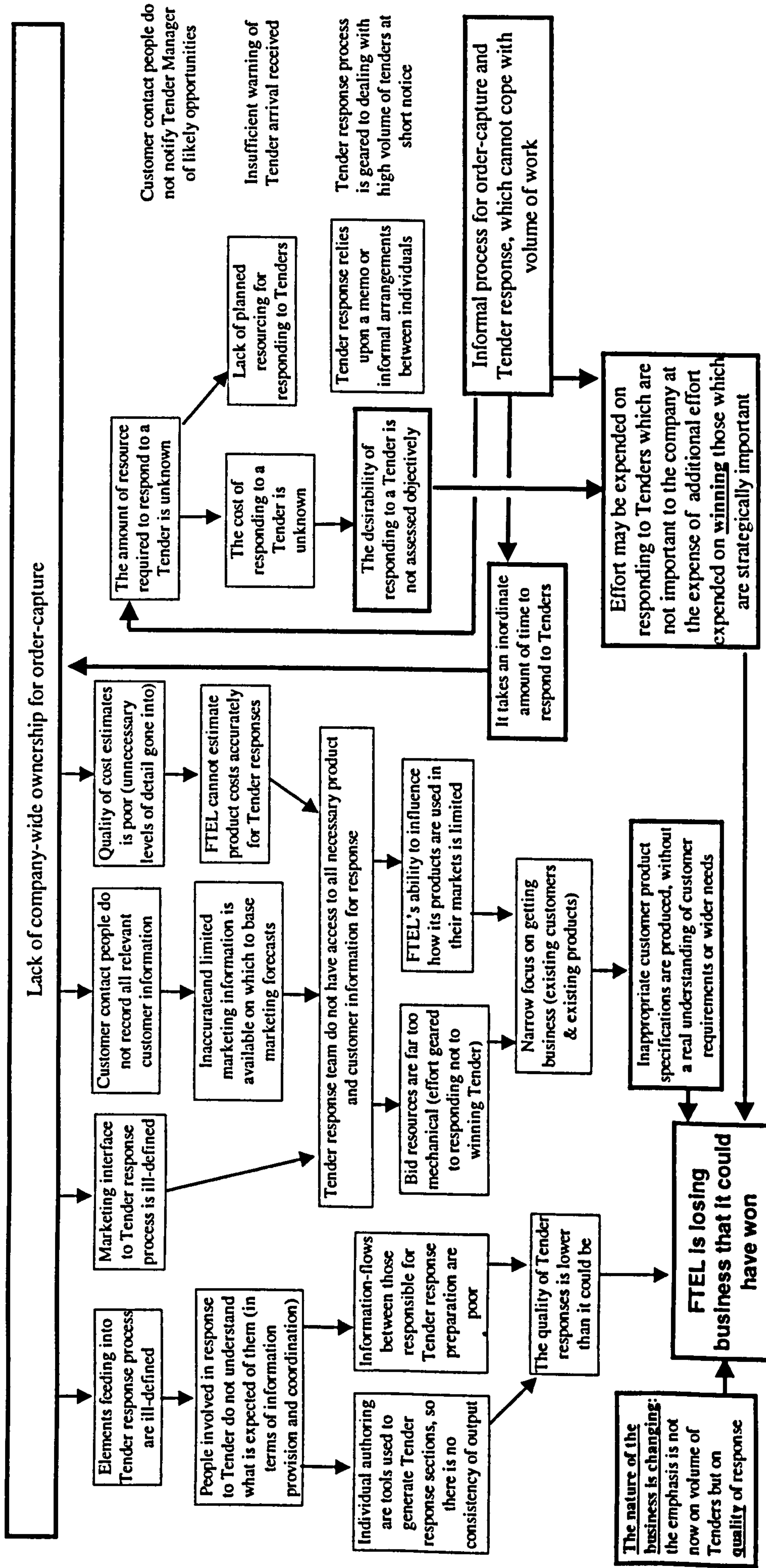
The Project Management Accountant's priorities were transformations:

- 2 *Because of the limited sphere of influence/knowledge of the existing team, and*
- 8 *Because he felt that the company did not have access to accurate customer marketing information.*

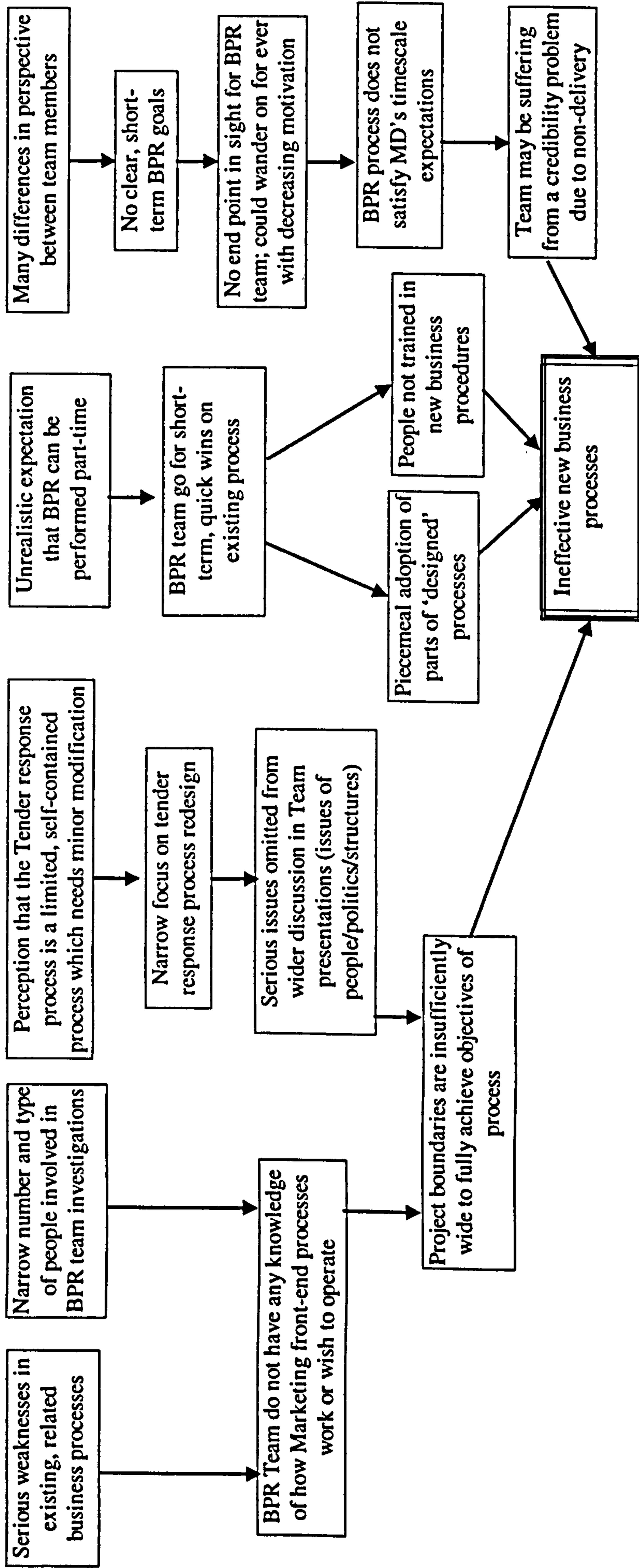
Problem Analyses From SSM Interviews

The diagrams on the following two pages present my synthesis of the various perspectives presented by individuals during SSM interviews, using cause and effect diagrams. While team members broadly agreed with my analysis in the SSM feedback workshop which I instigated, there was insufficient time in the context of this study to use these models for action research, so little detailed validation/feedback was received for the two models.

Problem cause-and-effect diagram for order-capture processes (of which Tender response is a part)



Problem cause-and-effect diagram for business process redesign initiative



***APPENDIX 5: GRAPHS OF SAMPLE DESIGN
CONTRIBUTIONS AT VARIOUS POINTS IN DESIGN***

The following graphs show representative samples from the sequence of design contributions in meeting A (recorded during episode 1, at the start of the project), meeting B (recorded during episode 3, when the project had been running for about three months), meeting C (recorded during episode 5, when the project had been running for about six months) and meeting D (recorded during episode 6, when the project had been running for about a year) respectively. Contributions are graphed by the level of decomposition using the coding scheme described in Chapter 9. Contributions related to meeting management, administrative and social issues were omitted from this coding.

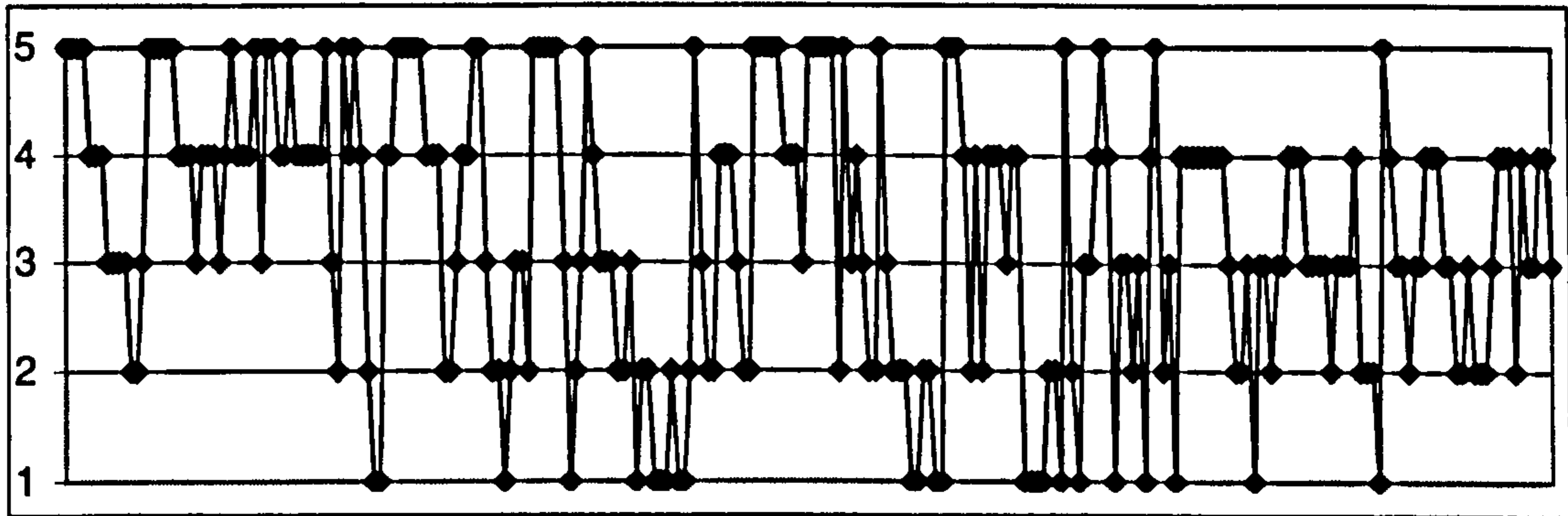


Figure A5.1: Meeting A Sample: Decomposition Levels By Sequence Of Contribution

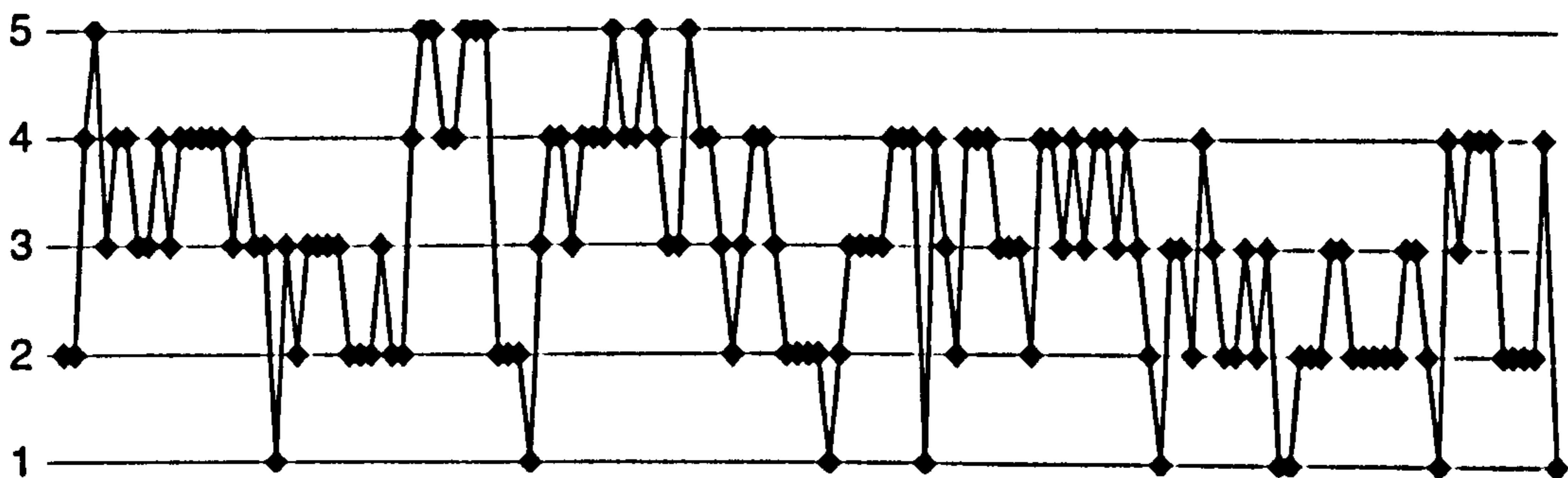


Figure A5.2: Meeting B Sample: Decomposition Levels By Sequence Of Contribution

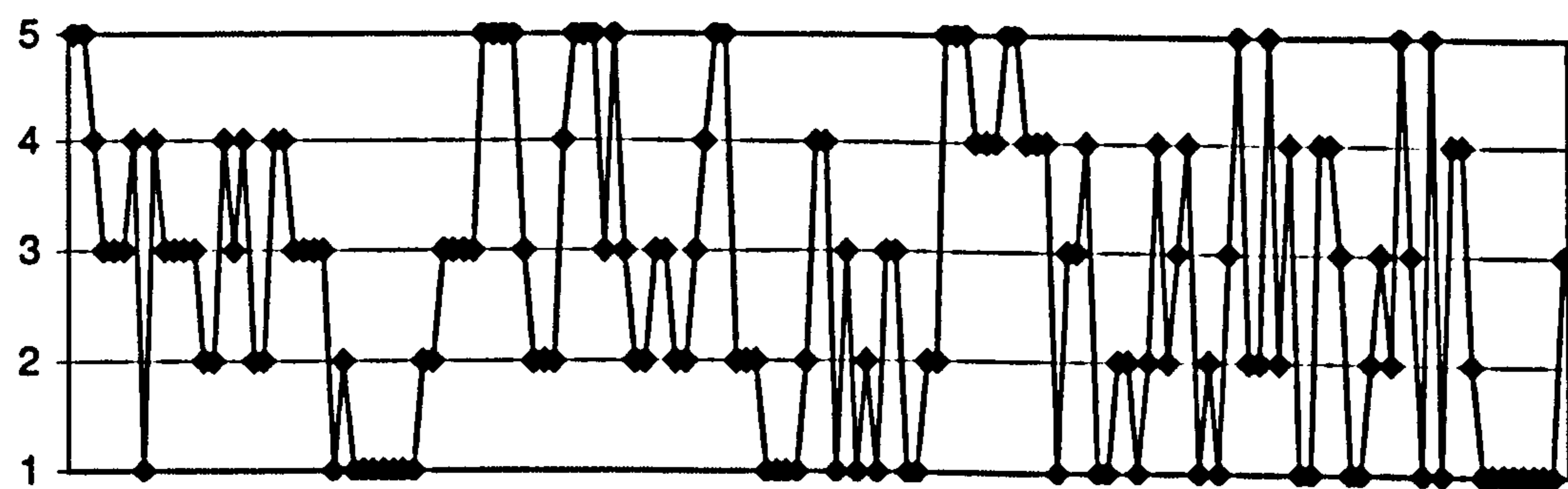


Figure A5.3: Meeting C Sample: Decomposition Levels By Sequence Of Contribution

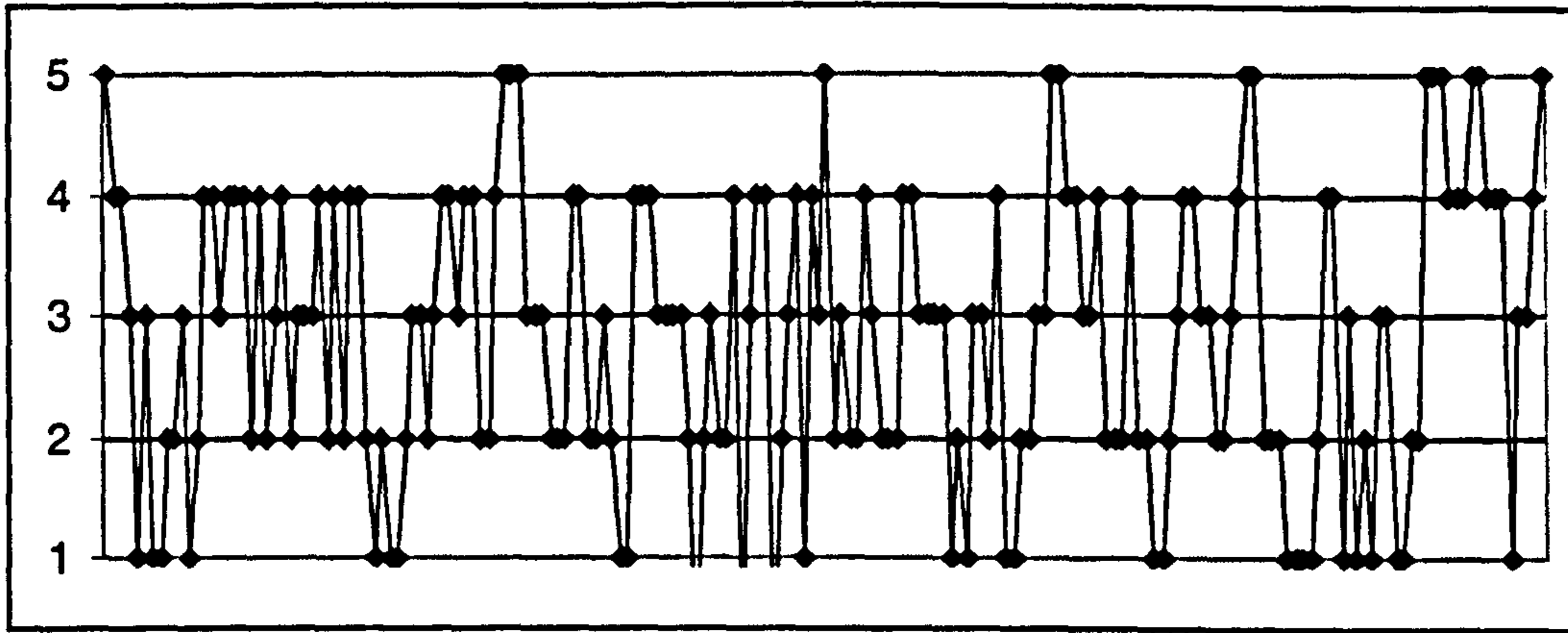


Figure A5.4: Meeting D Sample: Decomposition Levels By Sequence Of Contribution

References

- Ackoff, R.L. (1974) *Redesigning The Future*, Wiley
- Agre, P.E. (1993) 'The Symbolic Worldview: Reply To Vera and Simon', *Cognitive Science*, Vol. 17, pp. 61-69
- Akrich, M (1992) 'The De-Description Of Technical Objects', in W.E. Bijker and J. Law (Eds.) *Shaping Technology/Building Society: Studies In Sociotechnical Change*, MIT Press, Cambridge, MA
- Alexander, C. (1964) *Notes On The Synthesis Of Form*, McGraw Hill, New York
- Amoako-Gyampah, K. and White, K.B. (1993) 'User Involvement and User Satisfaction', *Information and Management*, Vol. 25, pp 1-10
- Anderson, J.R. (1981) *Cognitive Skills And Their Acquisition*, Hillsdale, NJ, Erlbaum
- Anderson, J.R. (1983) *The Architecture of Cognition*, Cambridge MA, Harvard University Press
- Argyris, C. & Schön, D. (1978) *Organizational Learning: A Theory Of Action Perspective*, Addison-Wesley, Reading, Mass.
- Argyris, C. (1987) 'Inner Contradictions In Management Information Systems', in R. Galliers, *Information Analysis, Selected Readings*, Addison-Wesley
- Avison, D.E. & Wood-Harper, A.T., (1991) 'Information Systems Development Research: An Exploration of Ideas In Practice', *The Computer Journal*, Vol 34, No 2
- Avison, D.E. and Wood-Harper, A.T. (1990) *Multiview: An Exploration In Information Systems Development*, Blackwell Scientific Publications, Oxford
- Ball, L.J. & Ormerod, T.C. (1995) 'Structured and opportunistic processing in design: a critical discussion', *Int. Journal of Human-Computer Interaction*, Vol. 43, pp 131-151
- Bally, L., Brittan, J. and Wagner, K.W. (1977) 'A Prototype Approach To Information Systems Design and Development', *Information and Management*, 1, 21-26.
- Bannister, P., Burman, E., Parker, I. Taylor, M., Tindall, C. (1994) *Qualitative Methods In Psychology*, Open University Press, Buckingham, UK
- Bansler, J.P. & Bødker, K. (1993) 'A Reappraisal of structured analysis: design in an organizational context', *ACM Transactions on Information Systems*, Vol. 11, No. 2, pp. 165-193
- Barley, S. (1990) 'Images Of Imaging: Notes on Doing Longitudinal Field Work', *Organization Science*, Vol. 1, No. 3, pp 220-247
- Barki, H. & Hartwick, J. (1989) 'Rethinking The Concept of User Involvement', *MIS Quarterly* March 1989 pp 52-63
- Barki, H. & Hartwick, J. (1994) 'Measuring User Participation, User Involvement and User Attitude', *MIS Quarterly* March 1994 pp 59-82
- Baroudi, J.J., Olson, M.H. and Ives, B. (1986) 'An Empirical Study of the Impact of User Involvement on System Usage and Information Satisfaction', *Communications of the ACM*, Vol. 29, No. 3, pp 232-238
- Baskerville, R., Travis, J. & Truex, D. (1992) 'Systems without method: the impact of new technologies on information systems development projects' in K. Kendall, J. DeGross & K. Lyytinen (Eds.) *The Impact of Computer Supported Technologies on Information Systems Development*, Elsevier Science Publishers, North Holland Press, pp. 241-269
- Baskerville, R., Travis, J. & Truex, D. (1996) 'Amethodical Systems Development: The Deferred Meaning of Systems Development Methods', Working Paper, Department of Informatics and Management Accounting, Copenhagen Business School, ISSN 0903-6571 96/1
- Beath, C.M. & Orlikowski, W. (1994) 'The Contradictory Nature of Systems Development Methodologies: Deconstructing the IS-User Relationship in Information Engineering', *Information Systems Research* Vol. 5, No. 4, pp 350-377
- Berger, P.L. and Luckman, T. (1966) *The Social Construction Of Reality: A Treatise In The Sociology of Knowledge*, Doubleday & Company Inc., Garden City, N.Y.
- Bertalanffy, L. von (1973) *General System Theory*, Penguin, Harmondsworth, UK
- Bjerknes, G. Ehn, P. & Kyng, M. (1987) *Computers and Democracy: A Scandinavian Challenge*, Avebury Gower Publishing Company, Aldershot, UK
- Bjorn-Andersen, N. (1988) 'Conference Overview. An Epistemological and Ontological Classification of the Contributed Papers', *The Computer Journal*, Vol. 31, No. 5, pp386-390
- Bjorn-Andersen, N. (1989) 'Are 'Human Factors' Human?' in H.K. Klein & K. Kumar (Eds.) *Systems Development For Human Progress, Proceedings of IFIP WG8.2*, Atlanta, Georgia, May 1987, Elsevier Science Publishers B.V. (North Holland)
- Bødker, S., Ehn, P., Kammersgaard, J. Kyng, M. & Sundblad, Y. (1987) 'A UTOPIAN Experience: On Design of Powerful Computer-Based Tools For Skilled Graphic Workers' in G. Bjerknes, P. Ehn & M. Kyng (Eds.) *Computers and Democracy: A Scandinavian Challenge*, Avebury Gower Publishing Company, Aldershot, UK
- Boehm, B.W. (1988) 'A Spiral Model Of Software Development And Enhancement', *IEEE Computer Journal*, May 1988

- Boehm, B.W., Gray, T.E. & Seewalt, T. (1984) 'Prototyping Versus Specifying: A Multiproject Experiment', *IEEE Transactions on Software Engineering*, Vol. SE-10, Number 3, pp 290-302
- Boland, R. (1985) 'Phenomenology: A Preferred Approach To Research On Information Systems' in E. Mumford, R. Hirschheim, G. Fitzgerald and A.T. Wood-Harper (Eds.) *Research Methods In Information Systems*, North-Holland.
- Boland, R. and Day, W.F. (1989), The experience of systems design: a hermeneutic of organisational action, *Scandinavian Journal of Management*, 5,2 87-104
- Boland, R J, Tenkasi, R V, Te'eni, D (1994) Designing Information Technology to Support Distributed Cognition, *Organization Science*, Vol 5, No 3, pp 456-475
- Booth, A (1989) *Human-Computer Interaction*, Lawrence Erlbaum Associates, Hove, UK
- Braverman, H. (1974) *Labour And Monopoly Capital: The Degradation Of Work In The Twentieth Century*, Monthly Review Press.
- Briefs, U., Ciborra, C., Schneider, L. (1983) [Eds.] *Systems Design For, With and By The Users*, North-Holland Publishing Company
- Brown, J.S. & Duguid, P. (1992) 'Enacting Design for the Workplace' in P.S. Adler & T.A. Winograd (Eds.) *Usability: Turning Technologies Into Tools*, ACM Press, New York, NY
- Brynjolfsson, E. (1993) 'The Productivity Paradox Of Information Technology', *Communications Of The ACM*, Vol. 36, No. 12, pp 67 - 77
- Buckingham Shum, S., MacLean, A., Bellotti, V. & Hammond, N. (1996) 'Graphical Argumentation and Design Cognition', AMODEUS Project Working Paper, available at: <http://www.mrc-apu.cam.ac.uk/amodeus/>
- Burrell, G. (1983) 'Systems Thinking, Systems Practice: A Review', *Journal Of Applied Systems Analysis*, 10.
- Burrell, G. and Morgan, G. (1979) *Sociological Paradigms and Organisational Analysis*, Heinemann, London.
- Callon, M. (1987) 'Society in the making: The study of technology as a tool for sociological analysis', in W.E. Bijker, T.P. Hughes, and T.J. Pinch (Eds.) *The Social Construction of Technological Systems, New Directions in the Sociology and History of Technology*, MIT Press, Cambridge, MA
- Callon, M. (1991) 'Techno-Economic Networks and Irreversibility', in J. Law (Ed.) *A Sociology of Monsters. Essays on Power, Technology and Domination*, Routledge, London, UK
- Cavaye, A.L.M. (1995) 'User Participation In System Development Revisited', *Information & Management*, Vol. 28, pp 311-323
- Chatzoglou, P.D. & Macaulay, L.A. (1996) 'Requirements Capture and IS Methodologies', *Information Systems Journal*, Vol. 6, pp 195-208
- Checkland, P. (1981) *Systems Thinking, Systems Practice*, John Wiley & Sons, Chichester.
- Checkland, P. & Scholes, J.(1990) *Soft Systems Methodology In Action*, John Wiley & Sons, Chichester
- Child, J. (1972) Organisation Structure, Environment and Performance: The Role Of Strategic Choice. *Sociology*, 6, pp 1-22.
- Child, J. (1984) *Organization: A Guide To Problems And Practice*, Paul Chapman Publishing Ltd.
- Child, J. (1985) 'Managerial Strategies, New technology and the Labour Process', in D. Knights, H. Willmott, and D. Collinson (eds.) *Job Redesign: Critical Perspectives On The Labour Process*, Gower.
- Chua, Wai Fong (1986) 'Radical Developments In Accounting Thought', *The Accounting Review*, Vol. 61, pp 601-632
- Ciborra, C.U. (1987) 'Research Agenda For A Transaction Costs Approach To Information Systems', in R.J. Boland, and R.A. Hirschheim (eds.) *Critical Issues In Information Systems Research*, Wiley.
- Clegg, C (1994) Psychology And Information Technology: The Study Of Cognition In Organisations, *British Journal of Psychology*, 85, pp 449-477
- Cooley, M. (1987) *Architect Or Bee?: The Human Price Of Technology*, Hogarth Press, London
- Corbett, J.M. (1987) 'A Psychological Study of Advanced Manufacturing Technology: The Concept of Coupling', *Behaviour and Information Technology*, No. 6, pp 441-453
- Corbett, J.M. (1989) 'Technically Embedded Constraints On Job Design and How To Overcome Them', *Proceedings Of IFAC Symposium on Skill Based Automated Production*, Vienna, November 1989
- Corbett, J.M. (1990) 'Human Centred Advanced Manufacturing Systems: From Rhetoric To Reality', *International Journal Of Industrial Ergonomics*, Vol 5
- Corbett, J.M. (1992) 'Work At The Interface: Advanced Manufacturing Technology And Job Design', in P.S. Adler & T. Winograd (Eds.) *Usability*, Oxford University Press, UK
- Corbett, J.M. (1995) 'IT And Work Design: The Negotiation Of Expertise' in Scarborough, H. (Ed) *The Management of Expertise*, London, MacMillan.
- Corbett, J.M., Rasmussen, L.B. & Rauner, F. (1991) *Crossing the Border: The social and engineering design of computer integrated manufacturing systems*, Springer-Verlag, London

- Curtis, B. (1987) 'By the way, did anyone study any real programmers?', in G.M. Olson, S. Sheppard, E. Soloway (Eds.) *Empirical Studies of Programmers: Second Workshop*, Ablex, New Jersey
- Curtis, B. (1992) 'Insights From Empirical Studies Of The Software Design Process', *Future Generation Computer Systems* 7, pp139-149, North Holland, Elsevier
- Curtis, B., Krasner, H. and Iscoe, N. (1987) 'Communication Breakdowns and Boundary Spanning Activities on Large Programming Projects', in G.M. Olson, S. Sheppard, E. Soloway (Eds.) *Empirical Studies of Programmers: Second Workshop*, Ablex, New Jersey
- Curtis, B., Krasner, H. and Iscoe, N. (1988) 'A Field Study Of The Software Design Process For Large Systems', *Communications of the ACM*, Nov 1988, Vol 31, No 11, pp 1268-1287
- Curtis, B., Walz, D. (1990) 'The Psychology of Programming in the Large: Team and Organizational Behaviour' in J.M. Hoc, T.R.G. Green, R. Samurçay, D.J. Gilmore (Eds.) *Psychology of Programming*, Academic Press, London, UK
- Dagwell, R. & Weber, R. (1983) 'System Designers User Models: A Comparative Study And Methodological Critique', *Communications of the ACM*, November 1983, Vol. 26, No. 11
- Dahlbom, B. & Mathiassen, L. (1993) *Computers In Context: The Philosophy and Practice Of Systems Design*, NCC Blackwell, Cambridge & Oxford, UK
- Darke, J. (1978) 'The Primary Generator And The Design Process', in W.E. Rogers & W.H. Ittelson (Eds.) *New Directions In Environmental Design Research: Proceedings of EDRA 9*, Washington EDRA, pp 325-337
- Davenport, T.H. (1993) *Process Innovation: Reengineering Work Through Information Technology*, Harvard Business School Press, Boston, MA
- Davidson, E.J. (1993) 'An Exploratory Study of Joint Application Design (JAD) In Information Systems Delivery', *Proceedings of the Fourteenth International Conference on Information Systems*, Orlando, Florida, December 1993
- Davidson, E.J. (1996) *Framing Information System Requirements: An Investigation Of Social Cognitive Processes In Information Systems Delivery*, Phd Thesis, Sloan School of Management, MIT, MA USA
- De Marco, T. (1979) *Structured Analysis and System Specification*, Yourdon Inc.
- Dorst, K. and Dijkhuis, J. (1996) 'Comparing paradigms for describing design activity', in N. Cross, H. Christiaans & K. Dorst (Eds.) *Analysing Design Activity*, John Wiley & Sons, Chichester, UK
- Eason, K.D. (1982) 'The Process Of Introducing Information Technology', *Behaviour and Information Technology*, Vol 1, No. 2, April-June 1982
- Easterby-Smith, M., Thorpe, R. and Lowe, A. (1991) *Management Research: An Introduction*, Sage Publications Ltd., London, UK
- Eden, C., Jones, S. & Sims, D. (1983) *Messing About In Problems*, Pergamon Press, Oxford
- Emery, F.E. & Trist, E.L. (1960) 'Socio-Technical Systems' in C.W. Churchman & M. Verhulst (Eds.) *Management Science Models and Techniques*, Vol. 2, Pergamon Press, Oxford, UK
- Eva, M. & Guildford, S. (1996a) 'A Survey of System Development Methods' in *Proceedings Of OR'38*, Conference of the Operational Research Society, Warwick Business School, University of Warwick, September 1996
- Eva, M. & Guildford, S. (1996b) 'Committed To A RADical Approach? A Survey of System Development Methods In Practice' in N. Jayaratna & B. Fitzgerald (Eds.) *Lessons Learned From The Use Of Methodologies*, Proceedings Of BCS Methodologies SIG Conference, University College Cork, September 1996
- Eysenck, M.W. & Keane, M.T. (1990), *Cognitive Psychology*, Erlbaum, Hove, East Sussex, UK
- Ewusi-Mensah, K. & Przasnyski, Z.H. (1991), "On Information Systems Project Abandonment: An Exploratory Study of Organisational Practices", *MIS Quarterly*, March 1991, pp 67-86
- Feignbaum, D.S. (1968) 'The Engineering and Management of an Effective System', *Management Science*, Vol. 14, No. 12, pp B721-B730
- Finke, R.A., Ward, T.B., Smith, S.B. (1996), *Creative Cognition,: Theory, Research and Applications*, MIT Press, Cambridge, MA
- Fitzgerald, B. (1996a) 'An Investigation Of The Use Of Systems Development Methodologies In Practice' in *Proceedings of 4th European Conference on Information Systems*, Lisbon, Portugal, July 2-4 1996
- Fitzgerald, B. (1996b) 'Formalized Systems Development Methodologies: A Critical Perspective' *Information Systems Journal*, Vol. 6, pp 3-23
- Flanagan, J.C. (1957) The Critical Incident Technique, *Psychological Bulletin*, Vol. 1, pp 327-358
- Flood, R L (1995) 'What is happening when you problem-solve? A Critical Systems Perspective', *Systems Practice*, Vol. 8 No 2, pp 215-222
- Flor, N.V. & Hutchins, E.L. (1991) 'Analyzing distributed cognition in software teams: a case study of team programming during perfective software maintenance', in J. Koenemann-Belliveau, T. Moher & S. Robertson (Eds.) *Empirical Studies of Programmers - Fourth Workshop*, Norwood, NJ: Ablex

- Floyd, C. (1984) 'A Systematic Look At Prototyping', in R. Budde, K. Kuhlenkamp, L. Mathiassen, & H. Zullighoven (Eds.) *Approaches To Prototyping*, Springer-Verlag Books
- Floyd, C. (1987) 'Outline of a Paradigm Change in Software Engineering' in G. Bjerknes, P. Ehn & M. Kyng (Eds.) *Computers and Democracy: A Scandinavian Challenge*, Avebury Gower Publishing Company, Aldershot, UK
- Floyd, C. and Keil, R. (1983) 'Adapting Software Development For Systems Design With The User', in U. Briefs, C. Ciborra, L. Schneider (eds.) *Systems Design For, With and By The Users*, North-Holland Publishing Company
- Fox, J.A. & Tracy, P.E. (1986) *Randomized Response: A Method For Sensitive Surveys*, Sage Publications, Beverly Hills, California, USA
- Franz, C.R. and Robey, D. (1986) 'Organizational Context, User Involvement And The Usefulness of Information Systems', *Decision Sciences*, Vol. 17, pp 329-355
- French, J.R.P & Raven, B. (1960) 'The bases of social power' in D. Cartwright & A.F. Zander (Eds.) *Group Dynamics*, 2nd. edition, Row, Peterson, Evanston, Illinois
- Friedman, A.L. and Cornford, D.S. (1989) *Computer Systems Development: History, Organisation and Implementation*, John Wiley & Sons
- Gadamer, H. (1975) 'Hermeneutics and Social Science', *Cultural Hermeneutics*, Vol. 2, No. 4
- Galliers, R.D. (1987) An Approach To Information Needs Analysis, in Galliers, R.D. [Ed.], *Information Analysis, Selected Readings*, Addison-Wesley
- Galliers, R.D. (1991) 'Choosing Appropriate Information Systems Research Approaches: A Revised Taxonomy', in H-E. Nissen, R.A. Hirschheim, H.K. Klein (eds.) *The Information Systems Research Arena Of The 90s*. IFIP 8.2 Workshop, Copenhagen, Denmark, 14-16 December, 1990, Elsevier Science Publishers, North Holland, Amsterdam, pp 327-345.
- Galliers, R.D. (1992) 'Choosing Information System Research Approaches', in R. D. Galliers (ed.) *Information Systems Research: Issues, Methods and Practical Guidelines*, Blackwell Scientific
- Galliers, R.D. & Sutherland, A.R. (1991) 'Information Systems Management And Strategy Formulation: The 'Stages Of Growth' Model Revisited', *Journal of Information Systems*, Vol. 1, pp 89-114.
- Galliers, R.D. & Swan, J. (1997) 'Against Structured Approaches: Information Requirements Analysis as a Socially Mediated Process, in JF Nunamaker, Jr., & RH Sprague, Jr., (Eds.) *Proceedings of the Thirtieth Hawaii International Conference on System Sciences, Information Systems Track*, IEEE Computer Society Press. Los Alamitos, California, pp 179-187
- Gane, C. & Sarsen, T (1979) *Structured Systems Analysis: Tools and Techniques*, Prentice-Hall, New Jersey
- Gasser, L. (1986) The integration of computing and routine work, *ACM Transactions On Office Information Systems*, Vol. 4, pp 205-252
- Gentner, D. & Stevens, A.L. (1983) *Mental Models*, Erlbaum, Hillsdale, N.J.
- Giddens, A. (1984) *The Constitution Of Society: Outline Of The Theory Of Structure*, Polity Press, Cambridge, UK
- Giddens, A. (1993) *New Rules of Sociological Method*, (Second Edition) Polity Press, Cambridge, UK
- Gilhooley, K.J. (1989) 'Human and Machine Problem-Solving, A comparative Overview' in K.J. Gilhooley (Ed.) *Human and Machine Problem-Solving*, Plenum Press, New York
- Gill, K.S. (1991) 'Summary Of Human-Centred Systems Research In Europe', *Systemist* (the journal of the UK Systems Society) Part 1: Vol 13, No 1, Feb 1991, pp 7-27; Part 2: Vol 13, No 2, May 1991, pp 49-75
- Glaser, B.G. (1978) *Advances in The Methodology of Grounded Theory*, The Sociology Press, Mill Valley, CA
- Glaser, B.G. & Strauss, A.L. (1967) *The Discovery of Grounded Theory*, Aldine Publishing Company, New York
- Goldkuhl, G. & Rostlinger, A. (1993) 'Joint Elicitation of Problems: Important Aspects of Change Analysis', in D. Avison, J. Kendall, J. DeGross (Eds) *Human, Organizational and Social Dimensions of Information Systems Development (A-24) - Proceedings of IFIP WG8.2 Conference*, Noorwijkerhout, The Netherlands, May 1993.
- Guindon, R. (1990a) 'Designing the design process: Exploiting opportunistic thoughts', *Human-Computer Interaction*, No. 5
- Guindon, R. (1990b) 'Knowledge Exploited By Experts During Software System Design', *International Journal of Man-Machine Studies*, Vol. 33, October 1990, pp 279-304
- Hammer, M (1990) 'Reengineering work: don't automate, obliterate' *Harvard Business Review*, Vol. 68, No. 4, pp 104-112
- Hardy, C., Thompson, B. & Edwards, H. (1994) 'Method Use and Customisation in the UK: A Preliminary Survey', in C. Lissoni, T. Richardson, R. Miles, A.T. Wood-Harper, & N. Jayaratna (eds.) *Proceedings of the Conference of the BCS Information Systems Methodologies Specialist Group*, Heriot-Watt University, Edinburgh, September 1994

- Hedberg, B. & Jönsson, S. (1987) 'Designing Semi-confusing Information Systems for Organizations in Changing Environments', in R. D. Galliers (ed.) *Information Systems Research: Issues, Methods and Practical Guidelines*, Blackwell Scientific
- Hedberg, B. and Mumford, E. (1975) 'The Design Of Computer Systems: Man's Vision Of Man As An Integral Part Of The Systems Design Process' in Mumford, E. and Sackman, H. (eds). *Human Choice And Computers*, North-Holland, Amsterdam.
- Heidegger, M. (1962) *Being and Time*, Harper & Row, New York
- Heller, F. (1989) 'Human Resource Management And The Socio-Technical Approach', in *New Technology: International Perspectives On Human Resources And Industrial Relations*, eds G. Bamber and R.D. Lansbury, Unwin Hyman Ltd.
- Hirschheim, R.A. (1985) 'Office Automation: A Social and Organizational Perspective', John Wiley & Sons, Chichester, UK
- Hirschheim, R.A. (1986) 'Participative Systems Design User Experiences, Evaluation And Conclusions', *The Australian Computer Journal*, Vol. 18. No. 4
- Hirschheim, R.A. (1992) 'Information Systems Epistemology: An Historical Perspective', in R. D. Galliers (Ed.) *Information Systems Research: Issues, Methods and Practical Guidelines*, Blackwell Scientific
- Hirschheim, R.A. and Klein, H.K. (1989) 'Four Paradigms Of Information Systems Development', *Communications Of The ACM*, Vol. 32, No. 10.
- Hirschheim, R.A. and Klein, H.K. (1992) 'A Research Agenda For Future Information Systems Development Methodologies', in W.W. Cotterman & J.A.Senn (Eds.) *Challenges and Strategies for Research in Systems Development*, John Wiley & Sons Ltd.
- Hirschheim, R.A. & Klein, H.K. (1994) 'Realizing Emancipatory Principles In Information Systems Development: The Case For ETHICS', *MIS Quarterly*, March 1994, pp 83-109
- Hoos, I.R. (1976) 'Engineers As Analysts Of Social Systems - A Critical Enquiry', *Journal Of Systems Engineering*, Vol.4,No.2. Reprinted in Open University (1981): *Systems Behaviour*, Paul Chapman Publishing
- Hopker, O. (1994) 'Evaluation and Choice of Information Systems Methodologies - A Welsh Perspective', in C. Lissoni, T. Richardson, R. Miles, A.T. Wood-Harper, & N. Jayaratna (eds.) *Proceedings of the Conference of the BCS Information Systems Methodologies Specialist Group*, Heriot-Watt University, Edinburgh, September 1994
- Hornby, P., Clegg, C.W., Robson, J.I., Maclaren, C.I., Richardson, S.C., O'Brien, P. (1992) 'Human and Organizational Issues In Information Systems Development', *Behaviour & Information Technology*, Vol. 11, No. 3, pp 160-174
- Hufnagel, E. M. & Conca, C. (1994) 'User Response Data: The Potential For Errors and Biases', *Information Systems Research*, Vol. 5, No. 1, pp 48-73
- Husserl, E. (1931) *Ideas: General Introduction To Pure Phenomenology*, Macmillan, New York
- Hutchins, E. (1990), 'The Technology of Team Navigation', in J. Galagher, Robert E. Kraut, and Carmen Egidio (eds.) *Intellectual Teamwork: Social and Technological Foundations of Cooperative Work*, Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers. pp. 191-220.
- Hutchins, E. (1991), 'The Social Organization of Distributed Cognition', in Lauren B. Resnick, John M. Levine, and Stephanie D. Teasley (eds.) *Perspectives on Socially Shared Cognition*, Washington, DC: American Psychological Association. pp. 283-307.
- Hutchins, E. (1995) *Cognition in the Wild*, MIT Press, Bradford
- Iivari, J. (1989) 'A Methodology For IS Development As Organizational Change: A Pragmatic Contingency Approach', in H.K. Klein & K. Kumar (Eds.) *Systems Development For Human Progress, Proceedings of IFIP WG8.2*, Atlanta, Georgia, May 1987, Elsevier Science Publishers B.V. (North Holland)
- Jackson, M.C. (1992) An Integrated Programme For Critical Thinking In Information Systems Research, *Journal of Information Systems*, Vol. 2, pp 83-95
- Jayaratna, N. (1986) 'Normative Information Model-Based Systems Analysis And Design (NIMSAD): A Framework For Understanding And Evaluating Methodologies', *International Journal Of Information Management*, Vol. 8, pp 43-53.
- Jayaratna, N. (1994) *Understanding and Evaluating Methodologies, A Systemic Framework*, McGraw Hill, 1994
- Jeffries, R., Turner, A.A., Polson, P.G. & Atwood, M.E. (1981) 'The Processes Involved In Designing Software', in J.R. Anderson (ed.) *Cognitive Skills And Their Acquisition*, Lawrence Erlbaum Associates, Hillsdale, New Jersey
- Jenkins, A., Naumann, J. & Wetherbe, J. (1984) 'Empirical Investigation of Systems Development Practices and Results', *Information and Management*, 7, pp 73-82
- Kalton, G. (1983) *Introduction To Survey Sampling*, Sage Publications, Beverly Hills, California, USA

- Kappelman, L.A. & McLean, E.R. (1992) 'Promoting Information System Success: The Respective Roles of User Participation and User Involvement', *Journal of Information Technology Management*, Vol 3, No. 1, 1992, pp 1-12
- Kautz, K. & McMaster, T. (1993) 'The Failure To Introduce System Development Methods: A Theoretical And Practical Study', in J.P. Bansler, K. Bødker, F. Kensing, J. Nørbjerg and J. Pries-Heje (Eds.) *Proceedings of 16th IRIS*, University of Copenhagen, Denmark, Aug. 1983
- Keen, P.G.W. (1984) 'Building the Information Systems Research Community' *Information Technology Training*, Nov.
- Keen, P.G.W. (1987) 'MIS Research: Current Status, Trends and Needs', in R.A. Buckingham, R.A. Hirschheim, F.F. Land, and C.J. Tully (eds.) *Information Systems Education*, BCS, Cambridge
- Khushalani, A., Smith, R. & Howard, S. (1994) 'What Happens When Designers Don't Play By The Rules: Towards a Model of Opportunistic Behaviour In Design', *Australian Journal of Information Systems*, May 1994, pp 13-31
- King, S. & Galliers, R. (1990) 'An evaluation of four models of information system development from a CASE perspective', *Warwick Business School Working Paper No. 78*, Warwick Business School, University of Warwick, Coventry CV4 7AL, UK
- Kirsch, L.J. & Beath, C. M. (1996) 'The enactments and consequences of token, shred and compliant participation in information systems development', *Accounting, Management and Information Technology*, Vol. 6, No. 4, pp 221-254
- Klein, H.K. , Hirschheim, R. & Nissen, H-E. (1991) 'A Pluralist Perspective of the Information Systems Research Arena' in H-E. Nissen, H.K Klein and R.A. Hirschheim (eds.) *Information Systems Research: Contemporary Approaches & Emergent Traditions*, Proceedings of the IFIP TC8/WG 8.2 Working Conference on the Information Systems Research Arena of the 90's, Denmark 14-16 December, 1990, Elsevier Science Publishers, North Holland, Amsterdam, pp 1-26.
- Kling, R. & Scacchi, W. (1982) 'The Web of Computing: Computer Technology as Social Organization' in M.C. Yovits (Ed.) *Advances In Computers*, 21, Academic Press, New York, pp 1 - 90
- Krasner, H., Curtis, B. & Iscoe, N. (1987) 'Communication breakdowns and boundary spanning activities on large software projects', in G.M. Olson, S. Sheppard, E. Soloway (Eds.) *Empirical Studies of Programmers: Second Workshop*, Ablex, New Jersey, pp 65-82
- Kuhn, T.S. (1970) *The Structure Of Scientific Revolutions*, University of Chicago Press
- Kumar, K. & Bjorn-Andersen, N. (1990) 'A Cross-Cultural Comparison Of IS Designer Values', *Communications Of The ACM*, May 1990, Vol. 33, No. 5, pp 528-538
- Lacity, M. & Hirschheim, R. (1995) *Beyond The Information Systems Outsourcing Bandwagon*, John Wiley & Sons, Chichester, UK
- Land, F. (1987) 'Adapting To Changing User Requirements', in R. Galliers (ed.) *Information Analysis, Selected Readings*, Addison-Wesley.
- Land, F. (1992) The Information Systems Domain, in Galliers, R. (Ed.) *Information Systems Research*, Blackwell Scientific
- Land, F. and Hirschheim, R. (1983) 'Participative Systems Design: Rationale, Tools and Techniques', *Journal Of Applied Systems Analysis*, Vol. 10.
- Lanzara, G.F. (1983) 'The Design Process: Frames, Metaphors And Games', in U. Briefs, C. Ciborra, L. Schneider (eds.) *Systems Design For, With and By The Users*, North-Holland Publishing Company
- Latour, B. (1987) *Science in Action*, Harvard University Press, Cambridge, MA
- Latour, B (1991) 'Technology is society made durable', in J. Law (Ed.) *A Sociology of Monsters. Essays on Power, Technology and Domination*, Routledge, London, UK
- Latour, B (1992) 'Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts' in W.E. Bijker and J. Law (Eds.) *Shaping Technology/Building Society: Studies In Sociotechnical Change*, MIT Press, Cambridge, MA
- Laukkanen, M. (1994) 'Comparative Cause Mapping of Organizational Cognitions', *Organization Science*, Vol. 5, No. 3, reprinted in J.R. Meindl, C. Stubbart, J.F. Porac (Eds.) *Cognition Within and Between Organizations*, Sage Publications, California, 1996
- Lave, J. (1988) *Cognition In Practice: Mind, Mathematics And Culture In Everyday Life*, Cambridge University Press, Cambridge, UK
- Lave, J. (1991) 'Situating Learning In Communities of Practice' in L.B. Resnick, J.M. Levine, S.D. Teasley (Eds.) *Perspectives on Socially Shared Cognition*, American Psychological Association, Washington DC, pp 63-82
- Lave, J. & Wenger, E. (1991) *Situated Learning: Legitimate Peripheral Participation*, Cambridge University Press, Cambridge, UK
- Law, J. (1992) 'Notes On The Theory of the Actor-Network: Ordering, strategy and Heterogeneity' *Systems Practice*, Vol. 5, No. 4, pp 379-393

- Law, J. & Callon, M. (1992) 'The Life and Death of an Aircraft: A Network Analysis of Technical Change' in W.E. Bijker and J. Law (Eds.) *Shaping Technology/Building Society: Studies In Sociotechnical Change*, MIT Press, Cambridge, MA
- Lawson, B. (1990) *How Designers Think*, The Architectural Press, London, UK (Second Edition).
- Lea, M., O'Shea, T. & Fung, P. (1995) 'Constructing The Networked Organisation: Content and Context in the Development of Electronic Communications', *Organization Science*, Vol. 6, No. 4, pp 462-478
- Leavitt, L. (1972) *Managerial Psychology*, University of Chicago Press
- Lee, A. S. (1991) 'Integrating Positivist and Interpretive Approaches to Organizational Research', *Organization Science*, Vol. 2, pp 342-365
- Lewis, C, Rieman, J. & Bell, B. (1996) 'Problem-Centred Design For Expressiveness and Facility in a Graphical Programming System' in T.P. Moran & J.M. Carroll (Eds.) *Design Rationale: Concepts, Techniques and Use*, Lawrence Erlbaum Associates, Mahwah, NJ
- Lientz, B.P. and Swanson, E.B. (1980) *Software Maintenance Management, A Study Of The Maintenance Of Computer Application Software In 487 Data Processing Organizations*, Reading, Mass., London, Addison-Wesley
- Lowe, A. (1996) 'An Explanation Of Grounded Theory', Working Paper, Dept. Of Marketing, University of Strathclyde
- Lyytinen, K. (1987) 'A Taxonomic Perspective Of Information Systems Development Theory', in R.J. Boland, and R.A. Hirschheim (eds.) *Critical Issues In Information Systems Research*, Wiley.
- Mackenzie, D.A. & Wajcman, J. (1985) 'Introduction' to Mackenzie, D.A. & Wajcman, J. (eds) *The Social Shaping Of Technology*, Open University Press, Milton Keynes
- Maclean, A., Bellotti, V. & Young, R. (1990) 'What Rationale Is There In Design?' in D. Diaper et al. (Eds.) *Human-Computer Interaction Proceedings of INTERACT '90*, Elsevier Science Publishers B.V. (North-Holland)
- Maclean, A., Bellotti, V. & Schum, S. (1993) 'Developing The Design Space With Design Space Analysis' in T.P. Moran & J.M. Carroll (Eds.) *Design Rationale: Concepts, Techniques and Use*, Lawrence Erlbaum Associates, Mahwah, NJ
- Maddison, R., Baker, G., Bhabuta, L., Fitzgerald, G., Hindle, K., Song, J., Stokes, N. & Wood, J. (1984) 'Feature Analysis of Five Information Systems Methodologies', in T. Bemelmans (Ed.) *Beyond Productivity: Information Systems Development For Organizational Effectiveness*, Elsevier Science Publishers, North Holland Press, pp 277-306
- Madsen, K.H. (1989) 'Breakthrough By Breakdown: Metaphors and Structured Domains' in H.K. Klein & K. Kumar (Eds.) *Systems Development For Human Progress, Proceedings of IFIP WG8.2*, Atlanta, Georgia, May 1987, Elsevier Science Publishers B.V. (North Holland)
- Malhotra, A., Thomas, J., Carroll, J. & Miller, L. (1980) 'Cognitive Processes In Design', *International Journal of Man-Machine Studies*, 12, pp 119-140
- Markus, H. & Zajonc, R. B. (1985) 'The Cognitive Perspective in Social Psychology', in G. Lindzey & E. Aronson (Eds.) *The Handbook Of Social Psychology*, (3rd Ed., Vol. 1) Random House, New York, pp 137-230
- Markus, M.L. (1983) 'Power, Politics and Implementation', *Communications Of The ACM*, Vol 26, No. 6
- Markus, M.L. (1984) *Systems In Organisations*, Pitman
- Markus, M.L. & Bjorn-Andersen, N. (1987) 'Power over users: its exercise by system professionals', *Communications of the ACM*, June 1987, Volume 30, Number 6, pp 498-504
- Mathiassen, L. & Stage, J. (1992) 'The Principle of Limited Reductionism In Software Design', *Information Technology & People*, Vol. 6, No. 2, pp 171-185
- Mayer, R.E. (1989) 'Human Nonadversary Problem-Solving' in K.J. Gilhooley (Ed.) *Human and Machine Problem-Solving*, Plenum Press, New York
- Methlie, L.B. (1980) 'Systems Requirements Analysis - Methods And Models', in H.C. Lucas, F.F. Land, J.J. Lincoln, K. Supper (Eds.) *The Information Systems Environment*, Proceedings of IFIP WG8.2, Bonn 1979, North-Holland Publishing Company
- Mingers, J. (1984) 'Subjectivism and Soft Systems Methodology', *Journal of Applied Systems Analysis* Vol. 11, pp 85-103
- Mingers, J. (1996) 'Exploring the Critical Dimension in Multimethodology', Working Paper, Warwick Business School, University of Warwick
- Mintzberg, H. & Waters, J.H. (1985) 'Of Strategies, Deliberate and Emergent', *Strategic Management Journal*, vol. 6, pp 257-72)
- Mitroff, I.I. and Kilmann, R.H. (1975) 'Stories Managers Tell: A New Tool For Organisational Problem Solving', *Management Review*, July 1975, pp 18-28.
- Moran, T. P. & Carroll, J.M. (1996) 'Overview of Design Rationale' in T.P. Moran & J.M. Carroll (Eds.) *Design Rationale: Concepts, Techniques and Use*, Lawrence Erlbaum Associates, Mahwah, NJ
- Morgan, G. (1986) *Images Of Organization*, Sage Publications, California

- Moynihan, T. & O'Connor, N. (1991) 'A Method To Help End-Users Validate The Functional Specification For A Computer System', *Journal of Information Systems*, 1, pp191-206
- Mumford, E. (1972) *Job Satisfaction: A Study Of Computer Specialists*, Longman, London.
- Mumford, E. (1983) *Designing Participatively*, Manchester Business School, UK
- Mumford, E. & Pettigrew, A. (1975) *Implementing Strategic Decisions*, Longman, London
- Mumford, E. & Sackman, H. (1975) *Human Choice and Computers*, North-Holland Publishing Company
- Mumford, E. & Weir, M. (1979), "Computer Systems in Work Design: the ETHICS Method", John Wiley, New York
- Necco, C.R. (1989) 'Evaluating Methods of Systems Development: A Management Survey', *Journal of Information Systems Management*, Vol. 6, Issue 1, pp 8-16
- Neisser, U. (1976) *Cognition and Reality*, W.H. Freeman, San Francisco
- Newell, A. & Simon, H.A. (1972) *Human Problem-Solving*, Prentice Hall
- Newman, M. & Robey, D. (1992) 'A Social Process Model of User-Analyst Relationships', *MIS Quarterly* Vol. 16, Issue 2, June 1992 pp 249-266
- Nolan, R. (1979), "Managing The Crisis In Data Processing", *Harvard Business Review*, Vol. 57, No. 2, March-April 1979
- Norman, D.A. (1986) 'Cognitive Engineering', in D.A. Norman & S.W Draper (Eds.) *User-Centred System Design: New Perspectives on Human-Computer Interaction*, Erlbaum Associates, Hillsdale, New Jersey
- Norman, D.A. (1988) *The Psychology of Everyday Things*, Basic Books, Harper-Collins, USA (Previously published as: *The Design of Everyday Things*. 1990. New York: Doubleday)
- Norman, D.A. (1991) 'Cognitive Artifacts', in J.M. Carroll (Ed.) *Designing Interaction: Psychology At The Human-Computer Interface*, Cambridge University Press, UK, pp 17-38
- Norman, D. A. (1992) 'Turn Signals are the Facial Expressions of Automobiles', Addison-Wesley Publishing Company, Inc.. Reading, MA
- Norman, D. A. (1993) 'Cognition in the Head and in the World: Introduction to the Special Issue on Situated Action', *Cognitive Science*, Vol. 17, No. 1, pp 1-6
- Olle, T.W., Sol, H.G. & Tully, C.J. (1983) *Information Systems Design Methodologies: A Feature Analysis*, North-Holland, Amsterdam
- Olle, T.W., Sol, H.G. & Verrijn-Stuart, A.A. (1982) *Information Systems Design Methodologies: A Comparative Review*, North-Holland, Amsterdam
- Olle, T.W., Sol, H.G. & Verrijn-Stuart, A.A. (1986) *Information Systems Design Methodologies: Improving The Practice*, North-Holland, Amsterdam
- Olson, J.S., Olson, G.M., Storosten, M., Carter, M.R. (1993) 'Groupwork close up: A comparison of the group design process with and without a simple group editor', *ACM Transactions on Information Systems*, Vol. 11, No. 4, pp 321-348
- Olson, G.M., Olson, J.S., Carter, M.R., Storosten, M. (1992) 'Small group design meetings: an analysis of collaboration', *Human-Computer Interaction*, Vol. 7, pp 347-374
- Orlikowski, W.J. (1992) 'The Duality of Technology: Rethinking The Concept of Technology In Organizations', *Organization Science*, Vol. 3, No. 3, Aug 1992, pp 398-427
- Orlikowski, W.J. (1993) 'CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development', *MIS Quarterly*, September 1993, pp 309-340
- Orlikowski, W.J. & Baroudi, J.J. (1991) 'Studying Information Technology In Organizations: Research Approaches and Assumptions', *Information Systems Research*, Vol. 2, No. 1, pp 1-28
- Orlikowski, W.J. & Gash, D.C. (1994) 'Technological Frames: Making Sense of Information Technology in Organizations', *ACM Transactions on Information Systems*, April 1994.
- Orlikowski, W.J. & Robey, D. (1991) 'Information Technology and the Structuring of Organizations', *Information Systems Research*, Vol. 2, No. 2, pp 143-169
- Parnas, D.L. & Clements, J.C. (1986) 'A Rational Design Process: How and Why To Fake It', *IEEE Transactions on Software Engineering*, Vol. SE-12. No. 2, February 1986
- Pettigrew, A.M. (1973) *The Politics Of Organisational Decision Making*. Tavistock, London
- Pettigrew, A.M. (1975) *Towards a Political Theory Of Organisational Intervention*, Human Relations, Vol.28, No.3
- Pettigrew, A.M. (1985) 'Culture & Politics in Organizational Decision-Making', in J.M. Pennings (Ed.) 'Organizational Strategy and Change', Josey Bass, San Francisco
- Pettigrew, A.M. (1990) 'Is Corporate Culture Manageable?' in Wilson, D.C. and Rosenfeld, R.H. *Managing Organisations: Text, Readings and Cases*, McGraw Hill, London, pp 266-272
- Pigeon, N. (1996) 'Grounded theory: theoretical background' in T.E. Richardson, (Ed.) *Handbook of Qualitative Research Methods for Psychology and the Social Sciences*, British Psychological Society, Leicester, UK

- Pigeon, N. & Henwood, K. (1996) 'Grounded theory: practical implementation' in T.E. Richardson, (Ed.) *Handbook of Qualitative Research Methods for Psychology and the Social Sciences*, British Psychological Society, Leicester, UK
- Preece, J., Rogers, Y., Sharp, J., Benyon, D., Holland, S. & Carey, T. (1994) *Human-Computer Interaction*, Addison-Wesley, Wokingham, UK
- Reynolds, M. & Wastell, D. (1996) 'Breaking Down The Social Defences: Enabling Learning With Transitional Objects' in *Proceedings of 4th European Conference on Information Systems*, Lisbon, Portugal, July 2-4 1996
- Rittel, H.W.J. (1972) 'Second Generation Design Methods' Reprinted in N. Cross (Ed.) *Developments In Design Methodology* (1984), J. Wiley & Sons, Chichester, pp 317-327
- Rittel, H.W.J. & Webber, M.M. (1973) Dilemmas in a General Theory of Planning, *Policy Sciences*, Vol. 4, pp 155-169
- Robey, D., Farrow, D.L. & Franz, C.R. (1989) 'Group Process and Conflict in System Development', *Management Science*, Vol. 35, No. 10, Oct 1989, pp 1172-1191
- Rogers, Y. (1992) 'Mental Models and Complex Tasks', in Y. Rogers, A. Rutherford & P.A. Bibby (1992) *Models In The Mind*, Academic Press, London, UK
- Rose, M. (1988) *Industrial Behaviour*, Penguin
- Rosenbrock, H.H. (1981) 'Engineers And The Work That People Do', *IEEE Control Systems Magazine*, Vol 1, No.3 pp 4-8 September 1981. Reprinted in Paton et. al. (1984) *Organisations: Cases, Issues and Concepts*, Paul Chapman Publishing, London
- Rosenbrock, H.H. (1988) 'Engineering As An Art', *AI & Society*, Vol. 2, No. 4, pp 315-320
- Rugs, D. & Kaplan, M.F. (1993) 'Effectiveness of informational and normative influences in group decision making depends on the group interactive goal', *British Journal of Social Psychology*, Vol. 32, pp 147-158
- Rumelhart, D.E. & Norman, D.A. (1981) 'Analogical Process In Learning' in Anderson, J.R. (Ed.) *Cognitive Skills And Their Acquisition*, Hillsdale, NJ, Erlbaum
- Russo, N.L., Hightower, R & Pearson, J.M. (1996) 'The Failure Of Methodologies To Meet The Needs Of Current Development Environments' in N. Jayaratna & B. Fitzgerald (Eds.) *Lessons Learned From The Use Of Methodologies*, Proceedings Of BCS Methodologies SIG Conference, University College Cork, September 1996
- Saarinen, T. (1990) 'System Development Methodology and Project Success', *Information and Management*, Vol. 19, Issue 3, pp 183-193
- Sabherwal, R. & Robey, D. (1993) 'An Empirical Taxonomy of Implementation Processes Based on Sequences of Events in Information System Development', *Organization Science*, Vol. 4, No. 4, pp 548-576
- Sauer, C. (1993) *Why Information Systems Fail*, Alfred Waller Ltd., Henley-On-Thames, UK
- Scarborough, H. (1996) *The Management Of Expertise*, Macmillan Business, Basingstoke:
- Scarborough, H. and Corbett, J.M. (1991) *Technology and Organisation: Power, Meaning and Design*, Routledge.
- Schön, D.A. (1983) *The Reflective Practitioner: How Professionals Think In Action*, Basic Books, NY
- Scott Morton, M. S. (ed.) (1991) 'Introduction' to *The Corporation of The 1990s*, Oxford University Press, New York
- Silverman, D. (1993) *Interpreting Qualitative Data*, Sage Publications, London, UK
- Simon, H.A. (1960) *The New Science of Management Decision*, Harper & Row, New York
- Simon, H.A. (1973) 'The Structure of Ill-Structured Problems', *Artificial Intelligence*, No. 4, pp 145-180
- Simon, H.A. (1981) *Sciences of The Artificial*, Second Edition, MIT Press, Cambridge, MA
- Simon, H.A. (1988) 'Scientific Discovery As Problem Solving', Peano Lecture, reprinted in Egidi, M & Marris, R. (Eds.) *Economics, Bounded Rationality and the Cognitive Revolution*, Edward Elgar Publishing Limited, Aldershot, UK (1992)
- Smircich, L. & Morgan, G. (1982) 'Leadership: The management of meaning', *Journal of Applied Behavioural Science*, Vol. 18, No. 3, pp 257-273
- Sol, H.G. (1984) 'Prototyping: A Methodological Assessment', in Budde, R., Kuhlenkamp, K., Mathiassen, L. and Zullighoven, H. (eds) *Approaches To Prototyping*, Springer-Verlag Books.
- Star, S. L. (1989), 'The Structure of Ill-Structured Solutions: Boundary Objects and Heterogeneous Distributed Problem Solving', in L. Gasser and M. N. Huhns (eds.) *Distributed Artificial Intelligence*, Vol. II. San Mateo, CA: Morgan Kaufmann Publishers Inc., pp. 37-54.
- Star, S. L. (1992), 'The Trojan Door: Organizations, Work and the "Open Black Box"', *Systems Practice*, Vol. 5, No. 4.
- Suchman, L. (1987) *Plans And Situated Action*, Cambridge University Press, MA, USA
- Suchman, L. (1993) 'Response to Vera and Simon's Situated Action: A Symbolic Interpretation', *Cognitive Science*, Vol. 17, No. 1, pp 71-76

- Sumner, M. & Sitek, J. (1986) 'Are Structured Methods for Systems Analysis and Design Being Used?', *Journal of Systems Management*, June 1986, Vol. 37, Issue 6, pp 18-23
- Swartout, W. & Balzer, R. (1982) 'On the inevitable intertwining of specification and implementation', *Communications of the ACM*, Vol. 25, Bo. 7, pp 438-440
- Taylor, F.W. (1947) *Scientific Management*, Harper & Row
- Toren, C. (1996), 'Ethnography: theoretical background' in T.E. Richardson, (Ed.) *Handbook of Qualitative Research Methods for Psychology and the Social Sciences*, British Psychological Society, Leicester, UK
- Torkzadeh, G. and Doll, W.J. (1994) 'The Test-Retest Reliability of User Involvement Instruments', *Information & Management*, Vol. 26, pp 21-31
- Truex, D. and Klein, H.K. (1991) 'A Rejection of Structure as a Basis for Information Systems Development', in R.K. Stamper, P. Kerola, R. Lee and K. Lyytinen (eds.) *Collaborative Work, Social Communications and Information Systems*, Elsevier Science Publishers B.V. (North Holland) IFIP 1991
- Turner, J.A. (1987) 'Understanding The Elements Of Systems Design', in Boland, R.J. and Hirschheim, R.A. (eds.) *Critical Issues In Information Systems Research*, Wiley.
- Van Maanen, J. (1988) *Tales of the Field*, University of Chicago Press, Chicago, IL
- Vera, A.H. and Simon, H.A. (1993) 'Situated Action: A Symbolic Interpretation', *Cognitive Science*, Vol. 17, No. 1, pp 7-48
- Vickers, G. (1980) 'Education In Systems Thinking', *Journal of Applied Systems Analysis*, Vol. 7, pp 3-10.
- Visser, W. & Hoc J-M. (1990) 'Expert Software Design Strategies' in J.M. Hoc, T.R.G. Green, R. Samurçay, D.J. Gilmore (Eds.) *Psychology of Programming*, Academic Press, London, UK
- Vitalari, N.P. & Dickson, G.W. (1983) 'Problem-Solving for Effective Systems Analysis: An Experimental Exploration' *Communications of the ACM*, Vol. 26, no. 11, Nov. 1983 pp 252-260
- Vitalari, N.P. (1984) 'A Critical Assessment of Structured Analysis Methods: A Psychological Perspective' in T.M.A. Bemelmans (Ed.) *Beyond Productivity: Information Systems Development For Organizational Effectiveness*, Elsevier Science Publishers, North Holland
- Waddington, D. (1994) 'Participant Observation' in G. Cassell & G. Symon (Eds.) *Qualitative Methods In Organizational Research*, Sage Publications, London, UK
- Walsham, G. (1993a) *Interpreting Information Systems In Organizations*, John Wiley & Sons, Chichester, UK
- Walsham, G. (1993b) 'Reading the organization: metaphors in information management', *Journal of Information Systems*, No. 3, pp 33-46
- Walsham, G. (1995) 'Interpretive Case Studies In IS Research: Nature and Method', *European Journal of Information Systems*, No. 4, pp 74-81
- Walsham, G. & Waema, T. (1994) 'Information systems strategy and implementation: a case study of a building society', *ACM Transactions on Information Systems*, Vol. 12, No. 2, pp 150-173
- Walz, D., Elam, J. & Curtis, B. (1993) 'Inside A Design Team: Knowledge Acquisition, Sharing and Integration', *Communications of the ACM*, October 1993, Vol. 36, no. 10, pp 63 - 77
- Ward, P. (1991) *The Evolution of structured analysis: Part 1*, American Programmer, Vol. 4, No. 11, pp 4-16
- Wastell, D. (1996) 'The fetish of technique: methodology as a social defence', *Information Systems Journal*, Vol. 6, pp. 25-40
- Wastell, D. & Newman, M. (1993) 'The behavioural dynamics of information system development: a stress perspective', *Accounting, Management and Information Technology*, Vol. 3, pp. 121-148
- Weick, K. (1979) *The Social Psychology of Organizing*, Addison-Wesley, Reading, MA
- Welke, R.J. (1983) 'IS/DSS: DBMS support for information systems development', in C. Holsapple & A. Whinston (Eds.) *Data Base Management Systems*, Reidel, Dordrecht
- Wilkinson, B. (1983) *The Shopfloor Politics Of New Technology*, Gower Press
- Willcocks, L. & Mason, D. (1987) *Computerising Work*, Paradigm Publishing, London
- Wilson, B (1984) *Systems: Concepts, Methodologies and Applications*, John Wiley & Sons, Chichester.
- Wilson, D. (1993) 'Prototyping - A Technique For Participative Information Systems Design', *Journal of Computing and Information Technology*, Vol. 1, No. 4, pp 235-242
- Wilson, M. & Canter, D. (1993) 'Shared concepts in group decision making: A model for decisions based on qualitative data', *British Journal of Social Psychology*, Vol. 32, pp 147-158
- Winograd, T. & Flores, F. (1986) *Understanding Computers And Cognition*, Ablex Corporation, Norwood, New Jersey
- Winograd, T. (1995) 'From Programming Environments To Environments For Designing', *Communications of the ACM*, June 1995, Vol. 38, No. 6, pp 65-74
- Winter, M.C. & Brown, D.H. (1994) 'Thinking Systemically: Information Systems Development, Redressing The Balance', in C. Lissoni, T. Richardson, R. Miles, A.T. Wood-Harper, & N. Jayaratna (eds.) *Proceedings of the Conference of the BCS Information Systems Methodologies Specialist Group*, Heriot-Watt University, Edinburgh, September 1994

- Winter, M.C., Brown, D.H. & Checkland, P.B. (1995) 'A Role For Soft Systems in Information Systems Development', *European Journal of Information Systems*, 4 pp 130-142
- Wolfe, R.A. (1994) 'Organizational Innovation: Review, Critique and Suggested Research Direction', *Journal of Management Studies*, Vol. 31, No. 3, pp 405-431
- Wood, J.R.G. & Wood-Harper, A.T. (1993) 'Information Technology in support of individual decision-making', *Journal of Information Systems*, Vol. 3, pp 85-101
- Wood-Harper, A.T. (1990) 'Characteristics of Information Systems Definition Approaches', in R.L. Flood, M.C. Jackson, & P. Keys (Eds.) *Systems Prospects: The Next Ten Years of Systems Research*, Plenum Press, New York
- Wynekoop, J.L. & Russo, N.L. (1993) 'System Development Methodologies: Unanswered Questions and the Research-Practice Gap', *Journal of Information Technology*, Vol. 10, pp 65-73
- Yin, R. K. (1994) *Case Study research: Design and methods*, Thousand Oaks, CA: Sage Publications. (2nd ed., Applied Social Research Methods Series Vol. 5)
- Yourdon, E. (1989) *Modern Structured Analysis*, Yourdon Press, Englewood Cliffs, New Jersey
- Yourdon, E. (1993) *Yourdon Systems Method: Model-Driven Systems Development*, Yourdon Press, Englewood Cliffs, New Jersey
- Yourdon, E., and Constantine, L.L. (1975) *Structured Design*, Yourdon Press, Englewood Cliffs, New Jersey
- Zhang, J. & Norman, D.A. (1994) 'Representations in Distributed Cognitive Tasks', *Cognitive Science*, Vol. 18, pp 87-122
- Zuboff, S. (1988) *In The Age of the Smart Machine*, Basic Books, New York