

Modelling with managers : participative business modelling for effective strategic decision-making

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MODELLING WITH MANAGERS

Participative Business Modelling For Effective Strategic Decision-Making

Henk Akkermans

MODELLING WITH MANAGERS

Participative Business Modelling For Effective Strategic Decision-Making

(Modelleren Met Managers) (Participatieve Bedrijfs-Modellering Voor Effectieve Strategische Besluitvorming)

PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de Technische Universiteit Eindhoven, op gezag van de Rector Magnificus, prof. dr. J.H. van Lint, voor een commissie aangewezen door het College van Dekanen in het openbaar te verdedigen op dinsdag 27 juni 1995 om 14.00 uur

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prof.dr.ir. J.E. van Aken en prof.dr.ir. W.J.M. Bertrand

Copromotor: dr. J.A.M. Vennix (Katholieke Universiteit Nijmegen)

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TABLE OF CONTENTS

Chapter 1: In	ntroduction	1
1,1,	The Setting For This Book	l
1.2.	Purposes Of This Book	2
1.3.	Who Should Read This Book	3
1.4.	Approaches to Reading This Book	4
Chapter 2: Ef	fective Strategic Decision Making	6
2.1.	A Brief Literature Overview	6
2.2.	The Overall Research Model	
2.3.	Operationalisation of Concepts In The Research Model	
2.4.	Operationalisation of Relations In The Research Model	
Chapter 3: R	esearch Methodology	
3.1.	Design-Oriented Research	
3.2.	Empirical Research	
3.3.	Exploratory Research	
3.4.	Qualitative Research	51
3.5.		
3.6.	Research Validity and Reliability	
Chapter 4: Th	ne Participative Business Modelling Method	62
4.1.	PBM Consultant Attitude	63
4.2.	The PBM Tool Set	
4.3.	Generic PBM Project Design	
4.4.	Managing Problem Contingencies	
4.5.	Managing Organisational Contingencies	
4.6.	Trade-Offs In PBM Project Design	107
Chapter 5: Ca	ase Evaluation Procedure	
5.1.	The Development Of The Evaluation Procedure	
5.2.	Stage I: Data Collection	
5.3.	Stage 2: Display Construction	
5.4.	Stage 3: Causal Case Analysis	
5,5,	Stage 4: Cross-Case Analysis	
Chapter 6: Ca	ase Analysis	
6.1.	Case 1: Redesigning Operations In Newspaper Distribution	146
6.2.	Case 2: Achieving Inter-Business Unit Collaboration In Professional	
	Services	
6.3.	0 0 0	
6.4.	Case 4: Planning Strategy Implementation In Professional Services	
6.5.		
6.6.	Case 6: Understanding Supply Chain Dynamics In Electronics	

Chapter 7: Cross-Case Analysis		
7.1.	PBM Effectiveness	
7.2.	Relations From "Textbook Theories"	
7.3.		
7.4.	Multiple Relation Analysis	
Chapter 8: F	Reflections and Conclusions	
8.1.	Reflections On The PBM Method	
8,2.	Reflections On The Research Model	
8.3.	Reflections On The Evaluation Procedure	
8.4.	Conclusions	
Notes		
Notes To Chapter 2		
Notes To Chapter 3		
Notes To Chapter 4		
Notes To Chapter 5		
Not	es To Chapter 6	
Notes To Chapter 7		
	es To Chapter 8	
Literature R	eferences	
Summary (I	In English)	
Summary (I	in Dutch)	
Curriculum	Vitae	

PREFACE

I have long been interested in helping managers to make decisions with computerised models. This goes back to my early years at college, when I acquired my first programmable pocket calculator. My father, who was a business man, frequently made fairly complex calculations on paper while negotiating with French traders over the phone. I asked him about these calculations and was able to create an algorithm on my calculator that would enable him to take his mind off the calculations and concentrate on the bargaining. All he had to do was to push in a few basic numbers and touch the ENTER button a few times. While I was still feeling fairly smug about the way in which I had managed to squeeze this algorithm into the calculator's tiny memory I noticed that my father kept checking the electronic results with his own hand calculations.... He took the calculator with him to the office for a few weeks but he never really used it.

In retrospect, his behaviour is quite understandable: he did not trust the machine or the algorithm and so he could not trust the outcomes either. In the business world, the allowable margins of error are extremely small; one minor mistake can mean the loss of half a year's profit. In such situations, you use the model that you trust best — in my father's case, his own model on paper. If that was one of the things I learned from my father, it was probably my mother who instilled in me a never-ending desire to learn, to find out how things are, to research things.

These two sides to my personality have stayed with me and are very much present in this book. There is the attempt to create something managers will find useful, and at the same time there is the desire to research how, and why, this might be useful. Business relevance and academic rigour may seem to be two incompatible objectives, but I have had my examples of how it can be done. My first example was Cees Takkenberg. As a management consultant, he hired me whilst I was still a student to develop my first 'decision-support system'. As a university professor, he hired me a few years afterwards to conduct research on how simulation modelling might stimulate managerial learning.

This was at the University of Utrecht, where I met Jac Vennix. Jac is also one who knows how to combine practical relevance with theoretical correctness. From Jac I learned how to facilitate group modelling sessions using system dynamics techniques, the core of the method described in this book. But Jac also taught me how to strive for rigour in researching so-called 'soft' research issues. I will never forget his ultimate question in one of our telephone conversions: "Listen, Henk, what do you want to do? Do you just want to get a doctoral degree or do you actually want to do some proper research?"

However, my research work would never have reached that stage if some people had not believed in me and in what I wanted to do much earlier on. Joan van Aken and Wil Bertrand thought I was fit to become the youngest assistant professor in their department at Eindhoven University five years ago, when I had very little else to show to them than some wild ideas. At BSO/Management Support, Johann de Boer, Jerre Lubberts and Wiebe Cnossen gave me every opportunity to develop this field of socalled 'participative modelling' into a profitable business, once again based mainly upon their confidence in me and in this concept. I doubt if any of these five managers would have made the same decision had they been led by any of my sophisticated 'rational' models....

Over the years I have had the opportunity to learn from a great number of highly-skilled professionals. Among them were Wal van Lierop, Jan Telgen, Tjeu van Lierop, David Kreutzer, Paul Bogerd, Michiel van der Molen and Ivo Wentzler but there were many more. John Morecroft, John Rohrbaugh, George Richardson, John Sterman and Ken Platts were academics who helped me in an early stage in sharpening my research questions; Vincent Peeters introduced me to qualitative data analysis in the final stage of my research project.

For reasons of confidentiality, the people I have had the pleasure of working with in the course of the six projects described in this book must remain anonymous. Nevertheless, I do want to thank them all for their willingness to participate in the extensive evaluation process that was performed after each project. Without their cooperation, this book could not have been written, for who believes only the consultant's assessment of project success?

And then there is the case-evaluation process itself, which has taken place over the last two years. My research assistants Etiënne Rouwette and Jacqueline Bosker conducted all the evaluation interviews. Jacqueline then did a tremendous job of categorising and ordering all the interview material into huge 'matrix displays'. She could not have done so, had not Marjan Verbeek first dutifully transcribed what amounted to well over thirty interviews of one hour's length or more. It was a huge task, I know.

My bosses at BSO/Advies, Bram Kornaat and Harry Wagter, not only sponsored some of Jacqueline's work but were also most gracious in allowing me a substantial sabbatical to write this book. It might perhaps be more accurate to say: "write a *draft* for this book", because that is what the original text looked like without the innumerable improvements to my use of English proposed by Tim Wilkinson. Thanks Tim, for an impressive – and most humbling – job.

For all their kindness and support, it is not to all those wonderful people that I want to dedicate this book. This book is for my wife Pauline, without whom I would probably be incapable of doing anything constructive, let alone write a doctoral dissertation, and for our son, Ruben, whose recent birth put my authorial creation in the proper perspective.

Goirle, April 1995

CHAPTER 1 Introduction

1.1. The Setting For This Book

This book describes a method to improve the effectiveness of strategic decision-making processes. Such a method seems sorely needed because strategic decision-making is getting more and more complex. Not only do managers have to take into account more and more factors when they make decisions, but strategic issues are getting more and more interrelated: everything affects everything else. The accelerating pace of development means that changes which once evolved over several years now unroll within a few months. Meanwhile, competitive pressures mount relentlessly and allowable margins of error are eroded. One consequence, and perhaps the most important, is that strategic decisions are no longer made by the lonely leader at the top. Instead, the emphasis in strategic decision-making has switched to teamwork, with teams consisting of managers and professionals of widely different backgrounds, nationalities, perspectives and objectives.

How can managers cope effectively with such levels of complexity? One way has been to create simplified abstractions, or *models*, of their complex world. Because these models are simplified, they are easier to understand than the real world; because they are artificial, they are also easier to manipulate. With models one can conduct experiments that would be too costly or too risky to conduct in reality. Because one can experiment with them, they lend themselves to experiential learning. And finally, because these models are explicit, they lend themselves to communication with others and to rigorous questioning.

If models are so useful, why do managers use them so rarely? For it is probably safe to say that, for the majority of strategic decisions, little or no explicit modelling is used to support the decision-making process. Some people would say this is because one just cannot model strategic problems adequately; the problems are too vague, they contain too many 'intangibles', and their scope is too broad to capture in a more or less formal model. Others would say that managers lack the skills to understand abstract models or they simply do not trust models.

However, in one sense all managers are modellers; everyone uses *mental models* of reality in making decisions about that reality; we all create some kind of 'mental simulation' when thinking about the likely implications of our actions. So managers do use models to make strategic decisions; it is just that they rarely use formal and explicit models.

The real challenge is, therefore, to see if we can *improve* these managerial mental models by making them more explicit, opening them to discussion, to sharing by others and to creating platforms for understanding other people's perception of reality. Moreover, if these explicit models can be quantified, one can use them to *simulate* the future, and not just one future, but many different futures. The average mental model of a strategic issue can probably be described in terms of several dozens of variables and

relations between those variables. Unfortunately, people are not very good at tracking more than a few of those variables at a time; but that is precisely what computers, dumb as they are, can be very good at.

Given the potential for using formal and explicit models to support strategic decision-making, why then are they so often overlooked by managers? One of the main theses of this book is that this managerial non-usage of models has nothing to do with managers or models but has everything to do with the attitudes of the model-building experts. The traditional approach to modelling for managers has indeed been "modelling for managers". That is: a group of managers outlines the broad nature of a problem to one or more experts in mathematical modelling. The experts go away and analyse the problem as they understand it at that time. In the course of their analysis, they learn a great deal about this problem, quite possibly even to the point of modifying their initial perception of what the problem really is about. A few months later, when their model and analyses are complete and they have formulated their recommendations based on these analyses, they return to their clients. By this time, the client's managers will also have altered their perception of the original problem. Not understanding the exotic terminology and anyway failing to recognise the modellers' description as matching their own perception, the managers not unnaturally have little faith in this model created by outsiders. And because they do not trust it, they have no reason to accept the recommendations that accompanied it - and still less to act upon those recommendations. So the next time a strategic problem arises, the managers are unlikely to waste time and money consulting "those modelling eggheads".

Nothing is wrong with managers, nothing is wrong with models. But much is wrong with the *way* in which managers are usually confronted with models. This book describes a different way. This way is labelled "participative business modelling" or "PBM". This way is different, because PBM means "modelling *with* managers", rather than doing the modelling *for* them. "PBM" stands for:

- *Participation*: PBM stresses full participation of managers in the modelling process. This is the only way by which they will learn about the problem and develop a feeling of ownership for a model and hence confidence in the model.
- Business: PBM uses a language that is addressed to managers in order to involve them in the modelling process a business language and not a mathematical or computer language.
- Modelling: PBM draws on a wide array of different modelling techniques to enter into and sustain the modelling process. Models begin as just collections of keywords that are gradually converted into graphical diagrams which are in turn refined until – if required – they can be translated into formal models for computer-aided manipulation. PBM also explains what kind of modelling technique is appropriate in different situations and how to make the transitions between different kinds of modelling. In this way it bridges the gap between the fuzzy world of managerial mental models and the exact world of computer models in a series of small and logical steps.

1.2. Purposes Of This Book

This book was written for several purposes. Basically, the author wanted to write the sort of guide that would have been helpful to have at his elbow when he first entered the

field of business modelling some six years ago. His needs back then could be reduced to three groups of apparently simple questions:

- 1. How does one conduct a modelling project for strategic issues? What steps does one take, what tools does one use, what are the traps one should watch out for?
- 2. What are practical results of this kind of modelling? What kinds of problems can you use it for and in what kinds of organisations? Where does one find examples of real modelling projects for real managers facing real problems?
- 3. How does one conduct research in this area that is both relevant to business and yet also acceptable to academics (if, indeed, this is an inevitable trade-off)?

This book was written to give answers to all three groups of questions. It describes the PBM method as well as six real projects in which the method was applied. This should make the book relevant to the business world. It also describes in some detail the research methodology that was used to develop and evaluate the PBM method in these six projects. To that extent, the book is also very much addressed to the academic world.

1.3. Who Should Read This Book

The research underpinning this book is multi-disciplinary: it is based upon insights from many different fields of expertise. That was indeed one of the main attractions to the work in the first place, but it has also been a source of complications in writing about this work, for this multi-disciplinarity means that the book has several distinct readerships:

- Management consultants and managers: This book is intended, above all, for management consultants and their clients, managers. PBM is a management consulting method that happens to use special kinds of modelling techniques. Good management consultants are smart enough to pick out from this book those ideas that they feel they can use and incorporate in their repertoire. Good managers will be able to judge from browsing through the relevant chapters of this book whether this method offers an approach they would feel comfortable with, be it applied by consultants, external or internal, or by themselves.
- System dynamicists and other business modellers: The modelling methodology used in PBM is drawn mainly from the field of system dynamics. This approach, which has been around for over thirty years now, is especially suited to model vague, highly complex issues at the level of aggregation that is customary for strategic issues. Seasoned system dynamicists may find little new in this book in this respect, but they may appreciate the detailed description of the PBM version of system dynamics and the descriptions of its application to actual case studies. To the extent that all systems modelling approaches share several important characteristics, experts in many of the other 'business modelling' techniques that have emerged in recent years may likewise draw some benefit.
- Operations management professionals: Although originally intended to develop a modelling-based consulting method to support strategic decision-making in the field of operations management, its soon became apparent that PBM is equally applicable to tackle marketing as well as operational problems, problems in the electronics industry as well as in banking, in government agencies as well as in private organisations. Why, then, a specific focus on operations management professionals? Despite the potential breath of its applicability, no claims are made for PBM as a

cure-all. This book gives criteria to determine where it is best suited and by those criteria, PBM turns out to be particularly well suited to most strategic problems in operations management. The field of operations management has always been a fruitful area for simulation modelling. Perhaps because of this close fit, the improved approach to developing such models which is advocated here should make it doubly relevant.

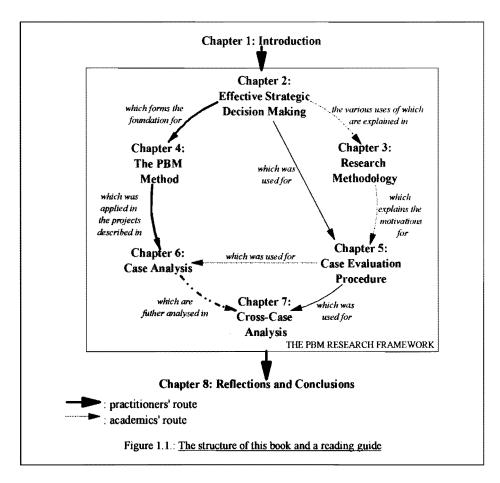
- Academics in organisation and management: It will be evident from the contents
 that this book has a strong research emphasis, addressed primarily to academics in
 the field of organisation and management. The author shares with many working in
 this field the desire to improve organisations, to design better organisational realities
 rather than just describe existing ones. Risky though this enterprise may be, this
 book leans heavily on new developments which seem to be pointing the way for this
 so-called design-oriented methodology in organisation and management studies.
- Qualitative and case study researchers from the social sciences: Social science researchers pursuing work which utilises the relatively new techniques of multiplecase studies and qualitative research may be gratified to find that the research design described in this book is also strongly indebted to methodological advances made in these fields.

1.4. Approaches To Reading This Book

The very diversity of perspectives entertained within this book means that few will read it in its entirely. Two different routes are suggested for those whose interest is primarily practice-oriented or academic as shown in Figure 1.1. This Introduction and the concluding Chapter 8 – the shortest chapters – are pitched to all sets of readership. The core of this book undoubtedly lies in Chapters 4-7 which describe the PBM method itself and how it has been applied to six actual consulting projects, together with some general lessons that were gained from those projects. However, it will be hard to understand these chapters without first reading Chapter 2, tiresome though it may be for some readers, which introduces the theory, or 'research model' of what effective strategic decision-making is and how it can be achieved.

Practically oriented readers are urged to struggle through Chapter 2 and then to read about what the PBM method entails in Chapter 4 before turning to Chapter 6 and the application of the method in six different cases. The cross-case analysis of Chapter 7 may be of less interest, though the first and last sections might be worth browsing through, whilst Chapter 8 provides a concluding assessment of the main research outputs.

Academically inclined readers should also read Chapter 2, and perhaps even glance over some of the notes to that chapter, which contain an assessment of the relevant literature, before proceeding through Chapters 3 and 5, which form the methodological components of this book. The case analysis of Chapter 6 should be of interest, and even more so the cross-case analysis of Chapter 7, which sets causal relations from the research model of Chapter 2 against the combined findings from the six cases. Chapter 8 contains some final messages for this audience too.



One further remark about the use of notes at the end of this book. These are not intended to be read integrally, side by side with the main text. If that had been the intention, they would have been placed as footnotes to the main text. Rather, the notes contain supplementary information, like references to the scientific literature, elaborations of arguments or cross-references to other parts of the book, so their purpose is mainly to provide additional material or indicate where such material might be found.

CHAPTER 2

EFFECTIVE STRATEGIC

DECISION-MAKING

Participative business modelling is a method that aims to accomplish effective strategic decision-making. But what is effective strategic decision-making¹? This Chapter introduces a conceptual model of this broad concept. As will become clear from the subsequent chapters, this conceptual model is of crucial importance not just for applying the method, but also for evaluating its performance. In this sense, the conceptual model guides the entire research process and for this reason is referred to as the *research model*².

A brief reading guide to this Chapter is the following: Sections 2.2. and 2.3. have to be read to grasp the main contents of this research model. Sections 2.1. and 2.4. are optional and intended for an academic audience. In Section 2.1. a brief literature overview is provided of recent viewpoints on what effective strategic decision-making means in a number of relevant scientific disciplines. Section 2.4. describes a number of causal relations between various elements of the research model. This last section is important for the cross-case analysis of Chapter 7.

2.1. A Brief Literature Overview

The founding disciplines for this research

An obvious purpose of a literature overview is to sketch out the scientific fields of endeavour upon which the current research is based. This is somewhat problematic in the present case as the research reported here is strongly multi-disciplinary in nature: it has benefited from insights from many different fields of scientific endeavour. However, the following list of scientific fields covers its main areas of inspiration more or less adequately³:

- Operations Management (OM): The original impetus to conduct this research came from the field of OM, where there has been a strong demand for methods to improve the process of strategic decision-making on OM issues.
- System Dynamics Modelling (SD): Similarly, the main impetus to regard system dynamics as a method suited to tackle strategic issues originally came from the strong emphasis that was placed in the recent SD literature on client involvement, ownership and learning.
- Strategic Management (SM): Interestingly enough, the increasing importance that OM has attached to process-related issues was established a decade or more earlier in the field of strategic management.

- Operations Research/"Soft OR⁴": Similarly, it was found that the emphasis that was placed upon client involvement, learning, etc. in modelling projects had actually already been proclaimed several years before in the field of OR.
- Group (Decision) Support Systems: Currently, practitioners and researchers working on group model building are discovering that they can learn from others who work with groups of managers, as in the field of G(D)SS.
- Organisational Psychology: All these fields are generally new and are primarily interested in applying their methods to groups of managers. But there is, of course, also a long-standing and very diverse tradition of research into (small) group behaviour in its own right, without specific business application interests⁵.

A brief historical overview⁶

A huge number of people, both researchers and practitioners, in many different fields, have occupied themselves with strategic decision-making and ways of making it more effective. It would be a hopeless undertaking to try and give a full overview of all their findings for each of the fifty-five relationships of the full research model described in Section 2.5. The approach chosen for this literature overview has therefore been to select for each of the fields one book⁷ that was felt to provide a fair overview of the state-of-the-art thinking in that field on the issue of how to create an effective decision-making process. These books are in most cases recent compilations of writings from several different authors, and in two cases are literature overviews by highly distinguished authors assessing their own field.

Operations Management⁸

Here we are concerned mainly with "operations strategy", a subset of the broader field of operations management. Operations strategy (or manufacturing strategy, or production strategy, as the field is also sometimes called⁹) really started off with Skinner's path-breaking (1969) article: "Manufacturing-Missing Link In Corporate Strategy".

In the 1970s a number of different strategy frameworks were developed and applied in practice. This development more or less ends in the first half of the 1980s, when attention shifted to Japanese manufacturing techniques¹⁰ Gradually, process-related aspects of operations strategy start to gain in interest as it becomes apparent that these operations strategy frameworks often fail when applied in practice, almost invariable due to process-related factors¹¹. Terry Hill was the first to note this, as early as in 1980¹², but in 1989-1990 interest in process-related aspects reached its peak when both the American and the British Operations Management Associations dedicated their yearly conferences to the theme. Contributions to the 1990 British conference appeared in book format in 1992. It is this book, edited by Chris Voss, that is used as a sample of currently accepted thinking in the field of OM. After 1990, an important theme of the research in this field appears to be the development of frameworks that can address both the content-related and the process-related aspects of strategic decision-making in operations in a synergistic manner¹³.

System Dynamics Modelling¹⁴

A somewhat analogous development has taken place in the field of system dynamics. This field, too, has its founding father, Jay Forrester, who wrote the seminal publication in the 1960s: Industrial Dynamics (1961). Here, too, there was much experimentation with content-related, technical frameworks followed by a period of "soul searching" in the 1980s because implementation appeared to leave something to be desired. Ironically enough, one of the problems of this field may have been the very richness of Forrester's book. The nature of management decision-making, the proper role of models for learning, the need to address soft issues were already highlighted in the original work. A 1978 compilation of "managerial applications of system dynamics"15 contained few new suggestions on how to really apply system dynamics to managers¹⁶. The first concrete proposals for a new way of looking at model building appeared in the mid 1980s and came both from practitioners¹⁷ and from academics¹⁸. This new approach emphasised such things as a process consulting perspective,¹⁹ management participation, the importance of management learning and the need to incorporate knowledge-acquisition and process-structuring tools and techniques from other areas²⁰. So when Peter Senge published his management best-seller "The Fifth Discipline" in 1990, the field was at least conceptually ready for the high exposure to management attention it has since received. In 1992 a special issue of the European Journal of Operational Research contained a number of articles by prominent authors that described various aspects of this new approach. This special issue was republished in 1994 as a separate volume, called "Modelling for Learning Organisations"²¹, which we use here as an overview of the state-of-the-art thinking in system dynamics on how modelling can enable effective strategic decision-making.

Strategic management²²

Ironically, all these process-related insights had been recognised much earlier in the field of strategic management or strategic or corporate planning, as it was originally called. Launched by a seminal publication in the 1960 from another grand old man, Igor Ansoff²³, this field already discovered in the 1970s that such processes as strategic decision-making were definitely not strictly rational²⁴, that there were no rooms "where all these strategic concepts were worked out for the whole company"²⁵; indeed, that managers were not analytical, detached and silent decision makers but action oriented, intuition-driven men and women²⁶. Since then a variety of approaches has been developed in the strategy field, some focusing on managers, some on human relations, some on organisational structures and some on systems theories²⁷. All these approaches share the understanding that strategic decision-making is very much a human process²⁸. A good contemporary example of current thinking in strategic management on effective strategic decision-making and on what models and planning processes can do (or mostly not do) to bring it about is Henry Mintzberg's "The Rise and Fall of Strategic Planning".

Operations Research/"Soft OR"29

The beginnings of Operations Research (or Management Science, as it is called in the USA) are conventionally dated to World War II, but not until around 1979 was there a general recognition that something was wrong with the use of OR in practice. In that

year Russell Ackoff wrote what is still the most frequently quoted article in the field, "The future of OR is past"³⁰. This article touched off a seemingly never-ending stream of articles that debated whether the field still is in "crisis". Nowadays, many mainstream OR/MS adherents still have trouble leaving "the high, hard ground" where the practitioner "can practice rigorously", to venture out into "the swampy lowland where situations are confusing 'messes' incapable of technical solution."³¹. But that is mainstream OR. One movement which takes its origins from mainstream OR, and yet has tried to tackle the process-related issues that are inherent to "messy" strategic problems is labelled "soft OR"³². In "Rational Analysis for a Problematic World"³³ a collection of articles is presented on six UK-based methods³⁴ that can all be labelled as "soft OR". It appears that this field has undergone no dramatic changes since publication of this book³⁵, which is therefore chosen as the representative sample of current enlightened thinking in operations research on the issue of establishing effective strategic decision-making.

Group Decision Support Systems³⁶

"Soft" OR has its roots primarily in the United Kingdom, but the origins of Group (Decision) Support Systems lie almost exclusively in the USA. Moreover, whereas "soft" OR sprang forth from OR/MS, G(D)SS was engendered by research in information systems (IS), primarily in MIS (Management Information Systems) and DSS (Decision Support Systems). Not surprisingly, there has been considerable focus in this area on the use of IT tools, such as electronic brainstorming applications, teleconferencing, user interface designs, E-mailing, Local Area Networks and the like. Yet another difference is the relative novelty of the field, which is also not surprising considering its strong IT-emphasis. Rather than being fuelled by a single seminal publication by one grand old man³⁷, the field has been sustained by path-breaking research at several sites from the mid eighties onwards, notably the University of Arizona³⁸ and Colab at Xerox Park³⁹. A final difference from soft OR is that there has been a relatively large amount of laboratory research in G(D)SS, and far less research on group support in real-world contexts⁴⁰. But all these differences cannot erase the impression that both fields have much in common. Both focus on (small) group decision-making and on process facilitation rather than expert consulting, and both use IT-tools to boost decision-making effectiveness, to mention a few commonalties. The affinities are strong enough for some authors in the soft OR field to identify their field with the term "the UK-approach to GDSS"41.

In 1989 a special issue of the journal *Decision Support Systems* was devoted to a summary of the past ten years of GDSS research by the leading figures of the field. Although some authors characterise their field then as still being in "the horseless carriage phase"⁴², one can already distil quite some useful insights out of this journal issue, which will serve as our sample of the state-of-the-art in the field of GDSS⁴³.

Organisational Psychology44

The field with the longest research tradition is that of organisational psychology or small group research, with roots leading back into the 1920s and 1930s. This field is far too wide to attempt anything but a highly tentative sketch here. For an excellent overview the reader is referred to McGrath's book, which also serves as our literature sample for this field⁴⁵. At least the origins of organisational psychology are easy to

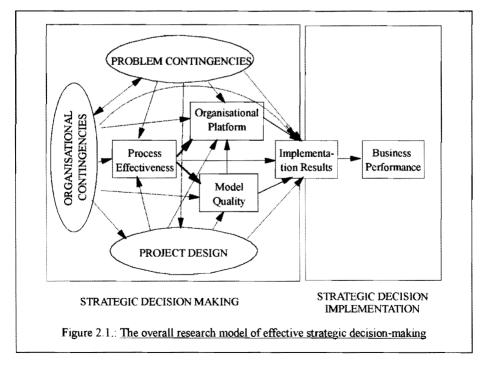
trace for it is again a field that was given a head start⁴⁶ through the boldly innovative research instigated by a leading figure – in this case Kurt Lewin, working within the group dynamics movement back in the 1930s.

This is a highly diverse, even fragmented field⁴⁷, with useful contributions in many different areas. For instance, a great deal of research has been devoted to the effects of group size, group composition and task type on group effectiveness. Another research stream has generated valuable insights into communication patterns in group, e.g. verbal dominance or indicators for conflict and consensus levels. Widely known are also the investigations into the effect of group conformity pressures on individual opinions and on group consensus. These results make organisational psychology an especially fruitful area for many of the other fields discussed above⁴⁸.

2.2. The Overall Research Model

The overall research model⁴⁹ is visualised in Figure 2.1. The main line of reasoning behind it is as follows:

- An effective strategic decision ultimately means a decision that will improve business performance.
- For performance to be improved, the decision-making process must have some immediate *implementation results* on an organisation.
- If any implementation results are to be obtained, two conditions will have to be met simultaneously:
- The problem must be correctly analysed, which in terms of our research model means that *model quality* will have to be OK⁵⁰.
- There must be a sufficiently strong level of organisational support for this analysis: the most brilliant analysis will end up in a drawer unless it enjoys an organisational platform⁵¹.
- Finally, every organisation will arrive at these two conditions given infinite amounts of time and resources. However, in the real world both time and resources are limited. Therefore any consultant wishing to facilitate decision-making processes, needs to establish an *effective process* of decision-making, one that is speedy, focused, and encourages good communication.



Various relationships exist between these main model variables. These relationships are indicated in Figure 2.1. by arrows between the boxes. In all cases, process

effectiveness is crucial. A poor process of group model-building will diminish the organisational platform and will frequently result in a poor model, and an unsatisfactory process yields few lessons for individual, let alone organisational learning. The arrow pointing from model quality to organisational platform stands for the basic notion that, regardless of how the process went, managers will only be willing to risk their necks for a decision if they are confident that the analysis that went into it was correct.

In addition, one should note that there are always contingencies — complicating factors specific to that particular project. Sometimes these contingencies are beyond the consultant's control. For instance, the project sponsor may be replaced by a hostile manager, the market may deteriorate suddenly, or the project may fall prey to some corporate cost-cutting program. But the consultant can react to most of these contingencies. Indeed, one difference between a high quality and a mediocre consultant may be that the former is able to discern these contingencies at an early date and change the project design to accommodate to these contingencies.

In our research model two kinds of contingencies are discerned:

- a. problem contingencies;
- b. organisational contingencies.

Thirdly, there is the way in which the consultant chooses to support this strategic decision-making process, namely:

c. the project design choices;

As is shown in Figure 2.1., these three aspects affect all the main components of strategic decision-making effectiveness. However, it should be noted that the dependency relations are not all bi-directional: the project design is determined by the contingency factors, *not* vice-versa. The project design task is, in fact, one of the main challenges for a PBM (or indeed, any) consultant, since it entails:

- · given the constraints of the particular organisation and this particular problem,
- selecting and combining a particular mixture of techniques and tools,
- in such a way that the project goals for this particular project become achievable.

2.3. Operationalisation of Concepts In The Research Model

The reader may agree that one needs an "organisational platform" to get decisions implemented, but what *is* an "organisational platform"? Without wishing to get too philosophical at this stage⁵², it is clear that a more operational description of this model concept is required. Indeed, such a description is required of all the high level concepts indicated above. This will be done in what follows by splitting up the concepts into variables of a more operational nature and then defining these operational variables⁵³.

Organisational Platform

In this research project, "organisational platform" means the level of support that exists in an organisation for the insights and recommendations that result from the decisionmaking process, in particular the level of support amongst the main stakeholders⁵⁴ and most particularly among those stakeholders who are directly involved in the decisionmaking process.⁵⁵

Implementing a decision always means change, and under normal conditions, humans tend to dislike change. So why would people support change?⁵⁶

- 1. Awareness: they feel that there is a serious problem⁵⁷ and that something has to be done about it;
- 2. Confidence: Furthermore, they need to be confident that the proposed solution is the right one;
- 3. Consensus: And these opinions need to be shared by the other stakeholders.
- 4. Commitment: Ultimately, it comes down to how determined the stakeholders are to implement the proposed solution to the problem.
- 5. Ownership: Generally speaking, people tend to be committed most strongly to those ideas that they themselves have helped to create.

These five variables together, then, tell us a great deal about the strength of the organisational platform for the insights gained from a strategic decision-making process: would they all be strongly positive, the organisational platform is very strong; should they all be negative, organisational platform is weak. Should they be mixed, then some kind of assessment ought to be made⁵⁸.

Model Quality

The strength of an organisational platform for a decision depends strongly on the stakeholders' perception⁵⁹ of the quality of the analysis the decision is based upon. With PBM, this analysis always takes the form of some kind of modelling. Therefore the term "model quality" was chosen as a label for this group of concepts, i.e. both for the analyses of the problem, the models that were made for this model and the decisions that were based upon this analysis⁶⁰. When do we say that these are of good quality?⁶¹

- 1. Completeness: Firstly, if all the relevant data and factors are taken into account;
- 2. *Thoroughness*: Then if all the necessary analyses, both qualitative and quantitative, have been performed on these data.

- 3. Theory-basedness: It helps if these analyses are based upon some piece of existing (normative) theory regarding the type of problem at stake.
- 4. Usability: And finally, all this is of little use if the resulting recommendations are not sufficiently practicable⁶².

Process Effectiveness

As we have seen in our literature overview, most of the emphasis in strategy formulation used to be placed on the *content* of strategic decisions. The idea was that if one knew the right theoretical concepts, if one followed the right analytical steps, and if one applied the right decision criteria, then a sound strategic decision⁶³ was bound to emerge⁶⁴. In reality, it turned out that the outcome was rather different. We have seen that several fields learned that the *process* of strategic decision-making is at least as important as its content⁶⁵. Therefore, PBM pays very close attention to managing the decision-making process. Without an effective process, it is hard to achieve effective decision-making. Low process effectiveness leads to a weaker organisational platform and to lower model quality, as well as to less learning. Hence implementation results are bound to suffer as a consequence.

But what exactly do we mean when we talk about "process effectiveness?". When can we say that a decision-making process is effective? "Effective" has often been defined as not only "doing the thing right" (= efficient) but also "doing the right thing" (= effective). An effective process therefore means primarily a process that has both speed and focus:

- 1. Speed: The degree to which the decision-making process proceeds quickly;
- 2. Focus: The degree to which discussion centres around the most important issues⁶⁶.

But there are other aspects of process effectiveness that are also important. For various reasons it is also necessary to have good "involvement" and "communication"⁶⁷. These terms in themselves are complex and broad and will need to be more closely characterised:

- 3. *Involvement*: The degree to which the organisational stakeholders participated in the decision-making process. In this model, involvement has been interpreted rather narrowly, distinguishing two levels of involvement⁶⁸. Involvement has been excellent if:
 - <u>Project participation</u>: All the relevant stakeholders in the organisation participated in the project (e.g. as members of the project team);
 - <u>Workshop participation</u>: The project team members were present at all the workshops (which lie at the core of the PBM method);
- 4. Communication: the quality of the conversational process between the various participants⁶⁹. Characterising what defines a good communication process is tough because it is such a broad concept. In this research project, it has been found useful to distinguish five different aspects of communication. Communication has been very good if:
 - a. <u>Exchange of ideas/viewpoints</u>: Participants were able to present their own ideas and viewpoints to other participants;
 - b. <u>Openness</u>: The discussions were felt to be honest and proceeding without hidden agendas or evasions;

- <u>Common language</u>: The words used by the participants denoted the same concepts, i.e. they shared the same terminology and understood readily what the other was saying⁷⁰;
- d. (Lack of) Verbal dominance: All participants were able to contribute equally to the discussion;
- e. Freedom: Participants felt at liberty to introduce new themes.

A further, less obvious, aspect of process effectiveness which is nevertheless crucial is: $^{71}\,$

5. *Willingness to cooperate*: An effective process can only be achieved if participants feel positive about being involved in the project; that is, they "want" the project, and welcome active involvement in it⁷².

Implementation Results

It was just argued above that measuring the implementation of results is problematic for the area of strategic decision-making because too many intervening, disturbing variables are at play. Implementation results may be problematic from a research perspective, but that makes them no less essential from a business perspective. In general, there are two ways by which PBM projects may lead to implementation results:

- a) The direct way, through implementation of the project findings, with implementation leading to a measurable improvement in business performance.
- b) The indirect way, by which project participants gain new insights and change their behaviour according to these new insights, again with a resultant improvement of business performance.

One might label a) "the decision-making perspective", and b) "the learning perspective"⁷³. Which is more important is hard to say. Undoubtedly, projects in which *no* learning takes place are bound to be unsuccessful; conversely, as Exhibit 2.1. demonstrates, projects for which learning is the *main* implementation result can however be quite successful.

In Case 2 an especially broad and vague issue was the subject of the modelling effort. A group of business unit managers engaged in a PBM project to analyse why so little inter-business unit collaboration took place, when the market was increasingly asking for services which required such collaboration. The group soon found satisfactory answers to this question. To a large degree, these were structural, stemming from the highly autonomous mode of operation in which the business units had originally been established.

Although the group did come up with an analysis of the problem, it could not arrive at good and workable solutions for the problem. In that sense, the project yielded no decisions for implementation. What did happen though, is that the managers realised, as a consequence of the project, that their own behaviour was the root of the problem. They realised that the market was demanding that they work together more often, and they saw that other managers were 'victims' of the same structure as themselves. Furthermore, they realised that the solution to the problem lay in altering their own behaviour. This, the managers indicated in the evaluation interviews, is precisely what they did. In these interviews, managers expressed a strong commitment to looking actively for inter-business unit collaboration opportunities, and to disregarding some of the incentives which had previously led them to shun collaboration.

Exhibit 2.2.: Sometimes learning is the only implementation result .. and all that is required

In what circumstances then, can implementation results be said to be good?

- a. Business performance: In the long run, when the financial performance of the company has improved as a direct result of the project.
- b. *Decision implementation*: In the shorter run, when the insights gained from the project are translated into practice.
- c. *Insight*: During and directly after the project, when participants indicate that they have learned about the problem.
- d. Organisational learning (or "double-loop learning"⁷⁴): when, some time after the project, the participants indicate that they have started to appreciate how various aspects of the facilitation method can facilitate other problem-solving processes.

In Case 1, PBM was used to design a new set-up of the internal distribution department of a newspaper distribution company. In the evaluation interview, which took place a year after the project was finished, the operations manager indicated that, as a direct result of the project, yearly savings had been achieved in the order of more than ten times the project cost. Furthermore, he and another respondent indicated that they now also used several of the techniques employed during the project in their own work. These techniques included conducting informal group sessions with the main stakeholders, and using whiteboards, brainstorming techniques and graphical presentations in general. The operations manager had also done some reading on system dynamics thinking and had tried to apply systems thinking ideas in practice as well.

Most importantly, he indicated that after the implementation of the recommendations from the PBM project the same group had (without the external consultant) used these PBM techniques to explore even further operational improvements. At the time of the interviews, the design of this set-up had just been completed. The estimated additional yearly savings were identical to those of the original project....

Exhibit 2.3.: An example of organisational learning with PBM

A second group of umbrella concepts that need to be detailed out comprises the three concepts that were introduced in the previous section:

- 1. problem contingencies;
- 2. organisational contingencies;
- 3. project design.

Problem Contingencies

The first group of contingencies concerns various aspects of a problem. Every strategic problem is different; however, they are all "messy" or even "wicked", albeit in different respects:

- a. Scope⁷⁵: Some strategic problems have a broad scope, i.e. cover a broad range of closely related issues that must all be taken into account: others have a narrower scope.
- b. Tangibility: Strategic problems can be very "soft", and "squishy". A problem which relates to people's attitudes is often less tangible than one which concerns the design of operations systems⁷⁶. Another way of saying this is that intangible problems tend not to be analysed quantitatively⁷⁷.
- c. Data availability: A problem may have quantitative aspects, but what if there are no data, or no data of the right kind, to analyse quantitatively? In many cases, managers "stand knee-deep in data" ⁷⁸, but the (management) information they really need has simply not been collected.

In Section 4.4. we shall see that these three problem contingencies primarily affect 'model quality'.

The next two problem contingencies appear to affect mostly 'process effectiveness':

- d. Urgency: Some strategic problems are extremely urgent: not solving the problem rapidly may endanger the continuity of the organisation. Other strategic problems may cover a long-term issue when current business is going quite well; these have lower urgency.
- e. Political sensitivity: Finally, some problems are more politically sensitive than others. 'Politically sensitive' signifies that some kind of a career risk is involved in dealing with the problem. In some respects, this may be considered just as much an organisational contingency as a problem contingency.

Organisational Contingencies

The second group of contingencies relates to various aspects of the organisation, or that part of the organisation in which the project takes place, or, even more narrowly defined: aspects of the group of people participating in the project.

- a. Top management support: It has long been known that no project can succeed without top management support. By top management we mean the project sponsor⁷⁹. Normally, this sponsor does not participate personally in the workshops⁸⁰. The higher this support, the stronger involvement will be and the more adequate (read: bigger) the project size/budget⁸¹.
- b. Hierarchical diversity: The groups that attend workshops may vary in the number of different hierarchical levels that are present⁸². Of particular potential sensitivity are hierarchical relationships between bosses and their immediate subordinates. Incidentally, the hierarchical differences need not be purely formal: hierarchical diversity between members and non-members of an informal "dominant coalition" is just as real.
- c. Problem ownership: Groups can vary in the degree to which each of the participants feels this is a problem which it is his or her personal responsibility to

solve⁸³. For instance, an operations issue may be seen by most participants as the primary responsibility of the operations manager⁸⁴.

- d. Group size: Groups can vary in size as well. A group of 2-3 participants counts as small in this kind of process, 4-5 people is an average group size, 6-7 people a large group size, 8-9 people a very large group size.⁸⁵
- e. Working relations: Some groups know each other very well, and are accustomed to working together; other groups consist of relative strangers. Groups may also consist of subgroups that have good working relations internally, but not between subgroups.

All these organisational contingencies have a particular impact on the effectiveness of the decision-making process, i.e. the overall concept 'process effectiveness'.

Project Design Elements

The third group of intervening variables concern the particular project design that was employed. The term "contingencies" would be inappropriate here, for almost all these elements are under direct control of the PBM consultant⁸⁶.

- a. *PBM techniques:* Most clearly under control of the consultants are the specific techniques that are adopted for use in the project. The most important techniques that are typically used in PBM projects are the following:
 - Questionnaires;
 - Hexagon brainstorming;
 - System dynamics diagrams (causal diagrams, stocks-and-flows diagrams, graphical functions);
 - Workbooks;
 - Propositions;
 - (Conventional) data analysis
 - (Computer) simulation;
 - Final report.

For a discussion of what these techniques entail, the reader is referred to Chapter 4.

In addition, there are miscellaneous aspects of the particular version of the PBM method whose use or presence can vary in intensity from project to project:

- b. *Central (graphical) presentation*: This is the degree to which use was made of whiteboards, overhead projectors etc. to provide central (and often graphical) presentations of the models or the data under discussion.
- c. *Facilitator skills*: The skills of the facilitators or consultants can vary. It is useful to distinguish different kinds of skills:
 - <u>Process facilitation skills</u>: The skills the facilitators need to be able to steer discussions, signal failures of communication, promote active involvement of all participants, keep the discussion focused, sense and resolve tensions in the group, etc.
 - <u>Conceptual modelling/analytical skills</u>: The skills the consultants need to be able to summarise the main points from a discussion, distinguish a new promising direction in the discussion from a dead end, translate verbal statements into graphical and formal models, and create conceptual models that can be quantified easily yet remain readable.

- <u>Company-specific/subject-specific/industry-specific knowledge</u>: The knowledge the consultants need of the specific terms and practices of the client organisation, the subject being discussed (e.g. "operations", "marketing"), and the branch of industry the client company operates in (e.g. "banking", "pharmaceutics", "electronics").
- d. *Abstraction level*: The level of abstraction that is maintained in the sessions (or, conversely, the level of detail), which can vary from project to project.
- e. *Project size/budget*: The degree to which the project size was appropriate to achieving the goal defined for the project. The limiting factor for project size is normally the project budget.

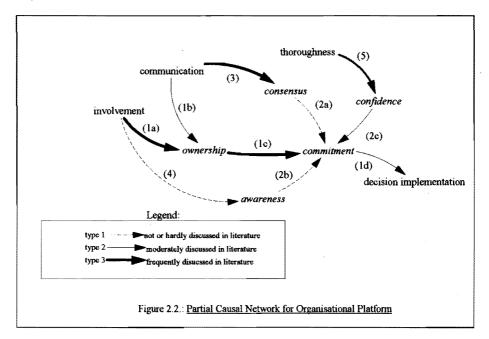
2.4. Operationalisation Of Relations In The Research Model

Between the variables introduced in Section 2.3. a great number of causal relations can be identified. Causal relations are relations in terms of: "X increases if Y increases" or "X increases if Y decreases". In the first example the relationship is called "positive" or "reinforcing", the latter example is a "negative" or a "balancing" relation. Many authors have investigated the various relations between the different components of our research model. These relations will be discussed here, and we shall also assess how often, and in what way, each relation has been referred to in the literature. Thick lines will indicate that the relation is mentioned often, dotted lines that it is rarely discussed.⁸⁷ These literature assessments can be found in the notes to each relation.

In order structure this discussion, relations have been clustered around the overall concepts in the research model. However, the reader will often find that these causal relations hop from one side of the research model to another.

Organisational platform

The first subset of causal relations mainly concerns aspects of the organisational platform for a strategic decision. As is shown in Figure 2.2., the following relations are especially relevant:



 Involvement (->communication) ->ownership ->commitment ->decision implementation⁸⁸:

This is a key assumption behind all process consultation approaches in general, and behind all participatory modelling approaches in particular. Tracing it backwards, this causal link reads as follows:

- 1d. Commitment->decision implementation: A decision will only be implemented if the people who have to implement it (i.e. managers) feel sufficiently committed to carrying through the process of implementation;
- Ownership--commitment⁸⁹: People are most committed to implement a decision when they consider it to be at least partly their own;
- 1a-b Involvement, communication- \rightarrow ownership⁹⁰: People only acquire ownership for an idea, model or decision if they have been involved in the discussions leading to its creation (relations $1a^{91}$ and $1b^{92}$).

This has led the author to describe the main motivation for the participatory element in the PBM method as: "no involvement, no ownership, no commitment, no implementation, no use".⁹³

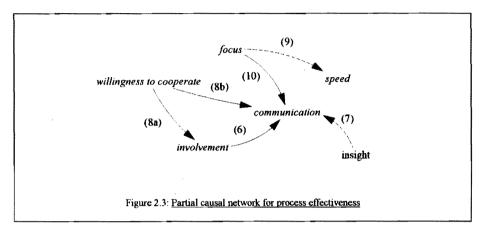
- 2. Consensus, awareness & confidence-commitment: Commitment is a core component of the organisational platform. Commitment is boosted by ownership but also by:
 - 2a. Consensus⁹⁴: A self-fulfilling prophesy: the more a group of people agree upon the analysis of a problem and the proposed solutions, the higher the perceived chances of implementation success for those solutions and thereby the greater the individual commitment to those solutions.
 - 2b. Awareness⁹⁵: The more important the participants feel a problem to be, the more they will be committed to deal with the problem.
 - 2c. Confidence⁹⁶: The more confident people are that they have found the right solution to a problem, the more committed they are likely to be to implement that solution.

Next we can look at the factors that affect consensus, awareness and confidence:

- 3. Communication ->consensus⁹⁷: The (perhaps naive) assumption in this book is that, for the majority of problems, it holds that the more and the better people communicate about a problem, the higher the consensus level they will achieve regarding it.⁹⁸
- 4. Involvement-xawareness⁹⁹: Another assumption is that people will become more aware of the potential impact of an issue if they are involved in a project which deals with various aspects (including the potential impact) of the issue.
- 5. Thoroughness→confidence¹⁰⁰: The more thorough the analyses of the model have been, the more confident participants will be that the model (and the recommendations that result from it) are correct. In particular, analyses which lead to some kind of (external) validation of the model should have this effect.

Process effectiveness

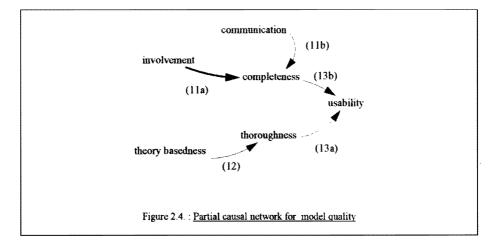
The next series of commonly distinguished causal relations all have to do with various aspects of process effectiveness. These are summarised graphically in Figure 2.3.



- 6. Involvement-communication¹⁰¹: One essential prerequisite for communication to take place is that people actually come together. That means that they have to be involved in the sense of "being present". If participants also become involved in the sense of "actively engaging in the discussion", then that will improve the various aspects of communication.
- 8. Willingness to cooperate ->involvement (8a¹⁰³), communication (8b¹⁰⁴): A crucial condition to an effective modelling process is that the participants are willing to cooperate in the process. If they are unwilling, they will try to avoid involvement. And if they are forced to be involved¹⁰⁵, they will try to avoid communicating openly and actively. This does not have to be a permanent situation: people may well have some initial reservations, which are overcome once they become enthusiastic about the process¹⁰⁶.
- 9. Focus-speed¹⁰⁷: This relationship is almost a mechanical one. If speed is expressed as the number of relevant issues being discussed per time unit, and focus is defined as the percentage of time that relevant issues are being discussed, then it follows that, other things being equal, the higher the focus, the higher the speed.
- 10. Focus-communication¹⁰⁸: Introducing some kind of a structure into a group process strongly improves the quality of that process, i.e. the quality of the communication. For most problem-solving methods, providing a structure, a focus, for the group sessions is one of the main ways of establishing process effectiveness.

Model quality

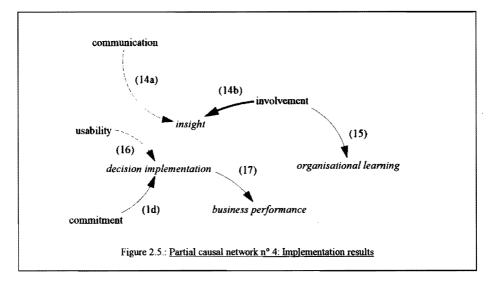
A few causal relations have variables from model quality as their primary elements. These are shown in Figure 2.4. and are discussed below:



- 11. Involvement (11a¹⁰⁹), communication (11b¹¹⁰)→completeness: Most strategic problems are so complex that no one has the whole picture, all the facts, or perfect knowledge. However, if all the people who can contribute some knowledge about the problem are involved and communicate about the problem, then this will have a positive effect on completeness. Even for old-fashioned "expert modellers", this has always been an important reason to consult members of the client origination.
- 12. Theory-basedness->thoroughness¹¹¹: If a model is based upon a pre-existing theory relevant to the field of a project, then this will normally enable more refined analyses. Thoroughness will, therefore, be higher than if no existing theories were available or were used.
- 13. Thoroughness, completeness—usability¹¹²: The better the model, the more practically usable it becomes. To paraphrase a well-known saying: "there is nothing as practical as a good model"¹¹³.

Implementation results

As will be apparent from a brief look at Figure 2.5., there are two "streams" of implementation results. The first concerns learning and the second decision-making. On most strategic issues, management needs a mixture of both. We shall first discuss the "learning stream":



- 14. Involvement, communication→insight¹¹⁴: This causal relation, together with Relation 1, summarises the fundamental idea behind the efforts of many modern-day participatory modelling techniques. This is the "modelling for/as learning" concept. The basic idea is the following: for anyone who engages in it, modelling the various aspects of an issue means *learning* about that issue. Traditionally, modellers did the modelling, and hence did most of the learning. Unfortunately, the people who should have done the learning, the managers, did not engage in the modelling process, and consequently did not learn a great deal¹¹⁵. In retrospect, the solution seems obvious: involve the managers in the modelling process so that they may obtain new insights. The higher this involvement, and the more intensive the communication, the more and the better insights will be obtained.
- 15. Involvement →organisational learning¹¹⁶. If people are involved in a relatively new problem-solving approach like this one, they may start appreciating the approach in its own right. In particular, they may adopt several of the techniques that are used in PBM to improve process effectiveness and apply them to other problems as well¹¹⁷. This 'organisational learning' will, of course, only really take root if the process has proceeded effectively during the original project.

Turning to the "decision implementation stream":

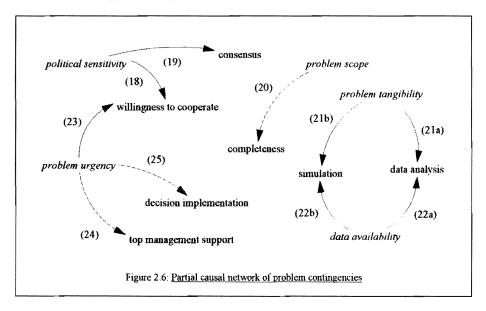
16. Usability->decision implementation¹¹⁸: In Section 2.2. it was stated that a decision will only be implemented successfully if it is of good quality and if it is supported by the organisation. Now we are one level lower in our analysis, at the level of the operational variables. A link between a variable of organisational platform and a

variable of implementation results was seen earlier on in Relation 1d, (i.e. commitment-->decision implementation). Here we find the lower-level link between model quality and implementation results: the greater the practical utility of a model and the recommendations resulting from it, the higher the likelihood of successful implementation.

17. Decision implementation →business performance¹¹⁹. This relation was already introduced in Section 2.2.: implementation of the right decision will improve business performance. What one should bear in mind, though, is that a multitude of external developments may affect the implementation of the solutions found in the modelling project. Even if implementation goes according to plan, unexpected external developments (an external strike, machine failure, macro-economic changes) may affect business performance. All these external developments are quite outside of the control of the consultant, in particular since they will only start to exert an effect after the modelling project itself has been finished.

Problem Contingencies

We now come to a larger cluster of causal relations. This cluster consists of all the causal relations that have to do with various problem contingencies. This partial causal network, which appears in Figure 2.6., can be read as follows:

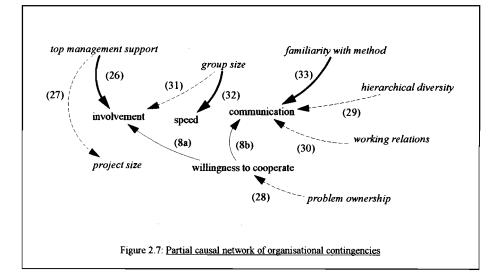


- 18. Political sensitivity→willingness to cooperate¹²⁰: If participants perceive some kind of career risk in discussing a problem they will be most hesitant to participate in the project. Also, if clear conflicts of interest underlie the problem, people may not wish to participate in an open, objective discussion of it.
- 19. Political sensitivity-consensus¹²¹: If there are genuine conflicts of interest between stakeholders, i.e. if the problem is primarily political in nature, then it is relatively unlikely that a full consensus can be reached.

- 20. Problem scope → completeness¹²²: The broader the problem scope, the harder it will be to take into account properly all the relevant data of all aspects of a problem. Hence, a broader problem scope is bound to entail lesser completeness.
- 21. Problem tangibility->data analysis, simulation¹²³: The more intangible a problem becomes, the less likely it is that quantitative analyses will be used to solve it.
- 22. Data availability-data analysis, simulation¹²⁴: Obviously, no (conventional) data analysis can be performed in the absence of sufficient quantitative data. And simulation models also need quantitative data to be run.
- 23. Problem urgency-willingness to cooperate: The more urgent a problem is, the more willing people will be to cooperate: "under pressure everything becomes fluid"¹²⁵.
- 24. Problem urgency \rightarrow top management support¹²⁶: Similarly, the greater the problem urgency, the more top management support is likely to sponsor the project strongly.
- 25. Problem urgency- \rightarrow decision implementation¹²⁷: And finally, the greater the problem urgency, the greater the urge will be to implement the project findings as quickly and thoroughly as possible.

Organisational Contingencies

Next come causal relations that are related to various organisational contingencies.

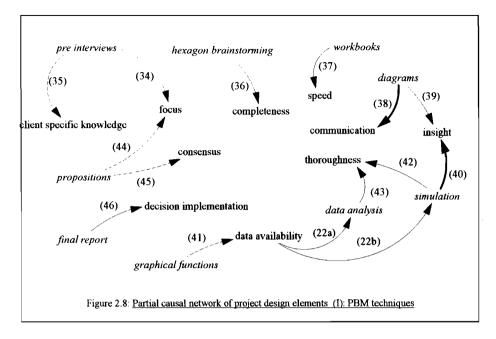


- 26. Top management support->involvement¹²⁸: If top management clearly backs a project, participants will be involved in it, regardless of their own initial attitudes.
- 27. Top management support->project size/budget¹²⁹: The stronger the support from top management support, the greater the likelihood that the project size will be appropriate. This is particularly important for a bigger, more costly project, since top management allocates the money.

- Problem ownership-willingness to cooperate¹³⁰: The more managers feel responsibility to solve a problem, the more the average participant will be willing to cooperate in the problem-solving process.
- 29. Hierarchical diversity→communication¹³¹: Higher hierarchical diversity may affect communication in two ways. Firstly it may be conductive to verbal dominance by the most senior group members. Secondly it may reduce the openness of discussions if an issue becomes more politically sensitive "when the boss is present".
- 30. Working relations → communication¹³²: The better the existing working relations between the participants, the more smoothly communication will proceed, for the participants already share a certain terminology, a certain understanding.
- 31. Group size \rightarrow involvement¹³³: The bigger the group is, the more complete the coverage becomes of all the relevant stakeholders, hence the better involvement becomes in terms of participating in the project.
- 32. Group size→speed¹³⁴: However, the big trade-off with group size is that the bigger the group becomes, the slower the speed will be. It takes longer to give everyone the opportunity to contribute, duplication of arguments occurs more often, and it becomes harder to keep sessions focused.
- 33. Familiarity with method-communication¹³⁵: Finally, communication may be improved if the participants have had previous exposure to the problem-solving method being applied. The better participants know the concepts and techniques involved, and the better they understand the role that is expected of them, the more smoothly the process will proceed. Frequent misunderstandings can arise through lack of such understanding, especially during the first stages of a project.

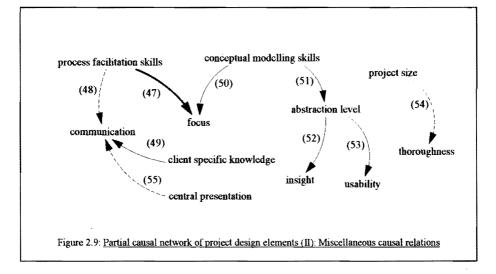
Project Design Elements

Finally, we come to causal relations that pertain to various elements of the project design for the decision-making process. This group of relations in totality is so large that we have divided it into two more manageable sub-groups. Figure 2.8 shows the causal relations that bear on the actual PBM techniques being used, Figure 2.9. shows the remaining miscellaneous relationships. Both the two sub-groups are discussed in more detail below.



- 34. Pre-interviews→focus¹³⁶: The main function of the pre-interviews for the consultants is to acquire sufficient feeling for the problem for them to be able to focus the first group session on a key aspect of the problem.
- 35. Pre-interviews \rightarrow client-specific knowledge \rightarrow ¹³⁷. In addition, these pre-interviews are useful for the consultants to acquire background knowledge about the client company, its specific terminology, etc.
- 36. Hexagon brainstorming→completeness¹³⁸: Hexagon brainstorming is a highly appropriate technique for ensuring one has identified all relevant aspects of the problem.
- 37. Workbooks->speed¹³⁹: Workbooks facilitate participant preparation for the workshops. With well-prepared participants, a workshop can proceed with fewer repetitions and other delays.
- 38. Diagrams ->communication¹⁴⁰: The illustrative power of diagrams, be they causal diagrams, or "stocks-and-flows", or other types, greatly facilitates communication. In discussions one can refer to a particular location on the diagram. A (good) picture is still worth a thousand words.
- 39. Diagrams→insight¹⁴¹: For the same reason, diagrams also provide quicker insight into what is really being said.
- 40. Simulation→insight¹⁴²: Simulation also provides insight, but in a different way. Simulation may reveal counter-intuitive dynamic behaviour, i.e. show the unexpected dynamic consequences of a certain structure. Simulation also shows the overall result of a large number of superimposed smaller quantitative effects.
- 41. Graphical functions->data availability¹⁴³: Graphical functions are specifically suited to provide quantitative estimates for parts of a model for which no quantified data were available. In this way (see Relations 29 and 30) they enable quantitative analyses such as simulation and other data analysis techniques.

- 42. Simulation→thoroughness¹⁴⁴: Having a runnable simulation model that can reproduce historical behaviour and also demonstrate the effects of different scenarios tends to improve thoroughness of the analysis.
- 43. Data analysis→thoroughness¹⁴⁵: The same holds for other data analysis techniques, such as Pareto analysis, regression analysis and linear programming.
- 44. Propositions → focus¹⁴⁶: Propositions can serve various functions. Most obviously, they focus the discussion because normally the only propositions that are discussed in a PBM workshop are those for which little or no consensus exists. These may amount to less than 20% of the total number of propositions.
- 45. Propositions →consensus¹⁴⁷: Propositions are often used in PBM projects to establish full consensus, especially towards the end of a project phase (see Chapter 4). The attempt is normally to try and reformulate disputed propositions in such a manner that a compromise can be reached.
- 46. Final report-decision implementation¹⁴⁸: The final report can serve as a vehicle for dissemination of insights. This dissemination is especially important for the eventual implementation of decisions resulting from these insights.



Among the miscellaneous causal relations between project design elements are a number of effects that the skills of the facilitator / consultant may have on the project outcome. In Section 2.3, these skills were divided into three: process facilitation skills, conceptual modelling skills, and client- or branch-specific knowledge.

- 47. Process facilitation skills→focus¹⁴⁹: A good session facilitator will be able to keep a discussion focused. Such a facilitator will gently steer discussions back to the main issue when they stray too widely, will make sure the session agenda is followed and finished completely, and yet will be flexible enough to react to unexpected developments.
- 48. Process facilitation skills→communication¹⁵⁰. In this way, a facilitator with good process facilitation skills will create an atmosphere of openness, without verbal dominance, an atmosphere in which viewpoints are readily exchanged and people

also feel free to introduce new themes. In short, such a facilitator will boost the quality of communication.

- 49. Client-specific knowledge →communication¹⁵¹: The facilitator's job becomes a lot easier if he or she speaks the language of the client and knows the main worries of the client, for if such client-specific knowledge is lacking, repetitions and misunderstandings are bound to occur between the external consultants and the participants from the client organisation. This typically tends to happen at the beginning of a project.
- 50. Conceptual modelling skills→focus¹⁵²: A business modelling consultant must have yet another¹⁵³ set of skills: conceptual modelling skills. The more refined these are, the better the consultant will be able to pick up those parts of the discussion that are most germane to the models being built and the more readily the consultant will be able to focus upon the main points.
- 51. Conceptual modelling skills ->abstraction level¹⁵⁴: A consultant also needs conceptual modelling skills to model the problem at a sufficiently high level of abstraction. Such a "bird's eye view" is required in order to rise above the suffocating mass of short-term details and endless side-arguments that tend to characterise uncoordinated strategic discussions.
- 52. Abstraction level→insight¹⁵⁵: If the abstraction level of a model is too low (i.e. it is a very detailed model) then it may be hard to capture its main messages. In that sense, the higher the abstraction level, the more insights can be gained. On the other hand, if managers are truly involved in the modelling process, then they may be able to grasp even a very complex diagram, because they participated in its creation.
- 53. Abstraction level \rightarrow usability¹⁵⁶: Another trade-off with aggregation and abstraction is that if models become too abstract, too distant from daily reality, this tends to detract from their practical utility.
- 54. Project size → thoroughness¹⁵⁷: Sometimes the project team knows very well what really should be done to get a complete and thorough analysis, but the money simply is not available to do the job properly ¹⁵⁸.
- 55. Central presentation—communication¹⁵⁹: In a discussion it usually helps if the discussion takes place around a whiteboard, flipchart or overhead projector where the subject under discussion is presented centrally.

CHAPTER 3

Research Methodology

This chapter describes various aspects of the methodology for the research project reported in this book.

- 1. The main objective of this research project was to design a modelling-based consulting method to improve strategic decision-making effectiveness; this makes it *design-oriented* research.
- 2. Designing entails repeated testing of 'prototypes' in actual consulting assignments; this makes this research also *empirical*.
- 3. Unfortunately, little research has so far been done on this type of model-based consulting; therefore, this research is also very much *exploratory*.
- 4. In researching strategic decision-making, one is looking for aspects of the 'inner worlds' of people, for aspects like 'commitment' or 'confidence', for such issues, a *qualitative research* design is often most appropriate.
- 5. A total of six consulting assignments were investigated, this means that the research design was based upon *multiple-case studies*.
- 6. Finally, one is left with the question of how can we know whether the evaluation results are likely to be correct; in other words, one is asking for *research validity* and *reliability*.

Each of these methodological aspects will be discussed in turn in the six following sections.

3.1. Design-Oriented Research

The primary methodology in this study is that of design-oriented research, the research methodology *par excellence* for studies in the applied field of organisation and management, or what in the Dutch language is called "Bedrijfskunde"¹. "Bedrijfskunde" is one of the *design sciences*, other examples of which include the technical sciences, the health sciences, psychotherapy, law, and business administration². These disciplines differ fundamentally both from the *formal sciences*³, such as philosophy, logic and mathematics, and from the *empirical sciences*⁴, such as physics and some of the social sciences. As "sciences of the artificial"⁵, the design sciences are, by their nature, concerned not with how things are but with "how things *ought* to be (...) in order to attain goals and to function."⁶

In this chapter we will repeatedly compare the design methodology with the methodology of the empirical sciences. There are clear differences but also many parallels between the two. The fundamental difference is that, in the empirical sciences, the objective is to *understand* reality⁷; in the design sciences, the objective is to *change* reality. Thus, a physician seeks to heal patients, not just describe their condition; an architect seeks to create a new building on a site, not just describe the contours and nature of the ground; an aeronautical engineer seeks to design a wing that will carry a plane in the air, not just describe speed and direction of air currents. And a PBM

consultant wants to improve strategic decision-making, not just describe what happens in a boardroom.

But these differences also point to an important parallel between empirical sciences and design sciences: before one can change something, one first has to understand it. For a physician to be able to heal a patient, he or she will have to *understand* the patient's illness. And if a consultant wants to improve strategic decision-making in a company, he or she will need to have a theory of strategic decision-making in general and a way of determining how the theory works out in particular cases. So the design sciences depend on knowledge from the empirical sciences⁸.

"The mission of a design science is to develop and transfer scientific knowledge that professionals in that area can incorporate in their repertoire"⁹. For professionals, *methods* are an essential ingredient of this scientific knowledge. These methods will have to be designed, but if a method is to be seen as scientific knowledge, its design will have to be carried out according to an appropriate scientific methodology. The question then becomes: What is an appropriate methodology to design a method for professionals?

Unfortunately, the methodology of the design sciences is still at a novice stage and the subject of ongoing scientific debate. There are no well-established research designs for methodologically sound design of a method to support professionals. That does not imply that there is no methodology; rather, it means that the existing methodologies have not matured. For the design sciences, the period of *normal science*¹⁰ clearly has not yet arrived.¹¹

Research deliverables

Since our objective is not just to understand strategic decision-making but to improve it, this research project has research *deliverables* rather than research *questions*. Three such deliverables can be distinguished.

1. A MANAGEMENT CONSULTING METHOD

The main deliverable is the PBM method itself. This is basically a management consulting method that makes extensive use of modelling techniques. But what do we mean by "a method"? A method has the following specific characteristics:

- A method is a repertoire¹², not a recipe. First of all, "the most productive view of any available methodology is to view it as a repertoire, not as a recipe. (..) relative novices grasp at the relative certainties of an ordered sequence of stages. The great chef, familiar with culinary materials, does not cook to a recipe, but his cook book enables many others to do so."¹³.
- A method has different levels. The PBM method can be seen as consisting of four different levels:
 - 1. Fundamental to any successful PBM project is the attitude the method requires from the consultant ¹⁴.
 - 2. One level higher comes the tool set any PBM consultant should be able to use, i.e. the individual techniques that are employed in PBM projects.
 - 3. The third level consists of a generic, 'standard' way of combining these techniques.
 - 4. At the top level we come to various kinds of PBM design guidelines: How does one deal with various contingencies, and what are the trade-offs one has to

make when tailoring the method to a specific problem and a specific organisation?

These four levels are dealt with in more detail in Chapter 4, which describes the PBM method at length.

- Design guidelines are an important part of a method. A design¹⁵ guideline is a <u>heuristic</u>, telling the professional that "in such-and-such a case, it's probably a good idea to do so-and-so^{"16}. Often, these guidelines take the form of indications and contra-indications: a list of symptoms when it is wise to do X, and a list of symptoms when doing X is probably unwise¹⁷. The fourth of the method components listed above referred explicitly to design guidelines, but these in themselves can be found at three different levels:
 - How do I use this particular technique? (Level 2);
 - When do I use this technique? / How do I use this method? (Levels 3 and 4);
 - When do I use this method? (Level 4)?

2. A THEORY OF STRATEGIC DECISION-MAKING EFFECTIVENESS

The PBM method, the main research deliverable of the research project described in this book, is intended to improve the effectiveness of strategic decision-making processes. But that in turn presupposes that we have some concept of what strategic decision-making processes are, and what effects certain interventions may have on these processes. That is, we need a *theory* of what makes strategic decision-making effective. Here, this theory is the research model described in Chapter 2. This research model is the author's synthesis from existing theory and his own case analysis findings. As such, it may be seen as a separate (be it a subordinate and not fully developed) research deliverable.

The research model consists of two parts; the variables and the causal links between these variables.

- The variables *describe* the project results; they 'keep score' by expressing key facets of the decision-making process in a case: How good was communication? How high was commitment? How broad was the problem scope? How large was the decision-making group? How much insight did the process generate?
- The causal links *explain* the project results: this and that led to that level of communication, which made ownership reach such-and-such a level, which made commitment like this, etc.¹⁸.

The close correspondence between this conceptual research model and many of the PBM design guidelines presented in Chapter 4 is no accident. The PBM consultant will want to *improve* decision-making, whilst the research model only tries to *explain* what happens in decision-making processes. But if one wants to improve, for instance, 'thoroughness', it is only logical that one will look at those variables that demonstrably affect 'thoroughness', such as 'simulation' or 'data analysis'.

3. A PROJECT EVALUATION PROCEDURE

A third deliverable of this research project is a project evaluation procedure. Developing, refining and testing any design, be it a consulting method or a new aeroplane, demands measures of its performance in actual operation. Since measuring strategic decision-making effectiveness may be more difficult than observing that a plane stays in the air for a certain period of time, an elaborate evaluation procedure for evaluating PBM projects had to be developed as well¹⁹.

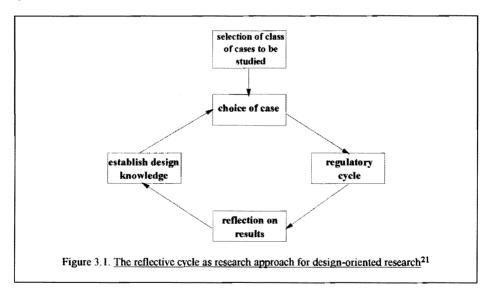
We will see that there are hardly any well-developed evaluation procedures for this purpose. Therefore, we can say that the evaluation procedure, as developed within the course of this project, is a third research deliverable, albeit relatively minor.

Research approach

Design oriented research calls for an approach fundamentally different from that of "conventional" empirical research. These differences are fundamental and will be discussed next. However, in order to translate a design-oriented approach into a practical research design, the actual techniques that are used are, to a large part, drawn from the body of empirical research knowledge in the social sciences.

THE REFLECTIVE CYCLE

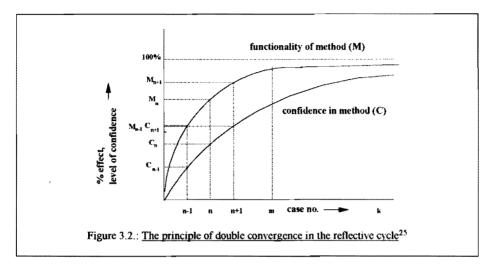
A first unique characteristic of design-oriented research is the "reflective cycle", illustrated in Figure 3.1. This cycle can be read as follows. First a case in which to apply the method to be designed is selected. In the execution of this case the so-called "regulatory cycle" is followed, which consists of the steps problem choice - diagnosis - design - intervention - evaluation²⁰. In other words, the method is applied to solve the problem at stake in this case.



After this case is finished, reflection takes place on the outcome. What aspects of the method worked well and what aspects did not work? And why was that? Was it due to certain aspects of the case or of the problem addressed in the case?²² The purpose of this reflection is to "boil out"²³ the "professional essence"²⁴ of the method. This results in additional design knowledge, which is basically an improved version of the method. Then a new case is selected, in which this improved method is applied and once more evaluated. The process continues until the designer has accumulated sufficient confidence in the method thus developed. Methodologically speaking, this confidence is developed in a process of *double convergence*.

THE PROCESS OF DOUBLE CONVERGENCE

The two converging processes that constitute the second fundamental element in a design-oriented research approach are depicted in Figure 3.2. Here we see that convergence takes place both in the functionality of the method being applied (M) and in the level of confidence one has in the method (C).



In design-oriented research, each case serves two purposes in the reflective cycle:

- 1. to improve the method;
- 2. to evaluate the method.

1) Improving the method.

It is obvious that a method can be *improved* over a number of cases. Each time the method is applied to a case the designer will find some aspects that did not perform as expected and should be changed: the method is improved accordingly²⁶. This improved method is then applied to yet another case, which may generate experiences that once again induce further improvements to the method, and so on. In theory, this process need never stop, however, one may expect that the improvements introduced as a result of the early cases will be larger than the improvements made after a large number of cases,²⁷ or in terms of Figure 3.2., $\Delta M_{n-1,n} > \Delta M_{n,n+1}$. The changes in the method will become smaller and smaller; *the improvement process will converge*²⁸.

2) Evaluating the method.

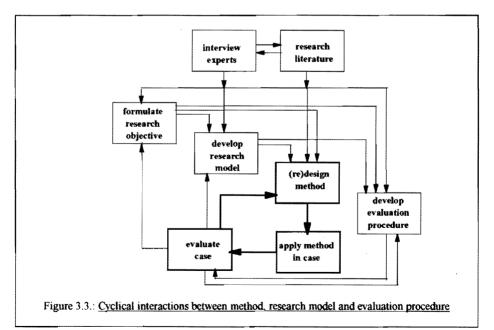
In addition, each case study provides an opportunity to *evaluate* the method and thereby build up confidence in its effectiveness. Each new application of the method creates additional insight into the method's indications and contra-indications, i.e. the situations in which it will work and in which it will not work. As a result, each new application will increase the level of confidence in the method when applied to an appropriate problem²⁹. Once again, one may expect that as the number of cases increases, fewer and fewer new insights into the method will be generated, and ever smaller changes to the level of confidence in the method will occur, or, in terms of

Figure 2.5, $\Delta C_{n-1,n} > \Delta C_{n,n+1}$. This second converging process is a convergence of the evaluation process³⁰.

From a viewpoint of classical empirical research, it might seem appropriate to 'freeze' the method as soon as possible and compare different applications of the same method. This would then enable some degree of statistical generalisation. But from the viewpoint of design-oriented research this is highly undesirable. Why should a designer not change an aspect of the method that he or she knows to be wrong?³¹ However, one might require from design-oriented research projects that the improvement process converges more quickly than the evaluation process, or, in other words, that the method does not change too much over the last few cases in which it is applied³². Figure 3.2. reflects this by showing that beyond the point where the functionality of the method changes hardly at all³³ the level of confidence in the method is still growing considerably. Described somewhat more formally, from a certain point m onwards, $\Delta M_{n/}M_n < \Delta C_{n/}C_n$. This is indeed what happened in the current research. After the lessons from the fourth case, the PBM method was changed hardly at all, but confidence in its functionality did grow considerably greater in Cases 5 and 6³⁴.

INTERACTIONS BETWEEN METHOD, RESEARCH MODEL AND EVALUATION PROCEDURE

A third essential characteristic of the present design-oriented research was that the processes of the reflective cycle and of double convergence applied to all three research deliverables — not just to development of the current design of the method, but also to the research model that guided this design process and to the evaluation procedure. This highly interactive, cyclical process is schematised in Figure 3.3.



At the core of this figure we find the reflective cycle. The current version of the method was applied to a case, the results were evaluated and 'boiled out' and new insights were incorporated into a new version of the method for subsequent application, etc. But the

same process took place for the evaluation procedure and the research model, our other two research deliverables. Case findings also necessitated changes in the research model and made it possible to improve the case evaluation procedure³⁵.

This figure also shows that the research model plays several important roles; it actually informs the entire research process. The research model influences both the method and the evaluation procedure, and, via the case findings, it is also indirectly influenced by them in turn. In the next section we shall look at these different roles of the research model in more detail.

3.2. Empirical research

In the previous section we set design sciences apart from the empirical sciences. But doing so does not take away the fact that much design-oriented research takes place in close interaction with the real world. Refinement and testing of certain types of design can take place in artificial environments (e.g. a wind tunnel for new aeroplane design), but for a method to support strategic decision-making this refinement and testing process can only take place in the real world of real decision-making. This endows the research with a considerable empirical component. In this section, we shall discuss three methodological implications which spring from that empiricism:

- the roles of the research model;
- the roles of reality;
- the double role of the researcher / consultant.

Roles of the research model

In Figure 3.3. we saw that the research model is both an *input* and an *output* of the research process. We have also described the important role that the research model fulfils *during* the research process.

INPUT TO THE RESEARCH PROCESS

The role of a research model as an *input* to the research process is well established in traditional empirical research in the social sciences. Three roles may be distinguished here:

- "1. an instrument to select appropriate research problems;
- 2. a guideline in choosing appropriate research methods;
- 3. a framework for interpretation of the research results"36.
- Selecting research problems. The original impetus to conduct the current research came from an analysis of deficiencies in strategic decision-making in operations management³⁷. This led to a choice to conduct case studies of strategic decisionmaking processes in the field.
- 2. Choosing research methods. As will be discussed later, the sheer number and 'soft' nature of the main concepts that were contained in the research model led to a choice for multiple cases, analysed by qualitative research methods.
- 3. Interpreting research results. The importance of a research model to interpret research data cannot be overstated. Without a good theory, the researcher is left to drown in a swamp of data; so many things happen in a decision-making process that a searchlight is needed to focus attention upon certain details. Without such a theory, crucial case evidence is bound to be overlooked or even misperceived³⁸.

OUTPUT OF THE RESEARCH PROCESS

It is clear that a research model provides an essential input to the research process. But that does not explain why a research model should also be an *output*, a deliverable of a research process; indeed, in traditional social science research, it may well be an almost heretical concept. According to the textbooks in this field, a research model is developed prior to the actual research³⁹.

Fortunately, this orthodox view is becoming somewhat outdated, at least in practice: "Changes in the original research questions – and/or in the corresponding hypotheses – during the execution of the research (...) are a normal practice. [However,] in research reports this is seldom expressed"⁴⁰, because "researchers who indicate that they fiddle with their research questions endanger their academic status by doing so"⁴¹.

In the present research, which is both exploratory and qualitative⁴², the research model was by necessity also an output of the research process. As will be explained in detail in Chapter 5, the research model that was presented in Chapter 2 is the end result of a long series of analytical steps in case analysis and cross-case analysis. As such, the research model can be seen as a theory on how different aspects of strategic decision-making effectiveness are determined by various organisational and problem contingencies, process characteristics and project design choices.

A PART OF THE REFLECTIVE CYCLE DURING THE RESEARCH PROCESS

The cross-case analysis was just the final step in a series of analytical steps. Throughout the various cycles in the reflective cycle, the research model was improved again and again, in the manner depicted by the cyclical process in Figure 3.3. This illustrates that there have been many versions of the research model, just as there have been many versions of the evaluation procedure, because every time a new insight emerged from the evaluations of one of the cases this insight was translated into the research model.

Role of reality

The research model is our searchlight on reality, or at least on our perception of it; it determines *what* aspects of reality we focus on. But that leaves the question of *how* we investigate, or 'measure', reality. In this respect, at least the following questions will have to be addressed:

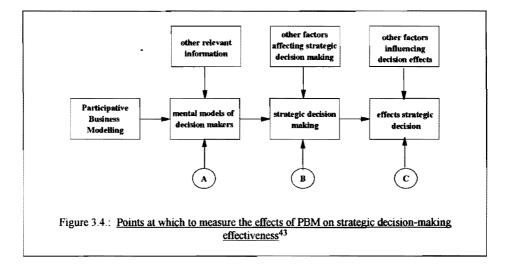
- a. What can we measure from reality?
- b. When are those measures to be made?
- c. What is the source of those measures of reality?
- d. In what detail do we measure this source?
- e. What is the yardstick against which the results are to be compared?

We will discuss these questions one by one.

A. WHAT CAN WE MEASURE FROM REALITY?

Our research model tells us that, in theory, the ultimate effectiveness of strategic decision-making is to be determined from the bottom-line results, from improvements in business performance. This makes it most unfortunate that, in practice, it is simply not possible to make an assessment of strategic decision-making effectiveness by measuring actual business improvements, as Figure 3.4. explains. Let us recall that the overall concept 'implementation results' consisted of:

- insight;
- organisational learning;
- decision implementation; and
- business performance.



In a PBM project, one hopes to influence the mental models of the decision makers. Measuring these changes in mental models takes place at point A in time. It has proved very difficult to establish whether one can successfully 'improve' mental models⁴⁴. One of the reasons for this is that decision makers have all sorts of other information at their disposal as well. During a PBM project, life goes on. Participants engage in some four or five workshops of a few hours over a period of several months, but they are continually confronted with the strategic problem during the rest of their working hours. This makes it hard to demonstrate that learning ('insight' or 'organisational learning' in our research model) has taken place as a direct consequence of the PBM activities.

Even more difficult is measurement at point B, where the changed mental models have led to an actual decision⁴⁵. But a decision gets made not just on the basis of the mental models of a small group of participants, but on the basis of a whole array of factors, including the mental models of a much wider circle of stakeholders. All these other factors and stakeholders are beyond the researcher's purview, and certainly out of his or her control. In those circumstances, how can it be established that *decision implementation* is a direct result of the quality of the PBM process?

Most problematic at all is measurement at point C. Exhibit 3.1. outlines the widely different impacts on *business performance* of two similar PBM projects. In both cases, factors lying outside the scope and certainly control of the project materially influenced the final results.

Example A : Business results more positive than justified by project

In Case 1, the savings realised by the client company one year after the PBM project were huge. Were these savings entirely due to the PBM project? One would hope the project could claim at least part of the credit (and that is what the respondents indicate), but at the time this company had been heading for bankruptcy. Something had to be done, and this particular project was only one of the measures that were taken.

Example B: Business results more negative than justified by project

In Case 3, a logistics strategy and structure were developed for the European distribution of the client's innovative new drug. Commitment to implement this strategy was high. However, no implementation took place. Was this non-implementation due to the project? No. As it turned out, the drug proved unsuccessful in the clinical trials that were critical for its release to the market. Eighteen months later a further clinical trial of the drug also failed and the company was eventually taken over.

Exhibit 3.1.: Why improvement in business performance is a not a trustworthy indicator of PBM effectiveness

In this sense, business performance, which is often measured in terms of gross profit, is a *bottom line variable* in more ways than one. In management accounting, profit⁴⁶ is the total sum of all costs and revenues, but the same is true from a methodological perspective: business performance is the total sum of just too many factors that have nothing directly to do with the PBM project .^{47,48}

The gist of the preceding paragraphs is not that measurement is impossible, since everything is measurable in principle, but that establishing *causality* from a measurement can be problematic. In general, the further away an implementation result is removed in time and causality from a decision to implement, the more difficult it becomes to establish the effectiveness of PBM or related methods. So in this research implementation results have been measured only because participants indicated that they attributed certain implementation results to the PBM process⁴⁹.

What we can establish with less difficulty are client attitudes shortly after a project is completed. Then we are measuring at what is called *the reaction level*, which is defined as participants' "liking of and feelings for [the project]"⁵⁰. This is what was measured when the performance of the PBM method was evaluated in terms of the research model concepts 'process effectiveness' and 'organisational platform'.

It would be nice if we could 'predict' implementation results from these concepts. So that, all other things considered equal, projects in which the reaction level was very positive (i.e. high scores for process effectiveness and organisational platform) were 'bound' to result in high levels of learning, decision implementation and business performance. Unfortunately, research has not shown any significant correlation between the reaction level and these higher levels⁵¹. Learning, decision implementation and business performance are all found to be causally interrelated, but no such causal links have been established with the reaction level.

There is some intuitive plausibility about this as well. We all know that sometimes a very negative experience can lead to a great business success, and that training programs which are great fun for the participant are not necessarily great learning experiences⁵². Thus if people say that they feel a project was useful then that does not mean it will permanently alter their way of thinking about the issue that was discussed, let alone what they do about the matter. Which leaves us where we started: the only way to assess implementation results is to measure them directly, but when we do so we cannot attribute the results to the PBM project.

B. WHEN ARE THE MEASURES TO BE MADE ?

We measure the effectiveness of a strategic decision-making process *after* the project is finished. That seems obvious, because you cannot judge how good the process has been before it is finished, but it still leaves us with two questions:

- How long after a project do we measure?
- Should we also measure prior to the project?

As far as the first question is concerned, no fixed time slots can be given. It is reasonable to assume that we should not measure too long after the project is finished (say not longer than half a year) otherwise memories will become blurred⁵³. On the other hand, one should also not measure within the first few weeks after a project is finished, otherwise participants will not have had time to put the whole project into perspective⁵⁴. That leaves us with a fairly broad time frame of anything from, say, t_{end} + 2 weeks up to t_{end} + 6 months. For five out of six cases making up the present research project this could be realised⁵⁵.

The purpose of carrying out pre-project measurement is laudable enough. Measuring certain variables before and then after a project should enable one to establish to what extent the project (or perhaps disturbing variables) influenced any changes in these variables⁵⁶. Certainly, pre-interviews were conducted in every case undertaken in the present research, and in four cases⁵⁷ questionnaires were used to measure certain variables. Despite this, the information proved of relatively little value in the final case analysis.

There are several explanations for this. A first explanation is that this so-called "pre-test post-test" design only works for a limited number of variables in our research model. For instance, one cannot ask a participant for his level of commitment towards a set of recommendations that have yet to be formulated. Nor can one ask how effective a modelling process was perceived to be if it has not yet taken place⁵⁸. In fact, of all the variables in the current research model, only *awareness, consensus* and *insight* can be measured both prior to and after a project, and even in these instances pre-project measurement is problematic. Why?

This brings us to our second explanation, which is probably the most important one. Adequate measurement of these three variables requires that *the problem is well known to the researcher prior to the project, but in PBM projects this is never the case*. This is for the essentially tautologous reason that were a problem to be wellcharacterised at the outset, there would be no need to undertake a PBM project in the first place. There are several examples of effective pre-tests on 'consensus' and 'insight'. For instance, people can be handed a list of problem aspects and asked to fill in rapidly how important they think these are⁵⁹, but compiling such a list is normally a substantial part of a PBM project! Another option is to have respondents themselves list what variables they think are important to a problem, but the definition of the 'problem' is often something which is only accomplished towards the end of the conceptual modelling phase!⁶⁰

Moreover, even if this problem definition can be kept more or less constant, it may still be problematic to compare these pre-project questionnaires with post-project responses. The same words may be used in both but the signification of the words may have changed. And if, after a project, people mention fewer variables that are important than they indicated beforehand⁶¹, does that mean that their knowledge has increased, decreased or has stayed the same,⁶² or simply that they did not have the time or could

not be bothered? And if they give totally different replies before and after, does that indicate that their mental models have merely changed or that they have improved?

A refined approach to the measurement of learning is to have participants describe a policy problem verbally, then to construct a so-called cognitive map from that description⁶³ and perform measurements on those cognitive maps, calculating, for instance, the number of variables, the length of the causal chains or the number of causal loops⁶⁴. Apart from the fact that this represents a particular – be it perfectly valid – interpretation of the term 'learning', it not only suffers from the disadvantage that it entails prior knowledge of the problem to be described, it also carries the additional disadvantage that managers, the typical participants in PBM projects, tend not to be overly enthusiastic about being subjected to such an exercise.

C. WHAT IS THE SOURCE OF THE MEASURES OF REALITY?

In this research project the primary sources for data were the perceptions of the *participants*. For many aspects of the research model, the motivation for doing this is clear enough. We are interested in people's 'inner worlds', so if one wants to know, for instance, how committed they are, an obvious idea is to ask them. And if one wants to know whether participants perceived the process to be focused, one can just ask them. Of course one may attempt to compare these perceptions with data from other, more indirect sources; however, that may be a fairly cumbersome undertaking, requiring at least some work on each variable, disproportionate to the needs of an exploratory 'breath-first' research strategy involving fifty to sixty variables (see below in the discussion of exploratory research).

There are, however, two areas of the research model for which participant perceptions seem less appropriate. The first area is that of the *project contingencies*. To any given respondent, the problem scope of the PBM project in which he or she participated is always "very broad", intangibility always "very high", and group size almost always "acceptable". Only the researcher knows that the 'average' project has, for instance, a broader scope than this one, that the problem needing to be addressed was relatively tangible and that a group of nine people is very large for a PBM project. For evaluations of this type, therefore, the researchers' assessment of the contingencies has often had priority over the client's assessment.

A second area for which participant assessment may appear to be inappropriate as the primary data source is *model quality*. Normally, participants are not modelling experts, and therefore are not in a good position to determine the quality of a model. Furthermore, their perceptions are bound to be strongly subjective: it is their own model after all. Surely there must be more objective ways of establishing model quality? This is an interesting issue. The following points should be taken into consideration:

• Objective measurement does not exist. There is no such thing as an 'objective' measure of model quality, not even for seemingly very 'hard' models. Let us take as an example a new stock replenishment algorithm. It might seem quite straightforward to determine the quality of such an algorithm by performing some calculations of reductions in inventory costs, lead times etc. Admirable though such measures may be, they all entail highly *subjective* elements. For instance, use of the algorithm might lead to very nervous demand patterns⁶⁵, or lead to highly undesirable working conditions — all these criteria that may be very relevant to the average organisation would be ignored by this seemingly 'objective' evaluation criterion.

- Customer perception is key. It is common practice for companies to measure the quality of their products in terms of the clients' perceptions for the sound reason that these are the purchasers of the products and, therefore, if they do not perceive the product to be good, they will not buy it. So even if a company has a battery of 'objective' technical criteria to establish product quality, in the end what counts is *customer perception* of product quality. Similarly, the purpose of the models developed in PBM is to make the decision-making process more effective. However brilliant a model might be technically, if it scores poorly in the client's perception, then the model will not be used in the decision-making process⁶⁷.
- Problem boundaries are always arbitrary. Strategic problems are extremely 'messy'. It is simply never possible, as an outsider, to determine to what extent all the relevant data have been used, or all the necessary analyses have been performed. Also, all strategic problems are strongly related to other strategic problems⁶⁸. The decision what to include, and what not, is always somewhat arbitrary; under these circumstances, the only knowledgeable arbiters are the managers involved.
- Other data sources count too. It is not just an organisation's stakeholders whose opinions count; there is also the consultant, who would like to think of himself as a fairly experienced modeller, his co-consultants and his academic peers, who all have had their say in the overall determination of model quality⁶⁹. So this evaluation may be subjective, but at least it is inter-subjective.
- Don't trust consultants. Finally, it is dangerous to let a modeller determine the quality of his or her own model: "The business world is full of consultants who claim that they are highly successful while their former clients are begging for them never to return again..."⁷⁰

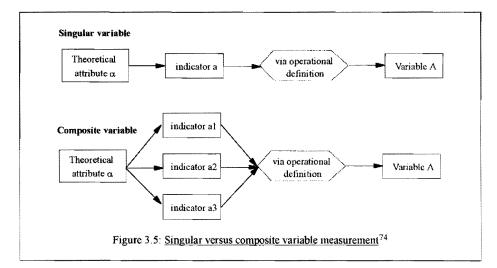
D. IN HOW MUCH DETAIL DO WE MEASURE THIS SOURCE?

Next we come to a trade-off in research design, the issue of direct or indirect measurement. Direct measurement is what happened in most of the evaluation interviews in this research project. As an example, *direct* measurement is asking participants something like. "Now we get to 'problem urgency'. What can you tell me about the urgency of the problem addressed in this project?" *Indirect* measurement is inquiring about problem urgency not by asking for a single response to a certain research model variable, but by asking a series of questions which describe various aspects of problem urgency. This was done in the pre- and post-questionnaires that were used in Cases 2 and 3 of this research project. A subset of these questions, regarding problem urgency, is shown in Table 3.1.

Questions on problem urgency		strongly. agree	agree	agree/ disagree	disagree	strongly disagree
1.	The problem is important to my organisation					
2.	The problem has my attention					
3.	The problem can have serious implications					
4.	It would be wrong not to attend to the problem					
5.	In my work I often deal with the problem					
6.	I am often fighting symptoms of the problem					
7.	It would have serious implications for my organisation not to provide a solution to the problem					
8.	The future of my organisation depends on the way this problem is handled.					

Table 3.1.: Indirect questions for problem urgency from questionnaire used in Cases 2 and 371

Figure 3.5. schematises the two procedures in abstract methodological terms, showing how theoretical attributes are translated into variables via 'indicators'. In choosing an indicator, one selects "an empirical phenomenon as a representative for a theoretical attribute"⁷²; the 'operational definition' then indicates how the variable A will be measured from indicator a. "Such a measurement can also be performed by using more than one indicator for each variable, with the operational definition indicating in what manner the indicators used are combined into a single measured value."⁷³



In our example of problem urgency, the questionnaire used eight different indicators, whereas the evaluation interview only used one. Seen in this perspective, indirect measurement is a superior way to measure variables in the research model as compared with direct measurement, since it yields several 'indicators' for the construct⁷⁵ thereby reducing potential misinterpretations by the respondent.

The main drawback of indirect measurement is *effort*. Our present research model contained some sixty-odd variables. If for each of these variables some five or six

different indicators have to be defined⁷⁶ and then inquired about at each evaluation interview, validation of the chosen measures will entail a huge effort, not just for the researcher, but also for the participants, who, however well-disposed they may be, are typically very busy managers. So the trade-off is between precision and effort, or, to be more precise, between *scope*, *precision*, and *required effort*, as one option would be to limit the number of variables that were to be measured. The latter option was not considered appropriate for the exploratory research design investigated in our research project, thought it might well be suitable for a more focused follow-up study.

As a final point of interest, the manner in which our research model was validated might suggest that multiple indices were indeed used to measure variables in the evaluation interviews, only not at the operational level, but one level higher. For instance, the high-level concept 'process effectiveness' was measured by asking about 'communication', 'involvement', 'focus', 'speed' and 'willingness to cooperate', and similarly for the three other high-level concepts in our research model. This argument cannot be sustained, however, because most of the case and cross-case analyses presented in this book were conducted at the level of these operational variables, not at the higher level of the overall concepts⁷⁷. Therefore it is untrue to say that these operational variables were indicators for composite variables and that they were not used independently.

E. WHAT IS THE YARDSTICK AGAINST WHICH THE RESULTS ARE TO BE COMPARED?

Measurement is only useful for evaluation purposes if we can *compare* its results with other values. But against what should we compare? In general, there a number of different evaluation designs possible that all offer their own particular opportunities for comparison⁷⁸:

- Compare with earlier measurements: Although some longitudinal comparison was conducted in this research, by comparison of pre-project measurements and postproject measurements, this was done only to a limited extent and with limited success.
- Compare with another method: The research project present here adduced plentiful evidence that the PBM method can be successfully applied to real-world strategic decision-making cases, but we are still left with the big question as to whether it works better than conventional methods. Unfortunately, this question is unanswerable: "Any 'successful' study is completely defenceless against assertions that it should have been done better, or quicker, or that some other approach would have been more successful. Since the same human condition cannot be investigated twice, methodology is *undecidable*: 'successes' might have been greater with some other approach, and 'failures' might be due to incompetence in using the methodology rather than to the methodology itself^{**79}. In practice, a consultant never encounters a situation where he might apply different methodologies to two similar organisations that face a similar problem and even if he could it would be hard to differentiate the influence of the consultant and the method on the outcomes of the projects.
- Compare with a control group: An alternative is to stay within the same organisation, but have one group participate in the modelling process and set up another non-involved group as a control group. In theory, this should not be possible since PBM assumes that all stakeholders are involved in the project⁸⁰. In practice, however, especially in larger organisations one finds that some stakeholders are involved little or not at all in the PBM process. In one project

where this turned out to be the case evaluation interviews were conducted with such a 'pseudo-control group'⁸¹, but control groups remain in general problematic in real-world decision-making processes.

In contrast with the difficulties posed by the above approaches, the following three ways of comparing measurements were less problematic:

- Compare with personal impressions: When one asks a respondent how she or he would characterise 'communication' in the project, the respondent will compare this particular communication process with communication processes in similar situations in the past. In other words, a comparison will be made with the personal impressions⁸² of the respondent. In itself, this looks like a highly subjective comparison, but it often proves to be surprisingly robust if that respondent's assessment is compared with the assessments of other respondents.
- Compare with other respondents: If every participant feels that "communication was very good in this project", then their impressions probably correspond closely. Each individual comparison may be subjective, but one would hope that the intersubjectivity of the collective result would carry some weight.
- Compare with other cases: The six cases over which the PBM method was developed comprised a wide variety of extreme cases and typical cases, large cases and small cases, very successful cases and very unsuccessful cases. The cases therefore provide a wealth of opportunities for comparison and contrast in the cross-case analysis presented in Chapter 7.
- Compare with theory: Finally, there is the role of existing theory. The research model described in Chapter 2 incorporates, at least in part, some textbook theories on related aspects in strategic decision-making processes. In the cross-case analysis, these textbook theories were tested for validity against what actually took place in the six cases investigated.

The double role of the consultant/researcher

A final aspect of empirical research that should be addressed is the double role of the author, who was involved in all six cases under study here in the capacity of modeller / management consultant, but who also conducted the majority of research activities in the case analyses. There are many reasons why the combination consultant/researcher is a natural one, but also many reasons why it may be potentially dangerous.

The combination is a natural one, because "real knowledge arises where the action is"⁸³. One cannot study strategic decision-making in the laboratory, one can only study it in real life. And in real life, managers are often quite reluctant (and with good reason) to let outside researchers poke their noses into sensitive internal business affairs⁸⁴. Sometimes, usually reluctantly, they invitee outside consultants in, So if academia wants to find out more about strategic decision-making, it will have to team up closely with management consultants⁸⁵.

There are several complications with this double role, however:

- First of all, there is a difference in *attitudes*. A professional is always interested in understanding a *unique* problem and helping to solve it, a researcher is interested in understanding a *class* of problems⁸⁶.
- Then there is a difference in *perspective*. A consultant does not look at a case from a distance, but from *within* the case. When one holds a piece of text too close, it can be hard to discern the writing, and to that extent a more distant outside

observer (i.e. a classical researcher) has the advantage. On the other hand, one has to be fairly close up to read the fine print, and that is where the consultant has the edge.

• Finally, there is a difference in *motivation*. A researcher simply wants to find out what happened; from a research perspective, an unsuccessful project is probably even more informative and useful than a successful one. For a consultant-cum-researcher, it is obviously rather different; there is always a very real danger that case findings will be interpreted selectively, with only the good news picked out and the negative evidence ignored.

So consultants are biased, but then so are full time academic researchers. It is just as easy to construct a stereotype of conventional researchers and say that they "choose their language and methods to impress their peer group"⁸⁷ and that they select their topics and research methods primarily "according to the known preferences of various funding bodies and the academic community, rather than suiting methods to the problem under investigation"⁸⁸.

All this means is that one must seriously heed the injunction "forewarned is forearmed" and take additional precautions to ensure that the two roles are not mixed up. Among the measures adopted in the present research project are:

- have an outside researcher conduct evaluation interviews;
- have an outsider researcher interpret interview texts;
- document every step in the analysis;
- feed case analysis results back to participants in so-called 'member checks';
- ask academic peers to check the analysis in a peer review process;
- archive all case material.

In short, do all the things one would normally ask from a 'proper' empirical research project. These measures will be discussed more in detail in Section 3.6. and in Chapter 5.

3.3. Exploratory Research

The current research has been essentially exploratory in nature⁸⁹, and "in exploratory research, the emphasis is on *discovery*, the main characteristic being *flexibility*".⁹⁰ Some explanation needs to be given as to why this path was selected and what it implied for the research design and the research approach.

Reasons for exploratory research

Of the various reasons why researchers would want to conduct exploratory research, the most important are:

- "Knowledge or theory regarding the field to be researched is insufficient, failing or mainly implicit (..);
- The researchers do not sufficiently know the practical possibilities of different research designs (..);
- The researchers want to develop an idea of the main (...) problems in the research area (...);
- The researchers want to develop new measurement instruments (..)"91.

Three of these four reasons apply to the present project. In the research reported here, there *was* insufficient theory on participatory modelling, the design-oriented research methodology *was* not yet fully developed, and there *were* no adequate measurement instruments. The only thing that was sufficiently developed in the literature at the outset of this research was an idea of what the main problems were in this area⁹². So this project tried to cover new ground in at least three areas:

- Design-Oriented Research: First of all, the particular research methodology that was adhered to, that of design-oriented research, is a very novel phenomenon with foundations that date back only a few years⁹³. At present, only a limited number of methodological recommendations are available and, as of writing, hardly any research has been reported that was set up, executed and reported completely according to this new methodology⁹⁴. Therefore, the researcher has very little to fall back upon.
- Participative Group Modelling: The area of the research itself, i.e. the use of participatory modelling techniques to support strategic group decision-making, is also not at all well researched, still remaining "largely an art"⁹⁵ A great deal of knowledge has been accumulated and written down regarding modelling *per se*, but documentation on few of the techniques that really matter in this area, such as knowledge elicitation techniques or different approaches to process facilitation, was available at the outset of this research project⁹⁶. What is certainly almost completely lacking is systematic evaluation of group model-building projects: "Almost nobody seems to pay systematic attention to the impact of [model building procedures HA] on the client organisation"⁹⁷. So once again, the researcher had very little to fall back upon initially.
- Explanatory and Evaluationary Case Studies: Thirdly, although case studies have by now become a more or less accepted research design, this acceptance is mainly limited to the descriptive, exploratory case study⁹⁸. In the present research, case studies were used to *evaluate* PBM effectiveness. Also, case studies analysis was conducted to *explain* why results were the way they were. This broader role for

case studies is being advocated by several authors⁹⁹, but few actually give workable suggestions on how to go about causal analysis and evaluation in case-study research designs¹⁰⁰. No well-tested measurement instruments were available to the author either. Once again, all these had to be developed within the course of this research project¹⁰¹.

Implications for research approach

The exploratory nature of this research has shaped the characteristics of the research approach, among the most important of which are:

- 'Breadth-first': One has the choice of examining a small number of variables indepth or a large number of variables more superficially. In an exploratory context, one does not really know what all the relevant variables are, nor their precise relationships, so it seems obvious to opt for a 'breadth first' search strategy, to paraphrase a term used in computer science: investigate a large number of variables and relations at least initially, and find out which of these appear to be the most significant. This still leaves place for a more focused, follow-up study (which is no longer exploratory) in which a small number of relations are picked and investigated far more thorough.
- Incremental and iterative. A wise saying is that "If you don't know where you are heading, take small steps at a time"¹⁰². Neither the modelling method, nor the research model, nor the evaluation method, nor even the overall research design were very clear at the start¹⁰³. In such a situation, it seems obvious to adhere to a 'prototyping approach', to borrow yet another term from computer science. That is: test an early version of the design as soon as possible, evaluate the results and adapt the design to the findings of that evaluation, then start another cycle of (re)design-implement-test-evaluation. This goes for all three deliverables, not just for the PBM method (Chapter 4), but also for the research model (Chapter 2) and the evaluation method (Chapter 5). In this research, this approach has taken the form of multiple case studies, as described in Section 3.5..
- Inductive and theory-building. If there is little theory, one has to develop it from the ground up, i.e. from data analysis. This is called an *inductive* research approach. A *deductive* research approach is to take a piece of existing theory and try to refute¹⁰⁴ it with empirical data¹⁰⁵. Here one *refines* existing theory, in an inductive research approach, one *builds* theory¹⁰⁶ bearing in mind that "building theory on the basis of in-depth understanding of a few cases is different from the traditional theory-testing goal of statistical rigor, parsimony and generalizability. However, this type of research can provide the genesis for new theory that may spawn further research that uses traditional studies."¹⁰⁷

The research method *par excellence* for inductive, exploratory research is qualitative research, which will be discussed in the next Section.

3.4. Qualitative Research

Why qualitative research?

In this research, we want to find out what degree of process effectiveness was reached when using the PBM approach (e.g. how good was communication, how high was involvement) and what level of organisational platform was created (e.g. how committed did participants become, what level of consensus was reached). Moreover, we want to find out *why* these particular levels were reached. But if we want find out *why* people communicate effectively or *why* they become committed then it becomes essential to gain some idea of their inner motives, their "inner worlds". In this research project, this has led to a choice for a qualitative research approach to case data analysis.

What is qualitative research?

Qualitative research has its origins in a number of methodological observations regarding precisely the kinds of questions that were asked above: Why do people behave as they do? These observations have profound methodological implications, which, put together, have led to the development of the qualitative research methodology. The main line of reasoning behind this methodology is as follows¹⁰⁸:

- Apparently, people's behaviour is based upon their perception of their environment.
- If one wants to understand why people behave as they do, one therefore has to understand their environment as they understand it: "Therefore, a central notion in the qualitative methodology is the method of *verstehen*.(..) This means role-taking, the ability to put oneself in the position of an individual or a group. For the researcher this means that one has to learn to define the behavioural situation according to the meanings that the actors themselves ascribe to the situation."^{109,110}
- This is why a purely deductive approach is not appropriate: one cannot simply develop a research model from existing theory, operationalise that and measure it. The research approach will have to be at least partly *inductive*, starting from the reality that is being researched and building theory on the basis of that research.
- This also means that there has to be a very *open* research procedure, one in which the researcher gets "first hand involvement with the social world. (...) Participation is not just taking part, but also experiencing events"¹¹¹ together with the actors. Hence the preference for participative observations and case studies in qualitative research designs.
- This also implies that *different methods* of data collection have to be used to arrive at a description of reality that is as complete as possible.
- On the other hand, the researcher cannot just limit himself or herself to this inner perspective of social reality. One has to make an attempt to "objectivate a meaningful reality into concepts"¹¹². This is where qualitative data *analysis* comes around.
- This makes the research design strongly *iterative*: "In the research design this objectivation is made possible by going through the cycle of data collection and analysis, reflection and testing for several iterations (..)"¹¹³
- Objectivation can be fairly problematic when one starts from individual subjective perceptions. One of the main techniques for arriving at an acceptable level of at least

'inter-subjective' objectivity is *triangulation*, which means systematically using several different sources of 'evidence' and constantly comparing and combining this evidence. The principle of triangulation is used in different ways¹¹⁴:

- 1. Data Triangulation. Different data sources are used interviews, session tapes, observation memos, newspaper articles, project documents; moreover, interviews are conducted with different participants and tape recordings are made of several group sessions.
- 2. Methodological Triangulation. Different research methods are applied to analysing the same phenomenon, including interviews, questionnaires, participant observation, theoretical deduction, causal analysis and member checks, to mention just a number of highly diverse research methods.
- 3. *Researcher Triangulation*: Several observers are used to witness the same phenomenon; including research memos from different researchers, interviews by different interviewers.
- 4. *Theoretical Triangulation*. Different theoretical perspectives are adopted to analysing the same situation¹¹⁵.

All this diverges strongly from the orthodox view of empirical research in the social sciences, with its traditional emphasis on deductive, 'hands-off' research designs using quantitative analysis of surveys or experiments¹¹⁶. It will therefore come as no surprise that, over the years, "the dichotomy between qualitative and quantitative research has become a caricature in the social sciences. Qualitative research is characterised as being 'soft' social science, interested in 'mushy' processes, and dealing with inadequate evidence. Quantitative research is considered hard-nosed, data-driven, outcome-oriented, and truly scientific."¹¹⁷

This distinction is not helpful, since there are only two kinds of research, good and bad. Quantitative research can be bad¹¹⁸, and qualitative research can be good¹¹⁹. What cannot be ignored, is the fact that quantitative empirical research has had a head start of several decades, so a researcher who wants to conduct a survey can go to a library, take any textbook on survey design off the shelve and more or less follow the instructions in there step-by-step. As discussed in the previous section, qualitative research designs are a long way from being in that position¹²⁰.

How does one conduct qualitative research?

A logical consequence of the previous point is that the qualitative data analysis method that was used in this research combined existing approaches, rather than duplicated a single approach. A detailed description of the qualitative case evaluation procedure can be found in Chapter 5. Let it suffice to note here that the approach can be characterised as having:

- A strong emphasis on textual information, on what people say, either in interviews or during modelling sessions.
- A strong emphasis on triangulation, both of data and methods and, to a lesser extent, of researchers.
- A clear emphasis on explicit recording of the research process through various kinds of memos.
- Huge amounts of data on which to start analysis, with two complementary approaches¹²¹ to coping with these huge amounts;
- Specialised software¹²² to organise and codify text fragments;

- ٠
- Data reduction in a series of ever increasingly highly aggregated 'matrix displays'¹²³; Finally, extensive explanatory analysis using causal diagrams and so-called 'scatter plots'¹²⁴. ٠

3.5. Case-Study Research

Why case-study research?

In traditional empirical research, the case study has been held in considerably lower esteem as a research method than surveys and experiments¹²⁵. The main "traditional prejudices" against the case-study research strategy have been a "concern over the lack of rigor"¹²⁶ and the idea that "case studies provide little basis for scientific generalisation"¹²⁷. So why were case studies conducted in this research, rather than experiments or surveys?

The first reason is that "in research on the basis of the design paradigm the case study is the dominant research design."¹²⁸ This applies to the design and evaluation of the PBM method described here, the objective of which was the design of a consulting method to support strategic decision-making. Such methods are usually applied in projects, or *cases*, each of which constitutes a test. Moreover, it takes multiple iterations of the reflective cycle to create design knowledge. As discussed in Section 3.1., results were 'boiled out' from each project as it was completed and were then incorporated into a new, improved version of the method. This new version was applied to the next project. All in all, six projects were undertaken in this manner, which fact alone makes this research case-based or, more precisely, *multiple-case* research.

A second reason is that, for several reasons, strategic decision-making has to be investigated in its *real-world context*:

- Strategic decision-making processes are highly complex; "the boundaries between phenomenon and context are not clearly evident"¹²⁹. This makes it hard to design an experiment or a survey to investigate these processes, because how does one know beforehand which variables are to be taken as dependent, which as independent, and which as disturbing variables?
- Our research model contains a large number of variables and relations, whereas "only a limited number of factors can be studied under laboratory conditions"¹³⁰. No experimental design can deal with some fifty variables and a slightly larger number of relations between these variables.
- A method like PBM was "designed to address the complexity facing real managerial teams"¹³¹. It must work well with real clients, who pay money for results and risk their own careers, clients who have a future and a past as a group. "This means that researching with any groups that do not have the above characteristics wholly discounts evaluating some of the primary characteristics of the (..) method."¹³² The implication of this is that "studies that do not reproduce such an environment may select as 'best' a technique that would be ineffective in the real world."¹³³

Thirdly, we have already seen that we are looking for inner motivations and perceptions of participants. We are looking for commitment, for perceptions of openness of communication, for perceptions of consensus. This means investigating 'people's inner worlds'. In the preceding section on qualitative research we have seen that this requires close *researcher participation*.

Fourthly, we have also seen that this research is exploratory and mainly aimed at *theory-building*. There is already an overabundance of theory-testing research in the various applied fields involved¹³⁴. A sensible follow-up research project might be to select a few interesting research hypotheses from this research, such as are discussed in

Chapter 8, and test these in a (pseudo-)experimental setting. But first exploratory research is required to generate these testable hypotheses.

Different kinds of case studies

A general definition of a case study is "an empirical enquiry that :

- investigates a contemporary phenomenon within its real-life context; when
- the boundaries between phenomenon and context are not clearly evident; and in which
- multiple sources of evidence are used."135

That being said, case studies can take very different forms. Some differences in characteristics of the client organisation and the types of problems that were investigated in the six case studies described in this book are shown in Table 3.2. As one can see, no case study even closely resembles another. (For an explanation of how these figures were derived from case evidence the reader is referred to Chapter 5.)

Case Characteristics	Case	Case	Case	Case	Case	Case	Min	Max
(= contingencies)	1	2	3	4	5	6		
Problem scope	-	++	-/+	++	+	++	-	++
Problem tangibility	+		+/-	-	-	_/+		+
Data availability	+	-/+		-	-/+	+/-		+
Problem urgency	++	+/-	++/-	+	+	+/-	+/-	++
Political sensitivity of problem	+/-	_/+	-/+	++	-/+	-	-	++
Top management support	-	+	-	++	+	-/+	-	++
Hierarchical diversity of group	-	-	-	++	-	-	-	++
Problem ownership in group	++	+/-	-	-	+	+	-	++
Group size	-	+	_/+	++	+/++	+	-	++
Working relations within group	+/-	+	-	-	+	+	-	+

Table 3.2: Differences in characteristics of the six case studies in this book

Far from it being a bad thing that this series was in no sense uniform, such *heterogeneity* is essential for any multiple-case research design. Heterogeneity is here taken to mean that "the cases differ from each other on the relevant variables"¹³⁶. The relevant variables in this research are the variables from the research model, some of which reappear in Table 3.2. And if, for instance, 'political sensitivity' were "--" in every case and 'willingness to cooperate' were always "+", then would be hard to make a valid claim for the causal reasoning "The higher political sensitivity, the lower willingness to cooperate will become"¹³⁷.

Another important difference between these six case studies is the role that they played in the design-oriented part of this research:

- Case 1 was an *exploratory* case study in every sense: it was the author's first consulting assignment, at a time when he was not yet sufficiently proficient in many of the conceptual modelling techniques that system dynamics offers. The need for client participation was acknowledged, but how this was to be achieved was not yet clear.
- Cases 2 to 4, by contrast, were very much *design-oriented* case studies. Case 2 added causal diagramming, systems archetypes and the use of workbooks, whilst Case 3 had stocks-and-flows diagramming, graphical functions, discrete-event

simulation and learning-wheel workshops as new elements (for an explanation of these PBM techniques, see Chapter 4). In Case 4 the approach was tried on a very broad issue and in a compressed time format; although it failed, some very fundamental lessons were learnt from this experience.

 Cases 5 and 6 then were mainly *evaluatory* case studies for a PBM method that changed little after the lessons of Case 4 had been absorbed. Cases 5 and 6 were very large modelling projects, for demanding multinational clients, on broad or very broad issues. They both went well¹³⁸, thus essentially finalising the process of methodical convergence that was described in Section 3.1.¹³⁹

Generalisation from multiple-case research

One final methodological issue regarding case research should be discussed separately, that of its generalisability. The question "How can you generalise from just a small number of cases, let alone from a single case?" is still frequently heard. However, the question is based upon an error in reasoning, as the following quotation illustrates: "Consider for the moment that the same question had been asked about an experiment: "How can you generalize from a single experiment?" In fact, scientific facts are rarely based upon single experiments; they are usually based on a multiple set of experiments, which have replicated the same phenomenon under different conditions. The same approach can be used with multiple-case studies (...)"¹⁴⁰.

Surveys and experiments have to be generalised *statistically*, only if the 'population' (i.e. the number of respondents) is large enough, can a sufficient level of reliability be achieved to make more general statements¹⁴¹. But statistical generalisation is just not appropriate for case studies. It's simply not *fair* to equate the findings from a case study of a project lasting several months, involving in-depth interviews with several participants and many hours of recorded sessions, which were carefully analysed in a large number of steps, with the findings of a survey which merely requires a questionnaire to be filled in by a group of anonymous respondents in ten minutes, answering only a small number of fairly general questions. So "a fatal flaw in doing case studies is to conceive of statistical generalisation as the method of generalising the results (...)ⁿ¹⁴² Rather, "multiple cases (...) should be considered like multiple experiments (or multiple surveys)"!¹⁴³

In case-study research, generalisation should be *analytical*. Analytical generalisation means that you confront a theory (e.g. the research model of Chapter 2, or the PBM design guidelines that will be discussed in Chapter 4), with the empirical results from the case study¹⁴⁴. If this confrontation is done successfully for several case studies, the evidence becomes stronger — and is all the more compelling if the case studies vary considerably on the variables that are of specific interest. "In analytical generalisation, one draws conclusions from a collection of case studies and generalises these conclusions by logical reasoning to a population of cases that have as many as possible similar relevant characteristics as the cases studied."¹⁴⁵

3.6. Research Validity and Reliability

In this section we look at a final and crucial aspect of methodology, namely, was this research conducted with sufficient thoroughness? Or, to formulate the question more academically, what can be said about research validity and reliability for the research reported in this book? Interestingly enough, this work can be criticised on two totally different grounds in this respect. Orthodox social scientists may criticise it for not being sufficiently rigorous, for being too broad in scope and too shallow in depth. On the other hand, practitioners and academics in the field of management and organisation may criticise this research for overemphasising empirical evaluation and underemphasising practical usability for professionals. We will discuss both points.

Criticism from 'the orthodox¹⁴⁶ design school': an overemphasis on evaluation?

The emphasis placed on validation in the present study? may seem overdone at first sight. For in an academic system where dissertation studies are to be finished within four years, every month spent on 'evaluation' means that a month less is dedicated to 'design'. And if design-oriented research is what is sorely needed, then why have a case evaluation process of more than one and a half man year like in the present study? This is the trade-off of 'rigor *or* relevance', which forces a researcher either to "stay on the high, hard ground where he can practice rigorously, as he understands rigor" or to "descend to the swamp where he can engage in the most important and challenging problems if he is willing to forsake technical rigor"¹⁴⁷.

To put it another way: organisation studies are an applied field. PBM is a practical method to be applied by professionals, by management consultants. So "surely the measure of success of research in an applied topic (...) is whether our knowledge has been improved to the extent that this improved knowledge can be applied in practice"¹⁴⁸. And if a strong emphasis on evaluation and validation leads to "conflicting or confusing results with little or no applicability, one is left wondering whether (...) [this evaluation work] was worth undertaking in the first place and, more generally, whether much of this style research is at all applicable to the (...) field."¹⁴⁹.

To this author this trade-off is false. In his work, he has always felt that he was attempting to achieve rigor *for* relevance. For what practical use are new methods, theories and case descriptions to professionals if these professionals cannot see how serious they should take the material presented here? For a management consultant, it is essential to know what part of a new method has been well-tested and can be called robust and what parts are for the time being just exploratory and tentative. If one cannot find such qualifications in a book its use becomes much more limited than if the strength or weakness of the evidence for each finding is indicated clearly.

Moreover, the field of management and organisation studies has long been dominated by the works of management gurus who write best-selling books aimed at business audiences. Some commentators have therefore "compared the study of management to early medicine, before science transformed itself by replacing the nostrums of quacks with treatments based on verifiable experiments."¹⁵⁰. This author would label management-guru teachings not so much as un-scientific, but rather as prescientific: at the very least, their ideas provide excellent material from which to build testable theories¹⁵¹.

However, no-one should be satisfied with a situation in which professional work in the business world remains overwhelmingly a matter of 'belief', or 'gut feelings', or 'common sense' Business management is different from medicine, but to suggest "that there can be no general principles of good management, and that corporate success depends on identifying the next fad ahead of the competition, (...) to believe that the systematic study of business is impossible, (...) requires the arrogant confidence of the Inquisition, (...) who visited Galileo [and] refused to look through his telescope since what he claimed could not be there"¹⁵².

So, to recapitulate:

- Research in management and organisation should be conducted as rigorously as possible to ensure its practical applicability and to "take one or two faltering steps on the road to making it a science, like modern medicine."¹⁵³
- Rigor does not automatically entail laboratory studies or field surveys, as has been discussed at length in this chapter. Qualitative case-based research can also be rigorous, and may be more suited for management and organisation studies.
- Rigor *leads* to relevance, because an applied researcher learns more about his or her method through careful examination of the case-study evidence¹⁵⁴.

Criteria for scientific knowledge

The design sciences and the empirical sciences are specific branches of science; the arts and the formal science are other types of science. In general, one can distinguish four fundamental criteria for scientific knowledge¹⁵⁵:

- 1. Scientific knowledge is developed within a scientific research programme¹⁵⁶;
- 2. Scientific knowledge is transferable to other persons by means of written material;
- 3. Scientific knowledge is generalisable to other situations,
- 4. Scientific knowledge is tested.

So whether one is interpreting Buddhist themes in the works of an 11th century Japanese poet or developing a management consulting method based upon system dynamics modelling, one always:

- has a certain academic audience in mind, a group of researchers to whom one feels related, a group that has certain ideas about how research in their field should be conducted and how it should not be conducted¹⁵⁷;
- has to write down one's findings in such a way that other people in this field can understand what is being said;
- has to set up one's research in such a way that one can say something sensible not just about the material that was the subject of direct investigation (be it a series of poems or a series of case studies) but also about other material that was not directly investigated (be they other works by this author or his followers, or be they other strategic decision-making processes);
- has to show evidence for one's claims, derived either from existing theories or from relevant data, or both.

But perhaps this is still somewhat too broad and vague for our purpose. After all, this book is not concerned with Japanese poetry; it presents a body of empirically founded, design-oriented research. Fortunately, both the empirical social sciences and the design sciences have more specific criteria for scientific knowledge in these fields.

CRITERIA FOR SCIENTIFIC DESIGN KNOWLEDGE

Design knowledge is a specific category of scientific knowledge, often being expressible as design guidelines. In the field of management and organisation, these design guidelines are always *heuristic*¹⁵⁸, that is, they take the form "If you want to achieve this-and-this in such-and-such circumstances, then it's a good idea to use that and that method/model/algorithm/technique." This is different from the *algorithmic* statement that says. "If you do this-and-this in such-and-such circumstances then in n % of cases that-and-that will happen".

This has important implications for what scientific design knowledge can and cannot be: "A deterministic guideline can be *proved* by scientific research (..) by way of *statistical generalisation* (..) But a heuristic statement can never be proved¹⁵⁹. It can be tested (..). That means that the researcher will present supportive (..) evidence, by which, in multiple case studies, confidence in the effect of the knowledge product can gradually be increased."¹⁶⁰

CRITERIA FOR SCIENTIFIC EMPIRICAL KNOWLEDGE

As was said before, the methodology of the design sciences is a relatively novel phenomenon. One can see that the social sciences have a longer methodological history merely from the fact that every recent textbook in this field¹⁶¹ mentions the same four specific criteria for empirical research in the social sciences:

- Construct validity the degree to which the theoretical concepts that are studied, the 'constructs', are being operationalised and measured correctly. To particularise to our own research, were we really measuring 'commitment', for instance, when we asked people if they were determined to implement the findings from the project?
- Internal validity the degree to which the causal relations that are made between these constructs are likely to exist in reality. On the basis of our research, how sure can we be that it was indeed high model ownership, and not some other factor, that led to high levels of commitment in most cases?
- External validity the degree to which the findings from the study can be generalised to a broader domain. (In what other kinds of strategic decision-making processes can one expect a similarly strong positive correlation between ownership and commitment?)
- Reliability the degree to which the research procedure could be repeated with similar results. (If someone else were to start from the same basic interview transcripts and follow the steps as indicated in Chapter 5, would this person be likely to arrive at the same high-level analysis and conclusions as those shown in Chapters 6 and 7?

Criticism from 'the orthodox empirical school': insufficient reliability

Table 3.3. shows how this research 'scores' in terms of the evaluation criteria for empirical research in the social sciences. This suggests that the present research may achieve acceptable levels of internal and external validity, but its reliability is relatively low and, most seriously, not even measured explicitly. Does that mean that the research is fatally flawed? The reader must form his or her own opinion about that, but the author, for his part, feels constrained to be very modest in any claims he would wish to make on the basis of this research method.

Design criteria	Research tactics used in the PBM research project
Construct validity	 multiple sources of evidence (interviews, session protocols, documents, observations, memos, existing theory in literature) use multiple, correlated indicators for each variable (not done) triangulation (multiple informants, data sources and researchers) chain of evidence (single causal model in Chapters 2, 7,8) data reduction¹⁶² (matrix display construction in case analysis, research model construction in cross-case analysis) "have key informants reviewing draft case reports"¹⁶³ (member check, peer review)
Internal validity	 compare with existing theory in literature¹⁶⁴ (literature sample in Chapter 2) analyse evaluation interview protocols construct causal case network on basis of this analysis (Chapters 5, 6) present findings to informants in member check (Chapter 5) create scatter plots of display values (Chapter 7) analyse causal chains (Chapter 8)
External validity	 conduct multiple cases vary cases in relevant dimensions¹⁶⁵ document cases as completely as possible use analytic generalisation compare with existing literature¹⁶⁶
Reliability	 create case-study analysis protocol (described in Chapter 5) create separate case databases for replicability compare different kinds of data have outsider conduct evaluation interview (in four out of six cases) use control groups (only very limited) use pre-measurements (only limited) establish quantitative measure for (α-)correlation reliability (not done) establish quantitative measure for intercoder reliability¹⁶⁷ (not done) have multiple analysts review material (limited) conduct peer review on case analysis reports (limited)

Table 3.3: Research tactics in the case evaluation procedure aimed at improving various aspects of validity and reliability

In his own defence, the author would like to point out that "all methods have inherent flaws—though each has certain advantages".¹⁶⁸ The advantages of the research method adopted to the present project were that interrelations between a large number of relevant variables in a very complex social phenomenon could be studied. The disadvantages were that this method was bound to be low in reliability and modest in generalisability.

At a more general level, two extended citations from well-known social science textbooks may be appropriate to defend the research design that was chosen:

"When you gather a batch of research evidence, you are always trying to maximise three things:

- 1. The generalisability of the evidence over populations of actors (A).
- 2. The precision of measurement of the behaviours (and precision of control over extraneous facets or variables that are not being studied) (B).
- 3. The realism of the situation or context (in relation to the contexts to which you want your evidence to refer) (C).

While you always want to maximise A, B and C simultaneously, you cannot. This is one fundamental dilemma of research methods. The very things you can do to increase one

of these reduce one or both of the other two."¹⁶⁹ So one has to made a trade-off. In case studies like the present research, the trade-off is that these "gain realism (C) at the price of low generalisability (A) and lack of precision (B)"¹⁷⁰.

Finally, this author is well aware that this research could have been more thorough, that higher levels of reliability and validity could have been reached. But "the emphasis on thoroughness is of a task setting nature. It is an ideal, to compare with controllability in experiments and random sampling in surveys. The actual research practice allows only approximations of these. (...) There is a certain saturation point up to which the researcher goes. Research is not striving for certain knowledge, but striving for plausible propositions regarding reality, which can be expanded or disproved in a later stage."¹⁷¹

CHAPTER 4 The Participative Business Modelling Method

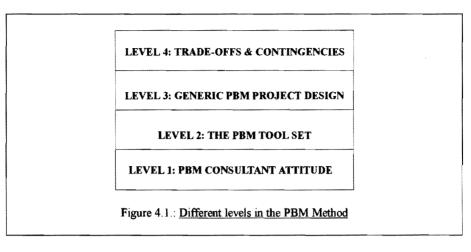
This chapter sets out to describe the PBM method in detail. The primary reason for doing this is to provide the reader with sufficient information about the method to appreciate the results from its application in six cases, evaluation of which lies at the heart of this book. Beyond this, the research model presented in Chapter 2 describes a general theory of how to achieve effective strategic decision-making. The reader has a right to know how the author has operationalised this theoretical research model into a practically applicable method.

However, the need for description of the PBM method brings with it certain consequences. One of them is *size*: this chapter takes some sixty pages to describe the PBM method, of which relatively few are dedicated to that part of the method which is usually discussed in the literature, i.e. the PBM tool set¹.

A further consideration is that of *validity*. This chapter describes the PBM method as the author used it in the last two cases². This means that many of the detailed design guidelines set out in this chapter are not fully backed up by empirical research or can be traced to existing literature. This means that the design guidelines can aspire at most to represent current 'best practice', rather than resting on a fully coherent body of scientifically defensible results.

A third consequence relates to *style*. As a matter of deliberate choice, this chapter addresses the practical needs of interested management consultants. "It actually takes you by the hand", as one fellow consultant commented. The author hopes that the many prescriptive statements and imperatives contained in this description will please the interested practitioner and will not be off-putting to the more academically inclined reader.

In PBM, a group of managers facing a strategic problem develops a model of that problem in a series of group model-building sessions, facilitated by one or more experienced modellers / process facilitators. Modelling in PBM moves gradually from very informal, qualitative and conceptual models to more and more formal, quantitative simulation models. PBM contains techniques and guidelines for this whole modelling process. Probably the easiest way of discussing these is by looking at the PBM method³ as being articulated on four different levels, as shown in Figure 4.1. Each of these levels discusses different aspects of the method. In this chapter, each of these levels will be discussed in one or more sections.



- 1. Fundamental to any PBM project is the *attitude* the consultant must bring to work with PBM successfully. Three aspects of this attitude are distinguished in Section 4.1.
- 2. Next comes the *tool set* any PBM consultant should be able to use, i.e. the individual techniques that are employed in PBM projects. These are well described in the literature, but are reviewed briefly in Section 4.2.
- 3. How these techniques are combined into a *generic project set-up* forms the third level, described in Section 4.3. Many of these design elements have also already been described in existing textbooks.
- 4. At the highest level are various kinds of *PBM design guidelines*: These aim to give advice on how one deals with various contingencies, and what sorts of trade-offs one has to make when tailoring the method to a specific problem and a specific organisation So far, such guidelines have been rare in the literature; here they are discussed at length in Sections 4.4. to 4.6.

4.1. PBM Consultant Attitudes

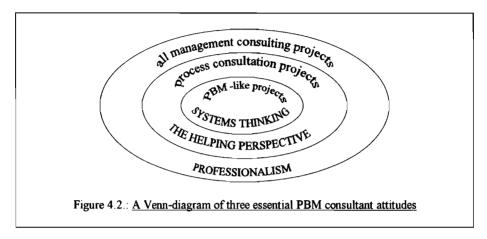
Crucial as the 'right' attitude is to successful conduct of any PBM project, this is, unfortunately, something that can only be learned experientially, not from a textbook⁴. Rather than attempt the impossible task of coaching the reader in a way of looking at the consultant's job, at his or her professional world, this chapter aims to outline the kind of attitude the author feels is appropriate.

Fortunately, the management consultants at whom this chapter is directed are likely to have adopted already at least parts of the three essential aspects of the 'right' attitude set out in Figure 4.2:

- professionalism;
- process consulting; and
- systems thinking.

These three aspects are interrelated in the following manner. In any serious management consulting project, one needs a professional attitude. Within management consulting, different kinds or styles of consulting are distinguished. One such style is "process consulting",⁵ which is often contrasted with so-called "expert consulting"⁶. All consultants who conduct process consulting projects should display what Edgar

Schein, the developer of the concept, calls "a helping perspective"⁷. This is what is meant by the term "process consulting" in Figure 4.2. Finally, PBM can be seen as one of a small number of management consulting approaches in which, in addition to a process consulting attitude, systems thinking is considered very important⁸.



Let us discuss each of these three aspects in more detail.

Professionalism

What is meant by "being professional"? The term is frequently used, and abused, by management consultants. For this author professionalism in management consulting means at least the following:

- *Dedication*: Show dedication to your client and to your job in everything you do. So be on time, stay within budget, be flexible, stay polite, don't fool around.
- Added value: Make sure you have something to add to the process that the client did not have already. If you can add nothing, get out. If you do have something to offer, then use your best skills to deliver as much added value as you can.
- Openness⁹: Tell your client when you feel there are problems. Don't have hidden agenda's. Tell the client (gently) when you are unsure what to do next yourself; share (whenever possible) your feelings. And most importantly: don't manipulate your client. If you have a good idea, tell the client directly about it, rather than using consultant's tricks to induce the idea from the client's mouth. Such manipulation may make the client feel good initially; It may also make the consultant feel good about having outwitted his or her client. But clients are not dumb; they will soon sense when they are being manipulated. Once they start to believe that the consultant apparently is not looking for openness but wants to play games, they will adopt similar behaviour.

A professional attitude on the part of the consultant to his or her work is certainly indispensable to the next aspect.

The Helping Perspective

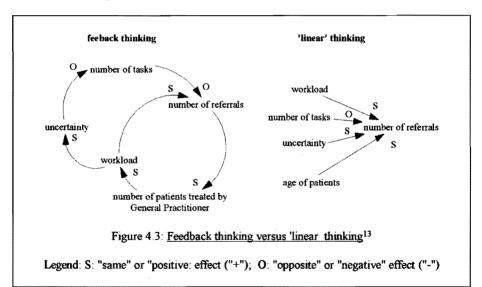
- The client retains problem ownership: The fundamental idea behind process consulting is that the consultant does not, as it were, say to the client: "Give me your problem, I'm an expert in this kind of problem. I will solve it for you and give you the answer." The process consultant must leave problem ownership with the client, saying: "I cannot solve your problem for you, you will have to do that yourself. However, I am very willing and able to help you to solve your problem." In many cases, clients do not want to hear this. What they want is for someone to take a problem off their mind and not be stuck with it. Unfortunately, only too often when the expert consultant presents his or her "expert solution", the same manager does not like the solution, for the reason discussed in Chapter 2: "lack of involvement leads to lack of ownership leads to lack of commitment"¹⁰. The result is another brilliant report that goes straight into the proverbial bottom drawer, never to reappear.
- The client is the problem expert: For modelling projects, this process consulting perspective has a collary. If the problem is to remain with the client, then the client must be treated as the problem expert. This is less simple than it sounds. Many practitioners and academics have a natural tendency to feel that they know more about a specific problem than the client does. This perceived superiority may be based upon knowledge of similar cases in other companies, or descriptions in the literature of a generic version of this particular issue. The impression may well be that the client is bogged down in details and does not see the big picture. All this may be true, but in a process consulting approach it is a fundamental error to lay out 'superior knowledge' when you want the client to remain in charge of the problem. If you offer a ready-made prescriptive theoretical framework to describe your client's problem then you run the risk that the client will say: "Oh, so you know it all already. You may as well do the rest of it. That will save us all a lot of time." An even bigger risk is that the client will say: Yes, it may look like that from your ivory tower but we tried that approach some time ago and it didn't work." (And the client may well be right there.¹¹)

So the consultant must always start from the information the client provides. Not just for the sake of client commitment, but also because, especially in the beginning, the consultant tends not to possess any 'superior knowledge' about this particular problem. However, if somewhere halfway during the project, the group does get bogged down and is really unable to get a grip on a particularly difficult issue, then the consultant would not be providing 'added value' if she or he did not show 'dedication' and strive to find a solution to the issue in some textbook, in a previous project, or through the knowledge of experienced colleagues. In the name of 'openness' and 'professionalism', any findings should then be relayed to the client. But to live up to the process consulting attitude, those findings should be presented in the right way: "You remember that difficult problem we had last time? I simply could not get it off my mind and I have tried to find a solution for it. This is what it looks like. Am I completely off the mark here or is there perhaps something useful in it for us? You look at it, you know your company inside out. I've just tried to think of a way of representing the issue in our model."

A Systems Thinking¹² Perspective

One can conduct process consulting projects without using PBM or any other modelling technique. Indeed, the vast majority of process consulting projects do not. However, if one does use PBM one should *not* use it from an expert consulting perspective, if one wants to achieve effective strategic decision-making, as we have seen in Chapter 2. So all PBM projects are process consulting projects, but with a 'systems thinking' perspective. What does this 'systems thinking' perspective mean? The following points come to mind first of all:

- Interconnectedness: The notion that all strategic problems are interconnected implies that if one changes one aspect of a system, every other aspect will change as a result. There are no ends to problems, no 'system boundaries'. Boundaries are always matters of *choice*, they are not preordained.
- Feedback thinking: All strategic problems are interrelated, but in a very specific way. In systems thinking, one does not look at problem causes as mere 'laundry lists'. Rather, as Figure 4.3 shows, one is always looking for feedback, for loops, for self-fulfilling prophecies, for vicious circles. This feedback thinking lies at the heart of system dynamics modelling and is fundamentally different from so-called 'linear thinking'.



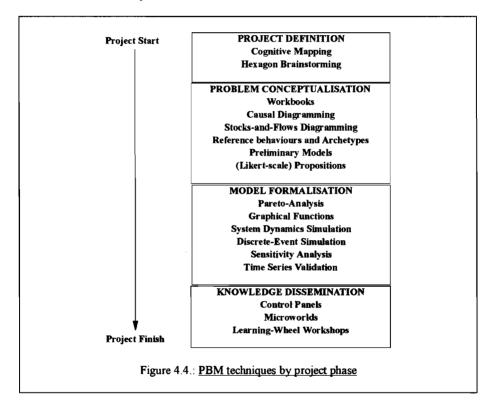
- The 80-20 rule¹⁴: Everything may be interrelated, but some relations are more important than others. Furthermore, there may be no system boundaries, but some factors are more 'core' to a problem than others. The 80-20 rule says that 20% of all factors and relations of a system will suffice to explain 80% of system behaviour. It also suggests that if you want to capture the whole system the last 20% will cost you 80% of your total time.
- All that is needed, no more than is required. Closely related to the 80-20 rule is this design guideline for modelling detail. One should start with a minimal representation of reality, and see what this model tells you. Details can then be added and refinements made as required. But one should never work the other way

round, modelling various bits of the real world without asking oneself whether these bits are required to fulfil the modelling purpose¹⁵.

• *Multiple subjective realities*: A fourth basic systemic notion is that there is no single, objective reality. The modeller's main materials are the individual mental maps of people. These maps are by definition subjective, diffuse and incomplete; no one has all the answers. The trick is to come up with an inter-subjective representation of reality that is acceptable to all concerned and can act as the basis for some kind of decision or insight. In the words of John Sterman, *All models are wrong, but some can be useful*¹⁶.

4.2. The PBM Tool Set

Armed with the proper attitude, the PBM consultant is ready to apply the various techniques that are in the PBM tool set. The overview of these techniques provided in Figure 4.4. follows the generic PBM project phasing described in Section 4.3. However, many of these techniques (e.g. hexagon brainstorming, workbooks) can be used in more than one phase.



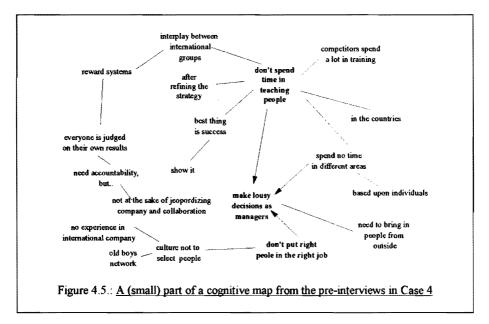
In the following pages each technique will be introduced briefly, usually with an example from one of the case studies described in Chapter 6. The objective is not to provide a training guide in these techniques; for training purposes the reader is referred to the textbooks referred to in the notes given with each subheading.

Project Definition Tools & Techniques

COGNITIVE MAPPING¹⁷

Cognitive mapping is not an essential technique for a PBM project, but it helps. First of all, it is a useful way to take notes. One can draw a cognitive map while listening to an interviewee and yet retain sufficient eye-contact. The cognitive maps drawn during the interview also assist recall of the structure of what was being said. It is also a good way of directing attention to causal arguments in a person's story. Furthermore, to be seen to be busy drawing cognitive maps during an interview shows the client what kind of process that he or she can expect: systems-based, visually oriented, comprehensive, and non-directive. And finally, as one client remarked to Colin Eden, the developer of the technique: "It's very flattering the way you are writing so much down."¹⁸

The technique itself – or at least the version used in the cases described – is fairly simple. One asks the interviewee a question like: "What is or are, in your opinion, the main problem or problems right now?" The response is written down in a few keywords on a piece of paper the interviewer is holding. One can ask then: "What causes this problem?" or "Where does this lead to?" The replies to that question are also written down. Lines are drawn between the various statements to indicate the links between them. Often a interviewee will add side comments to these causal links, giving further information about the subject. These are also written down and linked by lines. Soon a diagram such as the one shown in Figure 4.5. will appear¹⁹.



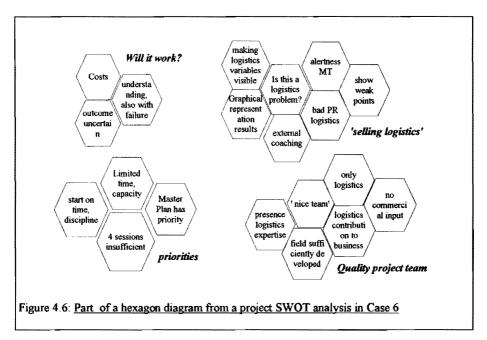
HEXAGON BRAINSTORMING²⁰

Hexagon brainstorming is an advanced application of nominal group technique (NGT)²¹. It has been found to be very effective for a wide variety of idea-generating tasks. In PBM, the technique is used at least once in each project, to make a group appraisal of project risks in a classical SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis, as shown in Figure 4.6. But the technique is also admirably suitable in the initial stages of conceptual modelling to focus upon main variables and problem issues or questions.

The procedure is as follows:

• The participants are asked to think in silence and write down a number of items in response to one or more questions the facilitator asks them.

- When everyone is finished, the facilitator asks each of the participants in turn to mention his or her most important item. Questions can be asked to explain the item, but direct discussion is avoided.
- The items are summarised in a few key words and written down on a six-sided ('hexagonal') coloured piece of plastic with a magnetic device at the back. The hexagon is placed on a central whiteboard.
- Different colours can be used for different questions or different types of answers.
- When every participant has contributed an item, the cycle is repeated until there are no more items to be added or the group indicates that sufficient information is on the whiteboard.



- Then the clustering process starts. A participant is invited to come forward and put next to each other two hexagons that he or she feels are closely related²². The participant is asked to explain the relation between the chosen hexagons. The next participant comes forward, then the third, and so on. Soon clusters of hexagons emerge. Gradually the process becomes more informal, with more people contributing simultaneously. Usually the process will stop after a while, with anything from 5 to 10 clusters on the board.
- The next step is to ask the group to label each cluster. The facilitator briefly mentions the various items of each cluster and asks the group for a fitting label.
- If different colours have been used, now is the time to look at the colour distributions. Are there clusters where a particular colour is dominant? What might that mean?
- Finally, the facilitator summarises the whole picture by setting the various clusters in perspective to each other in one brief 'story'. This distils the overwhelming complexity of 30-60 items into a few coherent sentences.

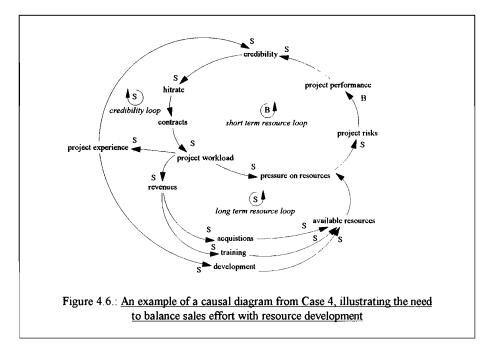
Problem Conceptualisation Tools & Techniques

WORKBOOKS²³

In Section 4.3. we shall see that workbooks are almost always used between two PBM workshops. Here they serve a dual purpose: they provide feedback on the results of the previous session, and they elicit information in preparation for the next session. In their simplest format, workbooks are nothing more than session minutes plus an agenda with explicit free space for comments. In a more refined format, workbooks can be used instead of a group discussion.

A crucial element is to invite the reader to provide comments and additional information after each main statement in the workbook. This can be done directly by asking: Do you agree or disagree with this statement? This is particularly appropriate for workbooks containing propositions (cf. Table 4.1. later in this section.) The invitation can also be indirect, by providing space on most or all pages of the workbook to record comments or suggestions.

The procedure concerning workbooks is quite straightforward. The workbooks are sent to the participants for completion, then collected (often by fax) and analysed by the consultants. The comments of each participant are fed back to the group in the next session.



CAUSAL DIAGRAMMING²⁴

Together with stocks-and-flows diagramming, causal diagramming is the most important diagramming technique in PBM. The main purpose of causal diagramming is to make evident circular connections between phenomena that give rise to *feedback*.

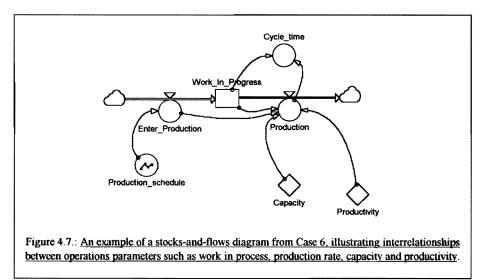
Figure 4.6. shows a causal diagram with three feedback loops that was developed in Case 4^{25} .

There are different ways of constructing causal diagrams in direct interaction with groups of managers. In PBM, the preferred way is to start from a preliminary model (see below), but one can start from one or two loops, or even from scratch. In any case, an important guideline is not to become trapped in the kind of linear thinking that was shown in Figure 4.2. Rather than ask for a laundry list of factors affecting a certain variable X, it is better to ask what Y influences X, and what Z affects Y, etc., and then seek for feedback relations in the model.

STOCKS-AND-FLOWS DIAGRAMMING²⁶

Also known as "flow diagrams"²⁷ or "systems flow diagrams²⁸, stocks-and-flows diagrams show how different variables in a continuous system influence each other, borrowing control engineering methods to distinguish flows of resources from the mechanisms that regulate the flows²⁹.

Stocks-and-flows diagrams are less straightforward to create and read than causal diagrams, because one has to adhere to a rigid diagramming syntax. The benefit of this rigidity is that the diagrams can be directly translated into differential equations which form the basis for system dynamics simulation models.



Stocks-and-flows representations work especially well in business environments where there is a clear flow of activities, products, or people. An example of a goods flow is shown in Figure 4.7. In fact, it is good modelling practice in any business modelling project to ask oneself what the main flows look like for the following six main business networks³⁰:

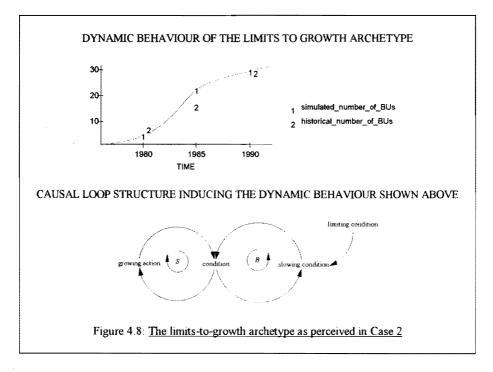
- 1. The *materials network*: the flow of products from raw materials via semi-finished products through to inventory of finished products;
- 2. The orders network: from forecasted orders via pending orders through to executed orders;
- 3. The money network: from cash-in via working capital to cash-out and beyond;

- 4. The *personnel network*: from new hires via training to experienced employees and terminees;
- 5. The *capital equipment network*: from new machines, offices, trucks etc. to obsolete equipment.
- 6. A group of *intangibles*, comprising such issues as motivation, company image, perceived product quality etc. This is a set of flows which is often neglected but usually has a crucial impact on overall business (and model) performance.

All these flows are interconnected via informational links. Normally not all these networks will be equally relevant for any particular problem, but usually several of them are.

REFERENCE BEHAVIOURS AND ARCHETYPES³¹

Often an experienced model builder will 'recognise' the first drafts of a conceptual model of a problem, for in system dynamics representations, many business situations look surprisingly alike. "This problem looks like a growth-and-underinvestment situation", or "a-fixes-that-fail situation", or "an-overshoot-and-collapse situation", the experienced model builder may say. Archetypes are typical patterns of dynamic behaviour that have occurred in many different cases, in many different fields, so often that they have been given a name. Archetypes are particularly useful to the modeller because they can guide him in designing the modelling process (but less useful to the problem owner). However, the PBM consultant has to be very careful that they don't become a mental straightjacket ³². Figure 4.8 provides an example which looks like the 'limits-to-growth' archetype, so called after the original Club of Rome report, as it was presented in Case 2, but which turned out to be misleading as the actual problem turned out not fit this archetype³³.



USING A PRELIMINARY MODEL³⁴

A preliminary model, or 'knock down'-model as the author usually calls it, is a relatively simple sketch of a problem situation that is presented to a group of participants at the start of a PBM modelling session. The idea is to provide a clear focus for discussion. The preliminary model is presented in a vulnerable, highly qualified manner, something like: "Just to give you an idea of the kind of model we are talking about, this is an example of a situation that may look somewhat like your situation. Of course it isn't, but we might use it as a starting point for our discussions. Now this is how it goes..."

After this explanation, the participants are invited to criticise the model. They are invited to add or remove connections and variables, change names and values. In this way the discussion can remain free yet focused. An example of a preliminary model is shown in Figure 4.24. of Section 4.3. (For a discussion of the pros and cons of preliminary models, see Section 4.6.)

(LIKERT-SCALE) PROPOSITIONS³⁵

Propositions in themselves are straightforward; so too are Likert scale propositions. A Likert scale proposition is one to which are added the following five answer options: strongly disagree / disagree / no opinion / agree / strongly agree. When expedient, one can limit these five to two or to three, as shown in Exhibit 4.1., which presents some propositions from Case 5.

What is less staightforward about propositions is the way in which they are used in PBM projects to focus discussion and achieve consensus. This goes as follows:

- Towards the end of the model conceptualisation phase, the consultant summarises the main findings coherently in the form of propositions. These propositions will often be descriptions of the causal diagrams or stocks-and-flows diagrams that have been developed up to that point.
- These propositions are sent to participants in workbooks. The participants fill in the workbooks and send the results back.
- Typically one finds that about 80% of the propositions are not being contested at all, or at most by one person³⁶. Those 80% will not be discussed during the next workshop, since the group already agrees with them.
- On the remaining propositions the opinions are divided: some for pro, some against, and some don't know. These propositions are discussed at length during the final workshop in the model conceptualisation phase, perhaps discussing them in order of decreasing importance for the overall result³⁷.
- In a majority of cases, the disagreements will be due more to the way a proposition is formulated than to a fundamental difference of opinion. One then tries to come up with reformulations that are acceptable to everyone. Only on one or two propositions does a real choice have to be made, but the social pressure to find a consensus mode for these is usually high enough to generate a formulation that all can agree to.
- The reformulated propositions are sent back to the participants in the final workbook of this stage.

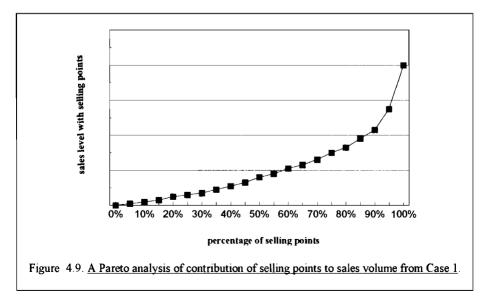
Proposition		False	Partly T/F
Customer irritation will occur in rural environments, where the branch office has an important social function, or where there is a history of previous office closures.			
Customer irritation can be expressed on a five point scale, ranging from no irritation to very great irritation.			
The degree to which client irritation leads to loss of revenues depends on the product type. The more trouble and money it costs the customer to remove a product from the bank, the fewer products will be withdrawn.			
Products of type 5 and 6 are very are very hard to withdraw and will therefore hardly be affected by customer irritation.			
Products of types 3 and 4 can be easily removed at short notice and will therefore be strongly affected by customer irritation			

Table 4.1.: Selected propositions from the model conceptualisation phase from case 5

Model Formalisation Techniques

PARETO-ANALYSIS³⁸

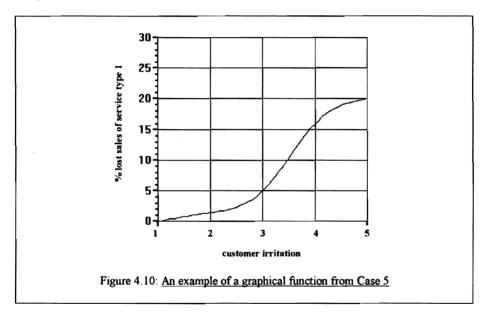
Pareto analysis, or ABC analysis, has nothing to do with simulation itself, however, it is often required to come up with data formats that can be used in a simulation model. It entails nothing more than a rigorous application of the 80-20 rule. In Pareto analysis one constructs diagrams such as that shown in Figure 4.9. from Case 1. Here we see that 20 % of the selling points are responsible for some 60 % of total sales, whilst the smallest 50% generate only a fifth of the total sales volume. Distributions of this kind are encountered all the time. Products for instance, may be classed as 'runners' and 'specials', 'runners' being a limited number of high-volume product lines and 'specials' the large number of low-volume product lines. Similar distributions apply to processing times as well.



These Pareto analyses are made on the basis of existing company data that are aggregated from a detailed level to an overall picture. The modeller then has several options as to how to incorporate the results from such analyses. The easy way is to take an average value, possibly conducting some sensitivity tests on how overall model performance responds to changes in this value. A more elaborate option is to distinguish a stream of "runners" and a stream of "specials" in the model. This is especially worthwhile if the distinction between the two streams seems relevant to obtaining insight into real world behaviour. However, one should not be tempted into making separate streams too easily, as it is a short step to ending up with a model with four or five different dimensions which will no longer be helpful in obtaining model insight³⁹.

GRAPHICAL FUNCTIONS⁴⁰

Graphical functions are a very useful way of overcoming the lack of availability of data that so often plagues strategic simulation modelling projects. The general idea is simple:



- Suppose one is interested in the relation between two variables, e.g. the level of customer irritation and the percentage of lost sales as a consequence of that irritation, as shown in Figure 4.10. No real-world data are available on this relation at short notice.
- One starts by drawing the matrix and assigning the variables to the X-axis and the Y-axis.
- Assign ranges to these axes. If these are hard to determine, take a range between 0 and 1, with 0 being "minimal" and 1 being "maximal" (e.g. when dealing with soft variables).
- One then determines the "average" situation: If X is currently at this point, then what is Y? If it is hard to denote a single value, one draws a hi-low bar to indicate the plausible range of Y values.

- Next one looks at extreme values of X: X=0 and X=maximal and determines corresponding values of Y in a similar manner.
- One repeats this procedure for various intermediate points.
- At this point it is useful to consider whether there is any reason to suppose the relationship would have a particular general shape. Is it linear or non-linear? Would we expect S-shaped growth, as is shown in Figure 4.10, or gradual decline?
- Armed with this knowledge, one now tries to draw a line through more or less the mid points of the scatter bars of Y values that have been determined for the various values of X. This becomes the graphical function.
- In a sensitivity analysis, one can look at the effect of changes in this graph on overall performance. Usually, relatively small changes will have hardly any effects, it is the overall pattern that counts.
- Simulation runs should also be done to check that one has indeed estimated the relation over the entire range of values that X can assume.

SYSTEM DYNAMICS SIMULATION⁴¹

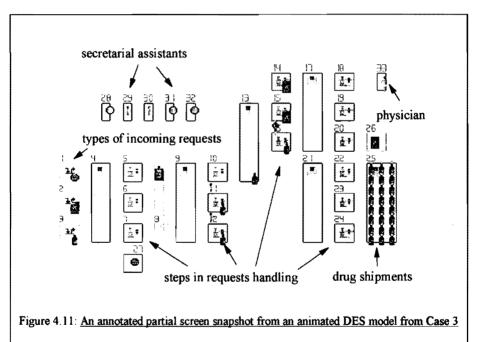
The use of system dynamics simulation is fundamental to PBM. Simulation is reproducing the behaviour of some (real world) system over time in a computer model. In system dynamics simulation, these systems are always conceptualised as continuous⁴², as networks of interconnected flows. Mathematically speaking, these continuous systems are represented with (often non-linear) differential equations. Stocks-and-flows diagrams provide one way of specifying the overall structure of these differential equations; indeed, in most of the current simulation software packages differential equations are created simultaneously with the creation of stocks-and-flows diagrams. This is illustrated in Exhibit 4.1., in which the differential equations automatically generated from the stocks-and-flows diagram in Figure 4.7 are shown.

		Work In Progress						
	<u> </u>	INTI 65						
		→ +dt*(Enter Production)						
		-dt*(Production)						
	•O>	Enter_Production						
	-	= Production schedule						
	- ()⇒	Production						
	Ť	— MIN(Capacity*Productivity,Enter_Production+(Work_In_Progress/TIMESTEP))						
-	0	Cycle_time						
	-	= Work_In_Progress/Production						
	0	Production_schedule						
	-	= GRAPHCURVE(TIME,0,10,[54,31,52,89,92,86,27,20,52,31,47"Min:0;Max:100"])						
	\diamond	Capacity						
		= 60						
	\diamond	Productivity						
		_ 1						
	Exhibit 4.1.: An example of a differential equations listing automatically generated from							
		a stocks-and-flows diagram (cf. Figure 4.7.)						
		a browne when north warman (w. r spare 1.7.)						

There is, of course, far more to system dynamics simulation. Several of the techniques described in this section deal with various other aspects of this modelling methodology.

DISCRETE EVENT SIMULATION⁴³

Discrete event simulation (DES) is "the other way" of making a quantified, dynamic representation of system behaviour over time in a computer model. In contrast to system dynamics simulation, the "world view"⁴⁴ of discrete event simulation is not one of continuous flows with gradually changing characteristics, but one of individual (discrete) "entities" whose characteristics (attributes) are changed at certain specific moments (discrete events)⁴⁵. A similarity between the two methods is that both world views recognise the concept of 'resources' that can be utilised in models to different extents. The pros and cons of using DES or SD are discussed in Section 4.6. Here it will suffice to point to the example shown in Figure 4.11. This model and similar ones one provided answers to such questions as the number of secretarial assistants and clinicians that would be required to man a call centre in order to deal with a certain arrival pattern of incoming requests for the client company's new drug.



SENSITIVITY ANALYSIS

Often only the values of a limited number of factors are of crucial importance for overall system behaviour⁴⁶. In most simulation models, the values of most model variables can be changed considerably without any significant change occurring in system behaviour. This is why sensitivity analysis is such a helpful technique.

In sensitivity analysis, one changes the value of a chosen variable considerably and looks at the impact of that change on another model variable. Some simulation software packages allow the user to conduct a systematic evaluation of a whole range of specific values with a single command⁴⁷. The effects of such changes in values are always insightful. If the model's output is hardly altered, then one need not worry too much about that particular variable, which is a useful insight. If considerable changes do occur, then one knows that one has a key model variable at hand that requires further attention, which is also a useful insight.

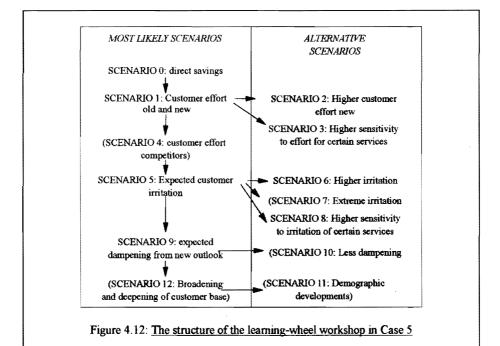


Figure 4.12. sets out the pattern of simulation scenarios that was traced in the 'learning-wheel' workshop in Case 5. Here all the scenarios shown in the right hand column are basically sensitivity analyses. For each of the values determined for the scenarios in the left-hand column one or two more pessimistic values were tested. For instance, in Scenario 5 the expected level of customer irritation was determined, but in Scenarios 6 and 7 the effects of higher levels of irritation were evaluated as well. This proved to be very reassuring for management: whenever there were critical assumptions in the model they knew where to find them, whilst they also knew which assumptions appeared not to be critical. That is the main purpose of sensitivity analysis.

TIME SERIES VALIDATION48

By time series validation is meant the validation of a model through comparison of a simulated rerun of the system's historical behaviour with its actual historical behaviour, so far as that is known. This sounds simple, and, in a sense, it is. One merely compares two graphs, one showing historical behaviour of a crucial variable over time, the other showing the simulated behaviour of that same variable over the same time period. In system dynamics simulation one is more interested in seeing global correlations in patterns of dynamic behaviour (e.g. a cyclical pattern, S-shaped growth, exponential decrease or increase) than in exact matchings of specific model values with corresponding historical values at a given point in time. This makes time series validation even simpler.

In another respect, time series simulation is less simple. Usually, the historical time series one needs are not available. For instance, none of the client companies in the six projects described in this book was able to produce relevant historical time series from its databases. Typically, one has to rely on people's memories, on expert assessments, which makes validation problematic.

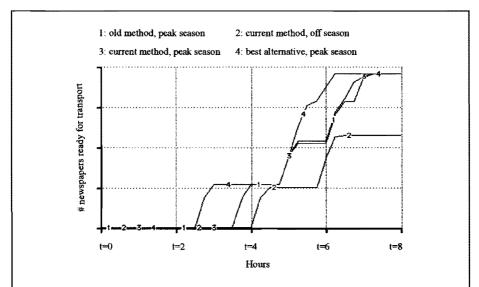


Figure 4.13.: Crude time series validation in Case 1

This shows the number of newspapers that are ready for external transportation at any time during the night shift. In order to secure timely distribution, all newspapers should be ready at t=6. Line 1 shows model behaviour under the old distribution system during the peak season. System performance is unacceptable, because the internal distribution process is not finished until around t=8. This corresponded closely with what actually had happened to the company when it hit the peak season in the summer preceding the project. Line 2 shows model behaviour for the current distribution system off season. This was the situation the company was in at the time of the project. Completion at t=6.5 corresponded closely with actual system behaviour at that time. So much for validation. Line 3 then goes on to show predicted behaviour under the current distribution system during the peak season, indicating that the underlying problem had not been solved and would recur. Line 4 shows predicted performance of one of several alternatives, which would be acceptable, especially in combination with other improvements not reflected here.

Figure 4.13. is a good example of the limited extent to which validation tends to be possible. No precise time series data were available here either, however, the clients did remember quite well the times at which the distribution operations under study were finished in two different situations (not surprisingly, since these times were absolutely critical for customer satisfaction). When the model was found to reproduce similar finishing times for both situations, the project team members felt sufficiently confident that the model was valid for their purposes.

Knowledge Dissemination Tools & Techniques

CONTROL PANELS49

The number of variables in system dynamics models is usually too great to monitor simultaneously. Frequently, it is a factor of ten or more greater than the magical "seven plus or minus two" variables that people are reported as being able to attend to simultaneously⁵⁰. That need not be a problem since a manager is typically required to pay close attention to only a few key variables. It has become good modelling practice to put these key variables together in what is called a 'control panel'.

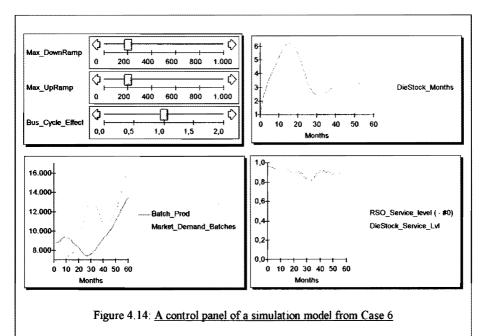


Figure 4.14. shows such a control panel from one of the simulation models that were developed in Case 6. The slider bars at the top left are set to the values of the main policy parameters; the user can change these values by drawing these sliders to the left or to the right. The three graphs show the performance of a few key output variables for the chosen values of the policy parameters. The more than one hundred other model variables are kept out of sight.

MICROWORLDS⁵¹

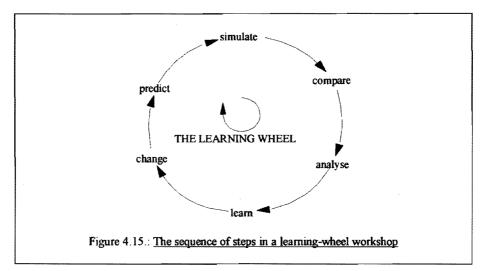
In a computer-based 'managerial microworld' all that one has is a control panel. The simulation model itself is no longer directly accessible. Only specific values can still be changed; the model structure itself has become fixed. The advantage of this is that interaction with the model becomes very simple and 'fool proof'. The disadvantage is that one has to find out the model structure by trial and error.

This drawback can be turned into an advantage in a *learning* context, which is precisely where microworlds are most often used. Because the educational value of simply 'playing the simulation' is doubtful, most 'management flight simulators' are

embedded in a workshop setting of briefings and debriefings, group discussions, videos and background documentation. In none of the six cases described in this book was such a microworld developed.

LEARNING-WHEEL WORKSHOPS⁵²

Once a simulation model has been developed and its performance has been assessed, it is often beneficial to conduct one or more "policy workshops"⁵³ in which this model is investigated with management in a systematic manner. For this purpose, a so-called 'learning-wheel' format has been found to work very well.



The generic sequence of steps in a learning-wheel workshop is shown in Figure 4.15. The crucial point in the learning wheel occurs at the step "predict", also called "(putting a) stake (in the ground)"⁵⁴. In this step, the managers are asked to predict model behaviour under the circumstances that have just been described to them. The model is then run and actual behaviour is compared with predicted behaviour. If the two are identical, all the better: management intuition has yet again been confirmed, thus increasing confidence in the model. If the two are different, either the mental model or the computer model is not correct. The causes for the differences are sought and analysed. The group is then ready to proceed to another thought experiment.

A note of caution: having to commit more or less in public to a certain value can be threatening to participants. One must take care to create a risk-free atmosphere in these workshops. The drawback of not asking for a public prediction is that participants will not really think through system behaviour, but will "lie back and enjoy the ride". In those circumstances little learning is likely to occur.

4.3. Generic PBM Project Design

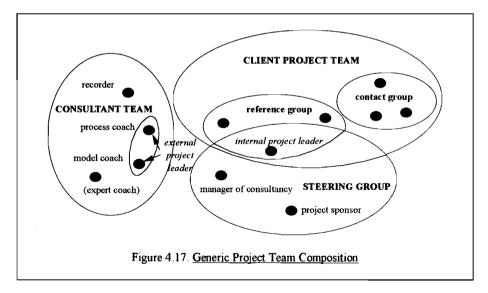
In the preceding section we identified the tools and techniques in the PBM 'toolset'. We shall now discuss, in terms of this toolset metaphor, 'the average job'. Sections 4.4 up to 4.6 will discuss how this 'average' or 'generic' job should be tailored to the specific needs and wants of a specific customer with a specific problem.

To deal with 'the generic PBM project' we will have to limit our scope somewhat. The following 'working assumptions' have therefore been adopted:

- We have a client organisation with a problem
- which is strategic, i.e. important for the survival of the organisation;
- which is complex, 'messy', so for which there are no easy answers;
- which has multiple stakeholders with different partial views of the problem;
- which top management wants resolved;
- for which top management decides that it will hire external consultants⁵⁵
- to tackle this problem in a participatory manner with the organisation's own people
- and in a project format.

Project Team Composition

For any project for which these working assumptions apply, the PBM consultant will want to create a project team composition which looks more or less like this:



1. THE CONSULTANT TEAM

In this team, four conceptually different 'roles' are distinguished⁵⁶. One person can perform multiple roles, even all of them, if required:

• The *process coach* is the session facilitator. This person's primary responsibility is towards management of the process, i.e. ensuring that communication goes smoothly, that focus is maintained yet participants feel at liberty to introduce new relevant themes, that conflicts are reconciled, etc.

- The *model coach's* primary responsibility is towards management of the <u>content</u>, ensuring that the models being created are consistent, looking for loose ends, presenting suggestions from a modelling perspective, etc.
- The PBM recorder deals with all the 'secretarial' aspects of the project, such as making session minutes, creating fair versions of sketchy hand-drawn diagrams, coordinating workbook design, distribution, collection and analysis, checking agendas, controlling the project archive. Although the job is 'secretarial', it requires a great deal more than secretarial skills because the recorder has to understand what is being modelled.
- An *expert coach* is optional, being added to the consultant team if it is felt that specific expert knowledge on some content area is required, e.g. specialised marketing experience or operations management expertise. The expert coach will cooperate mainly on a back-office basis (i.e. will rarely interact directly with the client), but may be asked to present his or her views at a modelling session.
- The *external project leader* is responsible for project management: i.e. the planning, budget, and progress. Normally this role will be undertaken by either the process coach or the model coach, depending on the relative seniority of the consultants in question, their project management skills and workload.

As said before, these roles can be shared. Moreover, even if the team consists of three different consultants, it will often happen that the process coach makes some remark regarding the model rather than the process, or that the model coach will perform some recorder tasks. The division of functions should not be absolute: the main objective remains to get the job done as efficiently as possible.

2. THE CLIENT PROJECT TEAM

The client team should reflect standard project management basics:

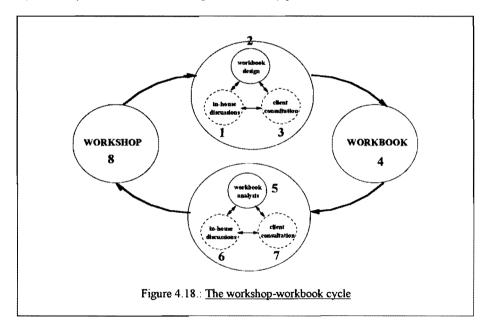
- There ought to be an *internal project leader*, who is the mirror image of his external counterpart (i.e. also responsible for project planning and progress). This project manager will be a member of the project team as well as of the project steering group. Often the internal project manager will be one of the primary "problem owners", e.g. the operations manager for an operations management issue.
- Within the client project team, one can normally distinguish project team members which form more or less the 'core' of the team. The internal project leader is one of them, but typically there are other participants who attend practically every session and are very active there, just as there are project team members who fail to attend one or more workshops. Rather than passively accepting such lapses, it is better to allow for them proactively in the project design by explicitly distinguishing a small *reference group*⁵⁷. Whenever one wants an informal session with 2-3 people from the client group, it is this reference group which is convened. (The function of such informal small sessions is discussed in the next section on the workshop-workbook cycle.) The remaining members of the client project team are said to reside in the *contact group*. This group can be larger, just as long as individual working sessions do not involve more than about eight people.
- 3. THE STEERING GROUP
- Whether they are set up formally or informally, almost all projects have some kind of steering group. In most cases, this is just the project sponsor and the

internal project leader. The steering group convenes only at certain key stages of the project to review progress so far and take decisions regarding the remainder of the project.

• It can be wise to ask a senior member of the consultancy — a managing partner or a principal consultant — for this steering group. This colleague will often welcome the opportunity to have a high-quality contact with a valued customer, and the project sponsor will notice that this consultancy firm is taking this project seriously. The PBM consultant himself will appreciate the fact that the narrower hierarchical and age gap between this senior member of his company and the sponsor helps to create an extra informal communication channel with the sponsor.

The Workshop-Workbook Cycle

A central element in the PBM project phasing is the so-called workshop-workbook cycle. Its dynamics are shown in Figure 4.18. They proceed as follows:



- 1. *In-house discussion*: After a workshop, you will usually evaluate this session with your fellow consultants.
- 2. Workbook design: On the basis of this discussion, you will make minutes of the session, conduct some additional analysis, maybe add some questions, and propose the agenda for the next workshop in a workbook.
- 3. Client consultation: It may be however, that you wish to consult your client first on some issue that arose in this workshop. You may want to do so before you design your workbook, or perhaps on the basis of a draft of the workbook (or you may not want to do this at all, which is fine as well.) If you do consult the client, you will do this in an informal setting with 1-3 people from your client group, often including the internal project leader: i.e. your reference group.

- 4. *Workbook*: Next the members of the client's project team will read and fill in the workbook.
- 5. *Workbook analysis*: The completed workbooks should be analysed before the workshop starts.
- 6. In-house discussions: Provided there is sufficient time (which is often a bottleneck) you should aim to discuss these results with your fellow consultants and decide your strategy for the next workshop.
- 7. *Client consultation*: Especially if you did not talk informally to your client beforehand, you may want to discuss the workbook results and your ideas about a suitable agenda for the next workshop with your client reference group at this stage.
- 8. *Workshop*: You are then ready for the next workshop, after which the cycle will be repeated.

Why adopt such a complicated design? This question is also addressed elsewhere in this book⁵⁸, but the main reasons are:

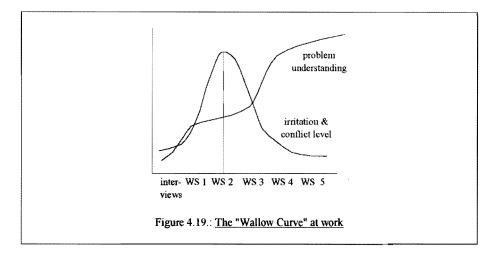
- Workbooks are valuable for idea generation, for gauging individual priority assignments, and for providing feedback.
- Small-group workshops are optimal for complex problem-solving and design tasks.
- Large-group workshops are needed for consensus-making and decision-taking.
- Contrary to the detached, analytical nature of workbooks, workshops are needed to promote lively communication and to enhance awareness, confidence and commitment.

By combining both small and large group meetings, both written and oral communication, PBM tries to preserve the respective strengths of these approaches and compensate for their inherent weaknesses.

The "Wallow Curve"

This is an aspect of PBM projects that has its roots in anecdotal observation⁵⁹, but the author has seen it confirmed often enough to venture introducing the notion of the "wallow curve"⁶⁰. A graphical rendering of the wallow curve is presented in Figure 4.19. The phenomenon is one that is encountered quite often in consulting projects of the kind we are discussing here. Indeed, it proved possible to identify when it was at work in virtually every case described in this book. Exhibit 4.1. discusses two such instances.

The dynamics of the wallow curve are as follows: In the first phase of a project, you learn about the client's problem quite rapidly. You conduct in-depth interviews with several people, and you soon find yourself able to discuss the issue with members of the client organisation using the right terminology and the right arguments. This continues until the first or second workshop, where you are still doing little more than making an inventory of all the relevant aspects of the problem.



However, after this initial phase of "issue conceptualisation"⁶¹ you have to move towards a good conceptual representation of the problem. You are entering the *design* phase: the project team has to decide what aspects of the problem it will focus upon, what things are most important and what are side-issues. As the modeller, you now will have to think of an overall structure, a general framework, for a model that will be both to the point, elegant and implementable and yet close to the client's perception of the problem.

This phase is extremely frustrating. You seem to be going round in circles without getting anywhere: you are truly "wallowing in the mud". This is the stage where you are sure that the project will be an utter failure, and you curse yourself for not realising that this problem and this group were fundamentally different from the other problems and groups you've worked with successfully in the past.

This phase is also the phase in which a great deal of irritation and conflict arises, both between you and your fellow consultants, but also between you and the client group (and probably within the client group as well). Project team members sense that the project is not moving forwards and become irritated because of your lack of understanding of their business. At this stage you have little to show that would give them confidence that you are competent to help them with this pressing and highly complicated issue. In this situation, dominant project team members like managers will itch to take over: they have their own ideas and are used to pushing them through.

Usually this process of irritation and conflict reaches its peak around the second (sometimes the third) workshop. After this workshop, conflict gradually declines. Why is hard to say. You as the consultant like to think that it is because, after a few nights of bad sleep, you have finally come up with a good idea to capture the overall structure of the problem that is both acceptable to the client, elegant and probably also formalisable. And, in retrospect, it is all so simple... You notice that in the next workshop the mood is more one of collaboration than one of conflict. You like to think that is because your team members like the new proposal.

The only jarring note to this self-satisfied feeling comes from knowing that small group research has established that *all* groups dealing with complex problems experience higher conflict levels during their second meeting, and that in almost every case conflict levels go down considerably in the subsequent meetings¹⁶² The literature in this field provides no final explanations for this. Perhaps it was the

quality of the model, perhaps the team members realised that their self-interest would not be served if the project were to fail, or perhaps the emotive clashes of the previous session were sufficient in themselves to induce more conciliatory behaviour in the next encounter.

In Case 5, everything went well up to the second workshop. There the discussion was to centre around some technical aspects of the internal consultants' normal work, which were claimed to be of great importance for the construction of the model. The external consultants, who were novices to the banking industry, did not fully appreciate the technicalities of the processes being referred to and found it hard to understand the terminology used. Also, the level of detail that the internal consultants wanted to incorporate in the model seemed to the external consultants to be too exhaustive and inappropriate, but they were unsure if they were right in this. The session dragged on for four hours without too many results. The internal consultants became irritated, and advised the modelling experts to discuss these basics with the internal project leader or else take a basic course in banking...

Case 6 likewise proceeded well until the second workshop, where the PBM consultants presented a partial model that they had drawn up in a previous session with the expert coach. However, they still had some questions about this model. The client project team members were irritated. They had already indicated in the previous session that they were not interested in this level of detail. The real problems lay somewhere different, they felt, and the consultants had also not taken into account some of the crucial performance indicators of the company. Furthermore, they doubted whether the formal frameworks from the expert coach captured their main current business problems. The PBM consultants had to wipe out their proposed model altogether; this was a dead end. After some deep thinking they came back with a workbook that contained an outline of a more fundamental model, which was received well and formed the basis for the eventual conceptual model.

Exhibit 4.1: Examples of the wallow curve

Whatever the reason might be, from this stage onwards you suddenly learn a great deal again about the problem. Expanding on the original idea for an overall structure, the team can rapidly develop a more or less complete conceptual model. The last one or two workshops can be dedicated to loose ends, to a more formal check of model details, and to plans for the next project stage.

Generic Project Phasing

As the earlier discussion of the PBM tool set indicated (Figure 4.4), a generic PBM project consists of four stages. Moving on from that discussion of what tools and techniques are most appropriate in what project phase, in this section we shall look at each of these four phases themselves in somewhat more detail. For this purpose Table 4.2 may be helpful. Here the main deliverables and average duration of a generic PBM project are presented by project phase. The commercial activities leading up to an actual project have been added as a separate pre-project phase here.

Project Phase	Deliverables	Duration	
Pre-Project	Project • Initial problem understanding		
Activities	Project proposal	1 ¹ / ₂ years	
Project Definition	Problem definition	1/2-2	
Phase	Revised project plan	months	
Problem	Conceptual model	1-3	
Conceptualisation	Problem insights & recommendations	months	
Phase	Revised project plan		
Model	Formalised model	1-3	
Formalisation	Problem insights & recommendations	months	
Phase	Revised project plan		
Knowledge	Problem insights & recommendations	1/2-2	
Dissemination	Final report	months	
Phase	 Management presentations 		
	(• Model documentation)		
	(• DSS)		
	(• Microworld)		

Table 4.2.:	The deliverables and	duration of a	generic PBM project

Pre-project Activities

Most PBM projects already have quite a bit of history before they ever get under way. Often a long series of commercial activities has preceded the project start. In some cases, it might take more than $1\frac{1}{2}$ year from the first meeting with the prospective client until the project commences; in other cases this process takes less than a month. This variation in gestation has much to do with problem urgency, as Exhibit 4.2. illustrates. If a problem is not perceived as urgent, top management will not readily sanction a project involving external consultants. That does not mean that one should abandon a "prospect", as potential clients are often called, if the problem at stake does not appear to be immediately urgent. For a problem that is truly strategic but left untouched is bound to become urgent eventually. This process may well take six or eighteen months. It will then pay to have maintained contact with this prospect over this period and to have already discussed a potential project to solve the now urgent problem with your client.

High urgency, short pre-project period

- In Case 1, distribution operations were in disarray. The company was losing money heavily; its
 customers were complaining; internal conflicts were high. Something had to be done. The client
 company had no experience at all with simulation, nor did it have an existing relationship with
 the author's IT consulting company. Nevertheless the green light was given to start a simulation
 project within a month after the first contact with the client.
- In Case 3, the client company was expecting that it would have to start distributing its spectacular new drug with a few months. A first interview with a sales manager from the author's consultancy was followed by a presentation to management and a subsequent project proposal. Two days later client management faxed their agreement to the proposal.

Exhibit 4.2.: Problem urgency and duration of the pre-project period.

Low urgency, long pre-project period

- In Case 5, the author was asked to express his views on an issue that recently arisen in a discussion between a sales manager and a manager at the client company. This resulted in several discussions, presentations to client management, more in-depth interviews with one of the problem experts and a proposal. This proposal was received positively a few months after the author's first contact with the client company. However, due to an internal reorganisation the client company was going through, it was agreed that both parties would meet again nine months later. This happened and a revised project plan was put forward. The project sponsor found that the proposed PBM project would fit well into a currently running internal project, which was engaging with the kinds of issues the model would have to solve. A few months later the project could start.
- In Case 6, the author and some of his fellow consultants were originally asked to give their views on a new logistics strategy document of the client company. In this discussion with the client's top management team, it was suggested that the company might use simulation models as training tools to facilitate dissemination of this new logistics strategy throughout the company. This resulted in a demonstration of the consultant's earlier work, discussions with internal experts and a project proposal. This proposal was agreed upon. Unfortunately, just before the contracts were to be signed, a corporate edict prohibited all new external consulting contracts for the remainder of the year. In the beginning of the next year, the project sponsor was too pre-occupied with other duties whilst his intended project leader had been transferred to a new post, with his successor not yet in place. Several months later, when this successor arrived, additional discussions were held with him and with the project sponsor. These resulted in a revised project plan. By now the client was facing many pressing and difficult problems, several of which might be addressed by the PBM project. This project started shortly afterwards.

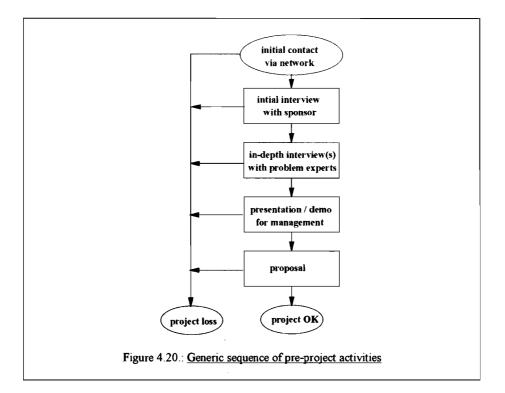
Exhibit 4.2.: Problem urgency and duration of the pre-project period (continued).

Every commercial process is different. However, Figure 4.20. may be an adequate representation of "the average" commercial process.

The *initial lead* will almost always come from the consultant's own network of contacts — from a colleague, from a sales manager, a former client, even a relative. Very few clients know so much about their problem, about simulation and about the market for modelling services that they will approach the PBM consultant directly.

This lead will result in an *initial interview* with the client's management, usually represented by the future project sponsor, who is normally the high-level problem owner. The network intermediary will usually be present to make the introductions but then it's entirely up to the consultant. The consultant will be 'measured up for size' by the manager. Displaying energy and a receptive attitude are far more important here than showing off expertise. It is better to ask smart questions than to give smart answers.

If this interview misfires, the consultant never gets a second chance. If it goes well, he or she will get an opportunity to learn more about the company and its problems during a subsequent *in-depth interview* with one or more problem experts, often including an operational problem owner who will later become the internal project leader. In this interview, the consultant is likely to be deluged with facts. Other than to be overly concerned with specific issues, listening, taking notes and asking the odd question is more important to make it clear that the consultant wants to *help* the problem owner. Once again, asking the right questions is better than showing off expertise. It is, however, quite proper for the consultant to refer to some of his or her earlier work in formulating these questions.



It is important to realise that at a first interview you should not expect to hear the *real* issues that are troubling this person. Often these are just too threatening or embarrassing to talk about openly with a stranger. Instead one gets the 'official party line' and lots of company terminology. This is quite acceptable, because the main purpose of this interview is to start building a relation with the designated internal project leader. Learning more about the organisation and its problems is only a secondary purpose.

The in-depth interview also serves to probe what kind of proposal and/or *presentation* is expected from the consultant. A presentation, if requested, will often include a live simulation of a model from an earlier project or of a sample model of the intended client company. Such a presentation will be attended by a larger group of company people, consisting at least of all those spoken to earlier on.

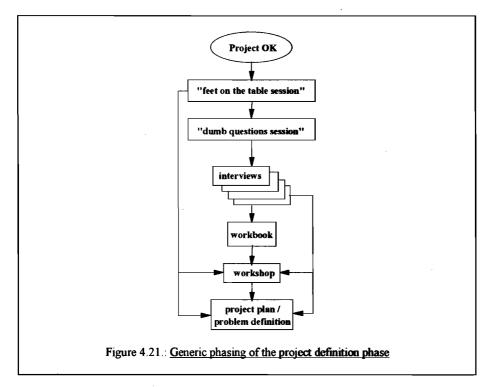
With or without a presentation, the consultant will be asked to write a *proposal*. For this proposal one should at least have checked the following with your interview partners:

- Main problem areas (fairly vague);
- Project team composition and availability;
- Data availability;
- Preferred project timing, feasible size and duration.

After this proposal has been received by the client, one may receive a telephone call or a fax giving the *go ahead*. More often though, the final details are discussed in a kick-off meeting. Then the project is ready to start.

Project Definition Phase

This phase may be short or extended, depending on the project requirements, but it is always useful to distinguish it from the next phase of model conceptualisation. This is because in PBM projects the problem is never clearly defined at the outset. As a consequence, one can never really judge what the project set-up should be in advance. It may turn out, even at this stage, that a PBM project is not feasible for this particular problem with this particular client. This phase therefore serves to explore problem contingencies: political sensitivity, problem scope, tangibility, data availability, etc. (cf. Section 4.4.). At the same time one is also looking for organisational contingencies: problem ownership, group size, top management support, working relations (cf. Section 4.5.).



A generic sequence of activities in this phase is shown in Figure 4.21. This figure illustrates that the activities in this phase can sometimes remain limited. For instance, if available time is limited and the coast seems clear as far as contingencies are concerned, an informal "feet on the table" session⁶³ with members from the reference group may be sufficient to come up with an acceptable problem definition and a more or less final project set-up.

A more thorough approach is to conduct a series of semi-structured *interviews* with the project team members to probe contingencies and various aspects of the problem itself. One may use a cognitive mapping technique (cf. Section 4.2.) in these interviews. A list of possible questions for these interviews is shown in Exhibit 4.3.

Questions probing for relevant aspects of the problem :

- What is, in your opinion, the main problem?
- What are the main causes for this problem?
- What are important consequences of this problem?
- What could be solutions to this problem?
- How would you measure success in solving the problem?

Questions probing organisational contingencies

- What can you tell me about (the following problem contingencies): scope, tangibility, urgency, data availability, political sensitivity?
- What can you tell me about (the following organisational contingencies): top inanagement support, hierarchical diversity, problem ownership, group size, working relations?

Exhibit 4.3. Questions for the pre-interviews in the project definition phase

When the consultant enters this interview round he or she will often still not know a great deal about the client organisation. In order to avoid asking too many naive questions, it can be useful to arrange a "dumb questions" session⁶⁴ with the reference group. Here one can ask all the basic questions mean? How many products lines does the company have? Who is in charge of this activity? etc. These questions can be prepared on the basis of relevant documents received from the client organisation. In any event, it always helps to start the round of interviews with a long in-depth interview with the project leader / problem expert where one can ask such questions in a relatively risk-free setting.

After these interviews, one may choose to synthesise one's impressions in a *workbook*. This workbook will contain a first draft of the problem definition / feasibility study / project plan that is the main output of this phase. It is strongly advisable also to conduct a more formal *workshop* with your project team on this workbook, both because their commitment to its content is essential, and because this workshop will give the participants a flavour of the kind of process they may expect in the next phases, thereby increasing their commitment to the process. In this workshop, the author has found it useful to conduct a short SWOT analysis in the format of a hexagon session: What are the risks and opportunities for this project? What are the strengths and weaknesses of the proposed project set-up?⁶⁵

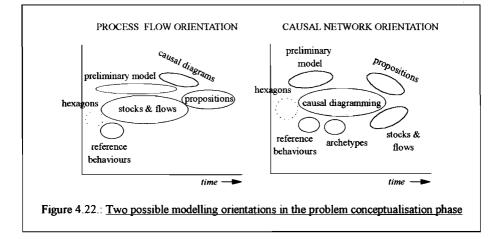
Problem Conceptualisation Phase

The problem conceptualisation phase is, intellectually speaking, probably the most demanding part of any PBM project. Unfortunately, it is also the phase that tends to vary most from project to project. Therefore, model conceptualisation still remains very much an art. There is no standard way of proceeding from one technique to another, and there are many different techniques that can be used So where does one start? And how does one continue?

There are certain recurrent aspects in conceptual modelling with PBM. Two such aspects are the previously mentioned 'wallow curve' and the workbookworkshop cycle. Two less obvious aspects, illustrated in Figure 4.22, emerge from a contemplation of the six projects described in Chapter 6. This reveals two basic types of orientation in the conceptual modelling phase: 1. the process flow orientation

2. the causal network orientation.

Each orientation has its own typical combination and sequence of modelling techniques.



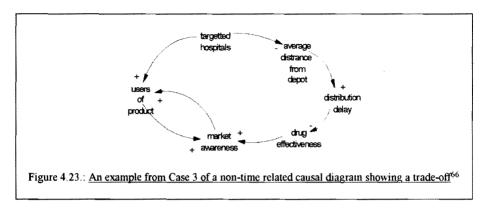
1. THE PROCESS FLOW ORIENTATION

Often the main focus of attention in a project is on how to deal with certain flows or business processes. This flow orientation is almost always present in operations management issues, the main flow there usually being the goods flow. However, flows can also been patient flows or customer flows. If this focus on business processes is present, then *stocks-and-flows* diagrams will probably become the most important diagramming technique. You can start off with them right away, as Figure 4.22. indicates.

In these situations the participants will probably have little trouble understanding the stocks-and-flows notion. Often they will have been drawing similar diagrams themselves. However, their notational system will be different from the system dynamics syntax. If this presents a problem, it can usually be overcome by explaining that the new syntax will be helpful in the model formalisation stage, since it allows simulation model equations to be automatically generated.

On the other hand, clients should not be expected to appreciate right away the differences between 'rate' and 'level' or other system dynamics modelling subtleties; the PBM consultant will have to guide them. It may be helpful, therefore, to start off with a *preliminary model*, possibly built up from scratch during a group session. Computerised preliminary models can also be used, because the stocks-and-flows diagrams that are needed to specify a quantified simulation model are already known to the participants.

In projects of this type, usage of causal diagrams will be limited, but nevertheless may be essential to visually explain trade-offs in the design or control of business processes An illustration of such a visualised trade-off is provided in Figure 4.23. Please note that this diagram has nothing to do with developments over time. This is quite common. So although it is of no use as a specification for a simulation model, this causal diagram it is quite useful to create insight into what the design tradeoffs are.



At the end of the conceptual modelling phase you may want to use *propositions* as described in Section 4.2. to check your model specifications and make sure consensus is achieved regarding these. Here your propositions will basically be informal verbal reformulations of the formal graphical and algebraic model equations in the stocks-and-flows diagrams (cf. Section 4.2.)

2. THE CAUSAL NETWORK ORIENTATION

If the focus is not on some kind of business process, *causal diagramming* is likely to be your most important conceptual modelling technique. Here you may also want to start off with an *preliminary model*, for reasons discussed in Section 4.2.: people may initially find it hard to think in terms of "variables" that can increase or decrease in value. A preliminary model can set the stage at the appropriate level and with the appropriate focus, and at the same time can help explain the modelling technique itself. A good example of a small preliminary model from Case 2 is shown in Figure 4.24.

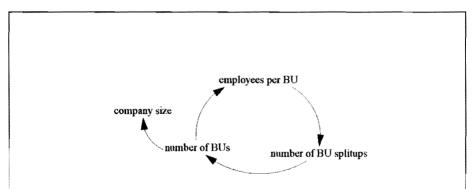


Figure 4.24.: The preliminary model in Case 2, showing the mechanics of business unit (BU) growth

This preliminary model shows the basic growth mechanism for the client company in Case 2. It served as the basis for the whole causal diagram that was developed later on. From this first loop, the facilitators could ask: "Why or when does 'number of employees' grow?" and elaborate from there. It illustrates that a preliminary model can be very small indeed, limited to just one feedback loop with a few variables.

In the course of the modelling process, *reference behaviours* and *archetypes* will come in handy. A cautionary remark: it is a mistake to begin right away with archetypes. The danger is that one will impose straitjackets on the client's problem. A good way of using archetypes is to discover during the causal diagramming process that the client's data suggest an overall pattern of dynamic behaviour that fits a certain archetype, and then discuss both these data and the archetype.

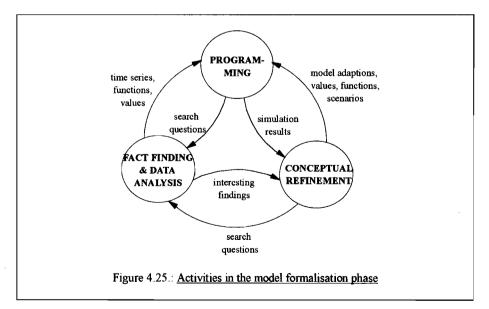
If the objective is to develop a formalised model out of this causal network, then levels and rates will have to be assigned. In other words, a *stocks-and-flows* diagram will have to be created. By now your client should be well accustomed to the causal diagramming mode and therefore may be confused by this new diagramming technique. Usually this is unavoidable, because most simulation software packages specify their model equations in stocks-and-flows notation⁶⁷.

One can end this phase with *Likert-propositions* if the aim is to do a thorough job. A cautionary remark here is that the propositions should not contain controversial statements that were not discussed already in one of the previous sessions. Propositions should summarise here what has been said before, not add new elements to the discussion.

Model Formalisation Phase

In the model formalisation phase one has no choice but to use all available techniques more or less simultaneously. Figure 4.25. provides a flavour of this process. Here one can see that there are three main activities taking place at the same time, with all three interacting strongly with each other:

- 1. Programming;
- 2. Fact-finding and data analysis;
- 3. Conceptual refinement.



1. PROGRAMMING ACTIVITIES

The conceptual model will have to be translated into a simulation language. This is a stream of activities in which the client is normally not involved. Programming and debugging in a computer simulation package remain something in which managers are normally not interested and which they prefer to delegate to technical experts. Provided they can still distinguish their conceptual model in the simulation software, and model behaviour seems plausible, then ownership is normally not a problem.

The project should already have generated a conceptual model in stocks-andflows formulation that is ready to be quantified. Normally, this model would be specified in the 'diagram view' of the simulation package used. All the same, it is better to start quantification with a new, small simulation model that captures the main dynamics of the system to be modelled. That model should be debugged and tested rigorously. Detail can then be added, step by step, until the functionality of the original conceptual model is reached.

In the meantime, this programming activity will receive inputs from the two other streams of activities:

- From the conceptual refinement activities, the programmer will receive different kinds of expert assessments: graphical functions, parameter and variable values and reference behaviours in the form of time series;
- From the fact-finding activities the programmer will receive similar kinds of data, but this time based upon external data and analysis of these.

These data will provide the necessary input to arrive at a runnable model. Once this stage is reached, the results from these simulation runs will lead to discussions in the conceptual refinement workshops.

2. FACT-FINDING & DATA ANALYSIS ACTIVITIES

Another stream of activities will consist of various fact-finding exercises. The search is for usable values for model parameters and variables, for estimates of relations between variables, and for historical time series. Here the client will be closely involved. The external consultants will need the assistance of experts in the various client data bases to locate the necessary data. However, the subsequent analyses of these data tend to require specialised expertise again, making client involvement in them normally low.

Rarely are the necessary data found in the required format. Rather, some substantial number crunching (e.g. Pareto analysis, regression analysis, or just cumulating separate activities into a few broad categories, or cumulating of small time periods into larger time periods) will have to be performed to arrive at data that are at a sufficiently high level of aggregation to be useful for the simulation model. This number crunching will cost considerable time and effort, but the effort will not be wasted:

The focus of the project team will be on finding data to make a runnable model. However, in this process the team will almost always gain interesting "nuggets of insight"⁶⁸. These findings may not be especially useful for the simulation model itself, but will interest the client greatly. Exhibit 4.4. gives an example. The client will be glad to discuss these findings in the conceptual refinement workshops. In Case 1, a large matrix was created from data held in the client company's data bases. The cells of this matrix contained the number of copies of each newspaper title delivered to each final distribution point. The original purpose of this database was to calculate accurately the average processing speed for different newspaper sorting systems. However, since this matrix was already available in spreadsheet format, it was quite easy to conduct a Pareto analysis on it. This analysis showed that the company could eliminate some 20 % of its smallest distribution points and yet lose only some 4 % of its market coverage. This was not essential information for the simulation model, but the potential cost savings in external distribution were considerable and, understandably, were of great interest to the project sponsor.

Exhibit 4.4. Example of an interesting 'side-effect' of fact-finding and data analysis for model formalisation from Case 1

3. CONCEPTUAL REFINEMENT ACTIVITIES

The results from the two preceding streams of activities are discussed in a number of model refinement sessions. This is quintessentially a group activity. Typically one finds that the conceptual model developed in the preceding phase can capture some 70 % of the problem, but not the 90% one that was aimed for at the outset. The model refinement workshops are aimed at capturing this last 20 %. This means that the project team has to be confronted with data and with simulation results.

Activities in these conceptual refinement workshops are of three kinds:

- 1. *Expert assessments*. For those elements of the conceptual model for which external data can not be found expert assessments will be required. These need not be very elaborate. Managers are surprisingly good at assigning values to qualitative concepts, as long as the concepts are precisely defined. These definitions come from the conceptual model. In this way graphical functions, value estimates and reference behaviours can be obtained.
- 2. Structural modifications. The intermediate results from fact-finding and programming will give rise to discussions in the project team. These discussions will lead to modifications to the conceptual model. More often than not, these will be simplifications. "I guess we don't really need this part for the simulation model after all", is a frequently heard remark in this phase. Simplification also occurs when one can capture a large number of qualitative effects into a single number, as Exhibit 4.5. illustrates⁶⁹.

In Case 5, one of the main model variables was the effort a customer has to make in order to reach a branch office of the bank. In the original conceptual model, this 'customer effort' depended on many different factors, such as proximity to a shopping centre, infrastructural obstacles as railroads or rivers, parking spaces, age and wealth distribution of the customer population etc. In the quantified model, all these factors were neatly summarised by a single number on a five-point scale, with '1' standing for very low customer effort and '5' for very high customer effort. This turned out to be very effective.

Exhibit 4.5: Quantification is simplification

A final note here: When precisely does client management find the answers to the questions formulated in the project definition phase? At the final workshop? No, they are found *all* the time. The experience from the cases described is that, by the time the project reaches the knowledge dissemination phase, the core project team members

will already know just about everything there is to learn from the simulation model. The main purpose of the learning wheel workshops is to recapitulate what was already known and explain project insights to non-core project team members.

Knowledge Dissemination Phase

The final phase of knowledge dissemination is quite straightforward. If you do not have a quantified model, you will limit yourself to summarising the main results in a *final report* and presenting the results to your project sponsor, team members and other stakeholders in the client organisation in a *management presentation*.

If there is quantified model, one or more learning-wheel workshops will have to be conducted with the project team as described in Section 4.2. Any insights from these workshops should, of course, be integrated in the final report and presentation. If one has a quantified model, the client will typically want to "keep the model". This means that *model documentation* will have to be written as well.

If one is making a model for a wider group of users than just the immediate project team, one may want to develop a *decision-support system* or a managerial *microworld* to disseminate project insights. This, however, is a task of such magnitude that it is better treated as a separate project, rather than as the tail of a PBM project. (See Section 4.6. for trade-offs between a microworld and a DSS).

A final word of caution: in practice the simulation model will rarely be used by the client after the project is finished, unless a follow-up project is initiated. This is because:

- The reality that was modelled will be altered by implementation of the recommendations resulting from the project. This may make the model structure, which reflects the old reality, invalid and useless for future explorations.
- The mental models of the managers involved will have been enriched by the modelling process. They will understand all the insights contained in the simulation model and so be in a better position to answer new questions themselves.
- The skills required to make structural adjustments to the simulation model are usually not present in the client organisation. Running a simulation, or even changing a parameter value, is far less difficult than redesigning part of a model structure. The latter will usually require expert outside help.
- As a result of the modelling project, a number of pressing problems will be solved, which automatically lowers problem urgency. And without sufficient problem urgency, there will not be sufficient impetus to set up a follow-up project.

This is not to say that nothing remains in the client organisation after the project. On the contrary, participants will have:

- 1. learned a great deal about the problem area under scrutiny;
- 2. learned about the problem-solving methodology (working in groups, diagramming and brainstorming techniques, etc.)
- 3. built a team of people who understand each other well.

The simulation software itself, however, tends to play a fairly insignificant role in all this.

4.4. Managing Problem Contingencies

The preceding section described the 'average' PBM project. Unfortunately, the 'average' project does not exist in the real world. Every project is unique, because every problem is unique and every organisation is unique. In practice, the consultant will have to deal with these unique characteristics and their contingencies. In Chapter 2 five different kinds of *problem contingencies* were introduced. These five problem contingencies reappear here. In Section 4.5. the task of managing a number of *organisational contingencies* will be addressed.

Managing Problem Scope

Every strategic issue is "messy", complex, and broad in scope — sometimes very broad indeed. For instance, designing a whole new corporate structure and strategy (as in Case 4) is a far broader issue than designing a new distribution network for a product (as in Case 3). How does one deal with a very broad problem scope? In general, the following guidelines can be given:

1. Achieve a close fit between problem scope, project goals and project size.

One cannot design an entire new corporation in two or three sessions of two hours each; that is a clear misfit between scope, goal and size. What you should do in such a case is:

- *Limit the scope*: e.g. examine a desirable and achievable growth rate not the whole company, but for an innovative new business unit; or
- Limit your goals: e.g. not an entire redesign, but an analysis of the main problems with the current structure. (in general, analysis tasks are less difficult than design tasks⁷⁰); or
- Increase the project size: e.g. obtain commitment not just to a few workshops, but a project involving several consultants and work groups of up to a half-year duration.
- 2. Achieve this fit in close collaboration with your project sponsor, project leader and project participants.

Altering the scope of a project unilaterally, without consulting your sponsor, is sure to antagonise the client. The proper way to proceed is to present to the sponsor,⁷¹ or the internal project manager,⁷² your impression that the current goals are too ambitious, or that the current project size is too small⁷³. They too want the project to be a success, so if they agree that, after a closer look, there is a mismatch between the current project definition and resources, they are likely to accept a re-specified project set-up. A more bottom-up, democratic alternative would be to may ask the project team members what they feel are the most important issues, and perform some kind of voting and ranking on those⁷⁴.

Managing Problem Tangibility

Strategic problems can also vary in tangibility. Issues relating to corporate culture or organisational change will tend to embrace many vague, elusive concepts like mutual

trust, employee motivation and so on; increasing production flexibility or pruning a product range, on the other hand, is more obviously tractable (like many issues in the field of operations). High problem intangibility is not an excuse for not developing a model; *intangibility is no contra-indication* for PBM. Useful system dynamics diagrams can be constructed of the most intangible of issues. Some remarks should be made in this respect however:

- Data availability: Don't expect to find out much from corporate databases about intangible issues. You may count yourself very lucky if you obtain a few data on e.g. 'company image' from the marketing department or 'employee satisfaction' from the human resource function. This may make external validation problematic (see Section 4.6).
- A method for the middle ground: In the author's opinion, PBM, or system dynamics in general, is best applied to problems of 'the middle ground', problems that encompass both 'hard', easily quantifiable aspects and 'soft' aspects⁷⁵. Of course PBM can also be used for primarily hard issues and for primarily soft issues, but its "core capability"⁷⁶ of being able to combine the two does not give it a competitive advantage in those areas.

For instance, PBM can handle highly intangible issues, but only in the sense that everything becomes a nail if the only tool in your toolset is a hammer. PBM will only out-perform techniques specifically developed for really soft, broad issues and political issues⁷⁷ when the problem at stake contains some tangible aspects as well⁷⁸.

At the other extreme, PBM can also be used for very 'tangible' issues. Yet it is probably not the approach of choice when designing a materials management system and certainly not a new silicon wafer architecture. In these sorts of cases PBM will only out-perform conventional 'hard modelling' techniques when the problem also contains some important soft issues.

• Quantification: feasibility and necessity: Any problem, however 'soft', can be quantified⁷⁹. However, managers often find quantification less necessary for soft issues; they do not expect a quantitative answer to an organisational culture issue, anymore than they expect a purely qualitative answer to an inventory management issue⁸⁰. This should be borne in mind in PBM project design.⁸¹

Managing Data Availability

Data availability is a major issue in project design. Fact-finding and data analysis activities may well consume one-third of total project time and costs. If the data needed are not available, or not available in an easily usable format, the consultant is in trouble if he or she budgeted a rosier world. A special note of caution here: the mere existence of large databases or piles of documents does not mean they contain the data that are needed. There are several reasons for this:

- *Time horizon*: Most system dynamics models tend to depict system behaviour over several years. In order to validate such a model, one will need time series data going back several years. Few organisations have 'corporate memories' of that span⁸²; the current and previous year's data may be easy to find, but beyond that things will become difficult.
- Organisational and environmental changes: Even if the organisation does store data for such a period, then they are probably invalid anyway, because there will have been too many changes to the organisation itself⁸³ or the environment⁸⁴.

- Aggregation level: If data are found, it is likely that they are on a very low level of aggregation; they will be operational data, and not the data a manager would want to look at⁸⁵. For this the data will have to be aggregated, refined and analysed.
- Lack of perceived importance: In many cases, the data will never have been collected simply because they were not considered important for operational control.

Whilst data availability is often a problem, this is not the biggest problem; data can always be collected. The biggest problem lies in formulating a good theory to guide what data are needed in the first place. If the modelling team knows precisely what it is that it wants to find out, then the corresponding data will be relatively easy to collect. If the team doesn't know what it is looking for, then it is quite likely that it will not find it... Only a good theory, i.e. a good conceptual model, will tell precisely what data must be collected.⁸⁶

Managing Problem Urgency

A problem must have urgency for a project to start. On more than one occasion, the author has found out that a proposed project fell through or was postponed simply because, in some respects perception, "things were still going too well" (cf. also Exhibit 4.2.). In those cases, the commercial lead-time for the project may well be one to two years, by which time the position will have deteriorated. And then it is not unusual for the client to sigh: "You're really too late. If we had only done this two years ago, then we wouldn't be in the mess we are now". In such circumstances, the consultant is advised to smile consolingly; the words "I told you so" must never cross his or her lips...

Managing Political Sensitivity

The most crucial problem contingency may well be political sensitivity: to what extent are people's careers at risk when this problem is being discussed? The higher this sensitivity, the lower will be the willingness to cooperate, the involvement and the openness of communication⁸⁷. Of course every strategic problem is politically sensitive to some degree, but how should one manage projects with politically highly sensitive problems?

• First of all, one has to notice this sensitivity for oneself⁸⁸. Few managers will readily admit to an outsider that a problem is personally threatening to them. If the project sponsor or internal project leader play a role in this political game (as they are bound to do) they too are likely to understate this dimension. So the consultant will have to look for clues. Pre-interviews are an excellent opportunity for this because it is only when people have the opportunity to talk in confidence for more than an hour that they will begin to open up to an outsider. The pre-interview is the time to be alert to hostile reactions to other participants and spot non-consensus issues. Questions about the openness of communication in general are less threatening than when they are directed to the particular problem. It is permissible to seek perceptions about average consensus or willingness to cooperate both in general and within the scope of the project and also about the soundness of the group composition.

- The next step is to *report your findings* back to the sponsor and your internal project leader. Confront them with your impressions⁸⁹; see if they agree or not. The findings may suggest that an altered approach is warranted, in which case this needs to be agreed. There are at least four potential options:
- Limit the scope: Try to focus on those aspects of the problem that are less politically sensitive, provided that these are worth investigating in their own right. It is quite valid⁹⁰ to limit your problem scope in this manner, as long as this is done in close collaboration with the sponsor. In terms of project management, it is better to successfully complete a project with a modest scope than to attempt a large project that is bound to fail⁹¹.
- Structure and communicate very clearly: If you do undertake the project, then you are likely to be facing two problems: Firstly, some or all participants will not want to communicate openly, and secondly, if they do communicate, conflicts will be frequent and intense. Exercises such as hexagon brainstorming can still be used with unwilling group members, thanks to the strong discipline they impose on participants⁹², but it should be stressed that PBM was never designed for use with unwilling groups. So if the assessment is that this unwillingness is structural and is unlikely to disappear after the first session, the next two alternatives should be considered:
- Withdraw from the project: PBM is a great method, but is not suited for all problems or to all people. A fundamental assumption of PBM is that the group shares some common goal and wishes to talk openly. There are other methods that have a more dialectic approach: their fundamental assumption is that participants do not have common goals but rather opposing ones⁹³. Those methods may be more appropriate here. Alternatively, it may be desirable to first undertake some kind of change management project in order to lower "organisational defences"⁹⁴. This will require extensive process intervention and conflict management skills from the consultants who conduct the project.
- Bring process intervention skills on board: A final option is to bring such skills on board not prior to, but during the PBM sessions. A person with intervention skills can either act as facilitator or, perhaps even more effectively, can remain silent until he or she feels an intervention is in order and takes over control temporarily. After this intervention, session control can be returned to the PBM consultants.

4.5. Managing Organisational Contingencies

Managing Top Management Support

Top management support is, by definition, high at the start of a PBM project, otherwise it wouldn't have started in the first place. Without a powerful project 'champion', someone high in the organisation who believes the project is of crucial importance, the necessary budget and investment of the participants' time will not be obtained. Surprisingly often, however, top management support declines during the course of the project, to the extent that it may endanger completion of the project. Of the six projects described in this book, this happened, to various degrees, in four projects⁹⁵. So declining top management support appears to be a genuine project risk. There are three reasons for this:

- 1. The project sponsor is *not a project team member*. In the majority of projects, the top manager is not an active member of the project team. This is usually a good thing⁹⁶, but a consequence of this non-involvement that the sponsor has no chance to acquire a feeling of ownership for the project.
- 2. New problems may demand for attention, especially, if a project continues for several months. The other way of looking at this is to consider oneself lucky that this top manager ever took the original decision to do this project. For it has long been known that a top manager will pay attention to "only a limited number of matters; he chooses those issues which he believes will have the greatest impact on the company. (..) Under normal conditions, he will limit himself to three or four major objectives during any single period of sustained activity"⁹⁷. So when new priorities intervene, as they usually will do over a period of four to six months, the sponsor is quite likely to be distracted, especially if he or she has not been kept up-to-date on project progress:
- 3. Contact with the sponsor is poorly managed. If the project sponsor is not briefed regularly and correctly, and if the sponsor is not consulted at key points, the project is bound to acquire the character of 'out of sight is out of mind'.

The first two problems are unavoidable. But what can one do to 'manage' this third problem regarding top management support? Well, at least the following things:

- Get commitment from the project team. You should aim to get your internal project leader committed to the project process as soon as possible. This project leader will often have good access to and credibility with the project sponsor. The same applies to the other project team members: if they are very positive about the project, the top manager will 'lose face' with his own people by cancelling a project that he personally championed at the outset⁹⁸.
- Inform and consult your sponsor. This sounds obvious, but is actually easier said than done. Often, the project sponsor is a very senior manager⁹⁹ with many matters to attend to and with corresponding pressures on his or her mind, so not readily accessible for informal discussions. The natural tendency is 'not to want to bother' the sponsor with project details. Normally, one would hope that the internal project leader has easier access to the sponsor¹⁰⁰. However, these two often have more to deal with in their mutual relationship than just this particular PBM project¹⁰¹; indeed, the PBM project may not even represent the project leader's highest

priority as far as his or her relationship with 'the boss' is concerned. One possible way of overcoming these hurdles is to arrange for one's own manager to be part of the project steering group (see Section 4.3) and in that capacity talk informally to the project sponsor on a regular basis. In that connection, formal steering group meetings are *not* the best opportunities for informal lobbying...

• Deliver quality work. Of course, the best way to obtain commitment from anyone for the project is simply to do a great job (and make sure your team members tell others about it.)

Managing Hierarchical Diversity

The guiding rule is to avoid large disparities in the organisational ranking of project team members, as is confirmed not only by the cross-case analysis in Chapter 7, but also by the literature review in Chapter 2. Two levels are quite normal in any group: often the internal project leader is higher-ranking than most other team members, and always some staff personnel or close assistants will be attending the workshops. But three different hierarchical levels become tricky, especially if these are direct hierarchical reports, i.e. "if the boss is present", because then only non-threatening issues can really be discussed openly. This is one reason why it is not a bad thing that the project sponsor typically does not attend the modelling workshops.

Managing Problem Ownership

The problem is usually not one of finding a problem owner, that is someone who feels that solving the particular problem at stake is really his or her personal responsibility. If someone feels that way, problem awareness is bound to be high, willingness to cooperate will be good and it is likely to be easy to obtain commitment to implement the 'solutions'. What does tend to be a problem is that the project will require active participation from several other parties in order to solve the problem but those parties do not see themselves as problem owners. Among the six cases studied in this book, examples included a need for clinical expertise to give guidelines within which to frame a proper logistics strategy (as in Case 3), or for marketing to estimate customer reactions to lower logistics customer service (as in Case 6), or for external distribution to take advantage of the improvements made in internal operations (as in Case 1)¹⁰². When people do not accept a problem as their own responsibility to solve, it can be very hard to get them to sit at the discussion table. It may be that nothing can be done about this. In the above-mentioned cases, the parties in question simply did not cooperate intensively but the projects carried on regardless. Perhaps the only plausible tactic is to ensure top management makes these parties participate initially, and then try to make them enthusiastic for the process as quickly as possible¹⁰³.

Managing Group Size

This related to the number of people who are participating in the project, and specifically in the individual modelling workshops. There are two reasons for including any person in a workshop.

1. *Knowledge*. They are knowledgeable about the issue. Two know more than one, three know more than two, and so on (with diminishing returns for each additional participant).

2. *Influence*. Their support may be needed to implement the findings, and involvement in the problem-solving process tends to lead to ownership of the results.

On this basis alone, group size should be as large as possible. However, there are also several countervailing reasons to keep group size small:

- Small groups are more effective. Relatively few people are needed to obtain a good, complete coverage of the main relevant viewpoints. In general, this number is lower than the total number of relevant stakeholders whose influence is important. Research¹⁰⁴ and experience have both taught that normally groups of three to five people are most effective in dealing with complex issues¹⁰⁵.
- Small groups need less structure. In small groups, discussion can take place more informally and therefore it tends to be more productive. The greater the number of participants, the bigger the need to structure the workshop proceedings, which requires additional effort and skills from the consultants¹⁰⁶.
- Small groups are faster. If everyone present contributes actively and sequentially, then the speed of discussion will deteriorate as the group grows larger¹⁰⁷.

The way to get around this trade-off has already been described in Section 4.3, where it was labelled 'the workshop-workbook cycle': interchange informal, idea-generating workshops, involving a small 'reference group', with more formal, decision-making workshops that involve the full project team. If necessary, keep an even broader group informed and indirectly involved through the medium of the workbooks.

Managing Working Relations

Existing working relations between group members do help: participants will share a common vocabulary and role patterns will be well-established, thus reducing the likelihood of political power struggles in the group. However, there is a risk here. If your group consists primarily of 'old mates', then the broader organisational platform for the project findings will probably be low: "Oh, it's them again!" Furthermore, one should not overstate the importance of existing working relations: it can also very refreshing to hear people discuss an issue from a new and different perspective.

4.6. Trade-offs in PBM Project Design

It has already been stated that there is no such thing as an average project. A good consultant will tailor the generic project set-up described in Section 4.3. to the specific needs of the particular problem of each particular client. In doing so, the consultant will have to make a number of choices. There are trade-offs in any design activity, including PBM project design, and these trade-offs are discussed below. Unlike the description of project contingencies in the two previous sections, we are now talking about the actual method itself¹⁰⁸. The following eleven project design trade-offs are all relevant for PBM projects:

1. Content Expertise Versus Process Expertise Versus Modelling Expertise

The majority of management consulting projects require content expertise from the consultant, i.e. expertise regarding the client's business, the particular functional area that is to be investigated, and the client's company in general. The importance of such expertise for a PBM consultant is not so clear-cut.

Good modelling skills are certainly also very important, given the place that business modelling takes in the PBM process. But the highest priority have process facilitation skills. If the consultant can not conduct a modelling session without offending the client, any project is doomed to failure before a model can be built.

This does not mean that content expertise is dispensable. Many clients expect outside consultants to have knowledge of their company, or, at least some industry experience. Content expertise is also very helpful in the first stages of a project, to avoid misunderstandings, repetitions and client irritation because the consultant does not understand the relevant terminology of the client. However, one is tempted to say that content expertise is of little help in discerning the client's real problem. At best it is a two-edged sword: knowing a lot about the client may help one think in the right direction, but it may also push one in the wrong direction on the basis of one's own pre-established biases. According to the process facilitation attitude described in Section 4.1., it should not be the consultant, but the client group that determines what the real issues are and how they should be tackled. [Incidentally, if the PBM consultants feel that at some stage the project team might benefit from specific input from a true content expert, one can always ask such an expert to perform an "expert coach" role as described in Section 4.3.]

DESIGN GUIDELINE:

Most of all the consultant needs process facilitation skills, then modelling skills, content expertise is an optional extra, provided the client does not demand it. If the project team asks for content expertise, attach an expert coach to the project team.

2. Pre-Interviews Versus A Start-Off Session

Following the generic project phasing described in Section 4.3., one starts off with preinterviews. But many modellers do not use interviews; they commence straight away (perhaps after an initial discussion with the project sponsor) with a group modelling session, involving hexagon brainstorming, causal diagramming or similar techniques. This is equally acceptable because we are faced with a trade-off here:

Trade-off aspects:	interviews	group session
completeness	++	+
consensus-making	-	++
communication	-	++
participant time-saving	+	-
consultant time-saving	-	+
consultant learning	++	÷
project risk reduction	++	-

Table 4.3.: pre-interviews versus an initial group session

The main *advantages* of doing pre-interviews are that they give a more complete picture, require minimal time investment from the participants¹⁰⁹, and provide ample opportunities for the consultants to learn about the client organisation and its problem. Perhaps most important of all, they give a better chance to weigh up the potential threats to the process: Is this the right project team? Are there many political issues? Do the consultants know the right questions to ask the group to work on? etc.

The main *disadvantages* of doing pre-interviews are that they are timeintensive (and therefore costly) for the consultant, and one forgoes a first opportunity to have the group discuss the issue and reach some kind of initial consensus.

DESIGN GUIDELINE:

In general, if the budget allows the time, do pre-interviews. The group process can start at a subsequent first workshop, using findings from the interviews as a platform.

3. Workbooks Versus Workshops

This is another trade-off between a group process and a bilateral process. It should be stressed that the vast majority of system dynamics modellers (or other business modellers) do not use workbooks extensively but rely primarily on modelling workshops. So why use workbooks?

Trade-off aspects:	workbooks	workshops
involvement & communication	-	+
participant time-saving	+	-
consultant time-saving		+
insight	_	+
workable group size	++	-

Table 4.4.: Pros and cons of workbooks and workshops

The main *advantages* of workbooks are that they save time for the participants and that they enable involvement of large groups (eight or more people) for input. The main *disadvantages* are that workbooks cost considerable consultant time and they

offer no group process leading to team building, consensus building etc. Furthermore, since a workbook is an asynchronous mode of communication, the client cannot immediately correct you if you get misunderstood a point, and conversely you cannot ask for immediate clarification when this is needed. In other words: true insight is fed by a conversational process¹¹⁰.

DESIGN GUIDELINE:

If your clients are pressured for time and you are dealing with a large group, use workbooks extensively for knowledge elicitation. In addition, use a combination of small informal sessions for creative thinking and large formal workshops for decisionmaking. If you are dealing with a small group of participants who have sufficient time, go for workshops and only use workbooks as session minutes and agendas.

4. Smooth Versus Abrupt Transitions Between Techniques

Relative novices to system dynamics modelling frequently ask as how to handle the shift from one technique to another, for instance, from hexagon brainstorming to causal diagramming, and from causal diagramming to stocks-and-flows diagramming. There is no direct answer to this. The proposed sequence of techniques is not a logical, but merely a temporal one. Each modelling technique provides a different way of *viewing* the same problem¹¹¹.

This notwithstanding, it does not hurt to make the transition from one technique to another as smooth as possible. For instance, in hexagon brainstorming one can ask for variable names that have a positive or negative effect on some state variable¹¹². The resulting diagram will probably lend itself quite well to causal diagramming. However, often other kinds of questions are more appropriate in this early stage of the project, and other kinds of questions may be less abstract for the participants who are confronted with them.

DESIGN GUIDELINE:

Don't try to 'translate' one type of diagram one-to-one into another. Each diagramming technique provides a different, and useful, view of the problem situation. Synthesis cannot be automated.

5. Preliminary Model Versus Empty Whiteboard

A hot topic with system dynamics modellers is the practicality of using a preliminary model (see Section 4.2.) and yet maintain sufficient client participation in the modelling process¹¹³. What are the advantages and disadvantages of using an preliminary model as against starting from scratch with an empty whiteboard? The main pros and cons are listed in Table 4.5.:

Trade-off aspects:	preliminary model	empty whiteboard
participation	-	+
ownership	-	-
focus	++	-
speed	+	-
participant modelling skills	+	-
openness	+	-



The main *drawback* of using a preliminary model is that, inevitably, client participation is less intense than when you start with a group from scratch. As a result, client ownership of the model is usually lower than with the 'empty whiteboard' approach. But there are also undeniable *advantages* to using a preliminary model, principally in the degree of focus that can be achieved. The consultant can direct the group straight to a very specific part of the problem, one that has been prepared and thought out in advance. As a result, the modelling process is speeded up considerably. For most participants, it is far easier to look at something and say: "This and that are wrong" than to start from scratch and think of a list of what is right¹¹⁴.

Advance preparation has the further advantage that it places less demands on the modelling skills of your client. It takes considerable skill to draw an 'elegant' stocks-and-flows model, to select the 'proper' flows and rates. Even starting off from a very simple base diagram, one has already laid the right foundations for the subsequent modelling effort, as the example from Case 2 in Exhibit 4.5. illustrates.

In Case 2, the first causal diagram started off from an almost empty whiteboard. The only thing that was on the whiteboard was a minimal positive feedback loop, showing how company growth led to more growth. (cf. Figure 4.24 in Section 4.3.) This surprised the participants initially, since the subject was to be collaboration problems between business units. But as the modelling process subsequently confirmed, the collaboration problems were largely a consequence of this company growth. The original positive feedback remained at the core of the causal model that was developed over the next sessions.

In Case 4, the consultants began with an empty whiteboard in an attempt to gain full client participation in the creation of a causal diagram. After the pre-interviews, the consultants were convinced that several of the participants had a clear view of certain dynamics that could be captured very well in a causal diagram. Unfortunately, this exercise went all wrong. No causal loops appeared on the screen, just a bunch of arrows pointing towards a single variable. At the end of the exercise, the model coach felt obliged to show the participants what the consultants had really intended the participants to create. Afterwards, one of participants remarked: "I simply did not understand what you were up to. I kept thinking and thinking, but I just could not figure it out." This was one of the participants who had described in the interview precisely the causal loops that the team had attempted to set out on the whiteboard....

Exhibit 4.5. How a very small preliminary model can lead to focus and how an empty whiteboard approach can fail...

But perhaps the most important reason why the general rule in PBM is always to start of from a preliminary model is *openness*. The consultant will almost always already

111

have some idea of what kind of model, in terms of the main loops and flows, may be appropriate for the particular issue at stake, certainly after a round of interviews and some in-house discussions with fellow consultants. If you fail to share those ideas with your client in advance, but rather coach the participants into reproducing what you had in your head, you are not being open. Referring back to Section 4.1. on this subject, you may get away with this sometimes, but sooner or later your client will see through you and understand that he or she is being manipulated. (The example from Case 4 headed towards that direction, but also in Case 2 some participants voiced similar suspicions afterwards.)

DESIGN GUIDELINE:

Always use a preliminary model to focus discussion; however, make it as compact as possible and present it as unassertively as possible¹¹⁵. Tell your client what you know.

6. Computerised Versus Manual Group Diagramming

Nowadays there is increasing use of so-called 'LCD-projectors' to transmit computer screen contents onto walls¹¹⁶ in a way that is readable for groups of people. The technology is widely available and not overly expensive. Various kinds of business modelling too, have adopted the technology to facilitate the model building process¹¹⁷. How does this approach weigh up against the more 'traditional' group diagramming technique, where the facilitators use a whiteboard or flipchart to sketch by hand the diagram that is being developed? The pros and cons are summarised in Table 4.4.

Trade-off aspects:	Computerised diagramming	Manual diagramming
professional image	+	-
neatness	+	-
visibility	-	+
technology failure risks	-	+
required modelling skills	-	+
opportunity for simulation	++	
opportunity for client modelling	-	+
speed	-	+

Table 4.6.: Pros and cons of computerised versus manual group diagramming

Evidently the computerised approach offers some clear advantages, but there is still a strong case to be made for old-fashioned manual diagramming. Perhaps the biggest advantage of computerised diagramming is the ability to perform quick simulation runs of the model during the development process. This kind of modelling, where one stays "within ten minutes from a simulatable model"¹¹⁸, can be very powerful. However, it is also a fairly high-risk activity: all too frequently a flaw in modelling logic produces very strange results, and this may create confusion and doubt in the client group¹¹⁹.

If one is not using the diagram in such a 'prototyping mode', but is rather just mapping the conceptual structure of the problem at stake, then a computerised diagram will still look very professional and readable (provided optimal technical facilities are available). However, at present the advantages of manual diagramming, i.e. its flexibility, ease of use, informality, speed etc. tend to outweigh the remaining advantages of computerised diagramming¹²⁰. Especially in the early stages of conceptual modelling, one needs all the flexibility one can get.

DESIGN GUIDELINE: If you are doing conceptual group modelling with a quantified model, consider using computerised diagramming. If you are not, stick to manual diagramming, especially in the first phases of the conceptual modelling process. Collary: In learning-wheel policy experiments, always use a computer projection.

7. Qualitative Versus Quantitative Simulation

In the past, merely qualitative modelling was 'not done' in system dynamics. Proper system dynamics modelling entailed rigorous testing of dynamic hypotheses with quantified simulation models. In the past decade, recognition has grown for the idea that qualitative modelling may be a valid exercise in its own right¹²¹. In the six projects described in this book, modelling remained qualitative in two cases. So usually we quantify, but sometimes we don't. Why?

Trade-off aspects:	Qualitative modelling	Quantitative simulation
Insight into model structure	+	+
Insight into dynamic behaviour	_/+	++
Insight into cumulative impact	-	++
Modelling effort	+	-/
Model validity	-	+
Model confidence	_/+	++
'Artificiality' with soft variables	+	-

Table 4.7.: Quantitative simulation versus qualitative modelling

Among the strong points of quantitative simulation, summarised in Table 4.7., is that it allows for a more thorough insight into the behaviour of the system under study in two ways:

- It shows the dynamic effects of the various *feedback* loops on system behaviour. Feedback often leads to so-called "counter-intuitive behaviour"¹²²: one expects that X will happen, but precisely the opposite of X happens.
- 2. It shows what the *cumulative*, overall effect will be on system behaviour of a large number of in themselves quite straightforward dynamic effects (see the example in Exhibit 4.2)

But you can also gain insights from qualitative models. You gain insight into the (static) structure of the system under study and, to some extent, you may also gain some dynamic insight if this structure closely resembles a well-known archetype of systems behaviour, as the second example in Exhibit 4.6. illustrates.

A third advantage of quantified simulation is that it allows one to conduct more rigorous validation tests, provided there are available historical time series of the system being modelled¹²³. Such validation certainly increases the client's level of confidence in the model, but, over and above that, managers always show a much

stronger belief in the recommendations resulting from a quantified model than from a qualitative study. All too often, however, this faith is not entirely justified. Quantified models tend to contain a large number of assumptions and simplifications that are overlooked by the manager. But once a number has been assigned to these unknowns, the model tends to acquire the status of an omniscient oracle¹²⁴.

An example of insight into cumulative effects

In Case 1, a new sorting system had to be designed for newspaper distribution. There were at least four different systems that showed considerable promise and each alternative had its own 'champion'. In the course of the modelling project, the various 'champions' could explain to one another the advantages of their own alternative, and they also acknowledged the strong points of the other alternatives. However, it was not until a quantified simulation model was developed that the cumulative effects of the relative strengths and weakness of the various alternatives could be properly assessed.

An example of dynamic insight from a qualitative model

In Case 2, a causal diagram was developed of company growth. From this diagram it became apparent that the very factors that had originally contributed to the growth of the client company, were now impeding that same growth. This is characteristic of a limits-to-growth archetype, resulting in an S-shaped growth pattern. No quantitative simulation was conducted to test this hypothesis rigorously; however, historical data on company growth clearly confirmed the pattern.

Exhibit 4.6.: Examples of insights gained from quantified and qualitative models

If quantified simulation is so advantageous, then why would one ever stop after the conceptual modelling stage? There are two main reasons:

- 1. Quantification represents a considerable investment of *time*, so it has to be worth the effort. In other words, if conceptual modelling delivers adequate answers to the problem the client was originally facing, further modelling will not yield additional value.
- 2. Quantification may appear *artificial* if one is modelling a very soft issue. Although in theory one can make perfectly usable quantified models of very soft issues, one rarely does so in practice¹²⁵. Above all, the client will not expect a quantified model in such cases, in contrast to the expectations for a very 'hard' problem (e.g. an operations management issue). This does not mean that you, as the consultant, may not have your own ideas. If you feel that the group may still be missing an essential dynamic insight, you should certainly try to get the group into the model formalisation stage (which may not be easy).

DESIGN GUIDELINE:

Always try to develop a quantified simulation model, *unless* the problem at stake is very soft, or you and your client feel you have already adequate answers to the original questions, or you have insufficient time to formalise your model.

8. System Dynamics Simulation Versus Discrete Event Simulation Versus Spreadsheets

One of the advantages of quantification is that one can verify intuitions regarding dynamic behaviour, but for that a quantified representation of a dynamic system (i.e. one that changes over time) is needed; that is called simulation. But what kind of simulation? Should one use a system dynamics (SD) language or a discrete-event simulation (DES) language? This choice is far less fundamental than is often suggested, being largely a matter of taste and preferred style, of availability of tools, and of specific modelling objectives, of past experience and 'cultural heritage'¹²⁶. The real world in essence is neither purely 'continuous' nor purely 'discrete', but may be conceptualised with equal validity in both modes. Moreover, out of every ten problems that can be tackled effectively with quantitative simulation, at least six can probably be tackled with both SD and DES, at most two are awkward to model with DES, and at most two are hard to model in a SD simulation language. So there is a very large overlapping area where both simulation techniques will yield good results.

This does not mean that the trade-off between SD and DES is not genuine, but in the experience of this author, the choice of the actual programming tool is less important than other trade-offs described in this section, such as the mix of expert and process skills, the appropriate level of modelling detail or the use of workbooks. Usually, the client will be indifferent to the simulation language that is adopted.

This being said, what are the pros and cons of the respective simulation techniques? And how do these two compare to the most frequently used quantification tool of all, the spreadsheet? A balance is drawn in Table 4.8.

Trade-off aspects:	System Dynamics	Discr Event Simulation	Spread- sheets
dynamic behaviour	++	++	-
non-dynamic analyses			++
feedback loops	++	-	-
queuing theory	-	++	-
physical system animation	-(+)	++	
individual entity attributes		++	+
representing soft variables	+	-	-
conceptualisation support	++	-	-
data demands	++	-	
links to other systems	-	-	+
structural transparency	++	-/+	

 Table 4.8:
 System dynamics software versus discrete-event software versus spreadsheets for model implementation.

The main reason why system dynamics languages predominated in the cases described in this book, is the support they can lend to problem conceptualisation: the fact that there are a variety of qualitative diagramming techniques that guide you, step by step, towards a quantifiable model. This may be the biggest advantage of system dynamics over discrete-event simulation. Once you have arrived at a quantifiable model you still have a choice among different software packages, but it is often turns out most convenient to use the same software that you already used to draw your conceptual diagrams.

Another advantage is the facility that most SD packages offer to model soft variables via a graphical function (although there is no reason why this should not also be a feature for any DES package). Thirdly, a SD package will be especially convenient in cases where there are lots of feedback loops (although you can create feedback in a DES package as well.)¹²⁷ And finally, system dynamics packages tend to require fewer data than many DES models ¹²⁸.

The main strengths of discrete-event simulation, by contrast, may be physical system animation, a capability that is not intrinsic to DES per se. The possibility this gives to zoom in, on the computer screen, on pictograms of people at work or being idle on desks or at machines, to see queues of products piling up and then decreasing, is extremely powerful in 'selling' a model, both in the pre-project stage as well as during the project itself. So if the problem involves a physical system on a rather detailed level, discrete-event simulation has some strong advantages over system dynamics¹²⁹ A strength nearer to the core of DES is its ability to perform queuing analysis up to a very advanced level. If you have a problem primarily involving queuing theory, use DES. Don't use SD, despite the efforts of some SD software companies to incorporate queuing facilities in their packages¹³⁰. More generally, any modelling that requires looking fairly close at a system and representing the activities of individual entities (people, machines, vehicles) over a fairly short time horizon (hours, days), is likely to be better captured by discrete-event simulation. Again, this does not mean that such situations cannot be modelled with system dynamics software, as Case 1 illustrates.

In Case 1, the original intention was to model the system using discrete-event simulation. A DES package was demonstrated to the client at the start of the project. In the conceptual modelling stage, causal diagramming and stocks-and-flows diagramming were used to represent the distribution operations under investigation. Originally just to provide a simple basis for the final model in DES, the author developed a SD model of the system. As it turned out, this model could answer all the questions that were formulated at the outset. No discrete-event simulation was required after all.

In Case 3, the opposite happened. There the original intention was to develop a system dynamics model of the distribution network which the project demanded. There, too, various conceptual SD modelling techniques were used to conceptualise the system. However, it soon turned out that the design of the call centre in this network depended on rather too many stochastic variables and attributes of individual model entities. Therefore, a DES package was used for that part of the network. For the rest of the distribution network it turned out that the relevant network design trade-offs did not vary with time, but rather in the density of the depot network. A system dynamics package was used anyway to calculate this trade-off, but more because of its convenient use of graphical relations than for any other reason; a spreadsheet might have worked equally well.

Exhibit 4.7.: Implementation in SD or DES - a secondary issue, to be determined during the project.

Turning lastly to spreadsheets, they have a place only if you have no need for simulation. That is, when you are not investigating the characteristics of a problem over time, when dynamic behaviour is not of interest; for instance, if you want to perform Pareto-analysis, or regression analysis. Data analysis techniques provide crucial input for most simulation models, be they discrete or continuous, and spreadsheets allow you to make these analysis as in-depth and complex as you want to make them¹³¹. Also, the spreadsheets currently on the market can be integrated fairly well with other software, such as specialised data analysis packages or operational information systems¹³², which may give them an edge in some circumstances.

DESIGN GUIDELINE:

Use the conceptualisation techniques as described in PBM¹³³ for *all* modelling projects. Once you have developed a conceptual model, then choose an implementation environment. If your problem does *not* have strongly time-dependent features, use a spreadsheet. If the problem involves modelling physical operations at a fairly detailed level and/or extensive queuing issues, use a discrete-event simulation package. If none of the above apply, go for the system dynamics package.

9. Large Versus Small Models

A more adequate description of this trade-off would be 'large/complex/detailed models' versus 'small/simple/abstract models'. However, this is a tricky subject, which admits few absolute statements¹³⁴.

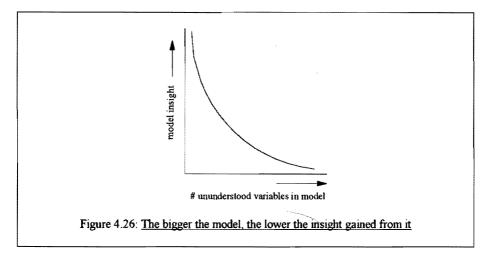
Model size	small	medium	large
Content:	idea rich	mixture	data rich
Purpose:	explanation of modelling technique	strategic decision- making	operational management
Life span:	very short (1 day)	short (3 months)	long (3 years)
Client understanding of model results:	intuitive	counter-intuitive	non-intuitive
Deliverable:	understanding	learning	answer
Consultant focus:	ensure usefulness	ensure participation	ensure trust/belief

Table 4.9: Different characteristics of small, medium-sized and large simulation models 135

The following guidelines may be offered:

- Model size is determined pre-eminently by modelling *purpose*: a model should contain as few elements as possible, but as many elements as are necessary to fulfil its purpose.
- The purpose of a small model is different from that of a large model, as Table 4.9. suggests. It is inappropriate to use a huge model for training purposes, and a very small model is rarely of use for an operational management issue.
- You should proceed *top-down* in modelling. Start with a small model, which replicates as closely as possible the reference behaviour you are looking for. Make sure you understand this small model completely before cautiously adding new variables and relationships step by step. As soon as you get lost, revert to the older simpler model that you understood, otherwise you lose track. This is illustrated by the graph in Figure 4.26¹³⁶: you will be unable to understand your model as soon as you have more than two or three variables in your model that are not fully understood.
- Expect your client to want more detail than you think is strictly necessary (according to one author, twice as much detail¹³⁷). Ease your client through the process of accepting that the big picture counts most and that more detail will not

normally provide much additional insight, without giving the client the impression that you are ignoring his worries. Indeed, it can be recommended to discuss this top-down modelling style with your client at the outset of the project ¹³⁸.



DESIGN GUIDELINE:

Keep your model as small as possible, but as large as necessary to fulfil your modelling purpose. Build up gradually from small to large. Use small models if the emphasis is on management learning.

10. Client Validation Versus External Validation

Validation means checking that the model is an adequate representation of the problem. The purpose of validation is to create confidence in the model¹³⁹. By client validation we mean that the client indicates that the model is correct, that it has "face validity"¹⁴⁰. By external validation we mean that model behaviour 'fits' with historical behaviour¹⁴¹. Not only are both kinds of validation important, both kinds of validation are required: your client might be wrong and your external validation might be irrelevant. If either type of validation is missing, client confidence in the model will be reduced.

Unfortunately, external validation is often problematic when it comes to realworld strategic decision-making issue. This is because:

- The required historical data may not have been archived for a sufficiently long period of time;
- The required data were never measured as they were not considered important or were too 'soft' to measure.
- The organisation and/or its environment have changed considerably in the recent past, thereby rendering past behaviour irrelevant to future system behaviour;

In Case 1, a simulation model of the current distribution system showed the same processing time as the client had experienced in the real world. A simulation run of an older version of this distribution system also showed processing times that corresponded with client memory. This strongly increased client confidence in the model.

In Case 5, the time horizon of the model (3-5 years) was such that it was impossible to collect data going back so far in time to conduct an external validation. And even if such data could have been collected, their validity would have been doubtful, since customer attitudes and behaviour towards banking operations, the main subject of the model, were said to have changed considerably in the past few years. Changes in the bank's own branch distribution made extrapolations of past client behaviour into the future even more precarious. Nevertheless, several project team members indicated that their confidence in the model was negatively affected by this lack of external validation.

Exhibit 4.8.: External validation leads to client confidence.

In these cases, in the absence of opportunities for external validation, most system dynamicists and PBM consultants rely solely on client validation, for two main reasons:

- 1. The client group collectively holds most, if not all, of the relevant knowledge regarding the system.
- 2. The client group's confidence in the model is essential if the modelling insights are to be implemented.

The risk in relying solely on client judgement is that the client may be wrong. However, two arguments can be advanced for this 'client-centred approach':

- In many cases, a decision will have to be made. It is not a question of whether a decision based upon an externally unvalidated model will be as good as one based upon a hypothetical validated model. It is more relevant to ask whether a decision based upon no explicit model at all will be as good as a decision based upon an explicit formal model.
- From an implementation perspective, the main purpose of validation is to increase client confidence in the model. If the client feels that the model is correct, then this will lead to confidence in the model (although the client's confidence in the model will be less than if external validation had been performed, as the example from Case 5 in Exhibit 4.8.illustrates).

This is not to be construed as a justification for 'sloppy' work. If you have a quantified model, you should try to validate it as thoroughly as possible; it would be unprofessional, and therefore 'un-PBM-like' (cf. Section 4.1.) not to do so.

DESIGN GUIDELINE:

Always ask your client to validate the model. If the model is quantified, try to collect historical time series of key variables to validate model behaviour. Keep in mind that such time series are often hard to collect in real-world decision-making, in which case you are to discuss the issue with your client. If the client has little confidence in the model, commitment to implementation will be low.

11. Simulation Language Versus Microworld Versus DSS

Model formalisation usually takes place first in a simulation language. The ensuing knowledge dissemination phase may proceed in three ways:

- 1. No further modelling takes place: the problem is solved, the modelling team has learned enough.
- 2. The model is translated into a decision-support system, with a user-friendly user interface, facilities for maintenance, etc.
- 3. The model is translated into a simulation-game, or "managerial microworld" as it is often called¹⁴².

The advantages and drawbacks of these three different end-versions of the model are summarised in Table 4.10.

Trade-off aspects:	Simulation Language	DSS	Microworld
additional development effort	+		
suitability for training purposes	_/+	+	++
decision support capabilities	+	++	-
company-specific data	+	+	-
ease of use		+	++
maintainability and transferability		+	++

Table 4.10.: Disseminating knowledge through a model in a simulation language compared with a DSS or a Microworld

A model in a simulation language is sufficient if the model is to be used only once and by a single group. If there are multiple groups who must face a similar problem, you will want to develop a DSS or a microworld. Microworlds are ideal if the main point is to explain some generic insights, for training purposes. However, if the main purpose of the modelling exercise is to support groups that will be making a certain decision (repeatedly), then one has to develop a decision-support system. In terms of structure, the main difference between a microworld and a DSS is that a microworld is normally generic, a DSS is specific. A DSS will contain the real data from the business of its user groups, whereas a microworld may at best contain the data from a business approximating that of its user groups.

DESIGN GUIDELINE:

If you develop a model for one-off use by a single group of managers, a model in a simulation language will suffice. If the model will be used to support (repeated) strategic decision-making by multiple groups of managers, develop a DSS. If you have multiple groups but the main purpose is training or knowledge dissemination, consider developing a microworld.

CHAPTER 5

CASE EVALUATION PROCEDURE

This chapter describes how the six cases that were conducted within the course of this research project were evaluated. The evaluation process has been no small matter; having lasted more than two years and taken up at least one and a half man-years of combined effort on the part of the author, two research assistants and a secretary. Approximately, one hundred hours of tape recordings were analysed to arrive at the material presented in Chapters 6 and 7, and the typed material for the six cases can barely be contained in two thick binders. The challenge has been to reduce the mass of documentation into serviceable measures of the quality of the PBM process.

5.1. The development of the evaluation procedure

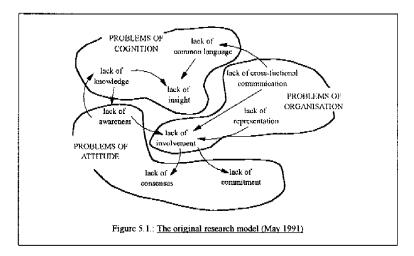
An interactive design process

The version of the evaluation procedure that is presented in this chapter is the result of many refinements. Attempts to conduct rigorous evaluations of real-world business modelling projects are a new phenomenon. There are few practical experiences and no tested, well-calibrated research designs to fall back upon in this area. Therefore, elaborating a workable yet sufficiently rigorous evaluation procedure has been very much a development process, much like the design of the PBM method itself.

That development entailed frequent interplay between successive versions of the research model, methods of data collection and findings from data analysis, each of which of has influenced the others and was in turn influenced by them. In order to explain the resulting differences in data that were collected for the various cases, and differences in the methods by which these data were collected and analysed, a brief historical overview of how all this led to the current version of the evaluation procedure is necessary.

The pre-evaluation period: Autumn 1989-Summer 1992

The origins of this research project go back to 1989, when the author started his doctoral dissertation research, within the framework of what was then called the LOOSIM Project². For the first two and a half years of this research, evaluation was a dimly perceived issue; the initial emphasis was directed towards software issues, such as appropriate simulation languages³.



The first version of the research model was published in spring 1991⁴. That model, shown in Figure 5.1., was based upon an analysis of the literature on operations strategy development projects. The analysis had identified nine lacks, all related to the process of operations strategy development. It should be noted that most of these lacks, e.g. lack of commitment, consensus, awareness or communication, are retained in the final research model presented in Chapter 2 of this book. But at this stage still few thoughts were spent on evaluation, because the first case had yet to start.

A period of exploration: Autumn 1992-Autumn 1993

This changed when the author conducted what would become his second case-study with Jac Vennix, then of Utrecht University. One of the pioneers in evaluation research for system dynamics modelling, Jac Vennix had already developed a questionnaire for this purpose⁵. This questionnaire was set up in Likert-scale⁶ format and tried to elicit client assessments of awareness, insight, shared vision, commitment, communication and efficiency. Participants in Case 2 were asked to complete two such questionnaires, at both mid-point and end of the project. Some time after the project, it was considered appropriate to conduct a follow-up personal interview with these participants? These interviews, conducted by research assistant Etiënne Rouwette, were tape-recorded, as some of the sessions had been; the respondents also filled in an additional questionnaire that attempted to measure post-project consensus to compare with an identical pre-project questionnaire. All this led to a first attempt at a 'proper' case evaluation.⁸.

In the succeeding months a similar procedure was followed with participants from Cases 1 and 3 (except for the pre- and post-test questionnaire in Case 1), by which time, Case 1 had been finished more than a year previously. The evaluation aspect seemed to have been solved.

A period of data collection: Autumn 1993-Summer 1994

Closer analysis of the questionnaire responses, however, showed that the initial version of the questionnaire was not reliable⁹; moreover, simply to devise a reliable version would probably require at least fifty to a hundred additional respondents¹⁰. That was clearly impossible within the scope of the LOGSIM research project. A further consideration was that evaluations of this type provided no causal explanations whatsoever, so that if the responses to a questionnaire showed e.g. high consensus, one would be none the wiser as to the reasons for that. It seemed the time was ripe for a new approach.

This new approach was so-called 'qualitative data analysis'¹¹. The motives for choosing the qualitative approach are discussed in Chapter 3: let it suffice here to note that this choice imposed an implicit need to collect huge amounts of data in the remaining cases. All modelling sessions in Cases 4 to 6 were taped, and research assistant Jacqueline Bosker conducted evaluation interviews with participants from these cases. These interviews were based upon a new, expanded version of the research model, which was broadly identical to the model described in Section 2.3.¹²

The author conducted more elaborate pre-interviews in Cases 5 and 6. These were also recorded and partially transcribed. All transcriptions, including those of Cases 1 through 3, were made by Marian Verbeek. Session tapes were scrutinised for relevant scenes; project documents were collected and analysed. The author made research memos during Cases 5 and 6, as did Jacqueline Bosker, who also served as recorder in Case 6. This whole process is explained in detail in Section 5.2.

The research assistant coded all the transcripts on the basis of the new version of the research model. Luckily enough, the older interview material turned out to be quite serviceable for this purpose. These coding activities did result in refinements to the research model¹³. The coded 'scenes' were categorised and clustered in matrices, or 'displays', which were aggregated up to a level that allowed an overview of project effectiveness to be presented on a single page. This process is explained in Section 5.3.

A period of causal analysis: Summer-Autumn 1994

After the case material had been assembled and aggregated in this manner, the author was still left with the tasks of achieving an overall understanding of what had happened in each case and finding a way of comparing the six cases.

For the first task, causal networks of each case were developed and fed back to the respondents in a so-called 'member check'. This process is explained in Section 5.4. For the second task of cross-case analysis, a data matrix was constructed by which possible relations between values for the variables in the research model could be assessed. A literature review was conducted to ascertain to what extent these relations could be supported by earlier research. This process led to some final changes in the research model¹⁴. All these cross-case analytical activities are described in Section 5.5.

5.2. Stage 1: Data Collection

One of the principles of qualitative research is *triangulation*: the idea that evidence for a hypothesis should come from as many different independent sources as possible¹⁵. This is why data collection in qualitative research is often so diverse and copious. In this research project, the main data sources were:

- transcripts of group modelling sessions,
- · transcripts of individual (or group) interviews,
- project documents,
- observations,
- research memoranda.

As this section will show, the amount of material collected has been huge. Not surprisingly, in retrospect, large parts of these data remained unused, or hardly used, in the final analysis. Nevertheless, all data were collected in six large case databases¹⁶.

Recording of sessions and interviews

The real core of the material upon which the case analyses and cross-case analysis are based is formed by transcripts of recorded sessions and interviews, in particular the evaluation interviews that were conducted with participants after each project was finished. Table 5.1. summarises the sessions and interviews that were recorded.

Case #	Pre-interviews	Sessions	Post-interviews 2 recorded	
Case 1	6 mindmapped	not recorded		
Case 2	6 mindmapped	2 recorded badly	6 recorded	
Case 3			3 recorded	
Case 4	8 mindmapped	3 recorded	4 recorded	
Case 5	8 recorded	12 recorded	6 (group) recorded	
Case 6	6 recorded	6 recorded	6 recorded	
Total:	27 mindmapped, 14 recorded pre-interviews	23 recorded sessions	27 evaluation interviews	
Est. hours tape	20 hours	35 hours	35 hours	

Table 5.1.: An overview of recorded sessions and interviews

This table confirms the extent of the recorded material, with the average interview taking 1 to $1\frac{1}{2}$ hours and an average session lasting 2 to 3 hours, an estimated grand total of some ninety hours of spoken words. A second observation is that the last material from the last two cases, and in particular from Case 5, is far greater than from the first four. This is caused on the one hand by the size of these last two projects: more people were involved and more sessions were conducted. On the other hand this is caused by the objective of not missing any relevant material in these cases, as had happened in the first four cases.

Thirdly, only the evaluation interviews were available in recorded format for *every* case. In order to get this complete coverage, this meant for some projects going back to the client company a long time after the project had been finished (Case 1, Case 4). On the other hand, in the last case this meant interviewing long before the project

was actually completed (Case 6). In the remaining cases, interviews took place one to two months after the project had finished. That was long enough not to get a response merely at the reaction level, and not so long afterwards that many details were forgotten.

Transcribing tape recordings

The second step in data collection was transcription of the collected tape recordings. This was not done for any of the modelling sessions, but it was done for all evaluation interviews and selected parts of the pre-interviews. Exhibit 5.1., featuring a short episode from a transcribed evaluation interview,¹⁷ gives some flavour of the difficulties that the transcriber has to face.

(...)

INTERVIEWER: But if you leave out top management I think when you want to have a change top management has to agree too, so you have to bring them in some time...

RESPONDENT: Yes but then I think you have to be very clear and very... You have to start the situation and the people contributing believe in the objective. Now I think there were, let's say, at least one absolutely for sure and one or two I would say dubious who did not agree with the objectives anyway. Now they may say in the meeting the right things but they actually may be not in agreement at all this is what the company should do. One for sure didn't - doesn't agree at all but you would not have known from the meeting which one it was. But he doesn't agree anyway and therefore in a way his presence was, I think, a bit of a waste maybe. I think certainly the company is very much, I think, a .. bit, it is not a team, let's say, to start with, so you have some dominant, rather dominant players who are very dominant with their views. It is also, I think, that certain individuals... It is not a company that actually encourages, or at least with certain individuals, that encourage this player's views that are not in accordance with their views. So this is what I said to Henk before the meeting: the presence of certain individuals would suppress other individuals saying what they really think. They know it is not invited and not really wanted to be heard, whether it's right or wrong, and okay, in the end it wasn't. In a way it didn't matter ... It got round to and say the first part was very safe anyway, just putting out words, and that was okay. People were anyone could give a word ... what came out as soon as, really, the first session went reasonably smoothly and then gradually deteriorated from then. So the first one a kind of the process was followed and then it gradually... the thing got lost and people started going into discussions of where some of the issues, I think, started to come out a bit but the conflicts in the company, the conflicts in views, and maybe a whole lot of things that frankly just killed the thing really. One person was not impressed by the process anyway; didn't think it was managed well, or neither the process was good nor the management of it was good, and it was clear after the first day that frankly this would become a joke. But I think also the way the whole thing probably ever came into being was wrong because I got the impression, maybe wrongly, it was kind a commission by one guy without really anyone around him wanting it particularly.

INTERVIEWER: The project?

RESPONDENT: Yes, and so I think if you gonna make these kind of things you need at least the team, or at least the majority of the team are in agreement that ... of what the objective is and the process to come to that objective and that you operate together to achieve it. I think anytime when one guy says "I think it is a very good idea" andis not actually destined to probably give the right result, and I think that was the case in the ... here. A lot of people they really wondered "What the hell are we doing here?" They thought it was a waste of time from the beginning (...)

Exhibit 5.1.: Excerpt from an evaluation interview from Case 4

Collecting project documents

Another source of data are project-related documents. These are not just the deliverables produced by the project team, but include such documents as company annual reports and internal reports. In addition, in every case there were newspaper and journal articles that provided an informative background to the project. Each document was analysed, the analysis put on file as a research memo and both were added to the case data base.

The completed questionnaires collected during Cases 2, 3 and 4 formed a special category¹⁸ of project documents, which were likewise added to the case database.

Noting down observations

The idea behind noting down observations is that it is often very hard, several months after a project has been finished, to reconstruct what was going on whilst the project was in progress. This is especially true for introspective observations concerning motivations (Why did we make the decision to do X, and what did we expect would happen?) or personal impressions (How did we feel that the session went? How confident were we, at that stage, about the eventual success?). Exhibit 5.2. gives an example of such an introspective observation¹⁹.

Memo 6/10/93 [At the start of Case 5, after in-house discussion with fellow consultant on 5/10]

considerations in design choices for Phase 1:

 \rightarrow not too participative, has to go fast, more pure knowledge elicitation

- Interviews and workbooks, rather than group sessions
- In workshops still confrontations internal consultants bank management
- Don't expect too many politics here
- Will be different in Phase 2 (internal consultants come from HQ, this is a model for managers, not a model by managers)

Two modelling streams:

- 1. Causal diagrams, graphical relations
- Stocks-and-flows →don't know precisely which ones, but are also in environment, e.g. customer categories. Are needed at any rate for quantified model.

Don't expect too many problems *content wise* in Phase 2. Do expect problems in project management, in getting people together and making time available. Client company does not appear to be too strong there (1.5 month delay initially)

Exhibit 5.2: Example of an introspective observation on consultant motivations and expectations from Case 5

Direct visual observations may be relevant as well. Non-verbal communication, remarks made when the recorder is off, a perception of a person's mood (e.g. irritated or tired), can all supply valuable information, especially if they can be correlated with taped data. Exhibit 5.3. contains an example of such a visual observation.

1/2/1994 [after a learning-wheel workshop with one of the 'test banks'] Bank manager at the end of workshop, after question on organisational platform for model: Original advice from internal consultant was mainly economical; it did not contain these kind of considerations [see session tape for rest].

Non-verbal reaction of internal consultant: Looks surprised at manager, bends over to look at thick portfolio with research data in front of him and lifts it partially as if to say "And what about this here, then?"

Exhibit 5.3.: Example of a visual observation from Case 5

Observations of both kinds were noted down by the researchers as they were made²⁰. These observations were then added to the case database, providing yet another opportunity for triangulation.

Writing down memoranda

Research memoranda are another essential part of the qualitative research methodology. In this research project, two different kinds of research memoranda were used frequently. First, there were memoranda of a summarising character. As mentioned above, such memoranda were used to summarise relevant information from project documents. But memoranda were also written to capture the main contents and interesting episodes from the pre-interviews, as these could be distilled from the cognitive maps and the interview tapes and transcripts.

Secondly, and perhaps even more importantly²¹, memoranda were written to document the case analysis process. Whenever a change or an addition was made to an intermediate analysis result, the reasons for the change were documented in a short memo. Tables 5.1. and 5.2. in the next section contain some examples of this kind of memo. Similarly, reflections on the research model, on the PBM method, or on the evaluation procedure were recorded in memo form as the projects proceeded. Exhibit 5.4 gives an example of such a self-interrogative memo written down when Case 5 was half complete and Case 6 had just begun.

14/12/94 On PARTICIPATION

How participative has this project really been? I feel that it has been more a matter of presenting a model and discussing it. It is of course participative to some extent. However, compared with Case 2, where the managers built the causal diagram with us in the first two sessions, it does seem somewhat less participative. Then again, I am not quite sure if that impression is really correct, because Case 2 was in fact manipulated participation [We more or less knew what kind of model we wanted the group to produce — HA]. Is that true participation?

 \rightarrow Perhaps the theory-richness of the domain also makes a difference. In Cases 5 and 6 there is a lot of theory, in Cases 2, 3, and 4 less so.

 \rightarrow Another difference in general might be the conceptual modelling skills of the consultants. I have to be honest, I do think that the basic structure of the model in Case 5 was made in a – largely opaque – modelling process that took place inside my head. So: the better you get as a modeller, the less the process needs to be participatory from that perspective. Or, the other way round: if you can't think of something yourself, you'd better ask the others...

Exhibit 5.4 An example of a self-interrogative memo

N.B.: The author does no longer support all the ideas that are presented here. The purpose is merely to provide the reader with an example of a memo that captures some thinking during projects.

5.3. Stage 2: Display Construction

A consequence of the huge amount of data in the case databases is that it is virtually impossible to retain an overview of all material that is available on the various aspects of our research model, e.g. every recorded remark on 'communication' or 'commitment'. One approach that qualitative research uses to overcome this problem of drowning in raw data is *data reduction*; that is, summarising a certain set of data in such a way that its main message is captured in a highly condensed text. This summary can then be combined with other summaries and the new text condensed again, and so on until a sufficient level of aggregation has been reached.

Coding transcripted materials

The first step in the analysis of each session tape and transcribed interviews was to break it down into *scenes* and assign *codes* to the scenes. This method is especially prominent in a particular branch of qualitative research²², "grounded theory".²³ Several useful procedures and even software packages²⁴ have been developed to assist in this coding process. Although the evaluation procedure used in this research project cannot be labelled as grounded theory²⁵, its procedures and software were found to be very helpful in making a first substantial step in data reduction.

In the coding process for this research project each 'scene' was given a unique identification. A scene, for this purpose, is a coherent part from an interview protocol in which a particular subject is discussed²⁶. Exhibit 5.5 on the next page shows how the 'raw' interview protocol that was presented in Exhibit 5.1, was divided into a number of separate scenes.

INTERVIEWER: But if you leave out top management I think when you want to have a change top management has to agree too, so you have to bring them in some time...

SCENE 8: willingness to cooperate, communication.openness

RESPONDENT: Yes but then I think you have to be very clear and very... You have to start the situation and the people contributing believe in the objective. Now I think there were, let's say, at least one absolutely for sure and one or two I would say dubious who did not agree with the objectives anyway. Now they may say in the meeting the right things but they actually may be not in agreement at all this is what the company should do. One for sure didn't - doesn't agree at all but you would not have known from the meeting which one it was. But he doesn't agree anyway and therefore in a way his presence was, I think, a bit of a waste maybe.

SCENE 9: communication.openness, communication.verbal dominance

I think certainly the company is very much, I think, a .. bit, it is not a team, let's say, to start with, so you have some dominant, rather dominant players who are very dominant with their views. It is also, I think, that certain individuals... It is not a company that actually encourages, or at least with certain individuals, that encourage this player's views that are not in accordance with their views. So this is what I said to Henk before the meeting: the presence of certain individuals would suppress other individuals saying what they really think. They know it is not invited and not really wanted to be heard, whether it's right or wrong, and okay, in the end it wasn't. In a way it didn't matter ...

SCENE 10: communication.openness, hexagon brainstorming

It got round to and say the first part was very safe anyway, just putting out words, and that was okay. People were anyone could give a word ... what came out as soon as, really, the first session went reasonably smoothly and then gradually deteriorated from then. So the first one a kind of the process was followed and then it gradually... the thing got lost and people started going into discussions of where some of the issues. I think, started to come out a bit but the conflicts in the company, the conflicts in views, and maybe a whole lot of things that frankly just killed the thing really.

SCENE 11: willingness to cooperate, top management support

One person was not impressed by the process anyway; didn't think it was managed well, or neither the process was good nor the management of it was good, and it was clear after the first day that frankly this would become a joke. But I think also the way the whole thing probably ever came into being was wrong because I got the impression, maybe wrongly, it was kind a commission by one guy without really anyone around him wanting it particularly.

I: the project?

SCENE 12: willingness to cooperate, consensus

Yes, and so I think if you gonna make ..., these kind of things you need at least the team, or at least the majority of the team are in agreement that ... of what the objective is and the process to come to that objective and that you operate together to achieve it. I think anytime when one guy says "I think it is a very good idea" andis not actually destined to probably give the right result, and I think that was the case in the ... here. A lot of people they really wondered what the hell are we doing here? They thought it was a waste of time from the beginning (...)

Exhibit 5.5.: Coded scenes from interview excerpt from Case 4 (cf. Exhibit 5.1.)

This exhibit also shows what is meant by *coding* scenes, each scene being labelled with one or more variables from the research model²⁷. When this is done on a computer it becomes very easy to search for all scenes that contained references to, for instance, 'willingness to cooperate' or 'top management support', or, as in Exhibit 5.6., all relevant references in a given interview protocol to a specified variable²⁸. By making such a selection, one can start working on Display Level 1.

<u>SC4:</u> (on grouping hexagons): 1 shifted a few and the dominant players were shifting them back. so 1 say forget it.

<u>SC8</u>: I think there were, let's say, at least one absolutely for sure and one or two. I would say, dubious who did not agree with the objectives.

<u>SC11</u>: I got the impression that it was kind of commissioned by one guy without really anyone around him wanting it particularly... When one say says "I think it is a very good idea and we're gonna do it" and everyone else around would prefer to be somewhere else, it is not actually destined to give the right result... A lot of people thought it was a waste of time from the beginning.

<u>SC14</u>: I think the fundamental problem was the way the thing was initially started by one man. saying this is a good idea without really considering how to do it, and it wasn't a management team kind of decision.

SC16: I know a number of people pushed for it to be cancelled.

SC18: E. [the project sponsor — HA] wanted to carry on at the end of the day; everyone else really said stop it.

SC22: It kind of never worked because people were getting frustrated by it.

SC31: I think nobody there got committed to it at all

<u>SC32</u>: If one is gonna do this, one of the first things is to make sure you have the right commitment from the right people.

SC33: ... You just get a memo saying you will be there

<u>SC34</u>: I know a number of people was kind of ...well, how do we get out of this thing? Some even categorically cancelled it out of their diary.. Lots of last minute bookings....

SC37: You really need to have at least a commitment generally amongst the people

SC39: The commitment [to the process] has to be right

14 scenes.

Summary: Many people did not want this project, they were forced to participate Rating: -- (referred to very often)

Exhibit 5.6.: Summarised references to 'willingness to cooperate' from all respondents in Case 4

Four types of displays

A very general definition of a data display is "an organised assembly of information that permits conclusion drawing and action taking^{"29}. Displays in the more narrow sense that is employed in the qualitative data analysis approach³⁰ normally comprise all sorts of matrices, graphs, networks and charts: "All are designed to assemble organised information in an immediately accessible, compact form, so that the analyst can see what is happening and either draw justified conclusions or move on to the next-step analysis the display suggests may be useful."³¹

In this research project, four different kinds of displays were distinguished in single-case analysis³²:

- 1. Display Level 1: Data matrix for a single low-level variable (e.g. 'consensus'), which contains all summarised references to aspects of this low-level variable of the research model, ordered by data source/respondent, with a summary for each respondent and a summary for the variable as a whole.
- 2. Display Level 2: Data matrix for one overall concept (e.g. 'organisational platform'), which contains respondent summaries for all variables belonging to this overall concept, with a summary for each variable and a summary for the overall concept as a whole.

- 3. Display Level 3: Data matrix for one case (e.g. 'Case 3'), which contains all variable summaries for each overall concept for this case, with summaries for the overall concepts.
- 4. Causal Network Display: A causal network per overall concept, which contains all the variables for that overall concept, their values and the causal links between these variables and other variables. The direction of the causal links (positive or negative) is indicated as well as an indication as to whether the links can be traced directly to display material or not.

Display Level 1 is constructed from the coded scenes, Display Level 2 from a number of Displays Level 1, whilst Display Level 3 is constructed by combining four displays of Level 3. These are discussed further below. The Causal Network Display, also constructed from Display Level 1, will be discussed in Section 5.3. on causal case analysis.

Constructing Display Level 1

Table 5.2. shows a display of Level 1. Here the case data on 'willingness' to cooperate are shown for Case 4. This display was constructed by repeating the process shown in the previous exhibit, Exhibit 5.6., for each data source. This is a relatively small display (and chosen partly for that reason.) R1 stands for 'respondent 1', R2 for 'respondent 2', etc.

A crucial step in the analysis, reflected in the bottom two rows of Table 5.2, is the *assignment of values* (+, -, ++, --) to verbal summaries. This step is crucial, because these values will be subsumed to the higher-level displays and will be used extensively in the cross-case analysis. The reason for this is that such values "are less ambiguous and may be processed with more economy"³³.

However, the verbal summaries are also retained in higher-level displays, because "although words may be more unwieldy than numbers, they also enable 'thick description' (..). That is, they render more meaning than numbers alone, and should be hung on to throughout data analysis. Converting words into numbers, then tossing away the words, gets a researcher into all kind of mischief".³⁴

Another thing worth noticing in this display is the fact that the two researchers who worked on these displays, the author and his research assistant, cross-checked each others' assessments. The research assistant would make up the initial display, the author would review this and suggest changes he felt were appropriate. These modifications were discussed and, at times, yielded further changes. The reasons for all such alterations were documented on the displays. This procedure is open to criticism as a way of attaining truly reliable results³⁵ but represented a modest attempt to maintain some reliability.

A less obvious observation is that there is a strong emphasis in this display on material from the post-interviews. The pre-interviews, pre-questionnaires and session tapes were used to a far lesser extent because this material was found to be less useful. The reasons for this differ according to the data sources:

• The *pre-interviews* that were recorded in Cases 5 and 6 did not lend themselves to evaluation purposes because they discussed strategic decision-making processes in general within the client company. For instance, an assertion that the client company in Case 6 was normally slow in making important decisions may be useful information for a consultant wishing to set up a PBM project, but it tells little to a

researcher wishing to find data on how fast decision-making was in this particular case.

- Each session was dutifully tape-recorded but, in the end, the tapes were only scanned for references to elements of the research model. In a different research setting, these tapes could have been very valuable³⁶, but that would have meant a far closer study of the 25 session protocols, totalling at least 35 hours. This was considered impractical.
- The pre- and post-questionnaires were aimed at measuring consensus and awareness regarding the problem. In most PBM projects, however, it is not clear beforehand what the problem is precisely, making it hard to ask people how they feel about this vague problem. It is also quite usual for respondents to declare that a problem is very important to them but one has few ways of finding out exactly how important, or what that implies for awareness.³⁷

R1	R2	R3	R4	Memoranda/
				Documents
SC7: We have only done a part of the process and perhaps that is because some people did not support the process and don't believe in it, that I don't know. SC20: We stopped halfway, partially also because one or two people didn't believe in the approach. SC22: I certainly do believe that everyone tried to contribute positively, but during the process I going right, we are not achieving our goal", then after a certain time you quit.	14 scenes [see above in Exhibit 5.6.]	SC5: (People did not know the method) Now there was a disbelief in the technique and therefore people who said: "Why am I sitting here?" and got irritated, and so on. SC10: I somewhat had the impression that this was a sale made by B. [the author's consulting company — HA] (Wasn't is supported by the people?) No there had been internal tension regarding that session There had been a session There had been a setting a leady indicated the impossibility of success. I did not believe in it myself, I have tried one week before to have it cancelled.	SC13: I think that everyone who was present there had a very positive atitude to give that input that could be expected from him at that time [insinuating that this was not the case by me resulting in irritation, interviewer] <i>Okay, JB1 HA</i> .	HA: There were three kinds of unwillingness: 1. People did not want the new strategy, and did not want to talk openly about their objections (R2, R4) 2. People did not want this participatory process, this method (R6) 3. People did not want to discuss this issue with their subordinates in this way (R3)
3 scenes SUMMARY: 2 people did not support the process, and because things were going so bad R1 also quit himself. RATING: +/- Most wanted to contribute positively, but not everybody 21 references	14 scenes. SUMMARY: Many people did not want this project, they were forced to participate RATING: Referred to very often	3 scenes. SUMMARY: Project was forced, people did not want it and did not grasp it. RATING: Others did not want it, even R3 did not want it himself either HA	l scene SUMMARY: attitude was positive Gives vogue/diplomatic reply, no reply really. HA RATING: Plus RATING: NA (HA)	
	al people did not	want this project at all.		

Table 5.2: Display Level 1 for 'willingness to cooperate' in Case 4.

Constructing Display Level 2

Constructing Display Level 2 then becomes fairly straightforward. The summaries for each variable from the two last rows in Display Level 1 are combined with summaries for the other variables. In this manner, the summaries from Display Level 1 on 'willingness to cooperate' in Table 5.2. can be found in Table 5.3. on the next page, which contains the Display Level 2 for 'process effectiveness' in Case 4.

Modelling With Managers

PROCESS EFFECTIVENESS	Focus	Speed	Involvement	Communication	Willingness to cooperate
Mindmaps pre- interviews	NA	NA	NA	no open communication, verbal dominance, old gang dominant coalition (2 ref)	NA
Sessions	-: there is too little steering, there's no direction and it's not about the project goal (13 ref)	NA	+: good that everybody is sitting round the table (1 ref)	-: a lot of discussion, partly because of a lack of common language and a dominance of two people (13 ref)	NA
R1 post-interview	: bad focus due to lack of steering facilitators (11 ref)	-: no speed because of bad focus (4 ref)	+: all important people were there and had a part in the project (4 ref)	+: mutual discussion was good, though sometimes some dominance and lack of common language. Enough room to participate and open atmosphere (14 ref)	±: most people tried to cooperate for the best, although some people weren't behind the process. In the end it went wrong and I was not behind it any more (3 ref)
R2 post-interview	-: wrong subject and bad steering (20 ref)	-: too quick, no time to come to an agreement (2 ref)	: wrong balance in national and international people (8 ref)	-: hardly any discussion, no common language, dominance of some people and lack of openness (21 ref)	-: most people didn't want the project, they were told to cooperate (13 ref)
R3 post-interview	-: too many different goals and too much talking about subjects already known by most participants (9 ref)	-: too quick for some and too much repetition for others (7 ref)	-: wrong setting because of background of people and group size (7 ref)	-: no common language and little openness because of hierarchy and internal goals (8 ref)	-: people were forced to cooperate, they didn't want it and didn't understand it (3 ref)
R4 post-interview	: different goals and no steering (7 ref)	-: no speed because the difference in goals made it difficult to come to agreement (2 ref)	+: right people were there, other factors meant that they couldn't contribute totally (5 ref)	±: no common language, atmosphere was open (5 ref)	NA
Memoranda	-: people talk about method not about project goals, model coach takes over facilitating (2 ref)		right people were there, but didn't participate equally	±: gradually more discussions during sessions, dominant people don't overrule discussions (2 ref)	-: who did want the project, now I am beginning to doubts about the sponsor. HA
Documents	NA	NA	NA	+: philosophy of company is openness and respect, and no hierarchical dominance (1 ref)	NA
# ref	62	15	26	66	20
OVERALL	-: different goals, wrong subject, insufficient steering	-: for some too much speed, for others too little, both because of bad focus	+: all important/relevant people, background of the participants caused problems	-: no common language, some dominance and lack of openness; free thinking and mutual discussion was possible	-: some people didn't want the project
OVERALL		process then when are	processes bad? It was imunication caused lac		ybody was

Table 5.2.: Display Level 2 for various aspects of process effectiveness in Case 4

The reader should note that his particular display is based upon a total of 191 scenes and memoranda, which in full would probably amount to ten to fifteen pages of text. This indicates the power of the data reduction approach, and also its dangers. One has to be very conscientious in moving from one level of aggregation to another, and the process of doing so needs to be documented properly.

For each project, seven of such displays were constructed: one for each measure of strategic decision-making effectiveness (i.e. 'process effectiveness', 'model quality', 'organisational platform' and 'implementation results'), two for organisational and problem contingencies. and the seventh for the various aspects of project design.

Constructing Display Level 3

The construction of Display Level 3 proceeded in a similar manner. This time the summaries for the four overall concepts and their underlying variables were combined in a single matrix for each project, which serves as a one-page assessment of the whole case. In Chapter 6, the reader will find that the analyses of the individual cases contain a Level 3 display for each of the six cases.

5.4. Stage 3: Causal Case Analysis

The three levels of data matrix display discussed in the previous section give a good *description* of the 'inputs' to the strategic decision-making process and its 'outputs'. The outputs of the process are, of course, our four measurements of strategic decision-making effectiveness, the inputs are the two kinds of contingencies and the various aspects of project design³⁸. But what these displays do not provide is an *explanation* of why these particular results were obtained. What caused commitment to be high in this case? Why was completeness only moderate?

In this research, an attempt has been made to arrive at just such a causal understanding of what actually happened in each case. This understanding is depicted in a number of *causal networks*. A causal network is "a visual rendering of the most important independent and dependent variables in a field study and of the relationships between them. (...) It is assumed that some factors exert a direct influence on others: X brings Y in to being, or makes Y larger or smaller. (...)^{"39}. A single causal network could have been developed for each case, but that would probably have been unreadable; therefore, four different causal networks were developed per case, one for each high-level measure of strategic decision-making effectiveness. As an example, Figure 5.2. on page 136 shows a relatively small causal network for 'model quality' from Case 2.

A causal network does not consist of circles and arrows alone: "A causal network, to be useful, also has associated text describing the meaning of the connection amongst factors. (..) Text and network together communicate more than either could alone."⁴⁰. Such a textual description for the causal network in Figure 5.2. is shown in Exhibit 5.8. on page 137. Each variable, each relation in the network, has a number; each relation is described separately and refers to that specific number. One can study the diagram, one can read the text, or one can do both⁴¹.

Collecting causal relations

Developing a causal network for a case is not a straightforward job. A causal network is, indeed, "the analyst's most ambitious attempt at an integrated understanding of a site."⁴² In general, one can choose between two approaches, a deductive and an inductive approach⁴³. In the *deductive* approach, the researcher starts with a preliminary causal network, based upon existing theory, and looks for data that will confirm this network. In the *inductive* approach, the researcher looks for mentions of causal links in the case data and with these constructs a causal network 'from the ground up', leaving the confrontation of this causal network with existing theory for afterwards.⁴⁴

In this research, a mixture of both approaches was used. The variables from the research model and several relations between them were already available at the time of the causal case analysis. In that sense, the approach was deductive: research started off from a (partial) preliminary causal network. On the other hand, initial versions of these causal networks were constructed 'from the ground up', from actual clues in the case material. To that degree, the approach was inductive⁴⁵.

Exhibit 5.7. on the next page shows how these clues were collected from the case material of Case 2 regarding elements of 'model quality'. The author scanned all the cells in Display Level 1 for mentions of causal relations involving elements of the

research model. Sometimes these remarks are very direct, sometimes they are little more than clues.

brainstorming-+completeness

(...) I did get the idea that there was some creativity, some free thinking, in the brainstorm session a number of ideas emerged. [Display 1, Respondent 4, Brainstorming, also: Communication]

I liked that combination so much, mapping and then clustering and then making connections and finding out what the problem is and also things that contradict you see quite clearly (...) [Display 1. Respondent 4, Brainstorming]

 $complexity \rightarrow (O)$ usability

I don't think it will be solved immediately because it is rather complex. (..)

That we have obtained a good image of the problem does not mean that you also have the solution, but the image was clear. You have achieved awareness with a number of people, including me, the image has become sharper. [Display 1, Respondent 2, Usability]

involvement-+completeness

With this group of six or seven people a number of recommendations have been produced without saying that this is the final word, that some other group of six or seven wouldn't have come up with a number of other recommendations. [Display 1, Respondent 5, Completeness]

propositions----completeness, matrices----completeness

When you have a brainstorm that is very broad and then you try to capture that quickly in a number of propositions because you want, of course, to get results quickly. Then you do have a problem because then you get to neat solutions but you think "Now I have lost this or that". The last time we were only talking defensive regarding these propositions, you know. All these people are busy and they all forget what was in the matrix and what happened in the first sessions. [Display 1, Respondent 4, Propositions] conceptual modelling skills facilitators \rightarrow thoroughness

I think you did very well, I thought it was very skilful too. A sharp analysis, yes, and a good use of the technique, at least in my eyes. No, I'm very satisfied. I also think it is a bargain, three men who are involved in this for a few weeks and can then create such awareness, know how to reproduce this in a report, and can communicate this to top management of this company. I think it's excellent. [Display I, Respondent 2, Facilitators]

central presentation-+completeness

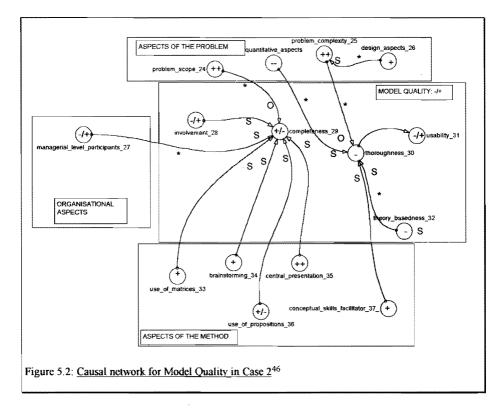
I think the tools, what I said just now, the combination of somebody calls something and it is immediately visualised and connected — and this clustering, I liked that a great deal. Little is lost this way, and now you have a constant overview of what's growing in the discussion; you see it happening and you can add to that and fall back upon, and I thought that was a very strong point [Display 1, Respondent 1, Central presentation]

Exhibit 5.7.: Causal relations referring to model quality mentioned in evaluation interviews in Case 2

All these relations are brought together in a table. This table is then sorted on overall concept ('process effectiveness', 'model quality', 'organisational platform', 'implementation results'). Sometimes one finds large numbers of such relations, but in this case there are only a few mentions in the case material (which is one of the reasons for choosing this example).

Constructing a causal network

These relations are then plotted in a causal network. Figure 5.2. shows the results of this plot. Every relation that is not marked with an asterix (*) is listed in Exhibit 5.7., i.e. was inferred directly from case evidence (we will go into these marked relations a little later).



The information density of such a causal network is very high: a considerable number of variables are displayed, together with their scores. They are grouped in boxes, each of which represents an overall concept of the research model. The score for the overall concept 'model quality' is also shown. Finally, the directions of the causal relations are also indicated. As in all the causal diagrams in this book, 'S' stands for 'same', or 'positive', and 'O' for 'opposite', or 'negative'. So the broader the 'problem scope', the lower 'completeness' will be (a negative causal relation), but the better 'involvement' becomes, the higher 'completeness' will be (a positive causal relation).

Adding 'missing link' relations

The relations marked with an asterix (*) are relations that were not evident from the case material; They were 'missing links'. These were added because without them the causal network does not contain adequate explanations for the scores obtained. If we look, for instance, at 'thoroughness', we see that it received a "-" score in this case. But why was the score so low? The evaluation interviews contain vague hints that the facilitators' modelling skills were perceived as good and that this influenced thoroughness. Since that relation is a positive one, on the basis of that relation thoroughness must also have been good! Since that was not the case, additional explanations will have to be found, or at least suggested.

This is where the 'missing link relations' come into play. The author, who after all had participated in every case and had read all the case material, tried to come up with alternative hypotheses about what could have kept thoroughness low. An obvious hypothesis is that thoroughness was low (i.e. not all the necessary analyses were conducted on the problem) because the problem was extremely complex $(25\rightarrow 30)$. A less straightforward hypothesis is that this problem was so complex because it was an organisational *design* issue, rather than merely an *analysis* issue $(26\rightarrow 25)$.

Thinking of plausible hypotheses is an inductive process. There is no direct case evidence to back them up. That should be evident from the diagram. Therefore, such hypotheses are indicated with an asterix. Exhibit 5.8. below shows how such 'missing link relations' are described and indicated in the explanatory text that follows each causal network. In the so-called 'member check' that will be discussed next the respondents were asked to pay particular attention to these marked relations.

'Model Quality' is also built up from a number of aspects: 'completeness', 'thoroughness' (of analysis), 'theory-basedness' (the degree to which existing theory is used) and (practical) 'usability'. Regarding these aspects, the following can be said:

29 The *completeness* of the analysis was acceptable.

 $24 \rightarrow 29$ This was especially so considering the wide scope of the problem.

A number of the techniques used contributed to this completeness. Mentioned specifically are:

- $34\rightarrow 29$ brainstorming with hexagons;
- $33 \rightarrow 29$ the usage of matrices and, more generally;
- $35 \rightarrow 29$ the central presentation, that enabled it to capture and keep track of most of the discussion.
- 36→29 Respondents are less positive about the usage of propositions, one feels that this obscures aspects of previous discussions.
- 28→29 Broad involvement in the project, in itself, improves completeness, but as indicated this involvement left something to be desired sometimes.
- 30 The *thoroughness* of the analysis was insufficient. (By thoroughness we mean the degree to which all the required analyses have been conducted.
- $37 \rightarrow 30$ The conceptual modelling skills of the facilitators did contribute,
- *25 \rightarrow 30but the problem itself was so complex
- $21 \rightarrow 30$ and intangible in nature that no good solutions came from the analysis.
- 31 This made the practical *usability* of the model limited.

Why were there no good solutions found? The interviews give no clear explanations for this. Possible explanations are:

- *32→30 Insufficient use was made of normative theories on how to design new organisational structures (if these exist)
- *26→25 This problem was so complex because it is a <u>design</u> issue: designing a new organisational structure is a far more difficult assignment than analysing the current structure. This because there are so many more options.
- *27→29Finally, this might not have been the right management level to which to address this question. These managers were pilots, not aircraft builders, left alone aircraft designers, only top management of the company can make such choices.

Exhibit 5.8: Verbal description of the 'model quality' network in Figure 5.2.

The quality of the model was inadequate. Formulated in general terms, the model-based <u>analysis</u> of the problem was OK, but we didn't succeed in finding good <u>solutions</u> for the problem in the model-building process.

Conducting 'member checks' and 'peer debriefings'

A 'member check' is a procedure frequently mentioned in qualitative and case-based research to improve internal validity⁴⁷ of the case findings⁴⁸. In a member check, "one presents facts and interpretations to participants to establish whether the reconstruction of reality as the researcher sees it is also recognisable to them⁴⁹. In a 'peer debrief' a similar process takes place, except that it is the researcher's peers, not the participants from the client organisation, who check the researcher's interpretations⁵⁰.

In this research project, both member checks and peer reviews were conducted for the case material. In the member checks, each respondent received a copy of the causal case analysis⁵¹. They were asked to look at the interpretations described there⁵², paying special attention to the marked (*) relations, because these contained the researcher's own interpretations⁵³. This suggestion may have helped to reduce the amount of data respondents had to check, but many respondents indicated that they were more or less overwhelmed by the amount of data that they were confronted with and gave fairly general answers. Sometimes, as in Exhibit 5.9., the replies were more specific, probably when the interpretations presented in the analysis were regarded as controversial. In general, therefore, the researchers saw the member check as little more than a fairly crude 'sanity check' on case analysis: if the researcher was really talking nonsense, the respondents would tell him so, whereas if the analysis looked plausible, they would tend to agree with it⁵⁴. The question of what would be done when respondents continue to disagree with on another at the member check stage was left unresolved.

- [To alternative hypotheses suggested by author:] Do not agree. We have tried through analysis to
 come to a list of requirements for a "new" organisation. The participants were certainly not just
 pilots but have a great deal of experience in aircraft building. However, involvement was limited
 because of work pressure etc.. Also, model perhaps too limited to arrive at sufficient depth in list
 of requirements?
- The company is (still) in a crisis: no vision of the future, most of top management do not have the ability to solve problems, nor the experience or the training. All this is <u>one big management crisis</u> that is part of the transition from a pioneer start-up company to a solid organisation.

• The original question was "Why won't they work together." And that was an <u>analysis</u> issue, not a design issue. This group did not have the obligation (formally or informally) to come up with a solution.

[To proposition on aeroplane metaphor:] This one is important. / For solutions the architects would also have to sit at the table. These were subcontractors. By the way I don't believe that architects and subcontractors would have got much further in this session. This is a <u>process</u> that needs to mature over time.

Exhibit 5.9.: Member check replies on marked relations in Exhibit 5.8 (on 'model quality' in Case 2)

As far as *peer review* is concerned, the author had two categories of peers: fellow consultants and fellow academics. His fellow consultants in the six projects all received a case report similar to that of the respondents at the client companies. For the academic peer review the author's research advisors had the full case material at their disposal. Their responsibility was to check the correctness of the interpretations made by the researchers at each step of the process.

Selecting most relevant causal networks

A total of 24 causal networks plus associated texts (four per case) were generated in this project. To present this material in its entirety would add at least thirty-five pages to the present work, which was considered too much. Instead, a selection has been made in Chapter 6 of those causal networks that were considered to be most relevant, as determined by the degree to which the explanations provided in these causal networks influenced the cross-case analysis and, in particular, the construction of the research model described in Chapter 2.

The biggest influence on that model had shortcomings in project design and execution, together with remedies for those shortcomings. Most of the weaknesses in these six projects were in the areas of problem analysis and client involvement, which fall under the causal networks for 'model quality' and 'process effectiveness'. Above we have presented the causal network and description for Case 2 — a case where model quality was inadequate (shown in Figure 5.2. and Exhibit 5.9). In Case 3, remedies were found for some of these shortcomings in model analysis, but, on the other hand process effectiveness was poor, so the causal networks for both process effectiveness and model quality from that case are examined in detail in Chapter 6. Process effectiveness in Case 4 is of course especially interesting, and in Case 5 the process was 'managed' well, incurring neither the mistakes from Case 3 nor the mistakes from Case 4, so the associated causal network for this case will also be discussed.

Finally, to complete our coverage of all four types of causal networks, a causal network for 'implementation results' will be shown using Case 1 as an example, whilst from Case 6 we will take the causal network for 'organisational platform'.

5.5. Stage 4: Cross-Case Analysis

In some respects cross-case analysis resembles single-case analysis. For instance, here too we make a distinction between descriptive and explanatory analysis. A *descriptive* cross-case analysis simply describes what the values were for the 'inputs' and the 'outputs' of the PBM process, but now at the level of six cases at a time. An *explanatory* cross-case analysis, on the other hand, describes a theory of why and how these outputs were obtained in these six cases.

But there are also clear differences, the foremost of which is that cross-case analysis is much more *precarious*, much riskier, than single-case analysis⁵⁵. One reason for this is the sheer amount of data to be interrogated. — in the present research, several megabytes of computer-stored text and figures. The alternative of basing the analysis upon highly condensed case data has the associated risk of losing meaning. Second, the methodology on how to conduct proper cross-case evaluations is still limited⁵⁶ and most of the available recommendations tend to be rather vague and broad⁵⁷.

But perhaps the most controversial issue of all concerns generalisation, especially when it comes to the explanatory aspect⁵⁸. Suppose one uses data from six projects to support the causal relation that good simulation modelling did lead to high levels of insight and vice-versa. That assertion, however, is open to the criticism of being based upon too few observations (only six instances). But, as we saw in Chapter 3, that is to think in terms of statistical generalisation, whereas case-study research uses analytical generalisation.⁵⁹ All case-study researchers use samples that are too small to justify statistical generalisation. The point is that one case-study does not represent a single instance: it is more appropriate to view a case-study as equivalent to one survey, and six case studies as equivalent to six surveys⁶⁰.

Creating a descriptive cross-case display

Happily, descriptive cross-case analysis is not a matter of great dispute, and in this particular research project it was also fairly straightforward since it entailed nothing more than aggregating the case analysis to the next higher level. In other words, we moved from a display at Level 3, which was the highest single-case level, to a display at Level 4, the cross-case level. Chapter 7 starts with a Level 4 matrix display, which sets out the six cases studied on the horizontal axis and our well-known four main measures of PBM project effectiveness on the vertical axis. The subsequent four displays in that chapter focus in turn on each of these four measures across the six cases, so that Table 7.2. shows 'process effectiveness' for the six cases, Table 7.3. shows 'model quality', etc.

Constructing the causal research model

Causal analysis for all six cases at once is far less straightforward. How should we proceed here? Once again we try to employ techniques that were found to be useful in single-case analysis. For causal analysis, we saw there that two general approaches could be distinguished: an inductive one and a deductive one. The inductive approach starts with a causal model based upon existing theory and tries to verify this with case

data, the deductive approach starts with case data, building a causal network from the ground up and comparing this with existing theory afterwards.

In our single-case research we used a mix of both approaches, with an emphasis on deduction. Here we will also use a mix, but this time with an emphasis on *induction*⁶¹.

- First an initial overall causal network was created from the separate sets of causal networks from the six cases. This was an analytically demanding task, in which the researcher's professional experience with constructing causal models came in handy. Although the literature does provide some general rules-of-thumb to guide this process⁶², it is indeed "a creative, synthesising one with a good dose of serendipity thrown in"⁶³.
- This initial causal network was then compared with existing theories in a number of related fields. This literature search, which was described in Chapter 2, revealed that the majority of the relations had indeed been previously identified, although some relations, it seemed, had been discussed little if at all.
- The literature search led to some pruning and adjustment of the initial causal network⁶⁴ to yield the refined causal network which stands as the research model discussed in Chapter 2.
- The relations in this final research model were then compared with the data from the six cases, as will be discussed next.

Creating cross-case displays for causal relations

This part of the evaluation procedure is the most exploratory one. Realistically speaking, it is impossible to 'verify' a causal network as described in Chapter 2 with case data.⁶⁵ We are talking about more than fifty variables that are interconnected by some sixty-odd relations. Just about every dependent variable is simultaneously influenced by several others, with some influences strong and others weak. There is no way to 'verify', in a *statistical* manner, such a large number of causal relations in any real way with data from such a small number of cases. And anyway, were are striving for analytical, not statistical generalisation.

It is nevertheless *interesting* to put the case data against some of the more crucial relations and see how they fit. From an exploratory perspective, this may lead to usable hypotheses that can be tested in more focused follow-up studies. In this spirit, the following exploratory 'experiment' was conducted:

	Simulation	Thoroughness
Case 1	++	+
Case 2		-
Case 3	++	+
Case 4		/+
Case 5	+	+/-
Case 6	-/+	+/-

Table 5.3: Reduced cross-case data display for simulation->thoroughness

• For each of the binary relations in the research models, the respective values of two variables for each of the six cases were listed in a display, in terms of plusses, minuses and their combinations. An example of such a display is shown in Table 5.3.

for the relation 'simulation leads to thoroughness' (Relation 42 from the research model in Chapter 2).

• The plusses and minuses were then translated into a linear scale in the following manner:

plusses & minuses	linear scale	plusses & minuses	linear scale
	1,0	+/-	3,566
/-	1,5	+	4,0
-	2,0	++/+	4,5
-/+	2,5	++	5,0

Table 5.4.: Translation of coded assessments to a linear scale

For our example of Relation 42, this resulted in the following matrix display:

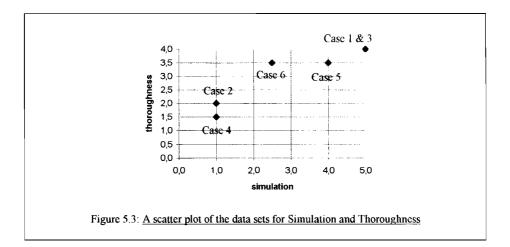
	simul	lation	thoroughness		
Case 1	++	5,0	+	4,0	
Case 2		1,0	-	2,0	
Case 3	++	5,0	+	4,0	
Case 4		1,0	/+	1,5	
Case 5	+	4,0	+/-	3,5	
Case 6	- /+	2,5	+/-	3,5	

Table 5.5.: Cross-case data display for Relation 42: simulation->thoroughness

Such displays can be very informative. In this example, they show that relatively low values for simulation (i.e. simulation was used little or not at all) correspond with low values for thoroughness, and vice-versa. Similar displays were created for all the causal relations in the research model.

Making scatter plots of cross-case data on causal relations

Matrix displays like that of Table 5.5., besides their many advantages, do have some drawbacks. They "throw away a lot of useful information on how close or far apart the sites are on dimensions of interest. (...) Something a bit more spatial is required"⁶⁷. One way of doing this is to use "figures that display data from all sites on two or more dimensions of interest that are related to one another. Data from the sites are carefully scaled, and laid out in the space formed by the respective axes."⁶⁸ Figure 5.3 shows such a "scatter plot" of the data on Relation 42 from Table 5.5.



This figure gives a better overview than the matrix representation. Immediately we see that, at least in the six cases investigated, the use of simulation was positively correlated with perceived thoroughness of the analysis. [Please note though that although the method superficially resembles bivariate statistical analysis, no statistical generalisation is implied. We are merely looking at how well the case data fit with our research model, and although the word 'correlation' was used a few sentences back, we are not calculating statistical correlation coefficients of any kind.]

For this particular relation, we can probably say that the relation was confirmed by the data from the six cases. We can do this with some confidence because the ranges of values are fairly broad for both variables. However, this does not mean that projects without simulation cannot result in thorough analyses; this scatter plot only visualises some case evidence for the hypothesis – which is well grounded in the literature – that simulation modelling can be instrumental in achieving a thorough analysis of a problem.

A final remark is on the direction of causality. In this relation, it seems obvious that the use of simulation leads to thoroughness, and not the other way round. With some relations, however, this is less straightforward. Does focus improve communication, or does good communication lead to focus? In this respect, the following points are in order:

- Because everything affects everything else, we have to make a selection of what relations we feel are most relevant.
- This selection is made on the basis of mentions in the literature and/or information from the evaluation interviews.
- For several relations, causality is probably bi-directional: good focus leads to better communication and in a process with good communication it may be easier to achieve good focus. However, only in those instances where both causal directions were mentioned in the literature or the case data were both links made explicitly, such as with communication leading to insight (Relation 14a) and insight leading to communication (Relation 7).

Selecting most relevant causal relations

The procedure described above was followed for all relations. For reasons of space and focus, not all causal relations will be discussed in Chapter 7. Two selections have been made:

- 1. A first selection was made of eleven relations that appear to be very frequently discussed in the literature, judging from our literature sample. These are discussed in Section 7.2. and can be viewed as comprising the well-established *textbook theory* on modelling-based support of strategic decision-making processes. This selection consists of eleven relations.
- 2. A second selection was made of the fifteen relations that appeared to be strongly confirmed by the case data and which are labelled here as *exploratory relations*. Three of these relations already figured in the first selection; the remaining twelve are discussed in Section 7.3.

In discussing these relations, the author did not limit himself to the evidence of the scatter plots alone, but drew on all available case data to back up his chosen line of reasoning.

Identifying key findings/key causal chains

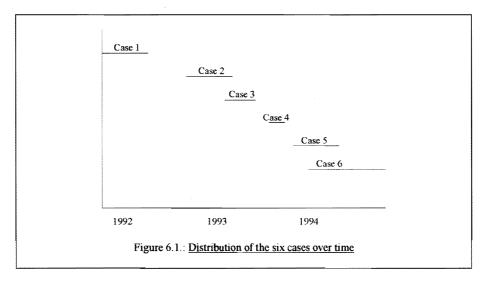
The final, and perhaps most ambitious step, has been to look at these relations from some distance and distinguish certain "causal chains"⁶⁹ or sub-networks of several variables and relations at a time, which together tell a coherent 'story' or theory. Three such sub-networks were identified and are presented in Section 7.4.:

- 1. A sub-network showing under what conditions involvement and communication will lead to ownership and commitment;
- 2. A sub-network illustrating the crucial role of good communication for participant learning;
- 3. A sub-network confirming the benefits of simulation for making better decisions and improving organisational support for them.

These three sub-networks may be seen as the key findings of the causal cross-case analysis. Put together, they also confirm the crucial assumptions of the PBM method, which, as we have seen, strongly emphasises client involvement, an open conversational process and simulation modelling.

CHAPTER 6 CASE ANALYSIS

In this chapter we shall discuss the six projects that were conducted within the context of this research project. These six projects were conducted within a time span of two and a half years, as shown in Figure 6.1.



What one cannot gather from this figure, but will become apparent as we proceed, is that all these projects varied widely in scope, size, type of industry, and success. This is all the better, because it gives us more opportunities for comparison in the cross-case analysis presented in Chapter 7.

The many tables and figures that the reader will encounter in this chapter are all based upon the 'displays' that were constructed in the case evaluation process as described in Chapter 5. In these case descriptions, we will adhere to the format that was chosen in our discussion of the research model in Chapter 2. So first we shall discuss various project contingencies, next project design aspects will be mentioned, and finally we will turn to project effectiveness in terms of process effectiveness, model quality, organisational platform, and implementation results. For every case one or two causal networks for these overall concepts will be presented as well.

Within the scope of this chapter it is not possible to present all the relevant information from these cases adequately. Fortunately, most of these projects have been published earlier as case studies in proceedings and journals. The reader is referred to these publications in the notes following the section title. Also, selected aspects of interesting episodes from these cases have already been presented in other chapters (e.g. Chapters 2 and 4).

Case 1: Redesigning Operations In Newspaper Distribution¹

Project setting

The client company in this first case had been acquired a few years beforehand by a major magazine publisher and distributor. It imported foreign newspapers and distributed these locally. Its business was extremely time-critical. All through the night vans with loads of newspapers from all over Europe would arrive at its distribution centre; these newspapers had to be distributed over a host of outlets in a few hours' time. Each outlet would receive its own individual package of different numbers of different newspapers. These packages changed over time. Most newspapers showed a clear seasonal demand pattern, with peaks during the summer holidays, when many foreign tourists came to the region.

The year before, top management of the parent company, led by its entrepreneurial founder-owner, decided that strategic measures had to be taken, in order to face growing competition in the unified European market. First, it was decided that all future deliveries of newspapers would have to be made before opening time of each outlet. Previously, some deliveries had been made as early as that, but most deliveries had been considerably later, especially deliveries to outlets at distant locations, and those deliveries containing newspapers which normally arrived late. This arrival before opening time should enable the client company to increase its sales of newspapers through better product availability at the outlets. Also, it might get more foreign publishers interested in using the client company as their distributor. Finally, it should discourage any potential competition.

The second strategic decision was to set up a single new internal distribution facility at the main site of the parent company, replacing the two separate facilities that the company had at the time. This new distribution facility would be operated by a new crew, consisting of personnel from the original two facilities and new hires. Using the broad expertise the parent company had accumulated in the distribution of its magazines – a closely related business it was thought – the crew would set up a distribution system that could accomplish the required higher delivery speed.

Problem contingencies

Unfortunately, the implementation of these measures did not go as smoothly as was expected. In large part this was due to the tightness of the time schedule and to the inexperience of the crew with the new situation, and the fact that the move to the new location had been planned to take place just before the yearly seasonal peak. So when the company actually made the transition to the new distribution system the first night was near-disastrous, according to several of the project participants. Owing to the crew's inexperience with the special characteristics of newspaper distribution, the original design of the distribution system was such that the required delivery speed could not be achieved with the volumes of newspapers that had to be handled. This situation slowly improved over the ensuing few weeks, but not without heavily increased costs because of higher headcount and higher external transportation costs. At around the start of the simulation project people had just about caught their breath again after a very turbulent summer.

Problem contingency	Score	Description
Problem scope	-	scope was limited to internal distribution
Problem tangibility	+	concrete problem with many quantitative aspects
Data availability	+	data from company databases and time measurements
Problem urgency	++	a solution to the problem had to be found quickly
Political sensitivity	+/-	design itself was technical, but power struggle around the project

Table 6.1.: Problem contingencies in Case 1

The reason for starting what was then called a 'logistics simulation' project was that things were going better, but not well enough. The client company was still losing money heavily; the expected increase in sale was nowhere visible, and yet distribution costs had almost doubled. Management remained convinced that there must be 'smarter' ways to set up the distribution system so that faster processing would be possible with fewer people.

Organisational contingencies

Unfortunately, how this was to be achieved was an issue about which little agreement existed. Everyone had an opinion, but there was no consensus. The company had considered experimenting with different distribution layouts and methods in real life, but this would have been very costly if it were to be done off-line, and attempting to do this on-line was ruled out after the experience during the peak season. Top management thought that 'playing with a computer model' might therefore have some advantages over 'playing with reality'.

Organisational contingency	Score	Description
Top management support	-	gradually, increasing opposition from top management
Hierarchical diversity	-	no hierarchical diversity
Problem ownership	++	problem had strong personal impact
Group size	- 1	relatively small group (2-4 people)
Working relations	+/-	some people couldn't work together, most could

Table 6.2.: Organisational contingencies in Case 1

After an initial quick scan it was decided that the simulation project would focus on the internal distribution operations of the client company, this being the most complicated and costly element in the distribution chain. A small informal project team was formed, consisting of the manager of internal operations, his assistant, the information systems manager for the company, and the author.

Project design

This was the first management consulting project for the author, who had joined his consultancy firm just a month before, so he had little business experience to fall back

upon. Whilst conceptual modelling techniques, such as causal diagramming, were not known to the author, at this stage he did have some experience with simulation modelling in general and with system dynamics simulation in particular. The concept of participatory modelling was also known and so the project did proceed in a similar manner to later projects, with frequent informal meetings for open discussions, for brainstorming and for presenting intermediate data analysis and simulation results. Table 6.3. gives an overview of the various aspects of project design:

Pre-interviews: +	not used	Data analysis: ++/-	used extensively (Pareto analyses, time measurements)
Hexagon brainstorming: +	metaplanning ² used	Simulation: ++	extensive system dynamics simulation
Causal diagrams:	not used	Final report:	overhead sheets
stocks-and-flows diagrams:	somewhat used	Central graphical presentation: +	used extensively
Graphical functions: -	not used	Facilitator skills: +	facilitator is objective, helps focusing
Workbooks:	not used	Abstraction level: -/+	fairly detailed modelling (e.g. time buckets of 15 minutes.)
Propositions:	not used	Project size: -/+	slightly inadequate (2 ¹ / ₂ man-months, duration 4 ¹ / ₂ months)

Table 6.3.: Project design aspects in Case 1

From this table it should be apparent that there was a strong emphasis in this first project on 'hard modelling', with extensive data analysis in spreadsheets and computer simulation, and very little use of conceptual modelling techniques or process-structuring techniques like workbooks or propositions.

Project findings

Most of the manifold outcomes were very practical in nature, and all led to eventual productivity improvements. The main areas of improvement were:

- Arrival patterns: An analysis of arrival patterns showed a 'dip' in newspaper arrivals early in the night. This showed that most personnel could arrive two hours later without loss of processing speed. This dip had never showed up clearly in practice, probably because employees simply tended to slow down if there was less work to be done.
- Sorting methods: There were clearly different ideas about how best to sort newspaper titles arriving in bulk for more than a thousand outlets. The project evaluated all these different ideas, using data from the company databases and time measurements on performance of different sorting methods. These data were fed into the simulation model, which showed that some methods clearly performed better than others (cf. the simulation graph in Section 4.1., Figure 4.13.)
- Packaging bottlenecks: Sealing packages of sorted newspapers had also been a bottleneck because all packages for all outlets had to be sealed in a single operation

at the end of the shift. Data analysis revealed that this sealing process could just as well start several hours beforehand, provided it was known what customers had already received all their newspapers. This would make one existing (fairly expensive) sealing machine obsolete, and would allow cancellation of an order that had just been made for an extra machine.

• *Workforce reductions*: In this department, the highest cost factor was labour. Sensitivity analysis showed that the improvements indicated above would achieve an adequate processing speed with a workforce reduction of at least 25% (in reality, this turned out to be around 50%).

Project effectiveness

As Table 6.4. shows, this was perceived by the respondents as a very successful project. The project received high scores on every aspect of PBM effectiveness. The author's own recollections of process effectiveness were less strongly positive, but this initial success made it possible to extend his work to subsequent projects.

High Level concepts	Operational var	iables				Overall as- sessment
Process Ef- fectiveness	focus: ++ clear purpose was deter- mined and followed through the project	speed: + high speed because of method and problem	involvement: + not every- body in- volved, par- ticipation had positive effect	communi- cation: ++ open, exten- sive discus- sion, without verbal domi- nance and with mutual understand- ing	willingness to cooperate: -/+ some suspi- cion in ad- vance	+: very good focus, high speed, good discussion, moderate willingness and in- volvement
Model Qual- ity	completeness: +/- project lim- ited to inter- nal distribu- tion and data of one night, involvement made it as complete as possible	thorough- ness: + analysis was good and trustworthy, limited by data in- complete- ness	theory basedness: + operations systems design guidelines used	usability: ++ results were used immedi- ately		+: not com- plete but thorough analysis and usable re- sults
Organisa- tional Plat- form	awareness: ++ important problem, pre- project awareness already high	consensus: + during the project con- sensus was reached	commitment: ++ good com- mitment because of involvement and simula- tion	ownership: + ownership through participation	confidence: ++ belief in solution because of simulation	++: aware- ness of problem, consensus and com- mitment reached, people felt ownership and confi- dence in solution
Implemen- tation results	<i>implemen-</i> <i>tation of de-</i> <i>cision</i> : ++ conclusions were imple- mented as soon as pos- sible	operations performance: + partly be- cause of the project op- erations performance was positive	business per- formance: + positive business results, partly attributable to the project	insight: ++ more insight is important project result	organisa- tional learning: ++ people took over tech- niques and want to use method more often	++: imple- mentation with good performance results; in- sight in problem and learning about method

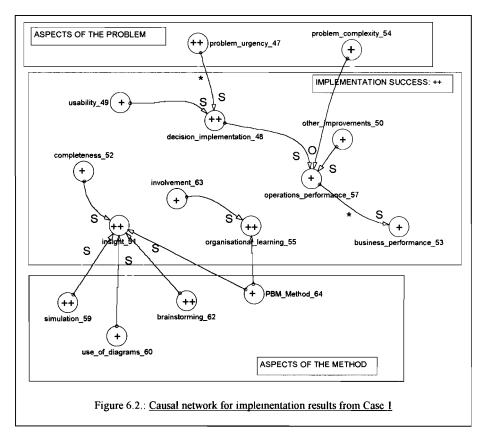
Table 6.4. Project effectiveness in Case 1 (Display Level 3)

Explaining implementation results

Why was this project so very successful in its implementation? The causal diagram in Figure 6.2. captures the main reasons. In retrospect, success was achieved both in terms of actual improvements in business performance and in the sense of improvements in management thinking and learning.

The actual *business performance improvements* (53) may be characterised as follows: The direct recommendations from the project were executed rapidly $(48\rightarrow 57)$. This was not remarkable, considering the urgency of the problem $(*47\rightarrow 48)$, and the practical usability of the results $(49\rightarrow 48)$. This implementation has led to an improvement in the operations performance, i.e. shorter cycle times and lower costs

(48 \rightarrow 57). It should be remarked though that enhanced performance was also partly attributable to a number of other improvements that were implemented simultaneously with, but independently from, this project (50 \rightarrow 57). This improved performance has also had a clear positive influence on business results (*57 \rightarrow 53).



Besides this, a learning process has started: People have obtained a considerable number of new *insights* in the detailed operations of distribution and logistics (51). The PBM method has contributed to obtaining that insight $(64\rightarrow51)$. Specific PBM techniques that were mentioned explicitly in this respect were the use of simulation $(59\rightarrow51)$, the use of diagrams $(60\rightarrow51)$, and brainstorming $(62\rightarrow51)$. And finally, respondents have also started to appreciate the PBM approach to problem solving and have adopted it, so-called *organisational learning* $(64\rightarrow55)$. This was made possible by their participation in the project $(63\rightarrow64)$.

Case 2: Achieving Inter-Business Unit Collaboration In Professional Services³

Project setting

The client company was a multinational company that was just entering a period of organisational change. In the past the company had been very successful in a particular market, in what we will call its 'old business'. Partly this success could be attributed to the company's particular organisational structure, which was traditionally a decentralised one, with highly autonomous business units (BUs) operating on a regional basis. The management style in these business units was entrepreneurial and was perhaps best characterised as 'healthy egoism'; each business unit tried to serve its own particular corner of the market as best as it could. This structure had provided the company with a highly flexible and dedicated workforce that was close to the customer base. This clearly was an asset for the 'old business'.

Problem contingencies

However, the market appeared to be changing. A trend could be distinguished towards what we will call the 'new business', in which the autonomous organisational structure seemed less well suited to serve the market optimally. In this 'new business', units would need to collaborate closely if the company were to remain competitive. Yet such collaboration was not a *forte* of the company at that time, due to the ethos of 'healthy egoism' mentioned above. Clearly, the prevailing attitude of most BU management teams would have to be altered, but how was this to be achieved? The existing ethos had been carefully created and nurtured by top management over a number of years.

Problem contingency	Score	Description
Problem scope	++	very broad scope
Problem tangibility	:	very vague, not concrete problem
Data availability	-/+	some data were used, but were difficult to obtain
Problem urgency	+/-	moderately urgent
Political sensitivity	-/+	a personal issue, but no career risks

 Table 6.5.: Problem contingencies in Case 2

Organisational contingencies

At the request of the company's top management, a pilot study was conducted by the authors with a group of BU managers. The primary goal of the pilot study was to evaluate if participative modelling could indeed achieve, in a time-efficient manner, the kind of change in management attitude that was considered necessary. A second goal was to come up with a more explicit analysis of the problem at hand and, if possible, with specific suggestions as to how the problem should best be handled. A project team was set up consisting of the author as model coach, an experienced system dynamics modeller/process facilitator as process coach and a student as recorder. As participants from the client organisation six managers were selected from one

particular geographical region, where several disputes over collaboration had occurred in the recent past.

Organisational contingency	Score	Description		
Top management support	+	top management supported the project		
Hierarchical diversity	-	hardly any diversity, one senior manager attended twice		
Problem ownership	+/-	some problem ownership with some participants		
Group size	+	group was slightly bigger than normal (6-8 persons)		
Working relations	+	were working together often		

Table 6.6.: Organisational contingencies in Case 2

Project design

A total of five two-hour sessions were conducted with this management group. Between each session a workbook was constructed and sent to the participants. In these workbooks the main results (e.g. diagrams) of the previous session were recapitulated and questions leading up to the next session were provided. In several instances responses to these questions were collected before the session to enable the project team to better focus on the main issues during the session itself and so make an optimal use of scarce management time.

Pre-interviews: +	used with cognitive mapping for first ses- sion	Data analysis: +	hardly used, only to illustrate historical limits to growth pat- tern
Hexagon brainstorming: +	used in first session, perceived as free but unstructured	Simulation:	not used
Causal diagrams: +	used extensively, per- ceived as good but difficult	Final report: +	two final reports, one half way, one at end; both received posi- tively
stocks-and-flows dia- grams:	not used	Central graphical presentation: ++	used extensively, per- ceived very positively
Graphical functions: -	not used	Facilitator skills: +	good structuring by facilitators
Workbooks: ++	used extensively; very positive assessment	Abstraction level: ++	Very high abstraction level
Propositions: +/-	used but with limited success	Project size: +	adequate, 1 ¹ / ₂ -2 man- months, duration 6 months

Table 6.7.: Project design aspects in Case 2

If we look at the project design aspects as shown in Table 6.7., we see that this project essentially was the mirror image of Case 1. Here hardly any data analyses or simulation studies were conducted, but much emphasis was placed on model conceptualisation techniques and written feedback via workbooks and reports. Considering the scope and vagueness of the problem, as well as the relatively low problem urgency and

limited management time available, the appropriateness of this project design seemed to be borne out by the findings.

Project findings

Since the preliminary interviews revealed more consensus than had been expected, it was possible to focus on the core issues from the start. A causal diagram showing the main causes for lack of inter-BU cooperation was quickly constructed. This causal diagram was explained in an intermediate report that was sent to the project sponsor.

The gist of the report was that the collaboration issue really was a side-effect of the particular mechanisms that the client company had developed to ensure rapid growth. These mechanisms had worked very effectively in the past; however, future growth would strongly depend on increased inter-BU collaboration. What the diagrams showed was that the same mechanisms that had produced rapid growth for the company in the past, were now blocking inter-BU collaboration and therefore were apparently working against future growth!

The project sponsor was interested in these findings to such an extent that three more sessions were commissioned to find measures that would remove these problem causes. This second half of the project was less successful. The market requirements for 'old' and 'new' business were further explored, but a consensus could not be reached on adequate solutions for the problems identified earlier on.

What did happen, though, was that the participating managers realised that what they could change were their own attitudes towards collaboration. And this is what they indicated in the evaluation interviews that they did. Over the course of the project, the problem of a changing market and inter-BU collaboration gradually shifted from being a remote, external issue into being a very tangible, internal issue. The managers discovered that perhaps the best way to promote collaboration was just to change their personal attitudes towards collaboration and their habits of working with other managers. In the true entrepreneurial spirit of the company the mood became somewhat like: "We don't need top management to tell us how to collaborate. We can do that perfectly well ourselves."

Project effectiveness

This project was a success, but not such an overall success as Case 1. As Table 6.8 shows, especially model quality was found to be lacking⁴. Not that the model did not provide a fine analysis of why inter-BU collaboration did not get off the ground. That analysis was perceived as excellent. No, model quality was lacking because the models did not help in identifying practical solutions to the problems that were identified so clearly. The original evaluation interviews did not contain any possible explanations for this. The author proposed several hypotheses in the member check that was conducted, but these were all rejected by several respondents. For a causal network explaining how these values for model quality came to be, see Chapter 5, Figure 5.2.

High Level concepts	Operational va	riables				Overall assessment
PROCESS EFFEC- TIVENESS	focus: + structured and with clear direction but with enough freedom to participate; last sessions less focused	speed: + efficient method slowed down a little by some factors	involvement: -/+ changing group com- position limited own- ership and consensus, not perfect composition for this problem, but participation itself very positive	communi- cation: ++ extensive exchange of viewpoints with enough freedom of speech, open atmosphere, no verbal dominance and mutual understand- ing	willingness to cooperate: + good will- ingness to cooperate	+: good focus, speed and willingness, very good com- munication but no constant in- volvement
Model Quality	completeness: +/- a lot of issues there, but maybe not all	thorough- ness: - no thorough analysis performed	theory basedness: - insufficient theory- basedness	usability: -/+ no usable results except awareness and some project deliv- erables, but project goals were reached		-/+: reasonable completeness, insufficient theory-based- ness, no thor- oughness, no usable results except aware- ness
Organ- isational Platform	awareness: ++ important problem, awareness of some people has grown by participating in the project	consensus: +/- opinions came closer but no con- sensus was reached	commitment: + most partici- pants are committed to the project results	ownership: +/- ownership enlarged by participation and work- books, linn- ited by tim- ing, bad preparation and lack of concrete so- lutions	confidence. NA	+: a substantial increase in awareness, no real consensus reached but conunitment and some ownership about results
IMPLE- MENTATION RESULTS	implementa- tion: -/+ no direct re- sults but change has started	operations performance: -/+ no opera- tional im- provement, but a process of change has started	business per- formance: -/+ no changes in business performance but a process of change has started	insight: ++ project re- sulted in more insight into the prob- lem of most participants as an im- portant pro- ject result	organisa- tional learning: + most partici- pants are positive about get- ting to know and working with the method	+/-: no imple- mentation of a solution or business im- provements, but the process of organisa- tional change started; more insight in the problem and getting to know the method

Table 6.8.: Project effectiveness in Case 2 (Display Level 3)

Case 3: Designing a Logistics Strategy In Pharmaceutics5

Project setting

The client company in this third case was an American pharmaceutical start-up company, wishing to set up operations in Europe. At the start of the project a European office had just been established, and the nucleus of a management team was operational. The main product of the company was a potentially life-saving drug, to be sold to hospitals throughout Europe.

Problem contingencies

The issue at stake was the design of an appropriate logistics strategy and structure for the European distribution of this drug. The time-critical nature of the illness in question posed very high demands on whatever logistics distribution system was to be developed for this drug. In addition, there were numerous clinical, marketing, financial and legal constraints to be taken into consideration.

Problem contingency	Score	Description
Problem scope	-/+	focused on logistics structure, but with strategy aspects
Problem tangibility	+/-	well defined problem, but abstract because the relevant business processes were not yet operational
Data availability		new product, unique product characteristics, insufficient time/budget to look for external data
Problem urgency	++/-	originally very urgent, after disappointing test results not urgent
Political sensitivity	-/+	some political sensitivity in relationship with holding

Table 6.7.: Problem contingencies in Case 3

The main technical complexities in this case were:

- The extremely time-critical nature of the illness in question, which required on-site delivery within 8 to 12 hours throughout Europe;
- Numerous other clinical, marketing, financial and legal regulatory constraints to be taken into account;
- Lack of existing operations and lack of other products with similar logistics requirements.

Organisational contingencies

The main organisational complexities in this case were:

- A brand-new management team, with heavy work schedules and travel commitments,
- The removal, early in the project, of the European business manager, who had approved the project originally;

• Disappointing test results for the drug, made public halfway through the project, which greatly reduced the original urgency of setting up European distribution, and thus lowered management interest in the project.

Organisational contingency	Score	Description
Top management support	-	original project sponsor removed at project start
Hierarchical diversity	-	core management team plus assistants
Problem ownership	-	mainly problem of logistics director
Group size	_/+	in most sessions small (3 people); sometimes larger
Working relations	-	very new group, been together just once or twice before

Table 6.10.: Organisational contingencies in Case 3

Project design

For this company a PBM project was conducted by the author, this time operating primarily as a process coach. A colleague experienced in mathematical modelling collaborated as model coach. Project duration was relatively short — just over three months. The project as a whole proceeded globally according to the generic PBM project phasing that was described in Section 4.3. So first structured interviews were held with all of management. Next several modelling workshops were conducted with various participants, the core project team consisting of the logistics manager, the financial manager and the manufacturing manager. In the model formalisation phase these conceptual models were enhanced with quantitative data and developed into several simulation models. In the knowledge dissemination phase management interacted with these simulation models in learning-wheel workshops.

Pre-interviews: +	conducted with cognitive mapping	Data analysis: +	not extensive because of lack of data
Hexagon brainstorming: +	used occasionally	Simulation: ++	discrete event simulation for call centre, system dynamics for depot net- work
Causal diagrams: ++	used to illustrate design trade-offs	Final report: +/-	comprehensive and per- ceived as useful for ex- ternal communication, but limited circulation
stocks-and-flows dia- grams: ++	used extensively to model goods flow	Central and graphical presentation: +	Always used. Perceived as very positive
Graphical functions: ++	used to make up for lack of external data in depot network analysis	Facilitator skills: +	External facilitation strongly contributed, but industry-specific knowl- edge was lacking
Workbooks: -	hardly used; perceived as a minus	Abstraction level: +/-	Call centre very specific, other recommendations fairly abstract/general
Propositions:	not used	Project size: +/-	slightly inadequate (2½ man-months), project size shrunk after nega- tive test results.

A glance at Table 6.7. shows that, by this time, almost the entire PBM toolset was used. Not used were workbooks and propositions, primarily because of the time pressure the team was under initially, before the disappointing test results were published, and subsequently because there was no longer a strong need to get all management closely involved and in consensus. Not using workbooks may have been a mistake: workbooks could have helped to keep everyone more or less up to date on what was happening in the project, and might have prevented some repetition in the modelling workshops.

Project findings

In this case multiple, interrelated decisions had to be made regarding the logistics strategy. Originally, six areas that needed further investigation were defined. After the project scope had to be narrowed, three areas were selected. Each of these three sub-projects had a clearly defined deliverable:

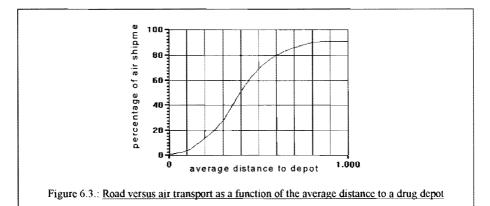
1. A CAUSAL MAP OF THE MAIN STRATEGIC TRADE-OFFS

The first sub-project had as its goal to identify and make explicit the many strategic trade-offs that had to be considered in the logistics set-up. Each of the various functional areas — marketing, clinical research, finance, regulatory, logistics and manufacturing — had its own primary goals and considerations, which sometimes coincided with one another but often did not. Therefore, trade-offs had to be made, preferably explicitly and with buy-in from all parties concerned. To make these trade-offs clearly visible, a causal diagramming technique was employed. Figure 4.23 in Chapter 4 shows a causal diagram of one of these strategic trade-offs.

2. DESIGN GUIDELINES FOR THE EUROPEAN DEPOT NETWORK

A second sub-project was to develop, on the basis of these trade-offs, practical design guidelines for the European depot network. At the time, the client company had hardly any existing operations in Europe, so the depot network had to be designed from scratch. What kind of network would be appropriate? The options varied from a single central European depot to hundreds of small depots within selected hospitals, and any number of depots in between.

To answer this question, a quantitative model was developed in a system dynamics simulation package. The crucial quantitative relationships in this model were modelled in close interaction with the experienced logistics manager of the company. Frequent use was made of graphical functions to make up for the lack of available hard data. Figure 6.3. shows an example of one of these graphical functions.



This graphical relation was drawn in a session with the logistics manager. It shows the percentage of shipments that will be freighted by air for increasing average distance from depots to hospitals. i.e. for increasing depot network densities. (Figures in this example are hypothetical). External research data providing strong external confirmation of this graph, which was after all merely the result of two expert 'guestimates', were obtained only after the actual project had ended.

The simulation model provided quantified answers to trade-offs between transportation costs and depot network costs. In the final evaluation, six additional qualitative evaluation criteria were also used to determine the optimal depot network structure.

3. DESIGN GUIDELINES FOR THE EUROPEAN CALL CENTRE

The third sub-project had as its aim to provide design guidelines for the European call centre that the client company wished to set up to control the distribution process. Here incoming requests for the drug would be handled and drug shipments would be processed. As such a call centre was non-existent at the time, a simulated operational model was developed in a discrete-event simulation language with animation facilities. This model provided answers to questions such as

- How many physicians do we need to sanction requests? And how many clinical research assistants?
- What opening hours will provide acceptable delivery times for the drug? Is there a need for a 24-hour service?
- What would be the gains in performance and costs from setting up an automated request-handling procedure?

This model was developed more or less in 'expert mode', but was explored at length in a learning-wheel workshop with management.

Project effectiveness

Results in this project can be deemed quite satisfactory, especially given the several bits of 'bad luck' that struck the project team, such as the early removal of the project sponsor and the disappointing clinical trial results for the drug announced halfway through the project. As Table 6.12 shows, model quality was adequate here, especially given the paucity of hard external (or internal) data.

The modelling process could have been better, especially where involvement outside of the core team was concerned. Changes in team composition that were a

consequence of this low involvement led to repetitions in the modelling sessions. Workbooks might have helped to overcome this somewhat.

Organisational platform was very good, although it should be mentioned that there are few direct data regarding support amongst non-core team members, as these were not interviewed. (In his response to the member check the internal project leader claimed that this support was OK.)

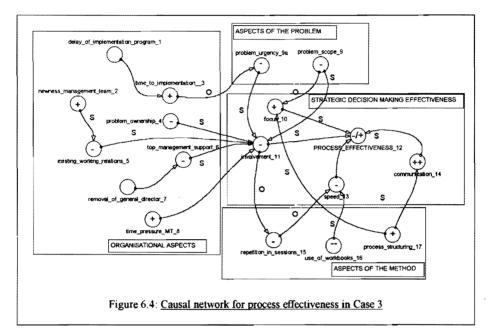
Finally, implementation results have been both very positive and fairly negative. The positive aspect has been the learning side of implementation: The PBM method was very much appreciated, and indeed the author was invited to conduct a second PBM project on a related issue some time later with this company. The negative aspect concerned decision implementation. As subsequent events turned out, the drug in question never made it to the market, as further tests failed to confirm even the 'disappointing' results that had hit the project mid-course. Neither the depot network nor the call centre was ever implemented and the company was finally taken over by a competitor.

High Level concepts	Operational va	Overall assessment				
PROCESS EFFEC- TIVENESS	focus: + good focus. Nature prob- lem changed during project but adjust- ment was fairly successful	speed: - efficient in itself but too much repeti- tion. Repeti- tion because of changes in participants between ses- sions. Could been over- come with written ma- terial be- tween ses- sions	involvement: - too little involvement outside core team. All MT mem- bers were interviewed, but little attendance at workshops	communi- cation: ++ communi- cation was very good	willingness to cooperate: NA	-/+: focus and communication were OK, but because of low involvement and repetition speed also became low
Model Quality	completeness: +/- most areas covered, mar- keting input not available and little ex- ternal valida- tion during project	thorough- ness: + thorough quantitative analysis of internal data, no external research con- ducted within pro- ject	theory base- ness: + theoretical confirmation of intuition; external re- search after project finish confirms findings	usability: + strategy & structure yes, detailed solu- tions not, but were not asked. Find- ings used to support similar deci- sion after project		+: list of issnes good, analysis issues with tools OK, external data & marketing not OK but later confirmed. So- Intion used for other project
Organ- Isational Platform	awareness: + good problem awareness afterwards. Pre-project awareness not clear	consensus: ++ full consen- sus. No di- rect post- project data on consensus outside core team	commitment: +/++ clear com- mitment because of participation	ownership: + more owner- ship through participation. Few refer- ences	<i>confidence</i> . +/- more belief through vis- ualisation and quantifi- cation. Less belief through lack of external validation	++/+: high levels of commitment and consensus. Awareness probably already fairly high before project. No direct feed- back from non- core team mem- bers
IMPLE- MENTATION RESULTS	implemen- tation: +/- original pro- ject on ice for a year. But good starting point avail- able, related decision was implemented	operations performance: NA	business per- formance: NA	insight: ++ great deal of insight gained	organisa- tional learning: +/++ good method, improve- ments pos- sible. R3 very enthu- siastic about approach. Follow-up project started	+: direct project goal not imple- mented before evaluation inter- views. Related decision was. Great deal of insight gained in problem and method. Follow- up project started

Table 6.12:	Project	effectiveness	'n	Case	3	(Display Level 3)	

Explaining process effectiveness

Process effectiveness was insufficient in this project. Why? The causal network explains:



Process effectiveness (12) was not good in this project. There are two explanations for this, one relating to external developments, the other concerning the way the method was applied.

ADVERSE EXTERNAL DEVELOPMENTS

There were two adverse external developments in this project. The first was the removal of the business manager (7). As a result of this, strong top management support was lacking $(7\rightarrow 6)$. As a result of this, there was little pressure on the stakeholders to become actively involved in the project $(6\rightarrow 11)$. Therefore, *involvement* outside the core project team was low (11).

This effect was exacerbated by the announcement of the negative clinical trials outcome. As a result of this, implementation of the program for which the distribution network was required was delayed (1). The time to implementation, initially less than a few months, was suddenly put back by least a year $(1\rightarrow3)$. Because of this, problem urgency suddenly became fairly low $(3\rightarrow9a)$. This also made attending at the workshops seem rather unimportant $(9a\rightarrow11)$.

OTHER ORGANISATIONAL CONTINGENCIES

In the background, some additional organisation-specific aspects need to be considered. The first one was the relative newness of the management team (2). Because of this, there was no established tradition of convening regular meetings, which would have offered a fine opportunity for conducting the sessions $(2\rightarrow 5)$. Also,

everyone was under considerable time pressure to complete other tasks (8). Both factors adversely affected broad involvement in the project $(8,5\rightarrow11)$.

FLAWS IN PROJECT DESIGN

But there were also deficiencies in the version of the PBM method being applied. Partly because of the variable attendance from session to session, there was considerable repetition for the 'regulars'; this repetition was felt to be needed to bring the newcomers up to date $(11\rightarrow15)$. However, this might also have been achieved by using workbooks which summarised the main results from the preceding sessions (16). These were hardly used in this case. As a result of both, progress was felt to be slow $(15,16\rightarrow13)$.

On the positive side, both focus (10) and communication (14) were good. In both cases this was considered to be due to the structuring of the process $(17\rightarrow 10, 14)$.

OVERALL ASSESSMENT

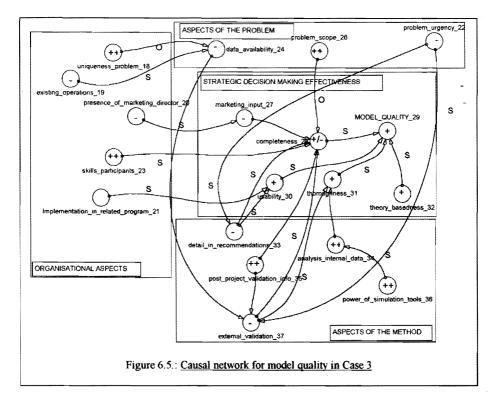
It needs to be said that, for a strategic problem, the problem scope was not overly broad (9). There were a limited number of difficult, but fairly clear issues to be tackled $(9\rightarrow 10)$. All in all, process effectiveness was insufficient in this case (12). Good communication and focus (14,10 \rightarrow 12) did not compensate for low involvement and slow speed (11,13 \rightarrow 12).

Explaining model quality

Unlike in Case 2, model quality was good in this project. The causal network in Figure 6.5. addresses the question of why that should have been so.

Model quality in this case was good (29): both the analysis of the issues at stake and the solutions presented for them were acceptable, with some reservations, which mostly have to do with two more or less blind spots in the analysis: external logistics data and marketing data. Hardly any external research was conducted to check and see if the 'world views' held internally were also externally valid (37). The main reason for this was the reduced problem urgency $(22\rightarrow37)$. In the original project plan several sub-projects had been defined which were to deal with external validation. After the disappointing test results, all that could be done was to finish the ongoing internal analyses. The same went for the level of detail in the recommendations of the project $(22\rightarrow33)$. With no program implementation in sight these had to remain vague, but could have been more precise had there been more time available to conduct all the possible analyses.

Both the lack of external research and the low level of detail in the recommendations detracted from the *completeness* of the analysis $(37,33\rightarrow 28)$. So did the lack of marketing input $(27\rightarrow 28)$ caused by the removal of the business manager at the start of the project $(20\rightarrow 27)$. During the project, a marketing voice was keenly missed.



Despite these difficulties, given the constraints of the project that client and consultant had agreed upon, the problem analysis appears to have been fairly *complete* (28). Why? First of all, in some respects there was very little external validation to be done, simply because data were not available in the real world $(24\rightarrow37)$. This was due, on the one hand, to the fact that the company had no existing distribution operations in Europe or in the USA (18 \rightarrow 24). Moreover, the problem at stake was almost unique (distribution of sensitive drugs throughout Europe in 8-12 hours) so that there were hardly comparable businesses to 'benchmark' from either (19 \rightarrow 24). Secondly, several independent sources of research performed by others (35 \rightarrow 37) have confirmed the team's findings since completion of the project (and, indeed, the evaluation interviews). Finally, the problem scope was fairly limited, compared to some other projects, so that completeness could indeed be achieved to an acceptable degree (25 \rightarrow 28).

Thoroughness gets good marks as well (31). Here too more external research could have been performed $(37\rightarrow31)$, but both qualitative and quantitative analysis of internal data (34), made possible by the power of the simulation tools employed (36 \rightarrow 34), positively affected the thoroughness of the analyses (34 \rightarrow 31).

Few references are made to the degree to which the analysis was based upon existing *theories* (32). The general tenor is positive in this respect. Finally, although the low level of detail of the recommendations might suggest otherwise $(33\rightarrow30)$, *usability* of the recommendations was at an acceptable level (30), also judging from the fact that the recommendations were applied to a related project $(21\rightarrow30)$.

Case 4: Planning strategy Implementation In Professional Services⁶

Project setting

The client was a multinational company that had recently changed its corporate strategy. Like many other multinationals, it had decided that it wanted to operate towards its customers as a global provider of project services, rather than as a company providing merely local services to its customers in different countries. Regarding the main idea behind this change of strategy, there appeared to be a fair amount of consensus at the senior management level. However, there also seemed to be much disagreement regarding how it should be translated into actual changes in organisational structure and procedures.

Problem contingencies

What was still lacking was an 'implementation plan' for the new strategy. Any plan had to be developed by all the stakeholders involved, it was felt, but that was a daunting task, given the complexity of the issues at stake and the large number and diversity of managers involved. This strategy implementation plan would include (a) an analysis of present bottlenecks in the business system, (b) suggested solutions for these bottlenecks and (c) an action plan to implement these solutions.

Problem contingency	Score	Description
Problem scope	++	problem concerning the entire organisation
Problem tangibility	-	main parts of the problem are qualitative/intangible
Data availability	-	historical management data were difficult to obtain
Problem urgency	+	an urgent problem that would not be quickly resolved
Political sensitivity	++	politics had a strong impact on the process

Table 6.10.: Problem contingencies in Case 4

Organisational contingencies

Top management realised that there would also have to be an organisational platform for the decision, i.e. consensus regarding the plan and commitment to implement it. Therefore the CEO of the company asked the author to use the PBM approach to assist his senior management in developing such an implementation plan. This approach would help management to deal with the complexity of the issues and with the complexity of involving a large group of managers. Finally, as it happened, the current CEO was stepping back and his successor was also present at the sessions, to get a feeling of current management thinking within the company.

Organisational contingency	Score	Description
Top management support	++	initially very strong, later sponsor became disappointed
Hierarchical diversity	++	different levels and imbalance caused bad communication
Problem ownership	-	mainly the problem of top management
Group size	++	for some people the group was too big (7-9 persons)
Working relations	-	most people didn't know each others' work situations

Project design

In this project the author operated as modelling coach. A senior colleague, more experienced in working with groups, would be the process coach, and a junior colleague acted as project recorder. The project design that was chosen by the project team was based upon the successful results from the three previous projects. The project started off with an initial round of interviews with the main stakeholders, complemented with a written questionnaire. On the basis of the findings from these interviews, it was planned that five workshops of two hours each would be conducted with these stakeholders. The first three workshops would be concentrated in one and a half day, because of the amount of international travel involved; these would focus on identification and analysis of the current bottlenecks. The fourth and fifth workshops were to take place one week later and would focus on solutions for the identified bottlenecks and on an action plan.

Pre-interviews: +	good in itself but not enough done with it	Data analysis:-	very limited because of time pressure and lack of available data
Hexagon brainstorming: +/-	eliciting issues went well, clustering went wrong	Simulation:	not used
Causal diagrams:/-	no depth and hastily made.	Final report: -	project sponsor satis- fied, but participants didn't get it and was not usable
stocks-and-flows dia- grams:/-	see above	Central and graphical presentation: +/-	OK for clarification, but not tuned to the people
Graphical functions: - -	not used	Facilitator skills:	bad steering and wrong relation with the client
Workbooks:-	were distributed but were not used. Would have been good for feedback and owner- ship	Abstraction level: ++	too generic
Propositions:	not used	Project size: -	inadequate (1½ man- months) because of early project stop

In reality, the project turned out rather differently, as Table 6.15 on the previous page shows. The interviews and questionnaire went as planned. These indicated an impressive number of bottlenecks, many of them on the cultural/political level. The first three workshops that were to address these bottlenecks, however, went very badly. Little constructive discussion took place, the models the project team had hoped to construct with the group did not appear on the white board, communication was not focused, and the third workshop ended in disorder. As a result, the two final workshops were cancelled. The project team did receive a new assignment from the CEO, which has to wrap-up all the insights and models developed by the team so far into a final report. This report was received well by the CEO and was said to summarise adequately the main issues at stake; however, the other participants never received it.

Project findings

As a result of the early project termination, few hard findings could be presented – the most tangible project finding being that the problem appeared to be a very touchy subject. In the final report, the following four trade-offs for the client company could be reported back:

1. BALANCING SALES EFFORT AND RESOURCE DEVELOPMENT.

(A causal diagram of this trade-off is shown in Figure 4.6 from Section 4.2.) The main message here was that the company was selecting new international prospective client faster than the skills, experience and resources to execute all the projects these 'prospects' required successfully could be accumulated. This raised a serious threat of project failures, which would have a strong negative impact on company credibility with precisely the international firms top management wanted to concentrate upon.

2. BALANCING CENTRAL LEAD AND LOCAL LEAD.

Traditionally, this company had cultivated a decentralised structure. The new strategy, aimed at international companies, seemed to require more central coordination. It was not clear at all who was to do what: the local operating companies or the newly installed central units. There were numerous conflicts in account development, in contract management, in project execution and in personnel training and hiring. The report merely identified these and did not propose solutions.

3. BALANCING LOCAL REWARDS AND GLOBAL REWARDS

A third trade-off concerned the client company's reward system. Revenues flowed to the operating company that was designated the leader for a project, without recognising the important contributions that other local operating companies might make. Here, too, several dynamics were at play that were identified in the report, but solutions could yet be presented.

3. BALANCING RULES AND COMMUNICATION

When the client company was still small, coordination had been based upon informal communication between managers who knew each other well. Now that the company had grown, that no longer seemed possible, so many rules and guidelines had recently been sent from corporate HQ to the local companies. Initially, such rules led to frustration on the part of local managers whose autonomy was being decreased. A

better approach would be for HQ to lead by example, showing that international projects could be conducted successfully, and thereby establishing what was labelled 'the-smell-of-success-loop'. That would increase management networking and would decrease the need for future top management guidelines. Unsuccessful projects would only reinforce the need for further regulation.

Project effectiveness

As can be seen from Table 6.16, this project went all wrong. Why was that? The overall picture is as follows:

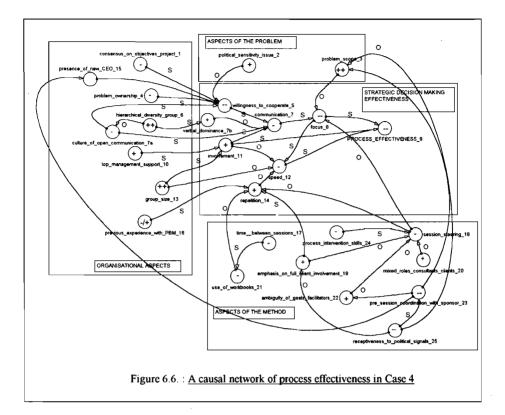
- Process effectiveness: was very low because: (a) numerous errors were made in project design; (b) political sensitivity of the issues involved made most participants unwilling to discuss them openly; (3) the problem scope was kept too broad to achieve adequate focus.
- Model quality was also inadequate. Although most of the issues were highlighted at one time or another, they were not analysed in sufficient depth, due to low process effectiveness and the premature termination of the project.
- Organisational platform for the project findings was very poor, which was not surprising in view of (a) the frustrating process, (b) the insufficient analyses of the issue and (c) the fact that the final report was never sent to the participants.
- Implementation success of this project was therefore zero. In the months that followed several of the proposed changes were implemented, but these changes could not be attributed to the PBM project.

High Level concepts	Operational va	Overall assessment				
PROCESS EFFEC- TIVENESS	focus: different goals, wrong subject, in- sufficient steering	speed: - for some too much , for others too little, both because of bad focus	involvement: + all impor- tant/ relevant people, background of the par- ticipants caused prob- lems	communi- cation: - no common language, some domi- nance aud lack of open- ness; free thinking and mutual dis- cussion was possible	willingness to cooperate: some people didn't want the project	: involvement was okay but bad focus and communication caused lack of speed and not everybody was willing to cooperate
Model Quality	completeness: +/- most impor- tant informa- tion was there, but not everything got enough atten- tion	thorough- ness: /+ hardly any analysis done during sessions, analysis in final report okay	theory base- ness: -/+ no normative theory, sys- tern dynam- ics theory used exten- sively	usability: - project didn't lead to usable results		-: most intor- mation was there, no analysis during sessions, no usable results, and not enough theory used
Organis- ational Platform	awareness: + all partici- pants were aware of the problem	consensus: consensus was impos- sible to reach be- cause so many other things went wrong	commitment: no commit- ment, not even to the project itself	ownership: - no ownership because of bad focus and willingness	confidence: - no confi- dence, mainly be- cause there were no results	-: awareness about the problem, but no commit- ment, consen- sus, ownership or confidence because no results were reached
IMPLE- MENTATION RESULTS	<i>implementa-</i> <i>tion</i> : -/+ some imple- mentation, but not attributed to this project	operations performance; NA	business per- formance: NA	insight: -/+ some partici- pants gained more insight into the problem, most didn't	organisa- tional learning: +/- some partici- pants are positive about the method, some are not	-/+: there has been no im- plementation and improve- ment of busi- ness perform- ance due to the project, some people have learned some- thing about the problem or about PBM

Table 6.16: Project effectiveness in Case 4 (Display Level 3)

Explaining process effectiveness

The preceding analysis may give a general idea of what went wrong, but this case is too interesting too leave it at a general impression. Figure 6.6, shows the causal network that was developed from the causal reasoning found in the case material for various aspects of process effectiveness (with apologies to the reader for the fine print).



This causal network shows that process effectiveness in the three PBM sessions was very low. Why was that? The evaluation has shown three main explanations for this failure. The first explanation has to do with the composition of the group of participants, the second with project design, and the third with problem scope. Each explanation will be discussed in more detail.

EXPLANATION 1: AN UNWILLING GROUP

Process effectiveness was low because most participants were unwilling to cooperate (5). This unwillingness to cooperate resulted in an awkward, stiff communication process $(5\rightarrow7)$. Awkward communication did not help in achieving focus $(7\rightarrow8)$, the discussion repeatedly skirted round the real issues, rather than identifying them directly. And focus is one of the main determining factors of process effectiveness: poor focus means an ineffective decision-making process $(8\rightarrow9)$.

But let us return to this very low willingness to cooperate. Several reasons for it were identified: The first reason was that there was no consensus on what the sessions were to achieve $(1\rightarrow 5)$. The project sponsor and the PBM consultants assumed that the strategy to be implemented was generally supported; however, in reality, there was still considerable resistance to it within the company. Also, several participants indicated that, in their perception, there was no culture of open communication in this group of managers $(7a\rightarrow 5)$ due to a large degree to the hierarchical differences between top management on the one hand, and the management layer below, on the other hand $(6\rightarrow 7a)$. Hierarchical diversity also encouraged verbal dominance of top management during the sessions $(6\rightarrow 7b)$. Furthermore, willingness to communicate openly was low because of the unexpected attendance at the sessions of the newly appointed CEO ($15\rightarrow 5$), who had been with the company only a few days and whose ideas regarding the present corporate strategy were not yet known.

These sessions were, in a sense, confrontations between bosses and their direct subordinates on a politically sensitive subject which related to the personal functioning of the managers involved, and problems regarding that functioning. Because of this political sensitivity, willingness to cooperate in an open discussion of these issues was very low $(2\rightarrow 5)$.

In retrospect, it is obvious that most of the participants really did not want this project to happen in the first place. Problem ownership $(4\rightarrow 5)$ was certainly not shared; In fact, it may have been limited to the project sponsor himself and a few others. His support was strong, and it was this top management support which forced these unwilling managers to the table, thus ensuring involvement in the narrow sense of physical presence of all major stakeholders $(10\rightarrow 11)$. Involvement in the broader sense (i.e. active participation in the discussion) remained very low (represented in this model as an aspect of communication (7)). All main stakeholders were represented, but this also made for large group size (9 managers), which slowed down communication $(13\rightarrow 11)$.

EXPLANATION 2: BAD PROJECT DESIGN

Project design was strongly flawed in this project. Given the group composition, it would have been hard to achieve an effective decision-making process within any project design, but in this case the numerous design flaws did make things considerably worse. The main flaw was insufficient steering by the facilitators during the sessions, which resulted in low focus $(18\rightarrow 8)$. This insufficient degree of steering had several causes.

First of all, the facilitators had an ambiguous relationship with the client due to multiple dependency relationships outside of the project, which reduced the facilitators' authority over a group of seasoned senior managers and therefore precluded strong steering $(20\rightarrow18)$. Secondly, the consultants' goals were mixed $(22\rightarrow18)$. Originally, the project had been seen by the project sponsor as a test case to evaluate the usefulness of the PBM method. By setting up the project as a showcase of PBM techniques, the method came first, the problem second.

Thirdly, there had been very little pre-session coordination of the consultants with the project sponsor $(23\rightarrow18)$. During the initial round of interviews, the original problem definition was changed and broadened. These changes were not discussed with the project sponsor, so that his precise goals and expectations remained unknown as well. (The unexpected attendance of the new CEO at the sessions, at the invitation of the project sponsor, might also have been either better prepared or even prevented had there been closer coordination between consultants and project sponsor $(23\rightarrow15)$.)

Fourthly, the consultants were insensitive to signals (25) during the preinterviews that this was, indeed, a highly sensitive issue, and that few of the participants welcomed this project. Had they realised the true size of the process challenge they were facing, project design would have been different: the problem scope would have been set much more narrowly $(25\rightarrow3)$; the emphasis on full client participation in the modelling process would have been weaker $(25\rightarrow19)$; and coordination with the project sponsor to achieve the aims would have been much stronger $(25\rightarrow 23)$.

The fifth flaw in project design was an over-emphasis on full client participation in the modelling process $(19\rightarrow18)$. As a result of the successes of the previous PBM projects, the consultants were convinced that it was best to start modelling with managers from scratch and create causal diagrams and in the course of an open discussion. But here there was no open discussion, the problems were huge and time was very limited, so, in retrospect, starting from an empty white board was a bad idea. It would have been better to present the modellers' own impressions openly and start a focused and more open discussion from there.

Not only did this lack of session steering lead to insufficient focus, it also led to some repetition $(18\rightarrow14)$: the group was forced to recreate, in a modelling format, many of the findings that had already been described in the report on interview results. Moreover, some participants had already had experience with a PBM project on a closely related issue and for them there was a real sense of doing things all over again $(16\rightarrow14)$. Some repetition might have been avoided by use of inter-session workbooks $(21\rightarrow14)$, but workbooks were impractical because of the very limited two-day time span $(17\rightarrow21)$ within which all three sessions had to be conducted. In any event, repetition militated against speed $(14\rightarrow12)$.

EXPLANATION 3: TOO MANY ISSUES IN TOO LITTLE TIME

The third main explanation for low process effectiveness relates to the strategic issue itself. The original problem scope (3) in this project was very broad – too broad, one might say – and it was expanded still further by the addition of important new aspects and viewpoints during the pre-interview stage. This is hardly surprising, given the significance of an issue like "implementing a global strategy" but it might have been preferable for the consultants to discuss this broadening with the project sponsor $(23 \rightarrow 3)$, and jointly decide whether to increase the time available or limit the scope of the problem. This discussion did not take place. Because of the very broad problem scope, focus was bound to be low $(3 \rightarrow 8)$.

Case 5: Assessing BRnch Office Viability In Banking7

Project setting

The client company was a medium-sized European bank. Its management structure was strongly decentralised, with much autonomy for management teams at local branch offices. At the time of this project, the company was going through an extensive streamlining operation, in which the local branches were being examined by a project team of internal consultants for possible cost-cutting opportunities. It was often found that some of the smaller neighbourhood offices of the local branch were lossmaking: too few clients utilised them for too few services. Would it not be better to close such offices and refer the customers to another office in the vicinity? Analysis of the available hard data could easily show the direct savings of doing so, but often the local bank managers would object to such a financially oriented conclusion. Their main worry was: "The direct saving are fine, but how will our customers react to this closure?" Here the available information was less helpful. Although there were extensive data on such facts as wealth distribution and service usage patterns for different consumer categories in different areas, these still said little about how people would actually react. Nevertheless, the local managers had to make a decision taking into account all aspects, both soft and hard. In the past, in the absence of better information discussions on these issues had dragged on for years, but under the present cost-cutting program swifter decision-making was required.

Problem contingencies

From this brief introduction the problem contingencies described in Table 6.13. will be evident. This was a problem with a potentially broad scope (the initial interviews led to over a hundred potentially relevant factors and probably even more relations). However, unlike in Case 4, another case with a very broad problem scope, here there was at least a very clear focus on a specific question: Should we keep this branch office open or not? Then again, the biggest problem-related difficulty in this project is not even captured in Table 6.13. This was the fact that the team was not trying to model the problem of a particular organisation, but the problem of a whole *class* of several hundred different organisations. In that sense, the problem scope was very wide indeed.

Problem contingency	Score	Description		
Problem scope	+	broad, but focused on a specific decision		
Problem tangibility	-	problem wasn't tangible, made more tangible with model		
Data availability	-/+	not all required data available, some information in people's heads		
Problem urgency	+	important and needed		
Political sensitivity	-/+	sensitive issue for local banks, not within project team		

As far as problem tangibility and data availability were concerned, there was a clear dichotomy: on the one hand the client was, like most banks, sitting on a 'digital gold mine' of detailed customer data; on the other hand, some highly important considerations such as 'expected customer irritation' were extremely intangible, and were not backed up by hard data.

As discussed earlier in Exhibit 4.2. of Section 4.3., this project had been in cold storage for more than a year because it was not considered sufficiently urgent. Eventually the problem had become urgent enough for the client's top management to commission the design of a decision-support system from the author's consulting company.

Organisational contingencies

A project team was set up consisting of a number of internal consultants on office location analysis, several local bank managers and three external modelling consultants. The author acted as the process coach, two of his colleagues performed the modelling coach and recorder roles.

Organisational contingency Score		Description		
Top management support	+	sufficient top management support		
Hierarchical diversity	- 1	few hierarchical differences, group of peers		
Problem ownership	+	problem owners are bank managers. Project team consisted of advisors on the problem and local bank managers.		
Group size	+/++	sometimes groups size too large, most of the time okay.		
Working relations	+	advisors and banks know each other.		

Table 6.18.: Organisational contingencies in Case 5

When the whole group was together group size could be large, particularly if other internal consultants, not involved in the project team, were in attendance. The reference group, the core modelling team, normally involved 3-4 people, one of them the project leader. Working relations between the internal consultants were quite good, thanks in part to the non-hierarchical atmosphere within the group.

As before, the biggest case-specific organisational complication is not adequately reflected by the set of organisational contingencies listed in Table 6.18. This is the fact that, at least initially, the external consultants were not 'modelling *with* managers', but were 'modelling *for* managers' the managers who were to use this model would not be involved in the conceptual modelling. So how was managerial ownership of the model too be achieved? To overcome this problem two bank managers were asked to participate in the conceptual modelling activities. Their involvement had to be less frequent than that of the consultants, but appears to have been sufficient, judging from the evaluation interviews. In the sessions that they did attend their input provided an excellent counterweight to the expertise from the consultants. These bank managers were, in a sense, the real problem owners, for over the course of the project the model was used to assess some of their own branch offices.

Project design

This project was far larger and more ambitious than the four preceding projects. Therefore, it made sense to cut it up into three separate phases, the end of each phase being marked by a steering group meeting which took a 'go no-go' decision for the next phase. In the first phase, a qualitative conceptual model was developed in a number of structured workshops. This model contained all the main factors and relationships the project team defined as relevant to the issue. In the second phase, the conceptual model was quantified in a further series of workshops, and was applied, refined and validated in two actual decision-making processes by local branch management teams. In the third phase, this refined model was then embedded in a more user-friendly decision-support system (DSS). Also, a structured policy workshop format was developed to lead local management teams through the various steps in the DSS. And finally, the internal consulting group was trained in the use of the DSS and the policy workshop.

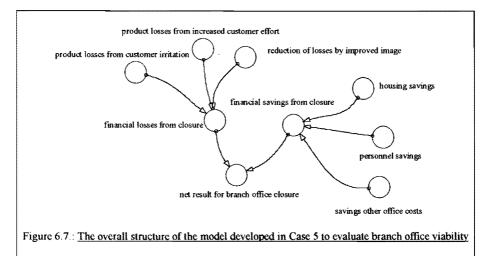
Pre-interviews: +	good, structured and useful	Data analysis: +	limited data available. but what was available was analysed
Hexagon brainstorming: +/-	reasonable good but too broad initially	Simulation: +	gives insight and stimulates discussion
Causal diagrams: +	focusing and informative	Final report: +	good final reports
stocks-and-flows diagrams: -/+	most found them difficult, some found them supporting	Central graphical presentation: +	informative. supportive and helps focusing
Graphical functions: +	make things clear quickly	Facilitator skills: +	good modelling knowledge, little company knowledge
Workbooks: +	good for preparation and involvement without taking much time	Abstraction level: +/-	good level of detail, as concrete as possible
Propositions: +	provides focus, insightful and forces choices	Project size: +	adequate (5-6 months duration, 8-9 man- months)

Table 6.19.: Project design aspects in Case 5

As Table 6.19. suggests, this project was a veritable showcase of PBM techniques. Not only was every technique from the toolset used (this is in itself not surprising, bearing in mind the size of the project, which was three times that of most of the preceding projects), but also the techniques worked well up to very well. Evidently the PBM method had matured by the time this project was started. The lessons from the previous cases were learnt well. Thus workbooks were used to maintain involvement and save time; propositions were used to ensure full consensus; frequent discussions were held with the internal project manager to check project progress and next steps, etc.

Project findings

Perhaps the most important finding was that it proved possible to structure, simplify and even quantify the broad and intangible issue of branch-office viability, without ending up with a low-quality end product. The spaghetti-like causal diagrams that were drawn in the initial stages of the conceptual modelling stage could in the end be simplified to an overall structure like that shown in Figure 6.7..



What surprised everyone was that most of the effects of bank closure on customer behaviour could be clustered into just three groups:

- 1. losses due to increased effort required from customers having to travel further to reach the next available branch office;
- 2. losses due to customer irritation through the removal of what in many small towns is one of the binding elements of the local community;
- 3. counter-balancing moderation of this losses through improved bank image due to a simultaneous upgrading of the remaining branch offices.

This is shown in the causal diagram. The losses could be quantified in financial terms and set against the savings resulting from closure, which were much easier to estimate.

Project effectiveness

This project was probably the most successful of the six cases described in this book (cf. Section 7.1.). That success was measurable in various respects, as Table 6.20 will also show:

• Firstly and most importantly, it was deemed successful from the perspective of the participants: post-project interviews have pictured the process as effective and a highly instructive experience for all involved. Despite the presence of the external consultants, there was a strong feeling of ownership of the final result. Despite the inherent 'softness' of many of the issues, there was confidence in the quality of the model.

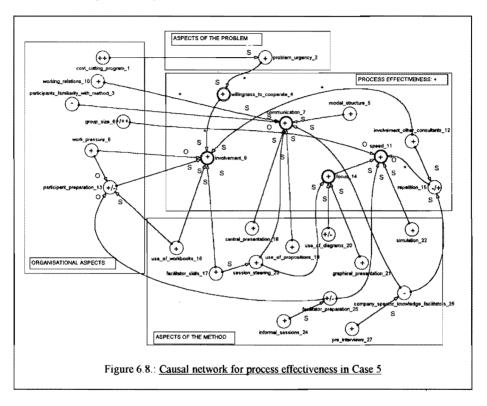
- The project has also been successful from a project management perspective: for all the uncertainties and contingencies, the project was completed on time, within budget and with all the required functionality.
- Finally, the project has also been a success from a business perspective: the DSS and the policy workshop format have subsequently been applied to several dozen decisions by different management teams.

High Level concepts	Operational variables					Overall assessment
PROCESS EFFECTIVENESS	focus: + some initial difficulties with defining the goal, after that good focusing	speed: + sometimes too fast, other times too slow, but finished on time	involvement: + good combi- nation of bank managers and advisors, although too inany changes in involvement; active par- ticipation limited by facilitators	communica- tion: + exchange of viewpoints, open discus- sion, enough freedom of speech, little verbal domi- nance, some lack of com- mon language between ta- cilitators and client	willingness to cooperate: + good willingness to cooperate	+: good focus and speed, good involvement although too many changes and limited ac- tive in- volvement, good communication and enough will- ingness
Model Quality	completeness: + model con- tains most important issues, some issues were consciously omitted	thorough- ness: +/- well ana- lysed model, some testing was done but no validation on historical time series	theory basedness: +/- insufficiently based on theory, but not sure if theory exists	usability: ++/- very usable model to sup- port the de- cision-making process, some people fearful of actually using it		+: fairly com- plete, enough theory used, very usable product, but not analysed thoroughly enough yet
Organ- isational Platform	awareness: + for some peo- ple awareness came after- wards, but overall every- body wants the model	consensus: ++ full consen- sus reached	commitment: ++/+ satisfaction with the model and commitment to it are very good	ownership: + participation enlarged ownership	confidence: + good confi- dence in the model al- though that would grow if it had been validated	++/+: good awareness, consensus reached, people are committed to the model, feel confident in using it and accept own- ership
IMPLE- MENTATION RESULTS	<i>implementa- tion:</i> the model continues to be imple- mented with support of a wide-spread commitment	operations performance: NA	business per- formance: NA	insight: + insight gained in problem and way of handling it	organisa- tional learning: + people learned about the method and possibilities of using it	+: people got more insight into the problem and learned about the method, the model is being implemented now

Table 6.20: Project effectiveness in Case 5 (Display Level 3)

Explaining process effectiveness

Process effectiveness was insufficient in Case 3 and was a disaster in Case 4, for different reasons. By Case 5 the author had apparently learned some lessons from these projects. Here process effectiveness was perceived as good, as we have seen, but why was that so? Figure 6.8 explains:



A number of reasons were given as explanations for the effective modelling process:

- a) First of all the participants showed a clear *willingness to cooperate* in the modelling process. This willingness probably also stemmed from the fact that it had become a fairly urgent problem ($*2\rightarrow4$), because the client organisation was in the middle of a cost-cutting operation ($1\rightarrow2$).
- b) This willingness to cooperate led to good *involvement* in the modelling process (*4→9), in terms both of attendance and active participation. However, the considerable work pressure that the participants were under meant that not everyone could always be present (8→9). The same work pressure also meant that participants did not always enter the modelling sessions well prepared (8→13), which did not enhance active involvement during the sessions (13→9). As much as possible was done to assist preparation; the workbooks summarised

As much as possible was done to assist preparation, the workbooks summarised findings to date well $(16\rightarrow13)$ and participants felt able to trust the facilitators to sort out each workshop's findings neatly and come up with new proposals next time $(25\rightarrow13)$. For this preparation the facilitators engaged in informal discussions with the internal project leader and one or two others $(24\rightarrow25)$.

Finally, the process coach made sure that everyone was contributing actively to the sessions $(17\rightarrow 9)$.

- c) A third reason why process effectiveness was good was that the sessions proceeded in a *focused* manner (14): in general only the key issues were discussed. In this the facilitators once again played an important part by regulating the flow of the sessions and cutting discussions short when required $(17\rightarrow23)$, making that side issues were not dwelled on too long $(23\rightarrow14)$. The techniques that were used also clearly contributed to focus; in particular, the use of varied diagramming and graphical presentation techniques were mentioned $(20, 21\rightarrow14)$.
- d) This focus assisted the pace of discussions (14→11). This speed was also increased by the effort made by the facilitators to do some homework between the sessions (25→11). However, repetitions did sometimes slow down the process (15→11). Repetitions occurred in the beginning because the facilitators had little knowledge of the client's industry in general and of the client company in particular (26→15). Later on, repetitions stemmed from the need to bring new project members, who had not been involved in previous sessions, up-to-date (12→15). In those workshops where this happened group size in itself slowed things down; usually group size was adequate (6→11). Finally, when the model was tested on two actual branch offices the ability to calculate a number of different scenarios considerably speeded up the discussion with local management (22→ 11).
- e) The fifth main reason for good process effectiveness was the good quality of *communication* (7). Most of the participants already knew on another prior to the project (10→7), but several additional factors aided the process, including session steering by the facilitators (23→7); use of whiteboards for central presentation (18→7); and use of propositions to structure discussions (19→7).

In the final phase of the project the transparent model structure also improved communication $(5\rightarrow7)$. As said before, at the start communication was less optimal because the facilitators did not yet understand the industry terminology and jargon $(26\rightarrow7)$. And also because the participants were unclear of what was expected of them: they were not yet familiar with the modelling method $(3\rightarrow7)$.

Case 6: Understanding Supply Chain Dynamics In Electronics⁸

Project setting

This last project was even more ambitious than Case 5. The part that is evaluated and described in here was the first stage, the conceptual modelling phase, of a project that was estimated to take more than a year, without a break, to finish. The client company was a large electronics multinational. The issue at stake was supply chain management, or what might be called the art of coordinating flows of goods from their original procurement through various stages of production, assembly, physical distribution, storage and sale. For any company this is a complex undertaking, but for this company, with its many production plants and markets spread throughout the world, its broad diversity of product lines in highly innovative markets, subject to world-class competition and volatile market behaviour, effective supply chain management was extremely challenging indeed.

Problem contingencies

The problem scope was very broad in this case. As in Case 5, the challenge was not to develop a model of a strategic issue for a particular organisation, but for a class of organisations: eventually, each business unit management team would have to find its supply chain management issues represented in the model.

Problem contingency	Score	Description
Problem scope	++	a very complex and broad problem, that is being kept as simple as possible
Problem tangibility ⁹	_/+	several tangible aspects, but overall not very tangible. Project goal is to make problem more tangible
Data availability	+/-	A lot of data available but not sure whether they are applicable to the problem
Problem urgency	+/-	An urgent problem but mainly in a long term perspective
Political sensitivity	-	Problem itself not sensitive, but some politics around continuation of the project.

	Table 6.16.:	Problem	conting	encies	in	Case	6
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Organisational contingencies

As in Case 5, a consequence of this choice for a generic model was that the initial modelling had to be modelling *for* managers rather than modelling *with* managers. However, as in Case 5, a satisfactory solution to this complication could be found by involving line managers in the conceptual modelling phase (in this case two logistics managers and the internal project leader, himself a former logistics manager.)

Much more problematic turned out to be the fact that the client company was understaffed and at the same time burdened with all sorts of other pressing problems.

Organisational contingency	Score	Description Not much top management support, other issues had higher priority			
Top management support	-/+				
Hierarchical diversity	-	little hierarchical diversity			
Problem ownership +		problem ownership should have lain at higher organisational levels but was not felt there. project members did feel ownership.			
Group size	+	was fine (4-6 persons)			
Working relations	+	participants knew each other but did not work together often.			

This undermined top management support, as expressed in frequent threats of delay to the project.

Table 6.22.: Organisational contingencies in Case 6

Luckily the group worked well together. Many participants knew one another from the past, there was hardly any hierarchical diversity and group size was more or less ideal.

Project design

Given the similarities with Case 5 and the good experiences in that case, it is not surprising that a similar project design was made for this project. So once again three phases were distinguished: a first phase of conceptual modelling with a project team of internal experts and logistics managers; a second phase of refining and testing the conceptual model on supply chains from one or more business units; and a third phase in which this validated model would be made generic and user-friendly¹⁰.

Apart from the many similarities, there were also differences with Phase 1 from Case 5, including:

- An emphasis on stocks-and-flows modelling (as compared to the emphasis on causal diagramming in Case 5.) As discussed in general in Section 4.3., this emphasis stemmed from the prominence of business flows notably flows of goods, of orders and of capacities in the problem scope.
- An emphasis on the use of executable preliminary models. This was done for two reasons, the first being that this was fairly simple to achieve because stocks-and-flows diagrams were to be used anyway, which can be quantified with relative ease (cf. Section 4.3.). The second reason was that in this goods flow control issue the dynamic behaviour of all the relevant variables was crucial. Because of the strongly non-linearity of this behaviour and its tendency to depend on specific values of variables, a comparison of the model structure and dynamics had to be possible to permit frequent cross-checking.
- An emphasis on the use of existing formal, prescriptive models and outside expert knowledge. This outside expertise took the form of an 'expert coach' (cf. Section 4.3). The main reason for this design choice was the assessment that a considerable amount of theoretical knowledge had already been accumulated in this field, which the project team would be able to adapt into practically usable bits.

Pre-interviews: +/-	necessary, but nothing special	Data analysis: -	no data analysis performed
Hexagon brainstorming: +/-	supportive for some, not adding anything for others	Simulation: -/+	Some example simulations but no models with real data
Causal diagrams: +	abstract, but good use of causal diagrams	Final report:	No real final report made in this phase
stocks-and-flows diagrams: -/+	for some participants too difficult, for others less so	Central graphical presentation: +/-	works well for most participants, sometimes diagrams too difficult
Graphical functions: +/-	different presentation than used to	Facilitator skills: +/-	Not enough steering, more support to focusing, discussions and abstraction level
Workbooks: +	good for feedback and preparation	Abstraction level: +	good level of abstraction, to which a great deal of attention was given
Propositions: +	good tools, effective and efficient, suppor- tive involvement, con- sensus and commit- ment	Project size: +	appropriate for this first phase (4 months duration, 3 man- months)

Table 6.23.: Project design aspects in Case 6

Table 6.23. also shows that the version of the PBM method that was used in Case 6 was more or less identical to the version used in Case 5. So once again the entire toolset was employed, insofar as the techniques were appropriate in the conceptual modelling phase (e.g. no data analysis).

Project findings

Given the fact that the project was not even halfway completed, there were few definite project findings in this first phase. More or less as a side issue, it was found that some of the stock calculation algorithms utilised in the client company's information system were incorrect, which was of great practical value to the client company.

Perhaps the most important general finding was that it again turned out to be possible to structure and simplify a very complex problem into a relatively concise model. In this case, the team found that most supply chain management issues could be represented conceptually as variations of two fundamental trade-offs:

- A short term trade-off between inventory levels and delivery performance;
- A long term trade-off between production capacities and lost sales.

The conceptual model that was developed subsequently had these two trade-offs and their interactions as its core structure.

Project effectiveness

The first phase of this ambitious project went well. Nevertheless, the scores on project effectiveness are considerably lower than those for Case 5. This should not be seen as

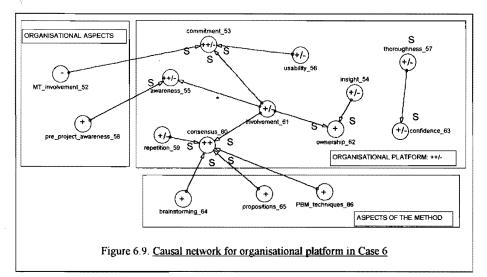
surprising, since at the time of the evaluation interviews much work still had to be done, and many things still had to prove their worth in practice. Furthermore, this sophisticated client group was already well accustomed to management consulting and modelling and therefore not easily impressed.

High Level concepts	Operational variables					Overall as- sessment
Process Effectiveness	focus: +/- initially un- clear goal and insufficient focusing, gradually im- proved through sup- port by facili- tator and tools	speed: -/+ not much speed, but process could not have gone much faster	involvement: +/- moderate group composition, lack of sales people, good active participation in workshops	communicati on: ++ extensive discussions with enough freedom and common language, open atmosphere, not much verbal dominance	willingness to cooperate: ++ notivated group which is willing to cooperate	+/-: moderate focus, low speed, moderate group composition but good active participation, very good communication and willingness to cooperate
Model Quality	completeness: + for now as complete as possible, some things were deliberately left out	thorough- ness: +/- some analy- ses done; rest of analyses and validation to take place in next phase	theory base- ness: + enough the- ory basedness	usability: +/- model not yet usable, good confidence it will be usable in the future		+/-: as complete as possible now, enough theory basedness, not thoroughly enough analysed and not usable yet but that will improve in next phase
Organis- ational Platform	awareness: ++/- a lot of aware- ness in project group, not in other parts of the organisa- tion	consensus: ++ consensus was reached	commitment: ++/- good commitment so far with project team, now commitment has to be secured in rest of organisation	ownership: + reasonable ownership	confidence: +/- some feel confidence in final product, oth- ers have to see it first	++/-: good awareness which is most important at this stage of the project, com- nitment, consensus, ownership and some confidence in project group, not yet in other parts of organi- sation
IMPLE- MENTATION RESULTS	<i>implementa- tion</i> : imple- mentation de- pends on commitment, model quality and embedding the model in the organisation	operations performance: improving operations performance is not diffi- cult	business per- formance: NA	insight: +/- getting in- sight is im- portant pro- ject goal, some insight by participat- ing, more in- sight has to come later	organisa- tional learn- ing: +/- some learned about the method and its concepts, others did not	-/+: some insight and learning, implementation has not yet taken place

Table 6.24: Project effectiveness in Case 6 (Display Level 3)

Explaining organisational platform

Process effectiveness had its flaws in this project: model quality was not yet optimal and yet organisational platform was very strong at this early stage. Why is that? The causal network in Figure 6.9. offers some explanations:



Support for this model was very strong with the participants, but was bound to be weaker in the rest of the organisation. This support was created mainly by the *involvement* (61) of the respondents in the modelling process:

- a) A primary aim of involvement is that it should lead to a higher *awareness* of the importance of the problem (*61 \rightarrow 55), although it has to be stated that this awareness already existed prior to the project (58 \rightarrow 55).
- b) Involvement should also lead to a strong *commitment* to do something with the insights that were gained in this project $(61\rightarrow56)$. Commitment does, of course, also depend on the eventual usability of the model $(56\rightarrow53)$. That commitment is probably far lower with management team members who did not participate in the modelling process $(52\rightarrow56)$.
- c) Thirdly, involvement should lead to a high level of *consensus* (61 \rightarrow 60). Several PBM techniques have nurtured this growth to consensus (66 \rightarrow 60). In particular the respondents mentioned the use of hexagon brainstorming (64 \rightarrow 60) and the use of propositions (65 \rightarrow 60). Finally, not all repetition is bad, because revisiting earlier discussion issues did also lead to increasing consensus (59 \rightarrow 60).
- d) In the fourth place, this involvement engendered a feeling of ownership of the model (61→62). This sense of ownership has been strengthened by the greater insight that was gained in the problem area (54→62).
- e) Finally, there is the issue of *confidence* in the model (63). This level of confidence is satisfactory, although everyone knows that the model is by no means finished. Nevertheless, the fact that not all the required analyses have been conducted does place a limit on the level of this confidence (57→63).

CHAPTER 7

CROSS-CASE ANALYSIS

This chapter provides a panoramic view of the six cases described in the previous chapter. We examine them in the two ways described in Chapters 3 and 5; that is, we *describe the degree to which the method worked* in these cases, but we will also look at possible *explanations for why the method worked* as it did. The former is done in the first section of this chapter, the latter in Sections 7.2. and 7.3. In these two sections we shall investigate possible causal relations between research model variables. For practical reasons, not all the relations of the research model from Chapter 2 are discussed in detail¹. Instead, we shall focus in Section 7.2. on those relations that were identified in Chapter 2 as having strong support in the literature. In Section 7.3. we shall focus on those relations that appear to be clearly confirmed by the case data from our modest sample of six cases. Finally, we will try to establish the main findings from this cross-case evaluation by looking at three crucial sub-networks of variables and relations in Section 7.4.

7.1. PBM Effectiveness

How well did the PBM method work in the six projects described in this book? To answer this question, we need to determine the degree of success achieved by the six projects in terms of strategic decision-making effectiveness, i.e. in terms of the four main concepts of our research model described in Chapter 2:

- 1. process effectiveness,
- 2. model quality,
- 3. organisational platform and
- 4. implementation results.

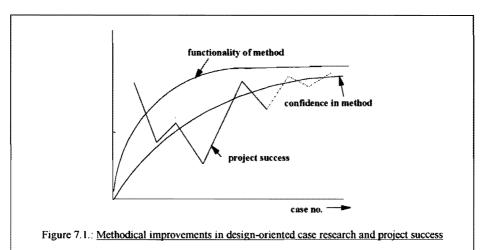
We will first make an overall assessment, and then zoom in on each of these four concepts.

Overall assessment

A cursory glance at Table 7.1., which summarises the key scores for each cases, suggests that these cases were fairly successful, but clearly PBM was not a panacea as only Cases 1 and 5 scored positively (+ or higher) across the board.

Overall concept	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Process Effectiveness	+	+	-/+		+	+/-
Model Quality	+	-/+	+	-	+	+/-
Organisational Platform	++	+	++/+		++/+	++/-
Implementation Results	++	+/-	+	-/+	+	-/+

One might argue that this is not surprising, since the method was still 'under development' during much of the period in question; this was design-oriented research, after all. Whilst that is undeniably true, one might expect to have seen a gradual improvement in project success over time. However, Figure 7.1, which first appeared in Chapter 3, suggests that need not be so, since a continuous, gradual improvement in the functionality of the method is still compatible with wide variations in project success from case to case.



This is precisely what seems to have happened in this research project². As one would hope, the method did show good project results towards the end, with a peak performance in Case 5 (the lower scores of Case 6 may reasonably be attributed mainly to the fact that this project was not even half-complete at the time of the evaluation interviews).

The almost utter failure recorded in Case 4, the immediately preceding project, might appear to contradict starkly this concept of gradual improvements in designoriented research. But what happened in Case 4 was that a method that had been used with success on fairly well-defined, non-political problems with middle managers, was now tried in a compressed time scale on a very broad, political issue with top managers. In engineering terms, a design that had been proved under very specific, favourable conditions, was now given a field test under quite different, much more difficult conditions. Of course the particular PBM project design that was used clearly failed in these conditions, but this 'field test' nevertheless provided valuable information to enhance the design of subsequent PBM projects and, indeed, to strengthen the method itself. These improved project designs were used with success in Cases 5 and 6 (and in other cases not reported in this book). So Case 4 clearly exemplified the saying: Good judgement comes from experience, experience comes from bad judgement³.

The very good scores recorded for Case 1 are also surprising in this light. Not only was it the first project that the author had tackled in a consultant capacity, the process itself drew on only a limited number of the techniques from the PBM toolset. How could the results have been so good? Part of the answer may be a measurement bias. The evaluation interviews were conducted more than a year after the project was finished. By then the participants may well have forgotten all their negative experiences of the project and have retained only the positive ones. This would correspond with the personal recollections of the author, whose own impressions were more moderately positive than those of the respondents⁴. It may also be relevant that the interviews were conducted with only the two persons most closely involved with the project, which is a very small and perhaps unrepresentative sample.

Another part of the answer may lie in the contingencies of problem urgency and problem tangibility. Case 1 had extremely high problem urgency, with everyone working flat-out to solve the serious problems the company was facing. Much more was going on than just the simulation project, and the combined effects of all these efforts resulted in success, but the respondents credited most of that success to the simulation project. This was undoubtedly assisted by the high tangibility of the main project issue, which made it 'classic' territory for a simulation-driven approach, given the well-proven nature of the technology in this area⁵.

Process Effectiveness

The data shown in Table 7.2. illustrate that, even after six cases, it is still not easy to achieve an effective process. For the typical PBM project, the problems that need to be addressed are complex, whilst group dynamics and external pressures tend to be high. From Table 7.2. it would appear especially hard to secure good *involvement* from all affected parties and maintaining sufficient *speed* in the process. Getting good involvement may be difficult due to the heavy job pressures under which participants typically must work and the limited problem ownership that usually exists, which may reduce willingness to cooperate actively.

Case #	Overall Score	Focus	Speed	Involve- ment	Communi cation	Willingness to cooperate
Case 1	+	++	+	+	++	-/+
Case 2	+	+	+	-/+	++	+
Case 3	-/+	+	-	-	++	NA
Case 4			-	+	-	
Case 5	+	+	+	+	+	+
Case 6	+/-	+/-	-/+	+/-	++	++

Table 7.2.: Process effectiveness by case

Maintaining sufficient speed or 'drive' in the process is invariably difficult. This is due partly to the lack of involvement: in several cases (Case 2, Case 3) the process was

slowed down because people who had missed one or two previous workshops had to be brought up to date.

The strongest point of PBM processes appears to be communication, which almost always receives good grades. Of course, communication has several aspects, such as openness, common language, exchange of ideas and lack of verbal dominance, but in general positive scores were obtained on all these aspects⁶.

Model Quality

Looking at the data on model quality in Table 7.3., one has to conclude that PBM does not automatically lead to top quality models. Completeness, for instance, is clearly often problematic, usually because the problem scope is too wide to allow a full coverage of all the relevant problem aspects. Only in Cases 5 and 6, which were much larger projects than their predecessors, was this less of a difficulty.

Case #	Overall Score	Complete- ness	Thorough ness	Theory- basedness	Usability
Case 1	+	+/-	+	+	++
Case 2	-/+	+/-	-	-	-/+
Case 3	+	+/-	+	+	+
Case 4	-	+/-	/+	-/+	-
Case 5	+	+	+/-	+/-	++/-
Case 6	+/-	+	+/-	+	+/-

Table 7.3.: Model quality by case

Thoroughness can vary widely, but one should perhaps rarely expect it to very high, given that validation (an important aspect of thoroughness) will always be problematic for the kind of problems PBM projects tend to deal with. Case 2 is especially negative, partly because of the author's own assessment, though, as was seen in Section 6.2, this judgement may have been overly harsh in retrospect.

Theory-basedness is often problematic given the general lack of theory on which to fall back. Usability is often quite acceptable. That Case 6 achieved a low score on this point is no surprise, since this project was not even half-complete when the evaluation interviews were conducted. The intriguing apparent correlation between values of thoroughness and usability (relation 13a in our research model) is discussed further in Section 7.3.

It would be premature to draw from that experience the conclusion that PBM is simply an inferior approach to constructing good models of strategic problems. Rather, the author would like to suggest that the data merely indicate that all the problems addressed in these PBM projects were very hard to model well with any technique, like most strategic issues are...

Organisational Platform

Apparently, using PBM is a good approach to create a strong organisational platform for a decision. The two most important elements of organisational platform, consensus and commitment, were usually high to very high as can be seen in Table 7.4.

Case #	Overall Score	Awareness	Consensus	Commit- ment	Ownership	Confidence
Case 1	++	++	+	++	+	++
Case 2	+	++	+/-	+	+/-	NA
Case 3	++/+	+	++	+/++	+	+/-
Case 4		+			-	-
Case 5	++/-	+	++	++/+	+	+
Case 6	++/-	++/-	++	++/-	+	+/-

Table 7.4.: Organisational Platform by case

It is interesting to note that, despite the strong lead taken by the external consultants in the modelling activities in the last two cases, participants still felt that it was their model that was being developed. The only lower score is for confidence. Here one should note that confidence in the model that was developed may depend considerably on the perceived quality of that model⁷.

Implementation Results

From a glance at Table 7.5. it becomes clear that implementation results are more often indirect, i.e. in terms of participant learning, than direct, i.e. in terms of actual implementation of decisions made during the project.

Case #	Overall Score	Implemen- tation of decision	Business Perform- ance	Insight	Organisa- tional learning
Case 1	++	++	+	++	++
Case 2	+/-	-/+	-/+	++	+
Case 3	+	+/-	NA	++	+/++
Case 4	-/+	-/+	NA	-/+	+/-
Case 5	+	+	NA	+	+
Case 6	•/+	NA	NA	+/-	+/-

Table 7.5.: Implementation results by case

Participants generally indicated that they had gained more insight into the problem, with the understandable exceptions of Case 4, a failure, and Case 6, a yet unfinished project. Furthermore, many participants have since adopted at least some of the aspects of the problem-solving approach and indicated that they were using, or intended to use, these aspects for future group problem-solving activities. This appreciation of the problem-solving method is labelled 'organisational learning' (cf. Chapter 2).

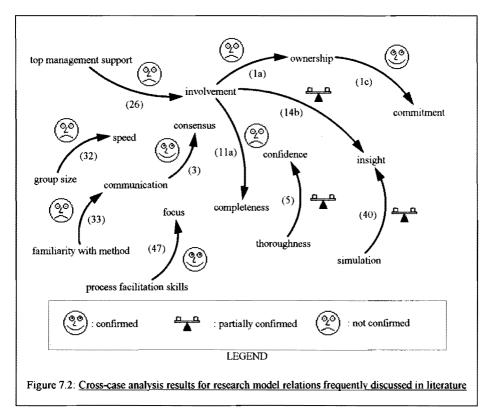
But direct implementation of decisions is often much more problematic. The reasons for this appear to be different in each case. In Case 2, a good problem analysis could be made but a new corporate design could not be created. In Case 3, the company's drug turned out not to be marketable for the intended target disease, rendering implementation of the distribution structure that had been developed superfluous. In Case 4, the project never reached the point of making any implementable decisions. Case 6 was an ongoing project. In general, it would seem

decision implementation is often conditioned by developments external to the project itself. One needs a good model and organisational support, certainly, but those alone are evidently not enough.

The fact that so few data on business performance after the project are available⁸ may therefore be less unfortunate than it would seem for the evaluation of PBM effectiveness. For how could this researcher claim that business successes were a direct result of the PBM method, or how could critics blame the PBM method for business failures, if a few hundred other things typically happen between project finish and decision implementation?

7.2. Relations from "Textbook Theories"

Of the sixty-six relations described in the research model of Chapter 2, only a limited number were found to be frequently discussed in the literature. We will label this set of eleven relations the *textbook theory* on how to achieve effective strategic decision-making through modelling. These relations are depicted in Figure 7.2. Following the conventions set in Chapter 2, the thick arrows between the variables reflect the frequency with which they are discussed in the literature.



This figure also indicates what relations were confirmed or partially confirmed by crosscase analysis. As was explained at length in Chapter 5, each of these relations has been set against the case data results that were presented in Chapter 6. In particular, a comparison has been made between the scores for each of the variables mentioned in each of the cases. If a relation between, for instance, 'involvement' and 'ownership' was present in these cases, then one would expect that whenever involvement was high, ownership would also be high, and vice versa.

Unfortunately, Figure 7.2. shows only three 'smiling face' icons, which means that only three of the eleven 'textbook theories' were clearly confirmed by the data from our six studies. Three additional relations were moderately confirmed, as is indicated by the balanced seesaws. The wider significance of these results will be addressed in

Section 7.4. and in the next chapter. Here we shall take a more detailed look at the data sets against which each of these relations were evaluated.

Ia. Involvement leads to ownership: (2)

The 'P' in PBM stands for participation, stands for involvement. Full client involvement is an essential ingredient of the PBM method. One of the main reasons for this emphasis on client involvement is precisely relation 1a: if managers are not closely involved in the modelling process, they will feel little ownership for the model; it will not be *their* model. Table 7.6. summarises the top-level case data for this relation (The plusses and minuses have been translated into a five-point scale, as discussed in Chapter 5).

	involvement		ownership	
Case 1	+	4.0	+	4.0
Case 2	-/ +	2.5	+/-	3.5
Case 3	-	2.0	+	4.0
Case 4	+	4,0	-	2.0
Case 5	+	4.0	+	4.0
Case 6	+/-	3.5	+	4.0

If we look at the data on this cornerstone of participatory modelling, then we cannot help but be initially disappointed, for a reasonable inference would be that involvement may lead to ownership, but certainly not always. In Cases 2 and 3 there was (relatively) low involvement but (relatively) high ownership, whilst in Case 4 involvement was high yet ownership was low. So half of the cases contradict this relation, which hardly endorses the assertion that involvement leads to ownership.

But surely so many authors can not be wrong? The main explanation for this surprising result – and indeed for the relation communication—ownership discussed below – may lie in the specific interpretation that was given to the terms in this research. They reader will recall that in Chapter 2 we defined 'involvement' as 'being part of the project team' or 'being present at the modelling sessions'. This narrow definition explains the disappointing results in two ways:

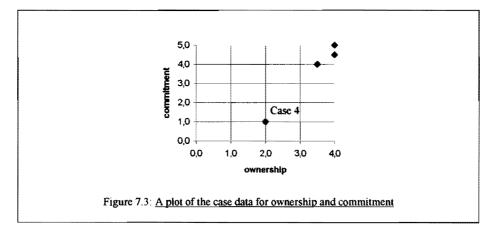
- In Cases 2 and 3 involvement was low because not all participants were present at every modelling session, for various reasons. But that does not mean that those participants who *did* attend frequently did not develop a feeling of ownership for the resulting model!⁹
- In Case 4 all stakeholders were forced to attend the workshops by their CEO. But sitting at a table is not the same as active participation. Active participation and involvement embraces such aspects as open exchange of ideas, a common language, and freedom to add new themes, which were absent in this case. Since those aspects were captured under 'communication' in this research project, and the data for Relation 1b, 'communication leads to ownership' (see Section 7.3.) indicate that communication was indeed poor in Case 4, the case data in reality appear to support the textbook theory.

1c. Ownership leads to commitment: ⁽²⁾

Textbook theory declares that it is important to get maximal client ownership of a model because client ownership will lead to commitment from the client to implement the model's recommendations. If clients do not feel that a model is theirs, they are unlikely to act upon it. This is strongly confirmed by the case data, as Table 7.7. indicates.

	ownership		commitment	
Case 1	+	4	++	5
Case 2	+/-	3.5	+	4
Case 3	+	4	++/+	4.5
Case 4	-	2		1
Case 5	+	4	++/+	4.5
Case 6	+	4	++/-	4.5

The close correlation between ownership and commitment is even more clear when the data are plotted as in Figure 7.3.



This incidentally illustrates the academic relevance of unsuccessful case studies; for had it not been for the disaster of Case 4, only a very narrow range of values would have been observed.

3. Communication leads to consensus: 🗐

The relation between communication and consensus is often discussed in the literature but is not universally regarded as a strictly positive one. In politically sensitive situations, it has been suggested, intensive communication may have a negative impact on consensus.

	communication		consensus	
Case 1	++	5.0	+	4.0
Case 2	++	5.0	+/-	3.5
Case 3	++	5.0	++	5.0
Case 4	-	2.0		1.0
Case 5	+	4.0	+	4.0
Case 6	++	5.0	++	5.0

Table 7.8.: Case data for Relation 3: communication-consensus

This idea would seem to be confirmed by the case data, for in Case 4, the only highly political sensitive project, consensus did indeed reach an all-time low. In all other cases good communication coincided with fair levels of consensus.

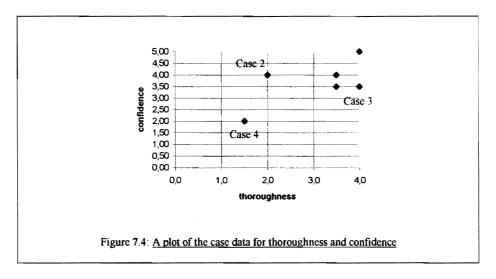
5. Thoroughness leads to confidence: $\frac{n}{2}$

The preceding relations dealt with various process characteristics that may influence organisational support. This particular relation concerns the effect of model quality on aspects of the organisational platform.

	thoroughness		confidence	
Case 1	+	4.0	++	5.0
Case 2	-	2.0	+	4.0
Case 3	+	4.0	+/-	3.5
Case 4	/+	1.5	-	2.0
Case 5	+/-	3.5	+	4.0
Case 6	+/-	3.5	+/-	3.5

Table 7.9: Case data for Relation 5: thoroughness->confidence

The case data shown in Table 7.9 provide partial support for this relation, as may be seen more clearly from the scatter plot in Figure 7.4:



There are two obvious exceptions to the rule. The first is Case 3, where the analysis was considered to be fairly thorough, yet confidence was only modest because so few real-world data had been available to test the model recommendations. The other is Case 2, where there was no quantitative validation, but participants still felt they had the right model. However, the general picture is more or less confirmed: the more thoroughly the model has been analysed, the more confident people are that the model is correct. Case 4 provides the negative example, Cases 1, 5 and 6 are the positive examples.

11a. Involvement leads to completeness: 🕲

The thought behind this relation was that one needs inputs from all stakeholders to arrive at a complete picture of a problem. This relation cannot be confirmed by our case data, as Table 7.10 indicates.

Case 1	involvement		completeness	
	+	4.0	++/-	4.5
Case 2	-/+	2.5	+/-	3.5
Case 3	-	2.0	+/-	3.5
Case 4	+	4.0	+/-	3.5
Case 5	+	4.0	+	4.0
Case 6	+/-	3.5	+	4.0

Table 7.10: Case data for Relation 11a: involvement→completeness

We see, first of all, that the values for both variables fall within narrow ranges, with those for completeness centred around 'good' (3.5 to 4.5), and even those for involvement running only from 2.0 to 4.0. This impedes a proper assessment of the relation.

But closer inspection reveals why the relation is not sustained with these data: The score '+' for involvement occurs three times, leading to a '+/-' in Case 4, a '+' in Case 5 and even a '++/-' in Case 1. In other words, to the whole range of values for completeness. And the same applies in reverse with a value of '+/-' for completeness occurring three times but preceded by values for involvement running the whole gamut from '-' to '+'. The present case data therefore do not uphold Relation 11a.

14b. Involvement leads to insight: $\frac{2}{4}$

The idea that involvement in a modelling process generates learning and insight is another cornerstone of all participatory modelling techniques. Please remember that we confine ourselves here to the opinions from the participants: if they say that they have learned as a result of the project, then it is assumed that learning has indeed occurred. We have not attempted to address questions as: Is this indeed the case? What was actually learned then? Was this learning achieved through modelling or merely by being present during discussions? Might another method have been superior? Was the level of involvement inadequate or, on the other hand, carried to far?¹⁰

	involvement		insight	
Case 1	+	4.0	++	5.0
Case 2	-/+	2.5	++	5.0
Case 3	*	2.0	++	5.0
Case 4	+	4.0	-/+	2.5
Case 5	+	4.0	+	4.0
Case 6	+/-	3.5	+/-	3.5

Table 7.11: Case data for Relation 14b: involvement-insight

The scores for involvement are disappointing. It would seem obvious that one learns through being involved, but apparently being involved is not enough (one needs to communicate as well, perhaps). Incidentally, the reason why not so many insights were generated in Case 6 had everything to do with the fact that this project was still in progress, and had very little to do with involvement.

An alternative interpretation of these data could be that the client will generally learn a great deal, whether everyone is deeply involved or not. In the majority of cases high scores for insight were found, regardless of involvement levels. For instance, in Cases 1-3 the score for insight is '++', but this high level of insight is achieved with involvement levels ranging from '-' to '+', i.e. across the entire range of involvement encountered in the cases¹¹.

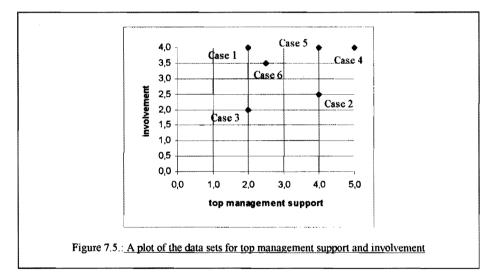
26. Top management support leads to involvement: 🙁

A top manager can force all stakeholders to the table. The best illustration of this is provided by Case 4, but Case 5 is another example of the textbook theory, as Table 7.12. indicates.

	top management support		involvement	
Case 1	-	2.0	+	4.0
Case 2	+	4.0	-/+	2.5
Case 3	-	2.0	-	2.0
Case 4	++	5.0	+	4.0
Case 5	+	4.0	+	4.0
Case 6	_/ +	2.5	+/-	3.5

Table 7.12: Case data for Relation 26: top management support-involvement.

Case 3 and 6 exemplify the negative version of the theory: low top management support leads to unsatisfactory involvement. Unfortunately, Case 1 and 2 do not fit the theory at all, particularly when the data are viewed from a graphical perspective as in Figure 7.5.



It has to be accepted that we can draw no conclusions on the basis of these data: Involvement can be good ('+') for values for top management support across the whole range from '-' up to '++'. There may still be a positive relationship between these two variables in general, but this effect does not appear to have had an overriding influence in these six specific cases.

32. Group size decreases speed: 🙁

Another text book classic is that with larger groups, sessions in particular and projects in general tend to proceed more slowly. But we find no support for this relation from the data as shown in Table 7.13.

	group size		speed	
Case 1	-	2.0	+	4.0
Case 2	+	4.0	+	4.0
Case 3	-/+	2.5	-	2.0
Case 4	++	5.0	-	2.0
Case 5	++/+	4.5	+	4.0
Case 6	+	4.0	/+	2.5

Table 7.13:	Case data	for Relation	32: group	size→speed.

Speed can be high in large groups (Case 2, Case 5) as well as in small groups (Case 1). It can also be low in large groups (Case 4) and in small groups (Case 3). The case data offer no evident explanation for this lack of correlation, except that speed was probably more strongly influenced by other factors. If we turn to the individual case evaluations, we find that in Case 3 speed was low because of low involvement, which led to repetitions, in Case 4 it was low due to a variety of reasons, unwilling participants in a political environment being one of them. In Case 6 speed was perceived as somewhat low, no doubt partly because of the complexity of the issue and probably because the project was still in an early stage. So we find a host of different reasons, none of them related to group size.

Another possible partial explanation is that bigger groups do indeed slow down the progress, but that in Case 2 and Case 5 the consultants may have found a way of overcoming this handicap.

33. Familiarity with method improves communication: \mathfrak{V}

Several distinguished practitioners in the business modelling world stress the need to make participants familiar with the particular method they use, be it system dynamics or soft systems methodology, prior to the real modelling process. This is supposed to improve the subsequent process considerably. It sounds like good advice, and probably is too, if one can get the client sufficiently motivated to comply¹².

	familiarity with method		commu	nication
Case 1		1.0	++	5.0
Case 2		1.0	++	5.0
Case 3		1.0	++	5.0
Case 4	-	2.0	-	2.0
Case 5	**	1.0	+	4.0
Case 6	1	2.0	++	5.0

Table 7.13: Case data for Relation 33: familiarity with method-communication

Unfortunately, the case data shown in Table 7.13 are of fairly limited value simply because hardly any of the participants were familiar with a PBM method. At most one or two participants out of a group of eight in Case 4 had encountered similar methodologies, whilst in Case 6 techniques stressing participation and teamwork were

said to be common practice within the client company. So the data tell us little other than that it does seem possible to have excellent communication in the modelling process without substantial prior exposure to the various aspects of the modelling method.

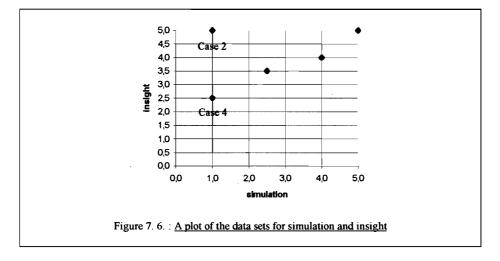
40. Simulation creates insight:

We have already examined the textbook theory that involvement in the modelling process leads to insight. A parallel to this relation is that conducting simulation experiments with a simulation model should also enhance insight. When one starts comparing cases the case data presented in Table 7.14 the first two cases seem to be in flat contradiction because in both cases a great deal of learning occurred, but in Case 1 extensive computer simulation was used, whereas no quantified model was developed in Case 2.

	simulation		insight	
Case 1	++	5.0	++	5.0
Case 2		1.0	++	5.0
Case 3	++	5.0	++	5.0
Case 4		1.0	-/+	2.5
Case 5	+	4.0	+	4.0
Case 6	-/+	2.5	+/-	3.5

Table 7.14: Case data for Relation 40: simulation →insight.

But looking further down, we see that the second case is really the odd one out, as becomes apparent from a glance at the scatter plot in Figure 7.6. Apart from Case 2, we find a neatly linear relation of five out of six scores (N.B.: the top right hand point stands for both Case 1 and 3).



Whenever simulation was used a great deal of insight was gained; furthermore, the higher the score for simulation, the greater the amount of insight that was gained.

So perhaps we should conclude that this relation is confirmed, but that it works only in the positive sense: simulation does lead to insight, but there are other ways to gain insight from a model than quantified simulation. As Case 2 illustrates, a qualitative model can also lead to substantial learning. One really would need more qualitative cases than the two shown in this graph to assess the validity of this relation properly (and of course far more quantitative cases as well).

47. Process facilitation skills lead to focus: ⁽³⁾

The final textbook theory relation is easy to evaluate. Judging from the cross-case data in Table 7.15, this relation holds for all six cases evaluated. Whenever the process facilitation skills were perceived by the respondents as good¹³, a clear focus could be maintained; whenever participants found process facilitation skills poor or only moderate, focus received low scores. So a good facilitator seems to be needed to keep a session focused.

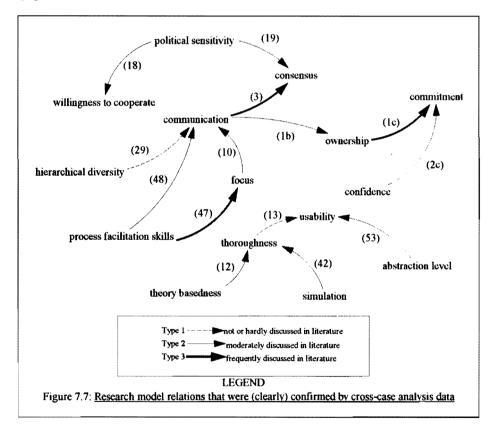
	process facilitation skills ¹⁴		fo	cus
Case 1	+	4.0	++	5.0
Case 2	+	4.0	+	4.0
Case 3	+	4.0	+	4.0
Case 4		1.0		1.0
Case 5	+	4.0	+	4.0
Case 6	+/-	3.5	+/-	3,5

Table 7.14: Case data for Relation 47: process facilitation skills->focus.

This strong confirmation is all the more remarkable since this is one of the very few relations where a single project design element seems to have a clear impact on strategic decision-making effectiveness. It is not that the beneficial effects of other elements (e.g. propositions or diagrams) are serious in doubt; nevertheless they do not seem to have an overriding influence on overall performance. But this particular relation, together with those containing simulation and abstraction level as project design elements, is among the few that do seem to have such an influence. This holds certain implications for method design, for the relation carries the clear message that *it is the designer who designs, not the method.*

7.3. Confirmed Exploratory Relations

The preceding section investigated cross-case data for eleven of the sixty-six relations contained in our research model. These eleven were selected for their special interest as representing relations that were more or less 'textbook theory'. But what about the other fifty-five relations? They too ought to be worthy of interest, especially any relations that might be substantiated by cross-case analysis¹⁵. In all, fifteen such relations, shown in Figure 7.7., were clearly confirmed. The thickness of the arrows once again indicates the frequency with which they are discussed in the literature. We find three thick lines, depicting the three relations that were already discussed in the previous section; the remaining twelve relations will be discussed on the subsequent pages.



Glancing over this partial causal diagram, one cannot help but be struck by the prominent place occupied by *communication*: three factors that affect communication and two other factors that are affected by communication. This prominence is all the more striking if we compare this diagram with Figure 7.1., the textbook theory, where *involvement* takes a similarly prominent position. This is consistent with the earlier discussion of Relation 1a, where it was suggested that the essence of the term 'client participation', as it is usually treated in the literature on modelling processes, is better

covered by the term 'communication' than by 'involvement' in our research model. To put this another way, it is not enough to get people around a table (= 'involvement'), they also have to share ideas, listen with interest and contribute openly (= 'communication') if the process is to be successful.

1b: Communication leads to ownership: 🗐

Our revised version of 'textbook theory' asserts that if people communicate openly and effectively in the course of the modelling process they will develop a feeling of ownership for the resulting model. The case data shown in Table 7.15. appear to confirm that relationship.

	comm	unication	ownership	
Case 1	++	5.0	+	4.0
Case 2	+++	5.0	+/-	3.5
Case 3	++	5.0	+	4.0
Case 4	-	2,0	-	2.0
Case 5	+	4.0	+	4.0
Case 6	++	5.0	+	4.0

If we look at the data case by case, we notice that whenever communication was good, so was ownership and vice versa. The only exception was Case 2, where communication was excellent but did not lead to high ownership. This may have been due to the low level of consensus that was reached in that project, because in situations where project participants fail to reconcile differing viewpoints it becomes very hard to develop a model that reflects everyone's ideas...

	conf	idence	commitment	
Case 1	++	5.0	++	5.0
Case 2	+	4.0	+	4.0
Case 3	+/-	3,5	++/+	4.5
Case 4	-	2.0		1.0
Case 5	+	4.0	++/+	4.5
Case 6	+/-	3.5	++/-	4.5

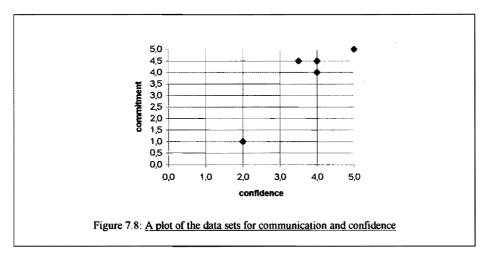
2c. Confidence leads to commitment: (2)

Table 7.16: Case data for Relation 2c: confidence-commitment

Incidentally, the fact that we have three identical data pairs, with the value '++' for communication coinciding with the value '+' for ownership in three out of six cases, poses an interesting dilemma when one considers two different purposes of evaluation. The high scores serve the primary purpose of demonstrating that the method has worked, but when it comes to the second purpose of determining why the method

worked, the data are far less helpful since there is so little variation in the values (Case 4 saves the day in that respect).

The theory is that people will not be committed to a decision if they are not confident that the decision is the right one. So high levels of confidence should coincide with high levels of commitment. Judging from the plot of the data sets in Figure 7.8, this is clearly the case. This figure leads further support to the relation in that the one case where model confidence was very low (Case 4) there was very low commitment as well.



What one should not forget, though, is that other factors than confidence – for instance, ownership – also determine commitment.

10. Focus improves communication: ⁽⁹⁾

This relation states that communication is improved if a good degree of focus is maintained¹⁶. This is sustained by the data in Table 7.17., which show that projects in which discussions were regarded as well-focused were usually characterised by good communication, whereas in the case where focus was absent, communication was bad as well (Case 4). Only Case 6 represents a minor exception, in that excellent communication was achieved without excellent focus.

	focus		commu	nication
Case 1	++	5.0	++	5.0
Case 2	+	4.0	++	5.0
Case 3	+	4.0	++	5.0
Case 4		1.0	-	2.0
Case 5	+	4.0	+	4.0
Case 6	+/-	3.5	++	5.0

Table 7.17.: Case data for Relation 10: focus-communication

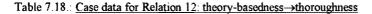
Of course in our research model many variables affect communication, in fact more than fifteen different factors. It is hardly surprising that the scores for some of these show a significant correlation with communication, but in this case the relation seems fairly plausible and strong at the same time.

12. Theory-basedness leads to thoroughness: 🗐

This is an interesting set of data. The reasoning behind this relation was that if you use more existing theory, your analyses will be more refined. Looking at the case data in Table 7.18, that seems to be confirmed. Every time when theory-basedness is relatively high, thoroughness is relatively high as well (bear in mind that thoroughness never becomes very high in an absolute sense, i.e. never goes above '+', and averages 3.1, i.e. halfway between -/+ and +/-).

This may, in fact, be an instance of a correlation that works in both directions in that a sound analysis may lead to the applicability of more theories. At any rate the correlation is clear, which one might interpret as good news for the relevance of academic theory in strategic decision-making.

	theory-b	asedness	thoroughness	
Case 1	+	4.0	+	4.0
Case 2	-	2.0	-	2.0
Case 3	+	4.0	+	4.0
Case 4	-/+	2.5	/+	1.5
Case 5	+/-	3.5	+/-	3.5
Case 6	+	4.0	+/-	3.5



13. Thoroughness leads to usability: (9)

The general idea behind this relationship is that the better your model is, the greater the utility of its findings will be: 'model quality improves usability". But because usability is part of the overall concept of 'model quality' in the research model, a surrogate variable had to be found, and the two key components, 'completeness' (13a) and 'thoroughness' (13b) were introduced as substitutes. Relation 13a was only partially confirmed, but Relation 13b was strongly confirmed as Table 7.19 shows.

Thoroughness was low in two instances (Cases 2 and 4), neither of which led to directly usable models¹⁷. In three other cases thoroughness was good ('+'), which coincided with fairly usable up to very usable results. Case 5 illustrates that it is possible to have a model that is not thoroughly analysed and yet is fairly usable.

	thorou	ghness	usability	
Case 1	+	4.0	++	5.0
Case 2	-	2.0	-/+	2.5
Case 3	+	4.0	+	4.0
Case 4	/+	1.5		1.0
Case 5	+/-	3.5	++/-	4.5
Case 6	+/-	3.5	+/-	3.5

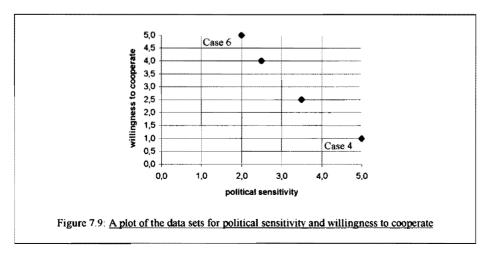
Table 7.19:	Case data	for Relation	13a: the	oroughness→usability

18. Political sensitivity decreases willingness to cooperate: 🗐

Politically sensitive problems pose career risks for participants and as a consequence, this relation postulates, they will tend to be unwilling to cooperate in the modelling process. Table 7.19 and Figure 7.9 show the case data on this negative relation.

	political sensitivity			igness operate
Case 1	+/-	3.5	-/ +	2.5
Case 2	-/+	2.5	+	4.0
Case 3	-/+	2.5	+	4.0
Case 4	++	5.0		1.0
Case 5	-/+	2.5	+	4.0
Case 6	-	2.0	++	5.0

The data plot is especially nice, showing an almost precise linear negative relation. Moreover, since the range of values is quite broad for both variables, one can safely say that these data provide strong supportive evidence for this relationship¹⁸. Finally, it is worth noting that in the majority of cases political sensitivity was not very high.



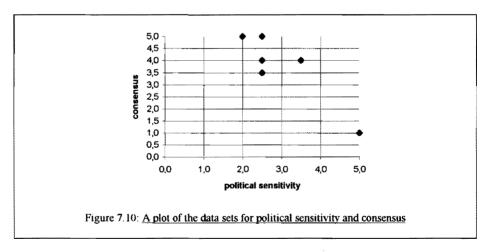
19. Political sensitivity decreases consensus: ⁽³⁾

The proposition here, which is at least partly corroborated by the case data presented in Table 7.21, is that if their own careers are at stake, participants will tend to disagree more vehemently than in situations that are not politically sensitive. A participative modelling project can not be expected to surmount this difficulty, is what these data suggest.

	political s	ensitivity	consensus	
Case 1	+/-	3,5	+	4.0
Case 2	-/+	2.5	+/-	3,5
Case 3	-/+	2.5	++	5.0
Case 4	++	5.0		1.0
Case 5	-/+	2.5	+	4.0
Case 6	-	2.0	++	5.0

Table 7.21: Case data for Relation 19: Political sensitivity->consensus

There is an element of tentativeness about confirming this relation because only Case 4 provides data on a situation of very high political sensitivity (5.0), as Figure 7.10 clearly illustrates.



29: Hierarchical diversity decreases communication: ${}^{\textcircled{3}}$

One of the PBM guidelines in Chapter 4 is that one should avoid too much hierarchical diversity in groups, especially in politically sensitive situations and especially if direct supervisor-subordinate pairs are present. But that does not mean that one can solve all communication problems by keeping hierarchical diversity very low. Hierarchical diversity may have some influence, but probably not much. The clear confirmation of this relation by the case results displayed in Table 7.22. may, therefore, be partly accidental, especially since the case material includes only one project where

	hierarchical diversity		commu	nication
Case 1	-	2.0	++	5.0
Case 2		1.0	++	5.0
Case 3		2.0	++	5.0
Case 4	+	4.0	-	2.0
Case 5	-	2.0	+	4.0
Case 6	-	2.0	++	5.0

hierarchical diversity was high (Case 4). For these reasons, the relation may be something of an oddity.

42. Simulation improves thoroughness: ⁽³⁾

It is comforting to see this relation is upheld by the case data (see Table 2.23). Whenever simulation models were developed, the resulting model was perceived as thorough. In retrospect, this is perhaps not so surprising given the depth of the analyses that are usually required to develop such a model. But there is no *a priori* reason to suppose that creating a simulation model would automatically guarantee that the model is perceived to be thorough.

	simulation		thoroughness	
Case 1	++	5.0	+	4.0
Case 2		1.0	-	2.0
Case 3	++	5.0	+	4.0
Case 4		1.0	/+	1.5
Case 5	+	4.0	+/-	3.5
Case 6	-/+	2.5	+/-	3.5

Table 7.23: Case data for Relation 42: simulation->thoroughness

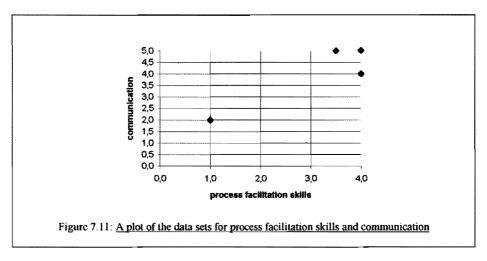
48: Process facilitation skills improve communication: \mathfrak{V}

The ostensibly reasonable idea behind this relation is that a skilled facilitator can steer a group of people to communicate without verbal dominance, openly and with a good exchange of ideas. It is, in fact, corroborated by the case data set out in Table 7.24., as might be expected in view of the strong links that have already been demonstrated between facilitator skills and focus and between focus and communication.

	process facilitation skills		communication	
Case 1	+	4.0	++	5.0
Case 2	+	4.0	++	5.0
Case 3	+	4.0	++	5.0
Case 4		1.0	-	2.0
Case 5	+	4.0	+	4.0
Case 6	+/-	3.5	++	5.0

Table 7.24: Case data for Relation 48: Process facilitation skills->communication

Two cautionary remarks are in order. Firstly, these data are based upon skills as perceived by the participants. Thus bad sessions might have been 'blamed' on the facilitators, rather than upon something else. The second remark is to draw attention to the uneven distribution of the scatter plot in Figure 7.11., with only one point in the down left corner of the spectrum and five other cases clustered closely together in the top right corner.



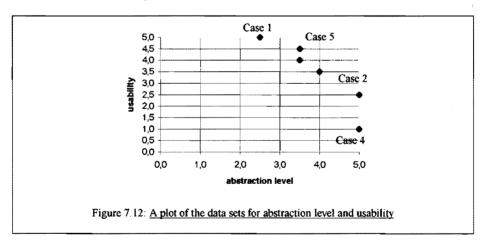
53: Abstraction level decreases usability: ⁽⁹⁾

System dynamics models are fairly abstract by design; systems are intentionally modelled from the distance of the so-called 'policy level'¹⁹ to avoid getting buried in heaps of irrelevant detail. Accordingly, a higher abstraction level should lead to more insight (Relation 52 in the research model from Chapter 2), but unfortunately, this Relation 52 was not confirmed by the data. This makes the cross-case analysis results for Relation 53 all the more interesting.

	abstraction level		usability	
Case 1	-/+	2.5	++	5.0
Case 2	++	5.0	-/+	2.5
Case 3	+/-	3.5	+	4.0
Case 4	++	5.0		1.0
Case 5	+/-	3.5	++/-	4.5
Case 6	+	4.0	+/-	3.5

Table 7.25: Case data for Relation 53: abstraction level->usability

The data in Table 7.25. suggest that more abstract models are of lower utility. Is that a disturbing result for system dynamics modellers? Should it persuade them to abandon the 'policy level' modelling guideline? Not necessarily, because usability refers to the degree to which a model is instrumental in facilitating the process of reaching an actual decision, and it is generally acknowledged that there is a trade-off between models that support actual decision-making and models that generate some kind of learning (cf. Section 4.6., Design trade-off # 9). Models of the first category are complex and have lots of detail; models of the second category are simple and aggregated. So from this perspective it is not at all disturbing that the data points in Figure 7.12. reveal an unequivocally negative relationship between abstraction level and usability. If anything is troubling, it is that a neat positive relationship could not be established between abstraction level and insight.



7.4. Multiple relation analysis

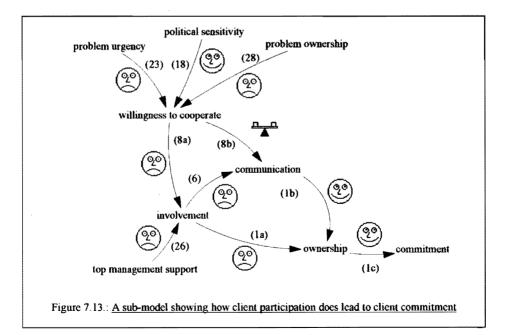
In the two preceding sections we looked at correlations between two variables. Often we had to conclude that the cross-case data showed no clear fit where the established theory asserted that there should be one. We could usually provide explanations for these bad fits by pointing to other factors that also had an influence on the variables in question. Most of the variables in our research model are affected by several other variables at a time — a circumstance that could be analysed further by multiple regression analysis techniques if the data lent themselves to statistical evaluation. Our case data are not emendable to statistical analysis but we can look at the case evidence for more than two variables at a time all the same.

In this section, therefore, we shall look at the case findings from a more detached perspective to try and pick out those 'chunks' of the research model which form so-called "causal chains"²⁰. This will enable us to find supportive material for many of the relations in the research model. In particular, it will be shown that our research confirms three key assumptions or lines of reasoning from our research model:

- 1. Client participation leads to client ownership commitment;
- 2. Good communication generates learning;
- 3. Simulation leads to better decisions.

These assumptions are crucial not only to the PBM method but also to its main founding disciplines, of system dynamics and process consulting.

1. Client participation leads to client ownership and commitment



The core assumption behind all participatory modelling approaches is that client participation in the modelling process is necessary to assure sufficient client ownership for the model, the analysis made with that model and decisions based upon these analyses. Client ownership, then, is key in achieving client commitment to implement decisions that derive from a modelling project. These assumptions appear to be confirmed when we look at our case results from the broader perspective that is visualised in Figure 7.13.

The relation ownership \rightarrow commitment was already confirmed in Section 7.2. and is probably one of the strongest findings from this research. No ownership means no commitment. Already in Chapter 3 we had concluded that the step from a client's commitment to implement a decision up to actual implementation of that decision is too big: there are just too many other factors which affect this process. This relation commitment \rightarrow decision implementation is unlikely to be confirmed unless one had survey data from a sufficiently large number of projects to permit statistical generalisations.

Which brings us to the issue of participation leading to ownership. Here the results are, on the face of it, confusing. There is a strong correlation between quality of communication and ownership, but no clear association between involvement and ownership. To understand why this should be, we have to go back to the definitions of our research model in Chapter 2. There we said that three levels of participation can be distinguished:

- 1. *project* participation: the degree to which all relevant stakeholders were involved in the project, e.g. as members of the project team;
- 2. *workshop* participation: the degree to which participants were able to attend every workshop that was conducted;
- 3. *discussion* participation: the degree to which all workshop participants actively engaged in the discussions.

We also stated there that this third level of participation was labelled as 'communication' within our research model.

It is this third level, 'discussion participation', or 'communication', that is really key in establishing ownership. People may receive project information (project participation) and they may sit at the table during workshops (workshop participation), but real ownership will not arise unless they actually talk about the model during its creation, suggest improvements or additions to it, and discuss aspects of the problem by means of this model with their fellow group members. So in this respect, we could say that the only really relevant relation here is Relation 1b, 'communication leads to ownership', and that relation is confirmed by the case data.

But let us look in more detail at the case data for Relation 1a, 'involvement leads to ownership', with the aid of Table 7.26. on the next page. What went wrong here? Cases 2 to 4 do not follow the pattern one would expect, since in Case 4 involvement was high, but ownership was low, whereas in Cases 2 and 3 involvement was limited and yet ownership was high. Why was that?

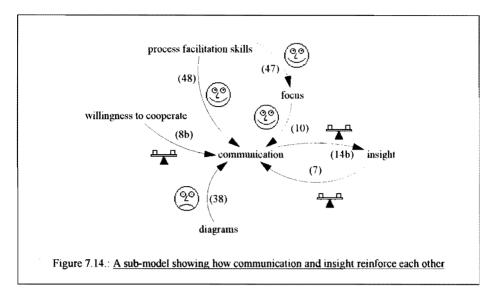
	political sensitivity	problem urgency	problem ownership	top mgt support	willingness to coop.	involve- ment
Case 1	+/-	++	++	-	-/+	+
Case 2	-/+	+/-	+/-	+	+	-/+
Case 3	-/+	++/-	-	÷	+	-
Case 4	++	+	-	++		+
Case 5	-/+	+	+	+	+	+
Case 6	-	+/-	+	- /+	++	+/-

Table 7.26:	Case data for factors affecting willingness to cooperate, involvement and
	communication

- In Case 4 involvement was high but communication and ownership were low because participants were forced to the table by top management (Relation 26). They themselves were, in fact, unwilling to cooperate and therefore did not communicate openly (Relation 8a): you can lead a horse to water, but you cannot make it drink. Why were they unwilling? Because to them this was a politically sensitive issue (Relation 18)²¹. Moreover, their bosses were present in the same room (Relation 29).
- In Cases 2 and 3 involvement was relatively low yet communication and ownership were very good. Low involvement here means that not all the project team members attended most of the sessions. This was because willingness to cooperate was limited (Relation 8a). And why was that? Because both problem urgency (Relation 23) and problem ownership (Relation 28) were limited: these were not problems demanding a rapid solution [N.B.: The score for problem urgency in Case 3 may seem confusing. The reader may recall that, initially, a logistics strategy had to be developed very rapidly (urgency = '++'), but after disappointing test results with the product in question this became a non-issue (urgency = '-'). Attendance at workshops did drop after these test results.]

Good communication generates learning

A second core assumption in PBM is that the conversational process it facilitates generates learning, or, in terms of our research model, 'communication leads to insight'. A more detached view of the case evidence suggests a partial network like that shown in Figure 7.14.



From this evidence, we may conclude that good communication did coincide with high levels of insight in the six cases studied. In fact, from Table 7.27. we can see that the main reason why Relation 14b: communication \rightarrow insight is not fully confirmed is Case 6, where communication was very good but only a small number of insights were obtained, and this was largely attributable to the early stage of the project at the time of the evaluation interviews.

	communication		insight		
Case 1	++	5,0	++	5,0	
Case 2	++	5,0	++	5,0	
Case 3	++	5,0	++	5,0	
Case 4	-	2,0	- /+	2,5	
Case 5	+	4,0	+	4,0	
Case 6	++	5,0	+/-	3,5	

Table 7.27.: Case data for Relation 14b: communication-insight

Not surprisingly, the converse relation insight \rightarrow communication (Relation 7), looks pretty robust as well. The way this should be read is that, as participants start understanding more about the problem and about the perspectives of the other participants, a common language is created and communication opens up, allowing a more effective exchange of ideas, which in turn leads to more insights, and so on

How does one get effective communication? First of all, participants have to be willing to take part in the conversational process (Relation 8b)²². Secondly, the discussions need to be structured so that a certain degree of focus is maintained (Relation 10). A good facilitator can create such a focus (Relation 47), especially with the aid of techniques from the PBM tool set, and can also be instrumental in creating an open atmosphere for discussions (Relation 48).

So far we have only talked about relations that were either confirmed or largely confirmed, with just one case to blame for the incompleteness of the fit. But communication is determined by a large number of factors. Diagrams are a good example (Relation 38); these are used extensively to facilitate discussions and to give better insight. But for diagrams, as for many of the other PBM techniques, goes that they do help but in themselves seldom make the difference between good and bad communication. Diagrams were used in most projects, both the successful ones and the less successful ones.

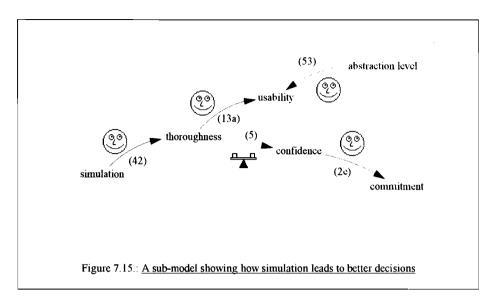
One final word of caution: what is meant by 'insight' or 'learning"? An honest answer is that we cannot be sure what the participants really meant when they indicated, as they did in most cases, that they had 'learned' a great deal from the project. 'Learning' is a very broad concept. It may well be that respondent A meant that he had learned some basic facts about the problem, whereas respondent B meant that he had obtained an improved intuition into the dynamic behaviour of the issue, whilst respondent C merely meant that he had learned more about other project team members' thinking about the problem. Communication does lead to learning, but what that entails we do not yet know precisely²³.

Simulation leads to better decisions

A point of ongoing controversy between system dynamics modellers and practitioners of other systems-based 'business modelling' approaches concerns the usefulness of quantified simulation models for strategic decision-making. For 'orthodox' system dynamicists, quantification is more or less a *conditio sine qua non*. The dynamic behaviour of social systems tends to be complex, non-linear and counter-intuitive. A qualitative model can only give the modeller a good view of the static structure of a system, not of its dynamic behaviour. Therefore, so goes the classical view, it is essential that a dynamic, quantified simulation model is constructed to arrive at sound and well-founded policy recommendations.

The alternative view is that strategic issues are simply too 'soft', too 'messy', to lend themselves to quantified analysis. Managers do not want or need quantified models of their strategic problems. When asked for quantitative estimates of soft variables in a model, managers will often shrug their shoulders²⁴, whereas they find the qualitative version of the model quite useful.

Both views are valid up to a point, the author feels. If a problem lends itself to quantification, simulation is generally very useful; if the problem does not lend itself to quantification, simulation becomes rather artificial. This feeling is not just based upon intuition, as Figure 7.15. shows. Whenever simulation was used in this research, it did indeed lead to 'better' decisions.



Decisions were 'better' in the sense of more 'thorough' (Relation 42), i.e. the participants felt that all the necessary analyses had been conducted. Another positive effect of a thorough decision is that the participants feel that the resulting recommendations are more readily usable. That in itself is another element of a 'good' decision in our research model.

But 'better' decisions also means better in the sense of being more strongly supported by the client organisation. For we have already seen in Section 7.2. that in these six cases 'confidence' in the correctness of the analysis, and the models, and the decisions based upon those models, was more or less positively correlated with thoroughness (with Case 2 as the main exception, i.e. a case where a model was perceived as not thorough yet confidence in the model was high). And confidence in a decision leads to commitment to implement it (Relation 2e).

Does this mean then that the 'orthodox' view is correct, and that we should always simulate? No, because in Case 2 the managers were quite comfortable with a model that they felt not to be too thorough, because it fitted their purpose. So once again; if you have a problem that lends itself to quantification, then simulate; if you have a problem that is too 'messy' to do so, then try to construct an insightful conceptual model with the client group.

CHAPTER 8

Reflections and Conclusions

Three full chapters have already been dedicated to the three main deliverables of the current research:

- the PBM method itself (Chapter 4);
- its underlying theory of strategic decision-making effectiveness (Chapter 2) and
- the case evaluation procedure (Chapter 5).

Also, the main empirical findings from this research were already discussed in the previous chapter:

- PBM is a well-suited method to support strategic decision-making processes;
- The key elements in the theory underlying PBM appear to be valid (i.e. the need for client participation, the role of communication in learning and the usefulness of simulation).

The objective in the current chapter is therefore to look back on this research from somewhat more distance and ask:

- In reflection, how 'good' are the deliverables?
- In conclusion, what else has the author learned from this research project?

We will confine ourselves to these questions in this final chapter.

8.1. Reflections On The PBM Method

How 'good' is the method? Despite his obvious bias towards his own creation, and the lack of a perspectivising distance from the work that engendered it, the author does not feel it is immodest to answer: "Pretty good, probably". This is because the PBM method is not, after all, totally 'new'. Similar mixtures of system dynamics modelling, group facilitation and knowledge elicitation techniques, blended together with management consulting fundamentals, have been around for several years now¹. Many of these PBM-like methods have been quite successful; "systems thinking" has not become a buzzword for nothing. So, regardless of the particular merits of PBM, methods like it do appear to be quite successful in improving the effectiveness of strategic decision-making.

That assessment might seem to conflict with the evidence of Table 7.1. in Chapter 7, which indicates that the rating of the overall effectiveness of the method in the six cases evaluated suggests limited success. Indeed, only Cases 1 and 5 scored plusses all round.

The easy counter to such a critique is that it was not necessary for all cases to show strongly positive results. In our design-oriented research approach, the first cases were primarily 'tests' of intermediate designs; their main purpose was to provide information which would help to 'refine' the PBM method. Its design was not considered final until after Case 4, so only Cases 5 and 6 were projects where the method had to show good results. And bearing in mind that Case 6 comprised only the initial third of a long-running project, that leaves Case 5 as the main test case. But perhaps it would be more pragmatic to accept that it is simply very difficult to achieve effective strategic decision-making; that it is rare to achieve exhaustive coverage of a strategic problem; that discussing complex, urgent issues with groups of people from different backgrounds and with different objectives is almost bound to be frustrating and time-consuming; and that many barriers can stand in the way of really implementing even a sound and well-supported decision. To compare the results of a PBM-supported decision-making process with those of a hypothetical ideal decisionmaking process is hardly fair. What is fair is to compare them with the results of a decision-making process without this kind of support, or a process with conventional expert consulting support.

Another way of reflecting on the question of how well the PBM method works is to make the answer dependent on the type of problem or organisation to which the method is applied. We have seen that using PBM can be awkward for certain types of problems and within certain types of organisational contexts. PBM is likely to work best in situations where:

- political sensitivity related to the problem is low or moderate (i.e. career risks for participants are limited);
- the problem is complex, in the sense that no one has an complete overview or all the answers;
- · the problem has some 'hard', quantifiable elements as well as some 'soft' elements;
- the problem is urgent, needing speedy answers;
- participants feel that it is in their common interest to resolve the problem²;
- there exists sufficient top management support to start a project in order to resolve the problem;
- the problem is primarily a question of 'analysis' of organisational causes to problematic behaviour (e.g. "Why does our delivery performance remain inadequate?"), rather than 'designing' a new organisational structure to generate better behaviour (e.g. "What is an adequate organisational structure to realise our new corporate mission?").

There are no strict rules about this but, in general, if most of the above indicators are positive, then PBM should offer a suitable approach to tackling the issue.

The reader may recall that this research project was initiated to develop a method to support strategic decision-making specifically in operations management. A glance at the above list of indicators would suggest that PBM should be particularly suited to most OM issues. OM issues are very complex yet have some quantitative aspects; typically, they display elements of a classical functional antagonism such as that between sales and production, representatives of the respective functions usually accept that, ultimately, an effective solution is in their common interest. The majority of cases studied in this research project happened to involve OM-type issues, whether these concerned internal cycle time improvement (Case 1), a logistics strategy (Case 3), location analysis (Case 5³) or supply chain management (Case 6). All these cases were largely successful as well, so PBM does appear to be highly applicable to the technical as well as the organisational complexities of strategic OM issues.

8.2. Reflections On The Research Model

Our research model occupies a central place in this book. Introduced in Chapter 2 and applied in Chapters 6 and 7, it describes a theory of how strategic decision-making can be effective. *But how good is this theory*? Once again, this depends on how one wants to define 'good'. For one thing, the theory contains a large number of variables and relations, so by its sheer breadth it probably encompasses most of the relevant factors, but that does not exclude the possibility that it fails to capture fully some of the crucial relations. This should not come as a surprise, for our research design was an exploratory one that was deliberately intended to take stock of a wide array of potentially relevant variables and relations, rather than focus in depth on a selected small group of relations.

The literature analysis in Chapter 2 showed that some parts of this theory are strongly substantiated in the scientific literature whilst other parts are hardly mentioned at all. It seems reasonable to assume that those well-supported parts of the theory and that were confirmed by our cross case analysis would be relatively 'good' or 'robust', or, at least 'better' than those parts of the theory that were poorly formulated in the existing literature or that could not be confirmed by our case analysis, or both. By this token, the three key findings from Section 7.4. would score relatively well:

1. client participation leads to client commitment and ownership;

2. communication generates learning;

3. simulation leads to better decisions.

Taken together, these three confirm the core assumptions of the theory underlying the PBM metod.

Turning to other aspects of the quality of our theory, it should be noted that it focuses on the *inputs* and *outputs* of strategic decision-making processes, rather than on these processes themselves. Our theory does not contain a description of what actually happens in decision-making processes, what stages can be distinguished, what interactions typically take place⁴; the process itself remains very much a black box. Whilst this might be cited as a weakness, the main motivation for developing this theory was to guide evaluation of the *effectiveness* of the PBM process, that is, its outcomes, its results — rather than describe the process itself.

The same response would also serve to deflect the possible criticism that, for a model made by a system dynamics modeller, it contains very few *feedback loops*. It does feature some such loops (e.g. from 'communication' to 'insight' and back) but these are minor and certainly do not fully reflect the extremely dynamic, feedback-rich process of group decision-making. To repeat, our theory was never designed to represent processes which evolve over time but solely the results of those processes.

Finally, our research model looks fairly comprehensive when compared with those used by researchers in related fields⁵. For instance, one important omission in most of these models, but captured in our model, is the role of the facilitators. On the other hand, one might wonder at the conspicuous absence of 'client satisfaction' from a theory that is aimed at supporting such a client-oriented business as management consulting...

8.3. Reflections On The Evaluation Procedure

As for our third research deliverable, *how good is the evaluation procedure?* Once more we have to give a mixed reply. In this research project we used a systematic approach to qualitative data analysis in order to arrive at high-level causal explanations of multiple-case phenomena. If we consider how little had been done previously in this particular area, then we can be quite pleased with this first, truly exploratory, attempt. Multiple-case research itself is a relatively novel phenomenon, and its application to evaluation purposes is still quite rare. Conducting evaluatory case studies to explain, rather than just describe, certain organisational phenomena is even rarer. And to do this for multiple case studies rather than for a single site, is almost unheard of, to the author's knowledge⁶. Despite the scantiness of existing material, we have been able to realise our ambitious research objectives with this procedure.

On the other hand, although this procedure may have led to the desired results in the end, it certainly was not in a time-efficient process. As described in Chapter 5, it took many man-months to collect and interpret all the materials, and only a fairly small proportion of that material has found its way into this book. So the current version of this evaluation procedure scores fairly low on the 'usability' scale, and it would be unrealistic to expect such an inefficient procedure to become a standard tool for research in management and organisation, let alone for commercial management consulting projects.

Far more efficient versions of this evaluation procedure will have to be developed if this is to be achieved. How these will look like is hard to tell, but one might speculate that they would discard pre-project data collection, and confine themselves to one or two group evaluation interviews with participants, centred around a standard, written questionnaire, perhaps completed individually in advance and based upon a stripped-down version of our research model.

In retrospect, it is easy to see how data collection and analysis could have been conducted more efficient in this research project. However, it certainly was not obvious at the time, and this may be one of the lessons of exploratory, qualitative research: that one has to collect huge amounts of material knowing that probably only a fraction will be used eventually, but not knowing what fraction that will be....

8.4. Conclusions

In the course of six years of research one makes many mistakes and learns many lessons, of which only a limited number could be transmitted within the scope of the current book. Therefore, the author would like to broaden this scope here by presenting some of these lessons as well-meant final messages to each of the various readerships identified in Chapter 1. He hopes that these do not sound too much as coming "from the guru in his tree"⁷, because that is certainly not how they were intended...

A final message for system dynamicists

- **Participative modelling is the future**. The traditional expert mode of modelbuilding is history, in system dynamics as in other fields. There can be no doubt that the future lies in developing smaller models in close cooperation with managers and with a strong focus on learning and communication.
- But use your strengths and know your weaknesses. System dynamics is weak in dealing with process-related issues and organisational complexity. These are barely mentioned in the SD textbooks, and few tools and techniques exist in the field with which to tackle them. But implementation stands at the core of what system dynamicists do, as other schools of business modelling have understood far better. The field of system dynamics must learn from them. What they can learn in return is the unique ability of system dynamics to move seamlessly from vague, conceptual, and qualitative diagrams on a whiteboard to tangible, tested, quantitative simulation models on a computer. System dynamics can deal with both soft and hard issues and that strength should be fostered.
- And write down what you do in practice. This can only take place if modelbuilders start writing down what they do in practice. The conspicuous absence of literature on how system dynamics models are developed to address real issues with real clients contrast starkly with the large amount of high-quality work that system dynamics modellers do in practice. The argument that client confidentiality must be preserved is rarely more than a weak excuse for not publishing project experiences. If SD practitioners fail to observe, in their contacts with fellow modellers, the tenets of team learning, openness and free exchange of ideas that they preach in their work with clients, then where does that leave the field?

A final message for management consultants

• Process consultation and modelling are the future. There will always be a market for old-fashioned expert consulting, but it will become an increasingly smaller niche. More and more, clients want to operate with outside consultants on a basis of equality, with each party contributing specific expertise. Management consultants are beginning to realise that, often, the real experts are the managers at the client company, not themselves, at least if one takes the ability to implement findings as the relevant expertise. So process consultation is the future, but the same is true of modelling. Managers of client companies are getting increasingly well-educated and equipped with sophisticated conceptual skills; many of them are already used to employing spreadsheets, statistical analysis and simulation. More and more, they expect management consultancies to use modelling, both conceptual and quantitative, to help them in their strategic decision-making processes.

- But mix and match. The biggest danger in this is that the hammer may be mistaken for the entire tool set. There is far more to business modelling than PBM, and there is far more to management consulting than business modelling. Different problems and different organisational settings require different techniques; and, depending on the situations, those techniques have to be applied in different ways. Soon clients in their professional capacity will come to expect from management consultants what they now already expect in their private capacity from their plumbers and carpenters: that these hired helps should be able to solve a wide range of problems with an appropriately wide range of adequate tools.
- And conduct project evaluation to learn from your mistakes. The best way to develop such a tool set and the knowledge of how to use it is to evaluate projects explicitly. Such a *post mortem* is not just good for relations with the client, who is often quite pleased to find a consultant who seems to be customer-oriented enough to offer an 'after-sales service'; more importantly, the consultant will find that you *learn* a great deal as a professional from such evaluations. As an outside consultant, you only see a very small part of what is going on in the client organisation. After the project is over, clients are often far more willing and able to explain what really happened, and why, provided that someone takes the trouble to ask them explicitly and in confidence. Listening to these explanations is a fine way to broaden and sharpen a consultant's tool set.

A final message for Operations Management professionals

- Simulation modelling remains a very fruitful technique for operations management. The field of operations management is still the biggest application area for simulation modelling. Problems in operations management are usually very complex yet fairly tangible, which is an excellent combination for simulation. Recent advances in simulation software, in particular in model visualisation and user interaction, have largely reduced the actual programming effort required for simulation modelling and thereby greatly enhanced the future of the OR technique simulation in operations management.
- But beware of the expert approach. The days when modellers could think "I'm the expert, you are the dumb user", are gone. As this book has shown, simulation will only successfully support decision-making if the decision makers understand the models and feel ownership for them. In operations management, where there has always been a strong emphasis on technical expertise and an under-valuation of process facilitation skills, this expert attitude may be the biggest roadblock to a more effective use of simulation.
- And keep focusing on the left-hand side of the decimal point. Simulation can be
 a very refined mathematical tool, but more important than the level of detail it offers
 is a model's adequacy in representing the essential characteristics of a system. After
 all, as one leader in the field once remarked, operations management is still the
 discipline that uses quantitative measures but nevertheless "focuses of the left-hand
 side of the decimal point"⁸.

A final message for academics in management & organisation

- Design-oriented research is the future. Design-oriented research comes naturally to researchers in the field of management and organisation. In this field one is fundamentally concerned with *improving* organisational behaviour, not just with describing it. It is pity that adequate methodologies to conduct design-oriented research are only starting to be discovered, but it seems clear that this is the way forward.
- But remember that testing is also part of design. An emphasis on the design of practically usable methods, frameworks and techniques should not eliminate the need for researchers in this area to test their research deliverables. An essential part of every design cycle, testing implies measurement. Unfortunately, management and organisation studies have not been distinguished by the quality of their measurement instruments. Development of such instruments, or testing the effectiveness of an existing method with an existing instrument, is an equally valid research objective as the development of a new method or framework. To do all three that is, develop a new method, evaluation procedure as well as test the method with this procedure, may be too ambitious a target within the limited time-span of most individual research grants. This suggests that more research needs to be initiated in the form of interlinked projects, with one project focusing, for instance, on method development, the second on developing a measurement procedure, a third on evaluation-oriented research, and so on. In a design-oriented methodology, all three are equally important.
- And learn from the social sciences. The emergence of a design-oriented methodology is an exciting phenomenon, in that it offers a new alternative to the straitjackets of the deductive methodology of the formal sciences or the empirical methodology of the social sciences. That is not to say that these can or should be dispensed with; both methodologies have existed and flourished for several decades and have generated a broad and profound body of knowledge. It is hoped that this book demonstrates the utility of methods from the social sciences in conducting design-oriented research, and thereby helps make a case for more training in social science methodology for novice researchers in the field of management and organisation, to further the development of a field-specific design-oriented methodology.

A final message for social scientists

- Evaluatory and explanatory research designs are on their way. A few decades ago case studies were considered 'not done' in social science research, and, even today, evaluatory and explanatory case study designs do not enjoy high esteem among many orthodox social scientists. But this situation is changing as more and more well-thought-out techniques and descriptions their applications become available amongst them, the present book, the author hopes. If social scientists reject these new research designs, then they are selling their own field short because that would signify the continuing exclusion of large and interesting areas of our social reality from their research ambitions.
- But complement these by more focused research designs. There remains of course a place for more focused research designs such as surveys and experiments, since those provide a natural complement to the customarily broad, exploratory

designs of case-study research. The research presented in this book, for example, has generated a wealth of possible relations and effects, but none of them have been analysed in any real depth. And such in-depth analysis is needed as much as exploratory research.

• And develop more techniques for qualitative data analysis. So far, little attention is being given in the literature to the practicalities of conducting evaluatory and explanatory case-study research, and particularly to refining and documenting better techniques for qualitative data analysis. Clearly, much more material is needed in this area.

NOTES

Notes to Chapter 2

¹The term "strategic decision-making" is used for the processes that are the subject of the present book. It is a term that was first used by Anthony (1965), who built on the work by Simon (1976), but its application here is not entirely correct because in the processes under discussion it is often very hard to speak of "decisions". Usually it is hard to define, especially beforehand, what the decision to be taken really is about; moreover, it is often not clear at the outset what the problem really is. In many cases the organisation merely feels that there is a serious problem of some kind, and that somebody ought to look hard at it. If, at the end, some decisions are actually made, it is often hard to say at what moment in time they were taken, by whom, and what they entailed. However, other terms have their own drawbacks:

For instance, one alternative would be to talk about "strategic problem-solving" or "managerial problem-solving". In the field of operations research, one finds the terms "decision problems" (Rosenhead 1989a, p.1) and "complex" or "messy problems" (Eden 1989, p.21). In the field of system dynamics, the process has been labelled "model-building" (Vennix et al. 1993) or "modelling for learning" (Sterman and Morecroft 1994). All these terms have the drawback of not covering all aspects of the process taking place in the projects described in this research. These were not just about solving problems or model-building, they were also clearly action-oriented: something had to be done, decisions had to be made, and fast.

At the other extreme are terms that suggest that more was happening than was actually the case. Authors who are not concerned some kind of modelling but are purely strategists or operations strategists talk about "strategy formulation" (e.g. Mintzberg and Quinn 1992, Voss 1991, Mintzberg 1994). This is not what was attempted in the cases investigated here (except perhaps to some degree in Case 3 and Case 4): not an entire strategy was being formulated but just an aspect of that strategy. (That is, if we want to see a strategy as a consistent set of interrelated strategic decisions (Mintzberg and Quinn 1991, Akkermans and Van Aken 1992).

Another suitable term might be "policy", for it is at "the policy level" (Forrester 1961) that we are modelling in PBM. This term is being used more often by authors in this field, e.g. Vennix (1990), Verburgh (1994), Wentzler (1993), Hall, Aitchison and Kocay (1994), but has the drawback, at least in the Dutch context, that the equivalent of policy, "beleid" is used more in the public sector, whereas "strategie" is commonly used in the private sector, and all the cases described in this book took place in the private sector.

²The several functions of this research model will be discussed in Chapter 3.

³This is not to suggest that there are not other fields that have something to say about the subject. For instance, a good case could be made for the inclusion of simulation-gaming (c.f. Greenblatt and Duke 1981, Gentry 1990, Crookall and Arai 1992, Wenzler 1993), decision-support systems/executive information systems (Keen and Scott Morton 1978, Rockart and De Long 1988, Paller 1990, Koers 1993) and management consulting (Schein 1969, Greiner and Metzger 1983) in this review. The reasons for excluding these fields from closer scrutiny are both practical and historical: they simply are areas with which the author is not familiar and, accordingly, have not contributed greatly to the research reported here.

⁴The author fully agrees with Lane (1994), who uses the term "soft OR" yet labels it "an unhappy term, since it carries a nuance of ease and longueur rather than expressing the ferocious difficulty of such work" (p.114).

⁵Both system dynamics and GDSS have discovered this fruitful area of organisational psychology (or, more specifically, small group research) and have dedicated literature reviews to them to explore its

implications for their own fields (Vennix et al. 1994, Pinsonneault and Kraemer 1989, Jessup and Valacich 1993).

⁶One cannot do justice to several decades of research in just a few lines per scientific field. The reader is referred to more elaborate historical interviews in the footnotes to the introductory header for each field.

⁷For most fields, the choice was relatively easy: nevertheless the selection was guided by asking experts in each field to name a book they felt would be most appropriate for the current purpose.

⁸More elaborate historical overviews of the developments in operations management are provided by Swamidass (1986), Adam and Swamidass (1992) and Anderson et al. (1989).

⁹See Akkermans and van Aken (1992) for a discussion of terminology.

¹⁰In the Netherlands, most of the operations strategy frameworks that are currently still in use appeared in print in the second half of that decade (Schaafsma 1986, Hoekstra and Romme 1992, Sharman 1987, Verstegen 1989).

¹¹See Akkermans and van Aken (1992) for an extensive review of these process-related shortcomings.
¹²Hill (1980). An updated version of this article was published as Hill (1992).

¹³The first such framework was Platts (1990), summarised in Platts and Gregory (1992). The proceedings of last year's European Operations Management Conference contain a number of other references to such research in progress (Platts, Gregory and Neely 1994).

¹⁴Excellent overviews of this field are provided in Vennix (1990) and in Lane (1993).

¹⁵Roberts (1978).

¹⁶The main exception being Robert's own contribution to this compilation (Roberts 1978a).

¹⁷Richmond (1987).

¹⁸e.g. Hall and Menzies (1983), Morecroft (1985, 1988).

¹⁹Best described in Lane's (1994) "Modelling as Learning" article, first published in 1989, which bases itself upon Schein's (1969) "process consultation" framework.

²⁰In this area a great deal of innovative work has been done by Jac Vennix of Nijmegen University (Vennix 1990, Vennix and Gubbels 1994) and George Richardson, David Andersen and John Rohrbaugh of S.U.N.Y Albany (McCartt and Rohrbaugh 1989, Richardson, Andersen and Rohrbaugh 1992, Vennix, Richardson, Andersen and Rohrbaugh 1994).

²¹Morecroft and Sterman (1994).

 22 An erudite overview of the history of this field is provided in Mintzberg (1994). Not from a historical perspective, but equally comprehensive, are Mintzberg and Quinn (1991) and Van Aken (1994b).

²³Ansoff (1965).

²⁴Mintzberg, Raisingnam, Théorêt (1976).

²⁵Mintzberg and Quinn (1991, p.96).

²⁶Mintzberg (1973).

²⁷van Aken (1994b, Chapter 3).

²⁸Interestingly though, Mintzberg's publication in which these old ideas about rational, sequential, content-oriented and culture-free decision-making were finally laid to rest and a new conception of the field was synthesised, was published only very recently. It is indeed interesting to notice that most of Mintzberg's critical remarks in this book concern publications that were written around 1980 at the latest. One suspects that most of the authors of these must be retired by now.

²⁹For an excellent historical critique of this field, see Rosenhead (1989a).

³⁰Ackoff (1979). Although Little (1970) and Urban (1974) already voiced many of the arguments earlier, Ackoff evidently stated them more eloquently, or at a more appropriate time, or both... ³¹Schön 1983, p. 42.

³²This label has been suggested by David Lane (1993).

³³Rosenhead (1989).

³⁴Probably the best known are "soft systems methodology" (SSM), developed by Peter Checkland and "strategic options development and analysis" (SODA), developed by Colin Eden.

³⁵Slightly more recent publications, such as Eden and Radford (1990) and Checkland and Scholes (1990) mainly expand on the ideas expressed in an introductory manner in Rosenhead (1989).

³⁶For an excellent review of this field, see Scheper (1991) or Jessup and Valacich (1993).

³⁷Though Huber's 1984 article in MIS Quarterly, which Scheper (1991) calls as "a milestone in the history of GDSSs" (p.14), must be described as such

³⁸Described in Nunamaker, Vogel and Konsynski (1989a and 1989b)

³⁹Described by Gray and Olfman (1989), amongst others.

⁴⁰Eden (1992) mentions various reasons for this difference.

⁴¹Philips (1990) was the first to do so and has been followed by Scheper (1991) and Eden (1992).

⁴²"We are still in the "horseless carriage" phase of Group Support System functionality. Basically, we have done little more than insert a computer into traditional paper and pencil approaches" (Nunamaker, Vogel and Konsynski 1989b, p.151).

⁴³A more recent collection of articles might be Jessup and Valacich (1993), which unfortunately was at the time of writing not in the possession of the author.

⁴⁴An excellent overview of this field is provided by McGrath (1984).

⁴⁵See above.

⁴⁶Not unlike to the situation in system dynamics, one is tempted to say that a great start can be a twoedged sword for a new field because, according to McGrath: "This effective marriage of theoretically based ideas, socially significant problems and experimental methodology had not occurred before in group research —and, sad to say, it has for the most part not occurred since." (p.22).

 47 McGrath himself is not altogether too positive about the continuity, diversity and relevance of much of the research: "If an entire field develops vast bodies of data, with little or no underlying theory – as has largely been the case in group research for fifty years – it is inevitable that the work in that field will have certain undesired features" (McGrath 1984, p.27). He does seem to feel that things have been improving lately in these respects, or that is what one would gather from McGrath's remark that "this book contains mention or description of a number of useful theoretical efforts, mainly fairly recent." (p. 27)

⁴⁸This has been acknowledged by several authors in the field of system dynamics (e.g. Vennix et al. 1994) and in the field of GDSS (e.g. Pinsonneault and Kraemer 1989, Scheper 1991). Apparently the other fields have yet to discover this literature.

⁴⁹This research model originates from a conceptual model of the process-related shortcomings in operations strategy formulation (Akkermans and van Aken 1992), which was based upon a literature overview of that field. Subsequent versions of the model were strongly influenced by Vennix's work (Vennix 1990, Vennix, Scheper and Willems 1993). That is not to ignore similar research models described elsewhere in the literature; the field of GSS in particular has generated several research models that display many similarities. Nevertheless, the author was unaware of these precedents at the time he developed his own research model. The next table gives a brief overview of some corresponding terms in each of these research models:

Akkermans (1995)	Pinsonneault and Kraemer (1989)	Nunamaker et al. (1989a)	Jelassi and For- oughi (1989)	McCartt and Ro- hrbaugh (1989)
Process effective- ness	Participation, time to reach decision; communication characteristics	Process character- istics: procedures, level of participa- tion, interaction of group members; time required to research resolution		Participatory proc- ess; goal-centred proc- ess, efficiency of the decision; adaptable process
Organisational platform	Consensus reach- ing, commitment of the group mem- bers, attitude of group members toward the decision	Satisfaction, con- sensus, decision confidence		Supportability of decision; legiti- macy of the deci- sion
Model quality	Depth of analysis; decision quality, decision breath			Data-based proc- ess; accountability of the decision
Organisational contingencies	Attitude, abilities, individual motives background, exist- ing social net- works, power rela- tionships	Group characteris- tics: size, cohesive- ness, motivation, history	Political orientation, leadership, group size, history of its members	

Problem contingencies	Complexity, na- ture, degree of un- certainty	Task characteris- tics: task type, complexity, degree of rationality	Complexity of the task	
Project design ele- nients	Facilitator, techno- logical support	Technology charac- teristics: hardware, software, setting configuration		

⁵⁰In the GDSS field and in organisational psychology the term "decision quality" is often used instead of "model quality". The drawback to this term is that in some cases it is not really appropriate to talk of a "decision" being taken but rather of insights that are gained, or "policy that guidelines" emerge. Hence the focus on model quality (c.f. Note 1).

⁵¹The term is borrowed from Stafford Beer's "Platform for Change" (Beer 1975).

 52 For a methodological discussion of the operationalisation process, the reader is referred to Chapter 3.

⁵³See Chapter 3 of this book and pp. 122-144 of Segers (1983).

⁵⁴This "stakeholder view of the firm" stems from Ackoff (1981). Ackoff states: "Stakeholders are all those inside or outside an organization who are directly affected by what it does" (p.30). In theory, stakeholders can be selected on two grounds: (1) *power*: relevant stakeholders are people who can seriously affect implementation of the project findings; (2) *knowledge*: relevant stakeholders are people who have a great deal of knowledge regarding the problem area. In the real world, these groups often coincide at least partly. Also in practice, it are most often managers (and their most trusted assistants) who have both power and knowledge (See also Chapter 4)

⁵⁵Ideally speaking, one would want all relevant stakeholders to be involved as much as possible in the decision-making process. In practice, that is not always possible, if only because this would inake group size unworkable (see Chapter 4).

⁵⁶The descriptions that are given here of the various aspects of organisational platform are presented informally for reasons of readability. However, these descriptions come very close to the actual definitions that were used in the case evaluation process.

⁵⁷Nowadays there is a tendency, especially amongst management consultants, not to speak of "problems" but rather of "issues" or even "challenges", because of the negative connotations of the word "problem". This author finds that unhelpful, to say the least. If people refuse to admit explicitly that something is a problem, then how open are they going to be in addressing the need to take some action? Of course every problem in life is also a challenge, but that is beside the point. The point is that (a) calling something "a serious problem", if it is one, is good for problem awareness and openness of communication, and (b) it is tantamount to an insult to a manager's intelligence to suggest that he/she cannot bear bad news; it is after all a manager's *job* to solve problems.

⁵⁸All variables do not have equal weight; however, it is hard to indicate in any quantitative manner what different weights they should carry. Clearly, commitment is most important here, because no decision will be implemented without sufficient commitment, and the ultimate benchmark for effective decision-making is its effect upon business performance. So commitment is the most important part of organisational platform. The relative weight of the other factors is less easily determined. Nevertheless, often one finds that lower scores on the other four translate into reduced commitment, one way or another. For instance, if consensus is low, then not everyone will be strongly committed, hence average commitment will not be very high in that case (See also Chapter 7).

⁵⁹Using people's perceptions to establish model quality may be controversial to some researchers. This issue is discussed in Chapter 3.

 60 An alternative would have been to label this concept "decision quality". But then again, in some cases it is very hard to point at an actual decision that was made.

 61 In this study we have selected criteria of model quality that would appeal to project participants, criteria from a *user* perspective, therefore. Three of the four criteria mentioned here were came forward from the first evaluation interviews. Only 'theory-basedness' was added by the author, on the assumption that system dynamics modelling would be suited for those areas for which there was relatively little existing theory. Nevertheless, there does exist in the OR literature a whole array of criteria from a *technical* perspective as well, such as 'well-posedness' (does the model provide a

correct and unambiguous answer to the problem), 'accuracy', 'robustness', 'sensitivity' 'flexibility', 'maintainability' and 'flexibility' (Saaty and Alexander 1981, van Harten 1989).

 62 As with organisational platform, it is hard to determine the distribution of weights for these four aspects of model quality. Intuitively one would think that usability would seem to be the key variable: if the recommendations are not usable, then implementation will not be possible.

⁶³Or, if that were the objective of decision-making, an entire strategy.

⁶⁴C.f. Ansoff (1965), Andrews (1965).

⁶⁵In the field of general strategy, these lessons were learned in the 1970s. In the field of operations strategy, similar lessons were learned a decade later (see Akkermans and van Aken 1992).

⁶⁶In the evaluation interviews for the cases, the respondents interpreted speed and focus primarily as pertaining to the modelling workshops they attended. In addition, one can also interpret speed and focus as referring to the overall decision-making process

⁶⁷This is because "involvement" and "communication" strongly determine many other aspects of strategic decision-making effectiveness. Two examples: (1) without involvement in the decision-making process, no ownership of the decision will be created; (2) without good communication no learning will take place. An extensive discussion of these and many other causal relationships can be found in Section 2.4.

⁶⁸Originally, a third level of involvement was distinguished: "Discussion participation", being the degree to which all the workshop participants actively engaged in the discussions. However, during the analysis of the evaluation data, this third level was recognised as actually being more a matter of "communication" than of "involvement", and coded accordingly. This may be a more narrow interpretation of the term "involvement" than used by many other authors. Good "participation" means not only being present, but also being actively present, in terms of assisting good "communication", the next element.

⁶⁹In other consulting approaches one might assume that this concept referred to the discussion between the participants and the facilitators. That is, of course, also a relevant aspect of communication. However, in participative modelling it is the people from the client organisation who do most of the talking, whereas the external consultants try to limit themselves to asking questions and steering the discussion. Therefore, it was not surprising that in the evaluation interviews "communication" was interpreted by most respondents as referring to the communication between different members of "the group".

⁷⁰For some system dynamics modellers, achieving a common language is one of the main reasons for using graphical models to facilitate strategic discussions within groups (Richmond 1987). For Scheper (1991) arriving at "shared meaning" is the most general objective of all group problemsolving activities. Please note though that, in terms of the research model presented here, that what Scheper calls "shared meaning" does, relates not only to "common language", but also to "consensus". This is because, for Scheper, "shared meaning" refers to the congruence of individual mental maps (Scheper 1991, p.118).

(Scheper 1991, p.118). ⁷¹In fact, this aspect of process effectiveness was only found to be indispensable during analysis of the first evaluation interviews.

 72 One might reasonably argue that "willingness to cooperate" should be assigned to "organisation contingencies", since that is the category which subsumes all other aspects about participants. However, the author has chosen to keep the concept with "process effectiveness", principally because (a) "willingness to cooperate" does not refer to a participant's attribute <u>prior</u> to the project (like "participant background"), but to the attitude displayed <u>during</u> the project, (b) there is a close correlation between "willingness to cooperate" and other aspects of "process effectiveness", in particular "involvement" and "communication", which are often strongly influenced by "willingness to cooperate".

⁷³This distinction is indeed a fundamental one: is the primary purpose of group modelling to arrive at smart solutions for problems, or is it (group and organisational) learning? Many people in the field of systems thinking (e.g. Senge 1990) and system dynamics proper (Morecroft and Sterman 1994) seem to think that learning may be even more important than finding smart solutions. The author's personal viewpoint is that both are important. In every good project, both are achieved; it is the project goal that determines which aspect has priority. For instance, is the project goal consensus building or trouble-shooting? Is it heightening problem awareness or DSS development? Is it team building or system analysis?

⁷⁴The term "organisational learning" here perhaps implies more than is actually meant. For Argyris and Schön (1978) "organisational learning" was equivalent to "double-loop learning", which they contrasted with "single-loop learning". Single-loop learning occurs when an organisation learns how to solve a particular problem, double-loop learning occurs when an organisation learns a better way to solve problems in general. Applied to the present case, if the participants say that they have started to appreciate several aspects of the PBM method, "double-loop learning" has occurred. Specifically, it is not claimed that the PBM projects creates a "learning organisation" (Senge 1990) in the general sense of that term.

⁷⁵Originally, the aspect "complexity" was also included in this list. However, during subsequent analysis it turned out that this concept added little to the notion of problem scope. therefore it was omitted in this final version.

⁷⁶There are always "soft" issues at play, even with such seemingly "hard" issues as factory layouts. and often these soft issues have an overriding effect on system performance (cf. Bertrand and Wortmann 1981, pp. 21-28.)

⁷⁷In practice one does find problems that have more quantitative aspects and problems that have fewer quantitative aspects, but from a theoretical viewpoint, "the distinction between soft and hard is not helpful" (John Sterman, Plenary Session 1994 System Dynamics Conference). *All* problems can be quantified completely, if needed, even if they refer to the softest of issues. Similarly, even a seemingly very "hard" issue can sometimes be analysed appropriately by using only qualitative techniques. In the 1970s Jay Forrester developed a quantified simulation model of a firm in which 70-80% of the variables were "soft" (Oral Communication MIT Summer School, 1992). There are examples of - quite useful - system dynamics models that deal with "culture", which includes variables such as "(amount of) magic per employee" (High Performance Systems, 1994). Finally, in Case 5 a successful DSS was created in which crucial roles are played by variables such as "level of client irritation" and "customer appeal of renovated office building".

⁷⁸Terry Hill, Faculty Workshop Operations Strategy, London Business School 1991.

⁷⁹"Top management " does not necessarily denote the CEO level (although in 3 of the 6 cases the CEO was the project sponsor). Especially in very large organisations (such as the clients in Cases 5 and 6) support at the highest level is not required. What is meant by "top management" is senior management at the highest level of the relevant part of the organisation in which the project takes place (in Case 3, the European general manager; in Case 5, the project leader for the organisational change program; in Case 6, the logistics manager for the product division.)

⁸⁰Case 4 was a notable exception to that rule.

⁸¹See also Section 2.3.

 82 This degree of hierarchical diversity was normally quite low; Case 4 was a clear exception (see Chapter 7).

⁸³Please note that this refers to problem ownership *prior* to the project; after the project. (problem) ownership is seen as part of organisational platform.

⁸⁴Such was the case in Case 3. In Case 4 problem ownership was also rather low. In most other cases problem ownership was more evenly shared.

⁸⁵In the cases studied here group size varied from small to very large (see Chapter 7). See Chapter 4 for design guidelines on group sizes.

⁸⁶Some aspects, such as the available budget or the available facilitator skills, are only partly under control of the consultant (though not completely out of his control either).

⁸⁷The following (arbitrary) rule was applied: 0-1 references: dotted line; 2-3 references: normal line; 4 or more references: thick line.

⁸⁸This reflects a causal chain that leads from Process Effectiveness to Organisational Platform to Decision Implementation.

⁸⁹The relation ownership—commitment (1c) has strong support in the system dynamics literature. De Geus (1994) has voiced it perhaps most forcefully: "I have not met a decision maker who is prepared to accept anybody else's model of *his/her* reality, if he knows that the purpose of the exercise it to make him, the decision maker, make decisions and engage in action for which *he/she* will ultimately be responsible. People (and not only managers) trust only their own understanding of the world as the basis for their actions" (p. xiv). Morecroft puts it differently: "Management teams are much more likely to use models when it is clear to team members that their ideas and knowledge are represented in the model (...)" (p.4) Lane (1994) explains why: "If a team or an individual can be truly facilitated

to construct a model or representation of their ideas, rejecting the message that model then produces becomes a rejection of their own ideas." (p.97). Similar remarks can be found in the fields of strategic management field (c.f. Mintzberg 1994, p.172) and in the operations management literature (c.f. Platts and Gregory 1992, p.49).

⁹⁰This relation will be split up into two parts: involvement \rightarrow ownership (1a) and communication \rightarrow ownership (1b).

⁹¹There is very strong and broad support for the notion that involvement does indeed lead to ownership (1b). In the field of system dynamics, Lane (1994) notes that "Lack of ownership (..) arises because the consultants [in expert consulting HA] operate as a separate group. It is then natural for their work to be done behind closed doors (..). The consultants spend long periods operating in their own world of abstractions in order to understand the problem (..)" (p.88). Similar remarks are made by Morecroft (1994, p.4) and by Vennix et al. (1994) and Vennix and Gubbels (1994) in the context of discussing the drawbacks of using a preliminary model, whilst for operations research both Eden (1989, p.29) and Checkland (1989, p.115) confirm its importance. In the field of G(D)SS, Nunamaker et al (1989) have stated: "the encouragement of group members to participate tends, overall, to result in a better shared sense of solution and "buy-in" of group members". Bass (1970) made similar remarks on strategic management, saying that lack of involvement would lead to "less commitment to see that the plan works well" (p.159, quoted in Mintzberg 1994). Finally, Hill talks about the importance of corporate ownership in the development of an effective operations strategy (1994, p.8).

 92 "Communication leads to ownership" is not often mentioned as a relationship. This is probably because most researchers do not make the strict distinction between "involvement" and "communication" that is drawn here. Only McGrath (1984), an organisational psychologist who directs close attention to group processes, makes a similar distinction. He notes, for instance, that "A group needs positive reactions [i.e. positive remarks made during the group discussions HA] in excess of negative ones in order to get (...) satisfaction from task performance itself. (...) It follows that groups with higher positive to negative ratios should have higher satisfaction." (p.151)

93"No use" here signifies "useless", rather than "no usage" although usage is also fairly unlikely in this situation.

 94 Perhaps precisely because it seems such an obvious relationship, our literature search revealed no discussion of the effect of consensus on commitment. It is not hard to imagine a hypothetical situation in which a consensus is reached that no-one really likes – a "lowest common denominator" solution, for example – but in general one would expect this relation to be positive.

⁹⁵Again, no explicit acknowledgement of this relationship was found in the literature searched, perhaps because there is an implicit consensus that the relation is obvious.

⁹⁶The notion that more confidence in a model or a decision results in more commitment has been observed in the SD literature: "A manager will not enact a solution (..) whose proponent does not have his/her confidence (..)" (Lane 1994, p.91). In the field of OR, Hickling (1989) describes a case study in which a calamity occurred after a policy of dealing with such calamities had just been developed: "The reaction (..) was one of calm confidence. The policy, underpinned by the high level of consensus and commitment gained through the process, stood the test well." (p. 187). We will return to the issue of "confidence" in a subsequent discussion of model quality.

⁹⁷The assumption that the relationship is always a positive one may be naive, but the relevance of the relation between communication and consensus appears to be substantial, judging from the literature references. We should distinguish two effects here. The first effect is that of conformity pressures on people in groups: "when there is a variation of attitudes among group members (on matters of importance) there will be pressures towards uniformity. If most members agree, the pressures will rest most heavily on dissenters. Those pressures will be enacted via communication, perhaps increased communication from others to the dissenter(s), designed to produce conformity to the group view" (McGrath 1994, p.241). McGrath traces this assessment of the importance of conformity pressures on people in groups back to the early work by Lewin and others (1984, p.233-234). It is this *positive* effect on consensus that is referred to in the OS literature (e.g. Platts and Gregory 1992, p.34, p.39). However, there is also a second effect, which is *negative*. This is what Mintzberg is referring to when he quotes Whitehead (1967, p.164), who states that "Planning can have the effect of sharpening the differences participants perceive between themselves and others, thereby increasing the conflict in the organisation" (quoted in Mintzberg 1994, p.197). When does this negative effect occur? In McGrath's

terminology when there is a "mixed-motive" task, such as the well-known prisoner's dilemma. With such tasks "communication is by no means a panacea for resolving conflict. Under some conditions it makes matters worse" (McGrath 1984, p.107). In terms of our research model a mixed-motive task would equate a problem of high political sensitivity.

 98 To a certain extent, there is overlap between the terms. One aspect of communication is "common language", the degree in which people use the same terms for the same concepts. Using the same terms to describe an issue is often tantamount to having a shared view of that issue.

⁹⁹No references were found which discussed the relationship between involvement and awareness – most likely because again the relation looks so obvious.

¹⁰⁰This relation is frequently discussed in the literature. Once more the message is mixed. On the one hand, "thoroughness", i.e. the degree in which all the required analyses have been conducted, does increase confidence, in particular in the case of quantitative analyses. Lane gives the example of linear programming in the oil industry (1994, p.87); Morecroft and van der Heijden (1994) describe the use of a number of partial model simulations to demonstrate "algebra in action" (p. 163), where "the partial model simulation increased the modelling team's confidence in the algebraic model by showing results that were intuitively plausible. The "stories" of dynamic behavior made sense and details of the simulated trajectories often matched people's expectations." (p.166). Similar findings come from the GDSS field. Here it is found that group support systems that provide some kind of "decision support" facility (e.g. a tool to conduct additional analyses) enhance model quality, and thereby increase thoroughness and confidence, whereas group support systems that only support communication may actually reduce confidence (Pinsonnealt and Kraemer 1989, p.213-214). However, this focus on the importance of analytical tools is mitigated by Eden, for example, who states that "The wisdom and experience of members of the team is a key element in developing decisions with which participants feel confident." (p.23). Hickling, in a description of another soft OR study, also stresses the importance of the group's judgmental capabilities: "Only those uncertainties which made the group feel less confident that they were doing the right thing, and those assumptions which threatened the validity of the results if they were proved incorrect, had made it to the lists." (p. 179). This is just as well, because already in 1950 Devlons noted that "It was a common error to impute to figures a greater accuracy and reliability than the basis on which they were arrived at could warrant on the most generous interpretation. And once the figures were called 'statistics' they acquired the authority and sanctity of Holy Writ." (Devlons 1950 p. 155, quoted in Mintzberg 1994. p.265). So thoroughness is certainly not to be interpreted as merely conducting the required quantitative analyses. For it is also this author's experience that, as Mintzberg has observed, "While hard data may inform the intellect, it is largely soft data that generate wisdom." (p.266).

¹⁰¹The relation involvement→communication (7) is not a positive one by definition. The way in which the term "involvement" is used in this book allows that the relationship between involvement and communication may be a negative one, for the bigger the group of people who are involved, the harder it will become to communicate effectively. All the same, in the literature a positive relation is assumed. Bass (1970) notes, in the context of strategic planning, that "Productivity and satisfaction are lower when [people are] planning for others because (..) there are more communication problems and consequent errors and distortions in following instructions" (1970, p.159, quoted in Mintzberg 1994, p.169). Pinsonneault and Kraemer (1989, p.207) found, in their review of the GSS literature, an inverse relationship between participation (read: involvement) and domination (read: communication/verbal dominance), although they could not determine which caused the other. Finally, Hill (1992) blames the inconsistencies of many operations strategies on the fact that operations managers "rarely (...) contribute to the making of corporate decisions" and, at the same time, that "top management request a manufacturing strategy statement from the production executive without becoming involved in its structure and development (..), which increases the difficulties in establishing a corporate strategy through dialogue and understanding" (p.7-8).

¹⁰²However obvious this relation may seem, it is only mentioned once in the literature searched. Hill (1992) notes that "Senior executives need to understand all the strategic inputs (..) for without this understanding the resolution between conflicting or non-matching functional perspectives cannot be fully investigated" (p.8). On the other hand, a converse reading of the relation is strongly supported in the literature.

¹⁰³Steiner (1979) noted as one of the most important pitfalls to be avoided in strategic planning: "Failure to create a climate in the company which is congenial and not resistant to planning." (p.294, quoted in Mintzberg 1994, p.155). An interesting observation is made by Voss (1992a) in a review of a number of OS development case studies: "The leadership for the process came from staff rather than line manufacturing functions. This is probably due to the volume of analysis needed in developing a manufacturing strategy. The volume may prevent line managers from becoming too involved." (p. 126) This sounds like a weak excuse, but is admittedly consistent with Mintzberg's observation on formal planning processes in general. At any rate, for whatever reason, willingness to cooperate with line managers was low here, which led to low involvement.

¹⁰⁵For instance as a result of top management pressure, as happened, to some extent, in Case 1 and, quite strongly, in Case 4.

¹⁰⁶This is what happens to a greater or lesser extent in most cases, and was especially so in Case 1. ¹⁰⁷Mechanical or not, no references were found to this relation.

¹⁰⁸This notion has been well understood in the field of system dynamics. Vennix and Gubbels (1994) state that the introduction of structure into group activities drastically improves group performance. (p. 134). Apparently, this notion originates from organisational psychology, for Vennix et al. (1994) quote authors from this field on the issue: "Bouchard (1972) indicates that introducing structure in group sessions drastically improves group performance. Hart et al. (1985) point out that without structuring of tasks and group processes, participants might become frustrated and group performance rapidly decreases." (p.33). Finally, also in the field of GSS, research has shown that GDSS increase task-oriented communication (Pinsonneault and Kraemer 1989).

¹⁰⁹There is wide support for this relation. The importance of involving all the stakeholders in arriving at a correct picture is strongly endorsed especially in the field of operations strategy, perhaps because it is a field where there have always been very different perspectives to be reconciled. Hill (1992) said it first (his 1992 text being based upon a 1980 publication): "[operations managers HA] fail, by default, to contribute at the corporate level and hence to help the company arrive at decisions which *embrace all the important* business perspectives." (p.5) [italics HA] Similar complaints are voiced by Maruchek, Pannesi and Anderson (1992, p.111) and by Voss (1992a, p.126). But the same idea can also be found in the strategy literature. Mintzberg insists that affected line managers (and not just staff planners) must be involved in strategic planning if it is to be effective, because "people removed from the daily details of running an organization can never gain the requisite knowledge." (p. 269). Once again, we will leave the final word on the issue to McGrath: "Groups offer the *possibility* of more accurate judgements than single individuals, especially on tasks with considerable complexity" (p.73). ¹¹⁰Interestingly enough, no references were found to support the fairly basic notion that, having assembled a group with the expertise need to deal with an issue around the table people must first to open their mouths before their knowledge can be shared...

¹¹¹This relation is discussed in the literature, but not in a positive sense. The consensus seems to be that there is no single theory for the majority of genuinely strategic problems, or if there is, it has to be very much adapted to fit the issue. In the field of OS, "grand old man" Skinner's opinion is that "There is no textbook or article that helps managers make these decisions to design the structure to meet the manufacturing task" (1992, p.22). And in the field of SD, another grand old man's remark is that "The multifaceted conflicting pressures of real decision-making are almost absent from economics textbooks and journals. The professional literature emphasizes how decisions should be made rather than how they are made (...)" (Forrester 1994, p.73). Senge and Sterman (1994) provide some real-world evidence, such as that in management games "professional economists create depressions in simple economic models" (p.198). So theory may be useful in theory, but hardly ever in practice...

¹¹²This may be a common-sense notion, but it is not one which is mentioned in the literature that was investigated.

¹¹³The original precept being: "There is nothing as practical as a good theory." (Lewin 1951).

¹¹⁴Not surprising for a relation that is claimed to be a fundamental idea, this relation is mentioned very often in the literature that was searched, as a brief anthology will show. Mintzberg (1994) notes

that "if the empirical research has taught us anything at all about strategy formation, it is that it (...) is best described as a form of learning." (p.241). Lane reaches back to an more primal source to endorse "the idea of learning and intuition building as the goal of a modelling process" (p.98) by quoting Galileo: "One cannot teach a man anything. One can only enable him to learn from himself." (p.98). Jac Vennix remains more down to earth: "Most insights about the characteristics of an ill-structured problem are gained during the iterative process of designing a computer model, rather than after the model is finished" (Vennix and Gubbels 1994, p.122) and also: "Model building induces learning in participants as their mental models are reshaped by discussion and interaction" (Vennix et al. 1994, p.38). From the field of OR comes the warning from Friend (1989), who points to the collary of this relation: "It is, however, dangerous for the participants in a group process to assume that what they have created on flip charts on the walls will immediately make sense to other people who were not directly involved." (p.156).

¹¹⁵A fine overview of this "soul searching" in policy/strategy modelling is provided in Chapter 2 of Vennix (1990).

¹¹⁶Hickling (1989) found evidence of this relation in the final report of the project he describes: here one appendix was "a description of the methodology, presented as part of the justification of the policy proposed." (p.191). Morecroft and van der Heijden (1994) likewise discerned signs of organisational learning in a final report: "Because the planners had themselves been involved in conceptualizing and building the model they felt comfortable interpreting model simulations, writing scenario stories, and integrating the simulations and stories into the overall scenario book." (p.170). Finally, also in the field of GSS, it has been observed that "Automated support for groups tends to change the way people work together, e.g. in terms of average meeting size, methods of addressing a complex problem, and group dynamics." (Nunamaker et al. 1989a, p.146).

¹¹⁷This is what happened in Case 2 and Case 3, where the author was asked to come back to conduct a second PBM project on a different area, after the project described here was finished.

¹¹⁸Despite its obviousness, or perhaps precisely because of it, this relation is hardly ever inentioned. The only author who does is Mintzberg (1994), and his formulation is well worth quoting: "every failure of implementation is, by definition, also a failure of formulation" [italics HA]. He explains: "Often, when a strategy fails, those at the top of the hierarchy blame it on implementation lower down: if only you dumbbells appreciated the brilliance of the strategy we formulated. Well, those dumbbells down below might well respond: If you're so smart, why didn't you take into account the fact that we are dumbbells?" (p. 25).

¹¹⁹For a relationship that seems so basic, it is disturbing to read in a literature review that "In our judgement, the greatest weakness of operations strategy research becomes evident when one searches for research that studies (...) the effect of strategy content and process variables on performance". These are "glaringly absent" (Adam and Swamidass 1992, p. 387).

¹²⁰We already encountered this notion in our discussion on communication leading to consensus. Indirectly, evidence from the Group Support area points in the same direction. There it is found that "automated support tends to raise the potential for conflict within a group as members tend to enter challenging comments through the electronic medium without fear of personal recognition or retribution." (Nunamaker et al. 1989a, p.150). In other words, automated support apparently reduces an inherent unwillingness to communicate openly on a politically sensitive issue. However, McGrath (1984) warns us not to push too far in one direction by pointing out that in most cases political conflict will be moderate: "It seems useful (...) to recognize that there is a middle ground or grey area where there is conflict among members, more fundamental than just different content positions on an issue, but nevertheless common interest and agreement on common goals." (p.94)

¹²¹Strategic problems almost always are politically sensitive to some extent. Using computer models to analyse them does not make them any less sensitive: "(..) any problem is embedded in a network of political, cultural and power relationships. It is naive and futile to imagine that these can all be cut through because a solution is known to be mathematically optimal" (Lane 1994, p.90). Isaacs and Senge (1994) have noted this with what they call CBLEs [Computer Based Learning Environments]: "Confronting management problems that are complex, non routine and counterintuitive, such as CBLEs pose, can create embarrassment and threat. (...) Under these conditions, people may unwittingly defend prior positions, select information and arguments that confirm already established views instead of looking for reasons to change their view (...)" (p.268).

¹²²At first sight this seems obvious, but it may not be, at any rate, the relation is seldon mentioned in the literature. Indeed the only (indirect) reference to it is from Voss (1992a), who, in an analysis of four cases of manufacturing strategy development in British firms, found that "The nature of the cross-functional team was a function of the scope. A broad scope had teams from many functions; a narrow scope had teams from a limited range of functions." (p.128). This finding can only serve as support for Relation 19 if we combine it with Relation 11a, and assume that this broader involvement was accomplished to ensure a complete coverage of all the aspects of the issue.

¹²³Again a seemingly obvious truth becomes less obvious on a closer examination. As was pointed out earlier in note 77 on problem tangibility, in theory *all* problems can be analysed quantitatively, even if they refer to the softest of issues. Or, as Forrester has put it: "We can make a formal quantitative statement corresponding to any statement that can be made in descriptive English. Lack of accuracy does not prevent quantifying ideas about policies. Assigning a number does not alter the accuracy of the original statement, but it does create a much more explicit basis for communication" (1994, p.63). But even if it is possible to do it, this does not mean that it is necessary to do so. It is the author's experience that managers tend not to expect quantified answers to very soft questions (see also design guidelines in Chapter 4).

¹²⁴Data can be both soft and hard. That does not signify anything about their usefulness or their reliability: "Anecdotal evidence is supposed to be soft, biased, and superficial. Yet we have just seen exactly the same about hard data — that these have a decidedly soft underbelly." (Mintzberg 1994, p.97). Managers are used to dealing with soft and incomplete data and do not feel uncomfortable about it, as long as they feel they own the data, as Platts and Gregory (1992) observed: "The impressions gained by the facilitators was that there was relatively little factual information (...) but that collectively the (...) managers seemed to have a reasonable understanding of what was needed. The issue of validity of subjective measures was not pursued in any depth. The indications were that the companies were relatively satisfied that they understood enough." (p.43).

¹²⁵Maruchek, Pannesi and Anderson (1992) found some interesting evidence for this relation in an assessment of experiences of six firms with manufacturing strategy development: "(..) in each firm there seemed to be a single critical event that precipitated the manufacturing strategy initiative. (..) All the firms explained the significance of this finding by stating that when things are going well, it is difficult to build a consensus for manufacturing strategy, since people aren't convinced that any changes need to be made." (1992, p.105). Hickling (1989) describes a similar situation: "a prime example of a blocked decision process — and further, one which had reached a state of urgency. (..) the level of conflict in the project group was also causing no little concern. And time was running out." (p.162).

¹²⁶Checkland (1989) describes a project where this may have been the case: "The head [of the Department — HA] had convinced his people that the difficult situation faced by the Department — and by [the Company] as a whole — was an opportunity as well as a threat." (p.103). Otherwise the evidence for this relation is scant.

 127 There can be no denying that there is logic in this relation. Case 1 of this research was a clear example of it. However, in the literature searched no reference to this relation could be found.

¹²⁸Top management is important for involvement, that is clear from our literature sample. In the field of strategic management, Steiner (1979) lists the following pitfalls:

- "1. top management's assumption that it can delegate the planning function to a planner.
- 2. top management (...) spends insufficient time on long range planning (...)
- 3. failure to assure the necessary involvement in the planning process of major line personnel." (p.294, quoted in Mintzberg 1994, p.155)

In the field of operations strategy formation, Voss (1992) describes four cases where "In all four cases, the process was initiated by senior management" (p.125). In a similar evaluation of case studies, Maruchek, Pannesi and Anderson (1992) report that "Each of the participants mentioned that there was some person in top management who was convinced of the importance of manufacturing strategy and provided the impetus to begin the process. The common characteristics of this person were that he was relatively new to the firm, was perceived as willing to take risks and provided top management support." These quotes also point to one of two limitations of top management support, namely that top management support tends to be greatest at the *start* of the project (cf. also Section 4.5.). This is where Platts and Gregory warn: "Although the Chief Executive might sponsor the exercise, this will not ensure that it progresses satisfactorily (..)". There needs to be a senior company manager who is

assigned internal responsibility for the exercise. (...) In the early studies no internal leader was nominated with the result that the exercise became relatively low priority (...)" (\mathbf{p} . 50). The second limitation of top management support is presented by Mintzberg (1994): "What does need to be questioned (...) are the naïve assumptions in the literature (...) that the commitment of top management automatically fosters the acceptance of planning" (\mathbf{p} .160). Clearly, more is needed than top management support alone.

¹²⁹Little support can be found for this relation in our sample from the literature, and that little support is indirect. The preceding references showed that top management support is crucial at the start of the project, and normally project size and budget are determined at the start of the project...

130 This is another relation that this author feels is quite self-evident, but no support at all could be found for it in the literature.

¹³¹Platts and Gregory articulate this relation quite well: "There is also a danger of free discussion being inhibited by the presence of certain people. This becomes particularly pronounced if one of the members is of a perceived higher 'rank' and is of an autocratic nature. This was the situation in some companies where the presence of the Managing Director was felt to suppress discussion at some of the workshops" (p.49). McGrath, as usually, knows how to formulate this phenomenon in more general terms: "Any given individual's rate of interaction will also be affected by the individual's 'position' in the group." (p.146). Please note that this last citation only relates to the "verbal dominance" aspect of communication, whereas the first also embraces the "openness" aspect.

¹³²Nunamaker, Vogel and Konsynski (1989) have found this relation to be relevant: "A physically large group from a common culture that has met repeatedly on a task may have a high degree of overlapping domain knowledge that results in the group being "logically" small." (p.147) No other references were found.

¹³³This relation is meant more or less as a mathematical one: INVOLVEMENT $\uparrow \approx \text{GROUP SIZE}// \text{ALL}$ STAKEHOLDERS. Nevertheless, few authors appear to see this as a relevant relation. Only Platts and Gregory have something to say on the subject: "The (..) workshops were considered to be more successful when they contained more rather than fewer people. The use of more people was thought to bring in a wider experience of the business and to promote discussion." (p.49)

¹³⁴Contrary to the previous relation, the effect of variations in group size on speed is mentioned quite frequently. In the field of system dynamics, it appears to be common knowledge that one should keep groups relatively small to maintain sufficient progress: "Generally, though, pressure of time has required that our processes (.) involve far fewer people" (Lane 1994, p.103), and "A small team, four out of the full team of ten, took part in this phase. It is difficult to imagine how one would have engaged the full team in this more detailed work." (Morecroft and van der Heijden 1994, p. 172). The need for a small group size is confirmed by organisational psychology: "Slater (1958) has found that for tasks involving decisions based on evaluation of exchanged information, groups of five or fewer are most effective" (Vennix et al. 1994). The field of GDSS claims it has found a way to overcome the problem of large groups at least for some tasks: "In a traditional meeting environment, conversation proceeds sequentially, with one member speaking at a time (..) group efficiency degrades with increased group size. Since automated support removes this constraint, automation makes it possible for every member of the group to contribute at the same time." (Nunamaker, Vogel and Konsynski 1989, p. 146). Moreover, according to Nunamaker et al. (1989b), "the efficiency of automated support becomes increasingly apparent as group size rises. (..) groups of size 8 or more tend to benefit more than groups of size 3 or 4." (p. 192). See also the design guidelines regarding group size in Chapter 4.

¹³⁵In the PBM cases described in this book, participants were expected to pick up this kind of knowledge as the project proceeded, just as the outside consultants learned most about the client company and its business during the project. Other modellers prefer to dedicate considerable time at the outset to explain to participants the method that will be employed. For instance, Morecroft and van der Heijden mention "a preliminary meeting that explained the mapping symbols, (...) in short, the representation scheme to be adopted" (1994, p.150). They also feel that "The project team should prepare (...) by reading selected papers that indicate the desired qualitative style of modeling based on system dynamics" (p.150). Lane agrees: "The client must be helped to learn whichever techniques are used in a project. In consequence, the consultant has a duty to provide tools that are easy to pick up and that express powerful ideas simply" (1994, p. 97). Perhaps, as Rosenhead (1989a) claims, some of the methods used in soft OR are less difficult to learn: "Even those without previous experience in the particular graphical notation are often able to adopt the language readily, and use it to suggest

modifications to the 'model'" (p. 16). All the same, we feel that Senge and Sterman (1994) may be getting a little bit carried away when they say that "Managers should be able to construct the models themselves in a short period of time. Managers must understand the software without computer expertise or technical training" (p. 200). If this remark means "being able to read a model in a certain notation" this author would agree, but in his personal experience more needs to be explained about the modelling method than just stocks and flows syntax.

¹³⁶Few authors mention the use of pre-interviews, one exception being Colin Eden from whom the idea originates. In his pre-interviews with clients, Eden (1989) creates individual cognitive maps and uses these to create a shared cognitive map in the first workshops. Based upon his experiences, cognitive maps also became customary in the PBM pre-interviews.

¹³⁷As was mentioned, no references to pre-interviews were found other than Eden (1989).

¹³⁸Vennix et al (1994a) mention brainstorming in the context of "elicitation tasks": "In the system dynamics model-building process, this type of thinking is often most necessary in the problem definition or model conceptualization phase where an individual or group is attempting to determine what factors or variables to include or exclude from a system's boundary" (p.32). Actually, "hexagon brainstorming" is nor a helpful designation since it stands at risk of being confused with "traditional" brainstorming, which has long been established as an inferior technique for information generation tasks. "Hexagon NGT +" (nominal group technique) would probably be a better term, for "There is considerable evidence that work on elicitation tasks in group settings should be performed by noninteracting, "nominal" groups, rather than with full discussion and exchange of ideas in an open forum." (Vennix et al. 1994, p.32) See also McGrath (1984, p.131) and Vennix and Gubbels (1994, p.124) for confirmation of this statement. McGrath (1984) indicates why this should be: "Interactive groups search 'reactively', and with less focus on the problem; they also tend to get into a rut on certain alternatives. Both Delphi and NGT groups search 'proactively' and extensively, without getting hung up on one or two alternatives." (p. 129)

¹³⁹The refined use of workbooks in connection with structured modelling workshops has been dcveloped by Jac Vennix. Vennix and Gubbels (1994) describe the method in action in a case study where they confirm our notion that "the workbook was also meant to *prepare* the participants for (..) the structured workshop [italics HA]" (p.132). The aim of workbooks is strongly related to the concept of a Policy-Delphi (Vennix et al 1994). And indeed, "(..) one advantage of the Delphi method is that time investment for participants is relatively low" (p.124). People only need 20-30 minutes to fill in a form that might well take 3 hours to discuss in a group setting. However, there is a trade-off, as McGrath points out: "Delphi groups take far less time per participant, but far longer calendar time and far more research administration time and cost per group, than either interactive groups or NGT groups (whose time and cost are about equal)" (1984, p.129).

¹⁴⁰There is strong support (and frequent reference) in the literature to this relation. Perhaps the best explanation for this relation is provided by Morecroft and van der Heijden (1994): "It is surprising how much people know if only you have an interactive way to represent, record and display the fragments of verbal, numerical and graphical information they typically provide" (p.155). Or perhaps Lane (1994) is even more to the point in writing: "The most widely used reason for creating an external representation of mental models is the great benefit that can be gained by structuring and sharing information. There are many reasons why it can be hard to transfer information from one person to another, but one of them is certainly that it can be hard to express ideas in a form that can be understood." (p.100). Much the same ideas live in the "soft OR" field. Rosenhead (1989) says that "If simpler, more transparent, less ambitious analytic tools are deployed, lay participation can be a reality". (p.14) and Checkland feels that "It is the function of SSM [Checkland's method Soft Systems Methodology] to provide such a language, and so enable the problem-solving activity itself actually to become more coherent" (p.113).

¹⁴¹"Common sense and experience both suggest that graphical methods have much to offer. Diagrams can display in spatial terms quite intricate networks of influence, causality, similarity or compatibility. Representations of considerable complexity, capturing perhaps provisional understandings of a situation, can be apprehended visually with surprising ease." (Rosenhead 1989a, p.16). Wolstenholme agrees: "the power of the diagram alone to provide a framework for thinking should not be underestimated" (1994, p.183-184).

¹⁴²It should come as no surprise that system dynamicists writing for a volume called "Modelling for Learning Organisations" should stress *en masse* the importance of the learning, the insights, one can

gain from a simulation model. What is surprising though is that they should all be so cautious about the conditions under which learning can be achieved. Only one reference was found to contain the "classic" explanation of why this relation holds: "Experienced managers frequently have accurate perceptions of causal structure and decision-inaking processes but draw erroneous conclusions about what happens when different parts of a system interact. Challenging models thus requires an inference engine to deduce the consequences of interactions among the elements of the map. Simulation provides that engine" (Senge and Sterman 1994, p.200). But apparently this is no longer a novel message for the field, and the state of the art has proceeded further, because four other references to this relation were found in this book containing cautionary remarks about when simulation models do not lead to new insights: "A key finding (..) is that game play alone is not sufficient for lasting learning. (...) learning comes from the full model-building experience, not primarily from simulation or game-play" (Graham et al. 1994, p.238, in a review of model-based computerised learning environments). Vennix et al. (1994) voice the same caution: "modelers may create an animated gamelike view of a simulation. Using these animations, users may interact directly with the simulation model, without having to come to grips with or understand the structure of the system under study. Such a facile ability to interact with a model, of course, has both positive and negative implications" (p.35). Senge and Sterman have labelled this "the video game syndrome" (1994, p. 211). Isaacs and Senge go one step further: Even if people don't fall prey to the video game syndrome, in their experience participants tend to one of two extremes: They use the CBLE selectively to discover ways to reinforce their prior views, or they treat the computer as an oracle that has all the answers" (p. 278). Neither has much to do with new insights. Clearly, there is little complacency in this field regarding the learning value of simulation models.

¹⁴³In PBM, graphical functions are used quite often when there are insufficient data available to quantify a relation. For one reason or another, no other model builders in our literature sample mention them (although most system dynamicists are known to use them on occasion.) But from the OS field, Platts and Gregory basically say the same thing: "When there were difficulties with the collection of factual data, subjective views and the use of group workshops were found to provide sufficient data for the exercise to progress (1992, p.52)".

¹⁴⁴ Once again this seems to be old news for the OR and SD experts, and is therefore not mentioned. "Confidence in the model (..) was the result of (..) the close dynamic fit between the model and historical time series, and the fact that participants could give real-system explanations for model behaviour in the policy simulations shown" (Vennix et al. 1994, p.43-44).

¹⁴⁵McCartt and Rohrbaugh found that decision conferences were not successful when they did not involve, amongst others, "building a computer-based decision model", and "reviewing computer output on implications of alternative choices" (1989, p. 251). However, Mintzberg warns against too much focus on *quantitative* data: "Hard information is often limited in scope, lacking richness and often failing to encompass important noneconomic and non-quantitative factors" (1994, p.259). In earlier research, he had already found that managers rely primarily on oral forms of communication (Mintzberg 1973, here p.258).

¹⁴⁶Any technique that structures group sessions can improve group performance, McGrath (1984) might say, but no direct references were found to support this.

¹⁴⁷Vennix and Gubbels (1994) describe a case in which discussion focused on those aspects of the problem on which differences of opinion appeared to exist, judging from the workbooks that were distributed. The use of propositions to focus on non-consensus looks to be closely related to this approach. Another use of propositions has been (in Cases 5 and 6) to present the model equations in an understandable format. This because "overt (or even covert) mathematics of any complexity is likely to render the analysis inaccessible to most of its potential clientele." (Rosenhead 1989, p.16). Cf. also Morecroft's use of "friendly algebra" (Morecroft and van der Heijden 1994).

¹⁴⁸Three cases are described in which the final report of the modelling project was an important vehicle for implementation. In Hickling's (1989) project for the Dutch government, the project result was written down in a document and "was adapted and polished, and finally submitted to the Second Chamber of the Dutch Parliament" (p. 186). After Morecroft's and van der Heijden's work within Shell "a somewhat elaborated version of the model generated simulations that were published in the company's scenario planning book (...) This modified model was used repeatedly to explore the effect on oil price and production of alternative OPEC strategies" (1994, p.170). Vennix et al. (1994) mention a project for the State of New York where "the (...) [final – HA] report to (...) [the client – HA]

was a book of more than 240 pages" (p. 45). Unfortunately, in this case this did not help decision implementation: "Faced with time running out on the 1985 legislation, the complexity of the problem and the recommendations, the observation that none of the insurers were in danger of immediate bankruptcy, and the possibility that further research might suggest a better solution, the legislature passed continuing legislation that simply extended the 1985 law another three years " (p.45).

¹⁴⁹The impact of the process facilitator should not be underestimated in modelling processes. "The facilitator plays a key role in shaping the discussion." (Morecroft and van der Heijden 1994, p.171). Indeed, Vennix et al. (1994) have found that "a facilitator with generic group facilitation skills is often better at directing the group process than a skilled modeller" (p. 31). The use of a facilitator has become standard practice in operations strategy issues as well: "It was found that in each case there was a person (...) who acted as a facilitator to the process. In three cases this was an outsider (...). The role of the facilitate inter-functional participation and to ensure that the process took place. " (Voss 1992a, p. 126). Platts and Gregory have also taken up the facilitation perspective: "Rather than act as external 'auditors' we have sought to act as 'facilitators'. Personnel within the company have been intimately involved in the process, our role being to provide the required structure, and to advise and assist when required" (p.33). Their clients also felt that an external facilitator was necessary, indicating that "They needed to have someone who would catalyse their involvement and progress the exercise" (p. 51).

¹⁵⁰Probably most of the authors quoted in the previous note would agree that process facilitation skills are also important for improving communication, precisely because unfacilitated groups tend to have such functional defects as lack of openness, verbal dominance and the like. Vennix et al. state that "These common defects in group process can usually and easily be overcome by a skilled group facilitator" (p. 33).

¹⁵¹Apparently, none of the authors reviewed in our literature sample were real expert consultants. This is certainly true of the operations researchers, who depict the typical client group as one that "will be looking for help in thinking through the issue they face, without expecting the consultant to act as an expert with respect to content" (Eden 1989, p.23). The same can be said for the system dynamicists, with Lane stating that claims to possessing expert knowledge may even have adverse effects: "When an expert consultant sends the message, 'I am an expert in techniques that will teach you about your business', he may (...) find that the client resents and rejects the power positions of such a project. Rightly or wrongly, the client may not accept that the 'experts' are actually expert in their business" (p.89). But even in the field of operations management, Voss (1992a) notes that at least client-specific expertise alone is not enough: "In all four cases the individuals had technical rather than process based skills. In one case this lack of process based skills led to problems with getting commitment from management." (p. 126). So knowledge of the client's business helps, but apparently it is not essential for success.

¹⁵²According to Eden (1989), conceptual modelling skills are "the skills to construct a model of, and appropriately analyse, the *content* which each member of the team wishes to address (p.21)". Morecroft and van der Heijden (1994) prefer the term "framework": "It appears to be very helpful for the facilitator to have in mind a framework to guide the meeting and to formulate questions. The more flexible the framework the better - one does not want to impose an "answer" on the group" (p.171). This framework is used by the facilitator "to translate the operating knowledge of the management team into the language of labels and boxes used in the diagram (...) A good facilitator can draw out a lot of facts and knowledge from the team by being intimately familiar with the many elaborations of the framework, hints, guidelines and examples" (Morecroft 1994, p.14).

¹⁵³The consensus in the literature appears to be that client-specific knowledge is not essential, but that process facilitation skills and modelling skills are both required: "Most often, both roles are required to manage properly this class of cognitive tasks" (Vennix et al. 1994, p.32). Moreover, the two sets of skills appear to reinforce each other, as Eden (1989) has noted: "The process management issues are not taken as independent of the content management issues. Rather, each aspect informs the way in which the other skill is best utilised." (p.21)

¹⁵⁴Aggregating, clustering, abstracting and integrating apparently are all synonyms for an activity that is of crucial importance in modelling of strategic issues. Furthermore, this activity requires specific skills that are usually expected to reside with the external consultant. Hodgson (1994) has noted this in hexagon brainstorming: "Pressure now builds on the facilitator to come to the rescue by

indicating some kind of order to remove the chaos." (p.362). Eden finds the same phenomenon in clustering cognitive maps: "It is only by using judgements that the essentially reductionist cluster analysis guides the *consultant* towards capturing the holistic properties of the aggregated data" (1989, p.38, italics HA).

¹⁵⁵This relation is stated most clearly by Lane (1994), who introduces as a measure of the value of the modelling process "one derived from the probability that a manager will truly grasp the results of a piece of analysis and act upon it. (..) By this measure, a model *falls* in value the more complex it becomes" (p.92). This is what Rosenhead (1989a) is talking about when he writes that "If simpler, more transparent, less ambitious analytic tools are employed, lay participation can be a reality" (p.14). But Eden and Simpson (1989) warn us that this does not mean that models cannot be complex and yet remain insightful to managers, provided that the managers have built the model themselves: "The messiness of the developed map is not as much of a problem to the client as it is likely to you, the reader. This is because the map is developed with the participation of the client, who directs elaboration and corrections. There is clarity that comes with familiarity, and with ownership of the material" (p.60). (See also the discussion on design guidelines for complex vs. simple models in Section 4.6.)

 156 An example of this is described by Vennix et al. (1994), who found at the end of their project that "the policy recommendations were extremely detailed and complex, and the model was able to represent them only approximately." (p.45). Indeed, "The logic of traditional, expert, consultancy says that the bigger a model is, the more ideas and effects it captures, and the greater its functionality, the better it is." (Lane 1994, p.91). Lane does not contest this logic, but rather goes on to add that there is a trade-off with the level of insight that managers can gain from this.

¹⁵⁷Unfortunately, no references were found for this relation in our literature sample.

¹⁵⁸This certainly happened in Case 1, and to a lesser degree in Case 3. In Case 4 the project was aborted by the dissatisfied sponsor. In Case 6 the project was still ongoing at the time of the evaluation interviews. In all these cases thoroughness was felt to be suboptimal, and one of the reasons mentioned for this was that insufficient time could be allocated to collecting all the relevant data and conducting all the necessary analyses on them.

¹⁵⁹This may be one more of those notions that is so obvious that authors no longer bother to mention it. It should be added that, for many authors, "using diagrams" usually means "using diagrams on the whiteboard".

Notes to Chapter 3

1There is no exact English equivalent for the Dutch term "Bedrijfskunde". Probably the closest is "Organisational Science" as applied by Daft and Lewin (1990), with an "emphasis on organisation dcsign" (p.3), "focus on equivocal problems" (p.5) and use of "heretical research methods" (p.6). Nevertheless, in most cases we will use the term "management and organisation", as this is the term best known to an English-speaking audience.

² van Aken (1994b, p.2).

³Historically speaking, the formal sciences have provided the dominant methodology for the majority of research in the field of Operations Management (OM). The "OR/MS paradigm" was very influential within OM up to the 1980s and remains the dominant paradigm in this area. In an overview of OM research Swamidass (1991) finds that 85 % of articles published in the field in 1987 were based upon either OR/MS, on statistical theory and simulation, and only 11 % was field-based /empirical. The kind of research approach that is common in OR/MS has been labelled "deductive": the researcher deducts new theories from existing material by formal methods. The dominance of this "deductive research" has undoubtedly resulted in some highly refined research (Swamidass 1991, p.797). But growing criticism is being directed towards this type of research in the field of OM, with the deductive approach being seen as largely responsible for the alleged gap between theory and practice. In an applied science, researchers should be producing usable knowledge for practitioners. However, the history of OM has been one in which many of the important innovations in the field were first developed by practitioners and only later analysed by researchers (Bertrand 1989). Some OM topics that are too fuzzy and messy, for example, "manufacturing strategy (...) are under-researched because they are unsuitable for deductive methods of research" (Swamidass 1991, p. 803).

⁴Prescntly the field of Operations Management appears to be looking at the empirical approaches from the social sciences as a counterweight to the dominance of deductive research in this field (Swamidass 1989, Flynn et al. 1990, Meredith 1993). By empirical research is meant "field-based research which uses data gathered from naturally occurring situations or experiments, rather than via laboratory or simulation studies, where the researchers have more control over the events being studied" (Flynn et al 1990, p.251).

⁵Simon (1969).

⁶Simon (1969, p.7).

⁷The following citation from Daft and Lewin (1990) supports this view: "The field of organization studies clearly has not become an applied science. Perhaps this can be explained by the natural reticence of social scientists to undertake prescriptive research. Social scientists are trained to do good empirical research and descriptive theory building without being overly concerned with implications for organisation design or performance outcomes" (p.4).

⁸This is consistent with Schein's suggestion that professional knowledge has both "an *underlying* discipline or basic science component upon which the practice rests or from which it is developed." and "an *applied science* or "engineering" component from which many of the day-to-day diagnostic procedures and problem-solutions are derived. " (Schein (1973), quoted in Schön (1983, p.24). ⁹van Aken (1994a, p. 21).

¹⁰"Normal science" is a term introduced by Kuhn (1962) to denote a research paradigm in a scientific field that has matured (for the time being). One of Kuhn's indications for how far a field has progressed towards the normal science situation is the prominence of textbooks in student education. Kuhn contrasts here the social sciences, history and philosophy with the contemporary natural sciences, where "until the very last stages in the education of a scientist, textbooks are systematically substituted for the creative sciencific literature that made them possible" (p.165). On the other hand, in what the author labels design sciences, such as "music, the graphic arts and literature, the practitioner gains his education by the exposure to works of other artists." (p.165). This viewpoint puts the prominence of case studies in management education in an entirely new light...

¹¹Because of their newness, organisational studies are nowadays often conducted from the normal science paradigm of the social sciences. According to Daft and Lewin (1990), "The field of organization studies has prematurely settled into a normal science mind set" (p.2), which is compared by these authors to "a straitjacket" (p.1).

¹²The term 'repertoire' steins from Schön (1983) who writes: "As a practitioner experiences many variations of a small number of types of cases, he (...) develops a repertoire of expectations, images, and techniques. He learns what to look for and how to respond to what he finds" (p.60).

¹³Rosenhead (1989b, p.350). Bertrand (1989) makes the same statement in his discussion on logistics designers: "To the experienced designer, these rules form an excellent pattern to guide his dcsign. (...) But using these rules is highly situation-dependent, and the experienced and able dcsigner is characterised by the ability to make the right translation for each situation (...)" (p.10).

¹⁴Even more fundamental than these attitudes are what Schein described earlier on as "the *underlying discipline* or *basic science* component." (Schein (1973), quoted in Schön 1983, p.24). For the PBM method, these are various basic sciences such as economics, operational research/management science, system dynamics and organisational psychology. Without such knowledge, a PBM consultant will probably not be very effective; but it would be going too far to say that this knowledge is part of the method itself.

¹⁵According to Simon (1969), all professional practice is concerned with 'design', which is the process of "changing existing situations into preferred ones" (p.55). This notion is supported by van Aken (1994), who states that "The core of the work of the professional consists of designing. On the basis of his analysis of the problem situation (...) and on the basis of his creativity and his design knowledge he makes a (...) design in order to solve, together with his client, the problem" (p.20). This is the sense in which we use the term "design" in the present book. This is especially true for professional consultants to organisations. As van der Zwaan (1990) states, "We could say that a management consultant ("organisatieadviseur") occupies himself normally mainly with the development of interventions, the design of better models and the conceptualisation of new organisational constructs" (p.7).

¹⁶According to van Aken (1994a), these design guidelines can be both 'algorithmic' and 'heuristic'. "Deterministic algorithms will lead to the intended result with certainty, stochastic algorithms will lead to the intended result for a percentage of cases that can be determined beforehand" (p.21). But, in many professions, most design guidelines, or what van Aken calls 'clinical knowledge', consist mainly of heuristics. "The effect of a heuristic is far less predictable. A heuristic is based upon the clinical study of similar cases. On the basis of that study, applications that are more and that are less likely to be successful can be distinguished, but an exact prediction (in statistical terms or not) is not possible. A professional has to work with heuristics in particular in complex problems, where many effects are working simultaneously and where an 'integral approach' is required, because the problem is hard to isolate from its context" (van Aken 1994a, p.21).

¹⁷van Aken (1991, p.17).

¹⁸This dual purpose of both describing and explaining is fundamental to most research models (cf. Segers 1983, Chapter 2). Miles and Huberman (1984) describe this distinction as follows: "Field research typically has both a *descriptive* and an *explanatory* function. The researcher wants to depict the local context and what happens within it *and* to disclose the rules and reasons that determine why things happen the way they do." (p.132)

¹⁹Actually, the aspirations held for the evaluation procedure went considerably further. Not only did the author want to establish to what degree the method had worked, but also why the method had worked as it did. It is this kind of causal explanatory analysis that is least well developed in the literature.

²⁰van Strien (1986), van Aken (1994a, p.20).

²¹From: van Aken (1994a, p.20).

²²This 'reflection' step bears close resemblance to the step 'induction' in the empirical cycle. The main difference between the empirical cycle and the reflective cycle here is that the former is primarily aimed at identifying laws in the *existing reality*, whereas the latter focuses on finding solutions for problems, and therefore is concerned with the *not yet existing reality* (van Aken 1994a, p.22). 23 van Aken (1991, p.17).

²⁴The professional essence of the method is a description of the method outside of a specific context (van Aken 1994a).

²⁵This figure is not intended to suggest that 'confidence' is always lower than 'functionality'. Indeed, one could also have drawn lines C and M such that C would always be greater than M. The point intended here is that k, the number of cases, should become great enough for M to become essentially stable over several cases (after point m), and for C not to decrease after point m.

 26 Every now and again a change may turn out not to be an improvement, but rather a worsening of the method. In that case the lines shown in Figure 3.2, will fluctuate both upwards and downwards, rather than increase continuously.

²⁷This can also be seen as an application of the law of diminishing returns.

²⁸This is what van Aken (1994a) calls the "second-order convergence process" (p.24).

²⁹Once again, this process need not be strictly monotonous: it is quite possible that, after an unsuccessful case, confidence in the method as a whole actually drops. In the current research project, this was for instance so after Case 4, which turned out to be particularly ineffective.

³⁰This is what van Aken (1994a) calls the "first-order convergence process" (p.24).

³¹One may argue that even in empirical case-study research this freezing is not required. For if one is looking for analytical generalisation rather than statistical generalisation, it is often more appropriate to have marked case-to-case change in those variables that one wants to investigate (Yin 1989). The nature of the method applied might be one such variable. However, the author feels that this is a relatively weak argument with which to defend the changes in the method over multiple cases; the design argument is a much stronger one.

³²van Aken (1994, p.24).

³³In practice, as well as in this research project, it is almost impossible, as well as undesirable, to freeze even a well-developed method completely. One always gets new insights as new technology and new theories become available and as the method is applied to new domains for new types of problems.
³⁴Cf. Chapter 6 of this book.

 35 Section 5.1. describes the historical development of this improvement process for the research described in this book.

³⁶Riley (1963, p.15), quoted in Segers (1983, p.37).

³⁷Akkermans and van Aken (1992).

³⁸Kuhn (1962) gives several delightful historical examples of this phenomenon from natural sciences as diverse as astronomy, physics and chemistry. The author himself had a similar experience when his research model did not yet include 'political sensitivity' as a problem contingency and he conducted pre-interviews in Case 4, where a politically very sensitive issue was to be discussed. In retrospect, it is clear that several respondents signalled this political dimension to the consultants, but these signals were ignored because they did not fit the theory. Similarly, in Case 2 'model quality' was found to be lacking in the eventual case analysis. In a previous analysis, conducted before 'model quality' was included in the research model, the researchers had found nothing but successes in this case (cf. Akkermans, Vennix and Rouwette 1993).

³⁹Segers (1983) speaks only of a "theoretical pre-phase of the research" (p.37). Maso adds: "It will hardly come as a surprise that changes in the research question are either not discussed or discouraged in the methodological curricula in social science research (1982, p.157-158).

⁴⁰Maso (1982, p.157).

⁴¹Maso (1982, p.157). Maso cites the example of a renowned social scientist who only dared to 'confess' to having considerably changed his research questions 18 months into the work, twelve years after his path-breaking study had been published.

 42 Two types of research for which Maso (1982) asserts that the research questions have to change during the research process.

⁴³Adapted from Vennix (1990, p.64).

⁴⁴Both Vennix's (1990) study and Verburgh's (1994) study tried to establish a thorough answer to this question, with only partial success.

⁴⁵The actual decision that is made and implemented is almost always at least slightly different from the recommendations that result from the PBM project. This was so in all six cases investigated.

⁴⁶Alliger and Janak (1989) talk in this context about "the dollar criterion" (p.333)

 4^{7} van Aken (1994a, p. 19) mentions seven measurement problems that tend to occur "in research that is directly aimed at the design and control of companies" (p. 19).

⁴⁸Another, more basic, reason for not using these post-project performance measures as evaluation criteria is the following one. Normally it takes at least a year, and often more, before the real long-term effects of a strategic project like those described become apparent. In most cases (except Case 1), the evaluation interviews took place less than half a year after the project was finished (in Cases 5 and 6 only a few weeks afterwards), so there are simply not enough data available on *long* term performance.

⁴⁹In particular, in most of the cases participants indicated that they had gained many insights as a direct result of the project. Of course participants may not be so good at reporting their experiences of learning (cf. Hofstadter and Dennett 1981), but still, if one takes the inner world of respondents to be of primary significance, as is one of the assumptions in qualitative research, one cannot ignore such unsolicited statements. Furthermore, since the research model incorporates interactions between insight and communication, leaving out implementation results would also render part of the analysis on process effectiveness incomplete.

⁵⁰Alliger and Janak (1989 p.331). These authors discuss a particular set of training criteria developed by Kirkpatick (1959a, 1959b, 1960a, 1960b), which has a four-level hierarchy of reactions—learning behaviour—results. The reader will notice that this hierarchy is almost equivalent to our hierarchy of process effectiveness & organisational platform—learning—decision implementation—business performance.

⁵¹Alliger and Janak (1989, p.335), who present findings from a literature assessment of 203 articles on training effectiveness.

⁵²Our research model is in line with these findings, which indicate that there is no correlation between reaction level (i.e. 'commitment' and other aspects of organisational platform) and learning (i.e. 'insight'). The only three inputs to 'insight' are 'communication', 'involvement' and 'simulation'. The first two of these operational variables are part of 'process effectiveness', the third is one of the 'project design elements'.

 53 Of course, one does have the advantage that, as in Case I. participants have more to say about implementation results, but then we just concluded that these are not reliable indicators of PBM effectiveness.

⁵⁴For instance, after the negative experiences in Case 4 the author thought it wise to let participants first cool off a little and give them time to put the sessions somewhat in perspective before they were interviewed...

⁵⁵Evaluation interviews in Case 6 were only a few weeks after project finish. Interviews in Case 1 were a year after the project had run. Most other interviews were one to four months after the project was finished.

⁵⁶This is a textbook experimental design, albeit without a control group, (cf. Cook and Campbell 1979, van der Zwaan 1990).

⁵⁷Only in Cases 1 and 6 were such questionnaires not completed, in Case 1 because the author had *not yet* thought of doing so, in Case 6 because he *no longer* thought it a useful exercise.

⁵⁸What was done in the pre-interviews in Cases 5 and 6 was to ask about 'commitment', 'speed' etc. *in general*, rather than in that specific case. This provided useful information for the consulting project, but was hardly usable information for an evaluation of the cases in question.

⁵⁹This procedure was followed by Wierda (1991, p.158-168), for example, to measure pre- and postconsensus. Dickson, Lee-Partridge en Robinson (1993) describe similar and other procedures for consensus measurement in establishing DSS effectiveness.

⁶⁰Also, there are all sorts of interpretative problems involved in these open-ended questionnaires. People may use totally different words to denote the same concept, or they may use identical high-level terms (e.g. 'quality', 'profit') to denote totally different ideas. Nevertheless, such a pre-consensus measurement was found to be useful for consulting purposes in Case 4.

⁶¹As happened in some cases in the studies by Vennix (1990) and Verburgh (1994).

⁶²It is a commonplace in the natural sciences, known as "Occam's razor", that if one needs more than a few variables to explain a certain phenomenon, one has not yet understood its essence completely. This is also a general belief in the system dynamics community (cf. High Performance Systems 1994).

⁶³Eden (1990), cf. also Section 4.2.

⁶⁴Cf. Vennix (1990), Verburgh (1994).

65Cf. Morecroft (1983, 1984).

⁶⁶Cf. Bertrand's discussion of the impracticality of the Wagner-Within algorithm (Bertrand 1989).

⁶⁷This does not mean that people disregard technical performance criteria: buyers of cars will look at the fuel consumption rates, safety factors, etc. Likewise, the participants in the projects described in this book did look sharply at technical criteria such as external quantitative validation in their assessments of model quality (See Chapter 6, Cases 3 and 5).

⁶⁸Cf. the practical test for interconnectedness suggested by Mason and Mitroff (1980).

⁶⁹Cf. the discussion of 'peer review' in Chapter 5.

⁷⁰Jac Vennix, personal communication, 1993.

⁷¹Cf. Rouwette (1993), Vennix, Schepers and Willems (1993) and Vennix, Akkermans and Rouwette (1993).

⁷²Segers (1983 p.138).

⁷³Segers (1983, p.138).

74Segers (1983, p.139).

⁷⁵Segers (1983, pp.133-140).

⁷⁶Developing a good set of questions for such a questionnaire tends to be a very demanding task. One needs to have a set of indicators that are strongly correlated, i.e. that all point in the right direction. That is a task which requires not only considerable creativity and theoretical refinement, but also extensive testing on large populations. As described in Section 5.1., the questionnaire from which Table 5.1. comes was found to be unreliable and could not realistically be made reliable within the course of this or other research projects that were using it.

⁷⁷Moreover, no correlations between these indicators in terms of their alpha-reliability were calculated (Segers 1983, pp.210-212.).

 78 See van der Zwaan (1990) for a discussion of different research designs for organisational studies that focus on evaluation.

⁷⁹Checkland (1989b, p.118).

⁸⁰Verburgh (1994) solves this problem by having the control group undergoing the same process but only somewhat later in time. This ensures participation by all stakeholders. However, the impressions from the experimental group are bound to leak out to the control group in a real organisation. This may not be a problem if one is measuring only learning effects, but for many of the other variables in our research model such a design would be highly problematic. Also, one might question how many client organisations would be willing to have the same strategic decision made twice.

⁸¹In Case 5, two persons had initially been involved apparently mainly for 'political' reasons but did not attend most of the sessions. They were interviewed and their assessments were indeed somewhat more negative than those of the participants who had been closely involved, thereby confirming one of the key assumptions in our research model. However, it is hard to establish to what degree this negative response was attributable to 'political reasons', or to low involvement. Because these data did not fit the overall case evaluation design, they were not used in the cross-case analysis in Chapter 7, but they are discussed in Akkermans (1995).

⁸²Van der Zwaan, session notes course "The case study as a research method", May 1992.

⁸³A phrase attributed to action research guru Arie Lewin, and the basic rationale behind all action research (e.g. Gill 1983).

⁸⁴Indeed, one of the main reasons for this author to join a consulting company part-time was his inability, as an assistant professor, to gain access to organisations where he could work on strategic decision-making processes in the real world.

⁸⁵Schein (1992) adds to this the observation that an outsider can only discover the "basic assumptions" in an organisation with the help of an insider. This is because "The outsider cannot experience the categories of meaning that the insider uses because she or he has not lived long enough in the culture to learn the semantic nuances, how one set of categories is related to other sets of categories, how means are translated into new behaviour, and how such behavioural rules apply situationally" (p.170). But explaining all this to an outsider costs time and energy to an insider, therefore this process "is likely to be more successful if insiders are also attempting to solve their problems and have asked the outsider for help. As a result this is defined as a clinical situation in which the outsider is providing help in a consulting role" (p.170, italics added).

⁸⁶van Aken (1993, p.20).

87Gill (1983, p.100).

⁸⁸Gill (1983, p.100).

⁸⁹Lewin and Daft (1990) appear to refer to the same concept when they talk about the need to do more *equivocal research*: "In the case of an equivocal problem, the researcher many not be clear about which questions to ask or which variables to measure. To gain new understanding of an issue, the investigator may need to have direct contact with the organizational phenomena and many need to use qualitative as well as formal modeling methods to devise new theoretical explanations" (p.5). ⁹⁰Maso (1982, p.159).

 91 Maso (1982, p.158-159), who also embeds these motivations within the social science textbook literature.

⁹²Cf. Akkermans and van Aken (1992).

 93 One may, of course, choose to see Simon (1969) as the first author to introduce the notion of "the sciences of the artificial". the design sciences, but that is different from describing a research methodology for these sciences. Schön (1983) goes considerably further, but still focuses mainly on professional design-oriented work. In the Dutch context, van Strien (1986) may be seen as the founding father for the concept of design-oriented *research*, although he prefers to talk about "problem-solving research", as contrasted to empirical research in the social sciences, rather than design-oriented research. Daft and Lewin (1990) acknowledge the need for this new paradigm as well, without providing too many practical recommendations regarding how to go about it. The first to offer such recommendations is van Aken (1991, 1994a, 1994b), who has introduced the concept of design-oriented research in organisation studies, i.e. in "Bedrijfskunde". He gives several practical recommendations for design-oriented research projects, such as the reflective cycle and the appropriateness of multiple-case studies in such research.

⁹⁴Some examples are Nagel (1992), Vos (1993) and Halman (1994). That does not mean that there has not been a strong emphasis on applied, design-oriented research in the Netherlands in the past. Excellent early examples of such research are van Aken (1978), Bertrand and Wortmann (1981) and Takkenberg (1983). Also, in the field of information systems such research projects are common practice (e.g. Bots 1989, Wierda 1990, Verbeek 1991, Verbraeck 1991, Hofstede 1992, De Jong 1992, Streng 1993, Mietus 1994). Finally, the field of sociotechnical research has also had a strong designoriented undercurrent (cf. van der Zwaan 1990, Hoevenaars 1992, van Amelsfoort 1993). ⁹⁵Vennix et al. (1994, p.30).

⁹⁶Much has happened since then. Notable publications in this area are Morecroft and Sterman (1994) and Senge et al. (1994). Nevertheless, a recent inside assessment still states that: "System dynamics model building has often been likened to an art, learnt through apprenticeship rather than from books (..) there is a need to create clear and penetrating documentation on system dynamics and on the procedures we use in practice. (..) I hope to see concerted efforts made by us to record our modelling experiences that should transform the practice of system dynamics from a limited art learnt through apprenticeship to a craft which can be learnt from books and practised widely" (Saeed 1995, p.2).

⁹⁷Vennix, Scheper and Willems (1993, p.534).

⁹⁸This role for case studies has been acknowledged even by 'orthodox' methodologists in the social sciences. But there it was still felt that "research aimed at a single case, with often non-replicable measurement procedures, and with a therefore unknown reliability, is not the most appropriate design to test causal hypotheses convincingly. This because both an explicit comparison point is lacking and because in general the unknown generalisability remains a highly disputable issue" (Segers and Hagenaars 1990, p.63).

⁹⁹Yin (1989) defends the 'modern' viewpoint: "We were once taught to believe that case studies were appropriate for the exploratory phase of an investigation, that surveys and histories were appropriate for the descriptive phase, and that experiments were the only way of doing explanatory or causal inquiries. This historical view, however, is incorrect." (p.15) Yin also gives some classic examples of famous explanatory case studies and, in a more recent publication (Yin 1993) dedicates three chapters to case studies for evaluation purposes.

¹⁰⁰Apart from Yin (1993), Miles and Huberman (1984) really stand out of the crowd with their highly practical *and* rigorous methods for causal analysis both in single-case designs and multiple-case designs (cf. also Chapter 5). More generally, the literature on qualitative research has most to offer here (see also Wester 1991).

 101 The historical development of this evaluation procedure as well as its final form are discussed in Chapter 5.

¹⁰²This may be an old Chinese saying, but it may just as easily have been invented by its Dutch exponent Johann de Boer.

¹⁰³In some respects, this may well be the usual case in design-oriented research.

¹⁰⁴Ever since Popper's "falsification is the way" one should probably write "refute" rather than "confirm" here (Popper 1974).

¹⁰⁵Of course every research project has both inductive *and* deductive elements. This is also true for this research (Cf. Chapter 5), where several cycles of induction and deduction were made.

 106 Cf. Meredith (1993), who speaks of "conceptual induction" and laments the fact that so little theorybuilding research takes place in operations management.

¹⁰⁷Daft and Lewin (1990, p.6).

¹⁰⁸This line of reasoning is based upon Wester's fine introduction to qualitative research (1991, pp. 20-21).

¹⁰⁹"Verstehen" is a term introduced into the field long ago by Max Weber (1985). For an in-depth discussion of this concept, see Scheper (1991, pp. 195-199).

¹¹⁰Wester (1991, p.19-20).

111Wester (1991, p.21).

¹¹²Wester (1991, p.21).

¹¹³Wester (1991, p.21).

¹¹⁴These four types of triangulation were first mentioned by Denzin (1978, referred to in Hutjes and van Buuren 1993, p.20.)

¹¹⁵The author cannot readily think of many situations in his own research were theoretical triangulation was clearly used. One exception might be the two conflicting views on the effect of communication on consensus, with one group of authors stressing conflict situations and the other group focusing on non-conflict situations (see Note 97 of Chapter 2).

¹¹⁶This 'orthodox view' is perhaps most eloquently expressed in Segers (1983) and Segers and Hoevenaars (1990).

117Yin (1993, p.57).

¹¹⁸Galliers and Land (1987) mention several problems that can arise from quantification. First there is the fact that "the need to apply values to variables often leads to the elimination of factors that, although they may have relevance, are difficult to value; thus applying to them zero value—which is probably the one value that they do not have!" (p.900). Secondly the fact that "the use of statistical tests implies a preciseness of measurement that is often not sustainable and could actually be misleading" (p.900). Thirdly the implication that "the need to limit the number of factors studied could also lead to conclusions being drawn that again could mislead the unsuspecting. In this case, the problem is that we are left not knowing whether different results could be obtained if other variables had been considered" (p.900-901).

 19 In Yin's terms: "Qualitative research can also be hard-nosed, data-driven, outcome-oriented, and truly scientific. Similarly, quantitative research can be soft and mushy and deal with inadequate evidence." (Yin 1993, p.57)

¹²⁰Miles and Huberman agree with this stereotyping for the situation in 1979: "The most serious and central difficulty in the use of qualitative data is that methods of analysis are not well formulated. For quantitative data, there are clear conventions the researcher can use. But the analyst faced with a bank of qualitative data has very few guidelines for protection against self-delusion, let alone the presentation of unreliable or invalid conclusions to scientific or policy-making audiences" (Miles and Huberman (1984, p. 16), quoting from Miles (1979)).

¹²¹Actually, these two approaches represent two clearly separate streams within the field of qualitative research. The first stream is the more text-based, "Grounded Theory" approach as originally developed by Glaser and Strauss (1967) and refined by such researchers as Wester (1991). The other stream has a stance clearly more "towards the structured end" (Miles and Huberman 1984, p.28) and places strong emphasis on data *analysis*, using ever more refined data displays. This stream is propagated by researchers like Miles and Huberman (1984). As shown by this research, these two streams need not come in conflict with one another.

¹²²The software package Kwalitan (Peeters, Wester and Richardson 1989).

¹²³Miles and Huberman (1984, Chapters IV, V and VI).

¹²⁴Miles and Huberman (1984, pp.181-185).

¹²⁵ Much like qualitative research has had a lower status than quantitative research.

¹²⁶And rightfully so, in many cases. For instance, in a review of case-based research in information systems, Benbasat, Goldstein and Mead (1987) found that "In many instances, the investigators had not considered some of the methodological issues. In general, the objectives of the researchers were not clearly specified. The reasons for selecting single-case versus multiple-case designs were not explained and the choice of the designs was not tied to the design approach. In many cases the data collection method was ambiguous and details were not provided. The use of triangulation to increase reliability was rare" (p.383).

¹²⁷Three short quotes from Yin (1989, p.21).

128van Aken (1994, p.23).

¹²⁹Yin (1989, p.23).

¹³⁰Galliers and Land (1987, p.900).

131Eden (1992, p.7).

¹³²Eden (1992, p.7).

¹³³Galliers and Land (1987, p.900).

¹³⁴In the field of information systems research, Galliers and Land (1987) suggest that over 50% of all research was laboratory based experimentation or field surveys. In the field of operations management. Meredith (1993) found only 5 % of publications in relevant journals being dedicated to case studies, and 4 % to field studies. Similar numbers are reported by Swamidass (1991).

¹³⁵Yin (1989, p.23).

¹³⁶van Aken (1994, p.24).

¹³⁷This being said, the reader should not be given the impression that these six cases were selected with this especially in mind. A professional consultant cannot permit himself to be overly choosy when it comes to doing projects.

¹³⁸That is, if we assume that the evaluation results for Case 6 were somewhat lower because the project was not even half-completed at the time of the evaluation interviews.

¹³⁹It might be added that the PBM method has been used several times since then for several other companies and problems, but without substantial changes in the method.

¹⁴⁰An extended but particularly appropriate citation from (Yin 1989, p.21).

¹⁴¹"In statistical generalization, an inference is made about a population (or universe) on the basis of empirical data collected about a sample. (...) This inethod of generalizing is commonly recognized because research investigators have ready access to formulas for determining the confidence with which generalizations are made, depending mostly upon the size and the internal variation within the universe and sample. Moreover, this is the most common way of generalising when doing surveys (...) and it is an integral (though not the only) part of generalizing from experiments." (Yin 1989, p.38) ¹⁴²Yin (1989, p.38).

¹⁴³Yin (1989, p.38).

144Yin (1989, p.38).

145van Aken (1994a, p.23).

¹⁴⁶It seems strange to talk of "orthodoxy" in a methodological school which was earlier on said to be just forming itself. What is meant here though, is that, whilst an explicit methodology for design-oriented research may be a novel phenomenon, the *practice* of doing design-oriented research in management and organisation goes back at least to the late seventies (e.g. van Aken 1978, Bertrand and Wortmann 1981, Takkenberg 1983).

¹⁴⁷Schön (1983, p.42).

¹⁴⁸Galliers and Land (1987, p.901).

¹⁴⁹Galliers and Land (1987, p.901).

¹⁵⁰The Economist (1993, p.65).

¹⁵¹van Aken (1994a, p.17).

¹⁵²Kay (1993, p.69).

¹⁵³The Economist (1993, p.65).

¹⁵⁴The evaluation findings from Case 2 are a good example. Here the evaluation method and the research model were not very refined at the time the initial case analysis was conducted, which led to very positive evaluation results. (Cf. Akkermans, Vennix and Rouwette 1993). But a second, more thorough analysis in the final stage of the research project revealed far more nuances and insights from the same case material, which led to more improvements in the PBM method than the original analysis had.

¹⁵⁵According to van Aken (1994a, p.21).

¹⁵⁶"Research programme" as used in the sense of Lakatos (1974).

¹⁵⁷This is what Lakatos (1974) calls positive and negative heuristics: "A research programme (...) consists of methodological rules: some tell us what paths of research to avoid (*negative heuristic*) and others what paths to pursue (*positive heuristic*)" (p.132.).

¹⁵⁸This discussion of heuristic and algorithmic design guidelines is based upon van Aken (1994b).

¹⁵⁹The implication of this is that ideas as suggested by Florussen and Wouters (1991) must be labelled nonsense. At a time when serious philosophers of science have long ceased daring to call themselves "positivists", these authors openly embrace the label and furthermore suggest that case studies should be used to test theories by means of comparing predicted results with the actual results...

¹⁶⁰van Aken (1994b, p.6).

¹⁶¹E,g. Eisenhardt (1989), Yin (1989) or Hutjes and van Buuren (1993).

162Eisenhardt (1989) calls this "iterative tabulation of evidence for each construct", and gives as main reasons: "sharpens construct definition, validity and measurability" (p.533).

¹⁶³Yin (1989, p.2)

¹⁶⁴Cf. Eisenhardt (1989, p.533).

 165 Eisenhardt (1989) calls this "theoretical sampling" and says that this "Focuses efforts on theoretically useful cases—i.e., those that replicate or extend theory by filling conceptual categories" (p.533).

¹⁶⁶Eisenhardt (1989) mentions both conflicting and similar literature and says that both confrontations "sharpen generalisability, improve construct definition and raise theoretical level." (p.533).

¹⁶⁷Cf. Vennix (1990, p.149-151).

¹⁶⁸McGrath (1984, p.30).

¹⁶⁹McGrath (1984, p.31).

¹⁷⁰McGrath (1984, p.33).

¹⁷¹Hutjes and van Buuren (1993, p.24).

Notes to Chapter 4

¹The very fact that the toolset is well covered in the literature is enough reason to keep this part brief. ²The version of PBM described here represents the current thinking of the author. As discussed in Chapter 3, the method did not change substantially after Case 4. This is not to say that the method did not change at all after that time, or that the author has not gained deeper insight into the method since then.

³This view of a method as consisting of different conceptual components is taken from Schein (1973) and Schön (1983), who distinguish three similar levels. For a discussion of this subject see Chapter 3.

⁴Thus, one cannot claim that this attitude is 'part' of the PBM method; rather, it is an essential prerequisite for successful use of the method. As such, it is one of the components of general "professional knowledge", as Ed Schein has put it: "A skills and attitudinal component that concerns the actual performance of services to the client, using the underlying basic and applied knowledge" (Schein 1973, p.39).

⁵The term and the concept were introduced by Schein (1969).

⁶Cf. Greiner and Metzger (1983).

⁷Schein (1969, Chapters 1 and 2).

⁸All other 'soft OR' techniques and the different blends one encounters in the current system dynamics literature may fall into this same category.

⁹Peter Senge (1990, Chapter 12) has introduced the term in a related context.

¹⁰As discussed in Section 2.4, Relation 1a-c.

¹¹In many cases, there is simply no real content-specific theory to hand. In Case 6, a more general theoretical framework was tried but it turned out that this did not really address the client's most pressing problems. What does happen quite often though, is that one sees from a modellers perspective, some general dynamic behaviour in a problem situation that has previously been described in system dynamics terms, a so-called 'systems archetype' (see Section 4.2.). Such notions can be very helpful in focusing the modelling effort, and in finding elegant and well-thought representations for specific client problems.

¹²"Systems Thinking" can be understood in two ways, one broad and the other narrow. In the broad sense, systems thinking means any approach that employs a *systemic* view of problems (cf. Checkland 1981). In the narrow sense, "Systems Thinking" has been used to label some of the more processoriented approaches in the System Dynamics community (cf. Senge et al. 1994). The terms are still very much in flux (as became apparent during the 1994 plenary sessions of the International System Dynamics Conference). In this context, the author is suggesting something in between. Because we are talking about fundamental attitudes here, something very broad is suggested; but because PBM is based upon system dynamics, and not on any of the other 'systems' approaches, some narrowing down is also intended.

¹³Adapted from Vennix (1990, p. 72). Vennix talks here about the 'econometric' approach versus the system dynamics approach. Similar diagrams appear in High Performance Systems (1994), which is also the source for the term 'linear thinking'.

¹⁴Another term might be "The Pareto Principle", after the discoverer/inventor of this notion.

¹⁵To quote Sterman (1991): "A model should have a clear purpose, and that purpose should be to solve a particular problem. (...) For the model to be useful, it must address a specific problem and must simplify rather than attempting to mirror in detail an entire system" (p.211).

¹⁶Oral communication, MIT System Dynamics Summer School, 1992.

¹⁷A good reference to cognitive mapping is provided in Eden (1989) and Eden and Simpson (1989).
 ¹⁸Eden and Simpson (1989, p.47).

¹⁹Colin Eden uses a more refined version of cognitive mapping. Firstly, he distinguishes more clearly between causes and consequences, the causes (and their causes) being listed downwards on the page, the consequences (and their consequences) being listed upwards. Eden also asks sometimes for the opposite of a certain development, to clarify the subject and stimulate discussion. Finally, he merges the various individual cognitive maps from his interviews into one shared mental map of the problem situation in a workshop (cf. Eden 1989).

 20 Hexagon brainstorming is a technique developed by Tony Hodgson from 1DON Inc. It is best described in the manual that accompanies the product (Idon 1992) and in Hodgson (1994).

²¹Closely related to hexagon brainstorming are such techniques as MetaPlanning (Novi, year unknown)

²²An alternative is to cluster the hexagons according to their position on some axis, e.g. time, or frequency of occurrence vs. effectiveness or importance.

²³The use of workbooks in system dynamics modelling projects was initiated and developed by Jac Vennix. (Vennix 1990, Vennix et al. 1994, Vennix and Gubbels 1994).

²⁴The classic reference to causal diagramming (indeed, to all SD conceptual modelling) is Richardson and Pugh (1981, Chapter 1).

 25 Figure 4.6. was taken from the final report to the sponsor, developed primarily by the consultants on the basis of pre-interviews. The workshop session that was intended to produce a diagram like this one was a failure.

²⁶A very good introduction to stocks-and-flows diagramming is provided in the Ithink® manual (High Performance Systems 1994). The subject is also discussed by Richardson and Pugh (1981).

²⁷The term used by Richardson and Pugh (1981).

²⁸Hall, Aitchison and Kocay (1994). Incidentally, in this article a number of different diagramming techniques are discussed, including causal diagramming and cognitive mapping.

²⁹According to the description of Hall, Aitchison and Kocay (1994).

³⁰Forrester (1961, pp.70-72) proposed the first five networks and suggested that informational links form a sixth network. The notion that intangibles form another generic model component was expressed most clearly by Barry Richmond of High Performance Systems (1994).

 31 Senge (1990) is the classic reference to archetypes. A number of them are presented in the appendix to his book. Additional guidelines on how to use archetypes (and how not no to use them!) can be found in the part on Systems Thinking in Senge et al. (1994).

³²Cf. John Sterman's wise reflections in Senge et al. (1994, pp.177-178).

³³The obvious conclusion from this archetype would be that the decreasing growth of the client company simply couldn't be helped: an external limiting condition, i.e. the size of the market, had started to operate. In reality, this turned out not to be the biggest problem cause for the client organisation, which was not external, but internal, and had to do with company structure rather than with market size.

³⁴The use of preliminary models was first described in some detail by Richardson et al. (1992), who labelled them "concept models". In Morecroft and Sterman (1994) several other examples of preliminary models can be found.

35The author is not aware of any texts describing this particular use of propositions, other than the current text.

³⁶Typically one will also find that a few propositions are just nonsense and are rejected as such by nearly all participants. Obviously, these should also be discarded from.

³⁷This may be decided by the consultants or the participants may vote on the issue.

³⁸Examples of Pareto analysis can be found in most undergraduate textbooks on quantitative applications of operations management e.g. Brevé (1990) (in Dutch) or Hill (1991).

³⁹In Case 5, the conceptual model at one stage contained different product types, client types, branch offices and geographic regions. In the final model, only a differentiation into six different product types and some distinctions between different branch offices remained.

⁴⁰Quite in respite to their great effectiveness and frequent occurrence, little has been written about graphical functions. One of the better references is High Performance Systems (1994, pp. 57-61).

⁴¹The seminal publication on system dynamics simulation is Forrester (1961); Richardson and Pugh (1981) is probably the most widely used student text book. High Performance Systems' (1994) software manual is a very accessible guide to SD simulation.

⁴²In order to represent a continuous system on a digital computer, approximation algorithms have to be used.

⁴³A good recent textbook reference is Hoover and Perry (1989). An older but noteworthy reference to discrete-event simulation is Shannon (1975).

⁴⁴For a discussion of different world views in computer simulation, see Akkermans and van Dijkum (1990).

⁴⁵For an in-depth comparison of different types of simulation, see Shannon (1975).

⁴⁶The problem is of course to find out what these factors are. For normally, it is impractical to vary all the variables over their entire range in combination with all other variables. In the projects described here, the focus is on those variables that are considered crucial for policy design, so-called policy variables. However, more formal methods have also been developed to identify what variables are dominant in determining overall system behaviour, such as Latin hypercube sampling (LHS) and Taguchi methods (cf. Clemson et al. 1995).

⁴⁷For instance, Ithink has a very useful "sensi specs" window precisely for this purpose.

⁴⁸The particular blend of model validation that is customary in system dynamics has been described by various authors, first of all of course Forrester (1961, 1994). An in-depth discussion of validation issues in system dynamics can be found in Meadows (1980).

⁴⁹There is not a great deal of literature on control panels. The author found the term for the first time in the Ithink-manual of High Performance Systems (1994, p. 153-154)

⁵⁰Cf. Miller (1956).

⁵¹The term was first introduced in the field of system dynamics by John Morecroft, but was originally coined by Seymour Papert (Morecroft 1988). The classic example of a microworld is People's Express, developed by John Sterman (1992). Several articles in Morecroft and Sterman (1994) discuss the pros and cons of microworlds, in particular Isaacs and Senge (1994).

⁵²The original reference to the learning-wheel concept is Byrne and Davis (1991) from Shell International's internal business consulting department.

53Vennix (1990).

⁵⁴At least that is the term used by Byrne and Davis (1991).

⁵⁵These may be consultants internal to the overall company, but at least external to the part of the organisation we are dealing with.

⁵⁶This multiple roles concept was developed and published in Richardson, Andersen and Rohrbaugh (1992), and was used in Cases 2 to 6 (and to a lesser extent in Case 3).

⁵⁷Credits are due to Michiel van der Molen for suggesting these terms.

 58 Notably in the discussion of the appropriate relations in Chapter 2 and in the discussion of the trade-off between workbooks and workshops in Section 4.6.

⁵⁹From Case 5 onwards, the author realised that this phenomenon had been a recurrent event in many of his PBM projects, but did not see it as a general rule.

⁶⁰This label was mentioned to the author by Carl Michel of McKinsey & Co., where the phenomenon is sufficiently well known for to have been named.

⁶¹As Tony Hodgson labels it, after Kees van der Heijden (Hodgson 1994).

62Cf. McGrath (1984).

⁶³Thanks to Paul Bogerd for introducing the concept and its label to the author.

⁶⁴Once again, thanks to Paul Bogerd for suggesting this label.

 65 This worked very well in Case 6. Here some additional risks and weaknesses were identified that had remained hidden in the interviews. Figure 4.6 in Section 4.2. shows partial results from this session.

⁶⁶For a discussion of this diagram, see Akkermans (1994).

⁶⁷This is true of Ithink and Powersim. Vensim, by contrast, also allows one to use causal diagrams which hide the specific nature (level, rate, auxiliary) of the variable in question.

⁶⁸High Performance Systems (1994).

⁶⁹A similar simplification process in the quantification of a conceptual model is described in Vennix and Gubbels (1994).

 70 An insight that is also generally supported in the literature on artificial intelligence (e.g. Kidd 1987). More specifically, this was also one of the hypotheses for the relative lack of success in Case 2 in designing solutions to make business units work together more often. Here the analysis of why the units did not work together went smoothly after a few interviews and workshops, but afterwards coherent design could not be made.

⁷¹One of the mistakes in Case 4 was that this did not happen when the pre-interviews showed that the problem was much wider than was initially appreciated by the project sponsor.

⁷²In Case 5 part of the first meeting with the internal project manager was dedicated to deciding what aspects of the problem would not be modelled.

⁷³Normally, one would expect you to do this prior to the project start, but problems sometimes turn out to be wider in scope than had been anticipated on the basis of initial discussions with 1-2 people. There should be no further surprises of this kind, however, by the end of the project definition phase.

⁷⁴This is what happened in Case 6, where only the 3-4 most important questions were chosen out of a larger series of questions brought forward by the project team members. The subsequent modelling effort was focused on finding answers to these key questions.

⁷⁵Cf. the indications and contra-indications for PBM from Chapter 8.

⁷⁶Cf. Stalk, Evans and Shulman (1992).

⁷⁷Examples include SSM, SODA, SAST or Strategic Choice. See Chapter 2 for a brief introduction to these techniques.

 78 Cf. Flood and Jackson (1991) and Lane (1993), and see also Chapter 8 for a more elaborate appraisal of PBM in comparison with other strategic problem-solving methods.

⁷⁹See the discussion in Note 123 to Relation 21 (problem tangibility \rightarrow data analysis, simulation) in Chapter 2.

⁸⁰This may be different in a flight simulator setting. For instance, the People Express flight simulator (Sterman 1992) contains several very soft relationships, such as the relation between work pressure and employee morale, and between morale and employee losses.

⁸¹That does not mean that you should always follow your clients preferences in this. See Trade-off # 7 in Section 4.6.

 82 In Case 2, one of the consultants had to go down to the corporate archives to dig up old annual reports to find data on company growth from its start fifteen years earlier.

⁸³In Case 6, the company wanted to set up its supply chain management differently in the future; but of course all the historical data related to the old organisational structure.

⁸⁴In Case 5, client behaviour regarding bank services was perceived to have altered considerably in recent years; also, charges for those services had been changed. Therefore, it was questionable whether data on client behaviour after office closures in the past could be used to validate a model which was developed to predict future client behaviour in such cases.

⁸⁵Several examples of this come from Case 1. For instance, the arrival time of each truck-load of newspapers to be sorted was known to the minute. It was also known what newspapers these trucks carried. Finally, it was known how many copies of each newspaper were to be distributed. But no one had ever thought of combining these data to calculate what percentage of the total load arrived during each half hour of the shift. Once this graph had been created, it immediately became obvious when bottlenecks would occur and when there was excess capacity available.

⁸⁶Another example from Case 1 illustrates this. In the modelling process it crucial to establish processing speeds for different distribution methods. Since these were not known, simple time-andmethod studies were performed with employees, who were asked to distribute various amounts of newspapers according to different methods. The data from these studies underwent regression analysis, which yielded a relation that would predict processing speed. But before the studies could be conducted, the modelling team first had to establish that, conceptually speaking, distribution time was built up from three different activities. Only then could experiments be designed in which one activity at a time was changed.

 87 As we have seen in Chapter 2; especially the correlation between political sensitivity and willingness to cooperate is confirmed in the cross-case analysis described in Chapter 7.

⁸⁸This may not come naturally. Consultants with high analytical skills, such as are required to develop good models, will often not be very sensitive to such subtle political signals as we are discussing here. However, the author does agree with Argyris (1990) that "it is possible for professionals who are highly competent in formal, quantitative analysis also to be aware of critical defensive routines." (p.78).

⁸⁹This is particularly difficult if the sponsor and/or project leader are part of the political problem.

⁹⁰Some management consultants even feel that just about all organisational problems are really problems of communication, that is political problems (Henk van der Veeken, oral communication)

⁹For instance, in Case 4, where political sensitivity was very high, it might have been an option to try and limit discussion to balancing the number of commercial targets (and hence project acquisition) with the ability of the company to conduct successful projects for clients. That would have left a problem of much narrower scope, but one that was still valid yet less sensitive politically and readily analysable with system dynamics modelling. Unfortunately, this author had yet to learn the hard way. ⁹²The author has had one positive experience with an unwilling group. This group was to discuss the pros and cons of a corporate standardisation project against which strong opposition existed. Although the most ardent opponent initially indicated that he was present "only as an observer", after some rounds he could not help participating. The consultant's finest hour occurred when this same participant suggested as a label "laziness" for the cluster containing (partly his own) arguments against the standardisation project.

⁹³E.g. SAST, Strategic Assumption Surfacing and Testing (Mason and Mitroff 1981). or stakeholder analysis in SSM (Checkland and Scholes 1990).

94Cf. Argyris (1990).

⁹⁵Some preliminary explanations: In Case 1, there were frequent discussions over budgets, and the original adviser to the top manager who had been a promoter of the project fell out of grace during the project. In Case 3 the general manager left the company and was not replaced. In Case 4, the project sponsor became dissatisfied with the low quality of the process in which he himself participated and actually cancelled the project halfway through. In Case 6 the sponsor came under pressure to focus all resources on another project that had already been delayed for more than a year. So one might say that most of the direct causes for lower top management support lay outside the consultant's control (apart from Case 4 of course.).

⁹⁶This may be a good thing, for if the sponsor is engaged in the sessions, hierarchical diversity will often become too large (see below) and the other participants will feel limited in their ability to discuss things openly.

⁹⁷Wrapp (1967), reprinted in Mintzberg and Quinn (1990, p.33).

⁹⁸This may actually have been one of the reasons for project continuation in Case 6.

⁹⁹At least in the author's case there was usually also a considerable age difference with the project sponsor.

¹⁰⁰This was done very well for instance by the internal project leader in Case 5.

¹⁰¹For instance, in Case 6 where the sponsor considered freezing the project and concentrating all efforts on another project, the internal PBM project leader was heading this other project as well.

 102 These are all examples from the field of Operations Management: it seems that problems in this field tend to be particularly cross-functional (See also Chapter 8).

¹⁰³This succeeded very well in Case 4; the secretary of the CEO who sponsored the project personally made sure everyone would attend.

¹⁰⁴Vennix et al. (1994) refer to Slater (1958), who has found that, for tasks involving decisions based on evaluation of exchanged information, participant satisfaction with the process was highest for groups of five.

¹⁰⁵The number of relevant stakeholders will be larger, from six up to more than twenty in larger organisations.

¹⁰⁶Cf. Vennix et al. (1994).

¹⁰⁷Two remarks to this: Firstly, researchers in GDSS claim that electronic support tools which allow for parallel participation make rapid discussions with large groups possible (e.g. Nunamaker, Vogel and Konsynski (1989, p.146). Secondly, small-group research indicates that, as groups become larger, the most dominant group member tends to speak more and more whilst the other team members tend to speak less (McGrath 1984, p.146).

¹⁰⁸In terms of the conceptual model described in Chapter 2, we are primarily looking at various "project design elements".

 1^{109} It is not just the hours spent in discussion itself: a typical interview will take $1-1\frac{1}{2}$ hours, a typical workshop 2-3 hours. It is also the travelling time to the central location where the session is to be held, the scheduling that is required to find a suitable time and place, and so on. However, all this should not be exaggerated; there is a lower time investment, but it is not dramatic.

¹¹⁰As the cross-case analysis of Chapter 7 will illustrate, this importance of the conversational process for insight has also been confirmed by the six cases evaluated.

¹¹¹A comparable situation can be found in the field of information systems. There one has diagramming techniques which focus on the activities performed in a system, diagramming techniques for the information flows in a system, and diagramming techniques to identify the structural relationships between data elements (E.g. activity diagrams and information diagrams in ISAC (Lundeberg, Goldkuhl and Nilsson 1982) and entity-relationship diagrams in NIAM

(Wintraecken 1987)). But, just as in system dynamics modelling, one can't *translate* one type of diagram into another.

¹¹²David Kreutzer has been known to follow this procedure (Kreutzer 1992, Eveleens 1994)

¹¹³Cf. Vennix and Gubbels (1994), Vennix et al. (1994).

¹¹⁴An insight for which acknowledgements are due to Johann de Boer.

¹¹⁵Perhaps the only exception is with a group that has substantial experience with the modelling technique in question. Even in a case when you know nothing about the problem (and therefore cannot create a preliminary diagram), this author would personally not go further than hexagon brainstorming in the first session.

¹¹⁶For small groups of 2-3 participants, a well-sized computer display would be sufficient; a mid-size alternative for slightly larger groups is the use of jumbo-size computer displays. For groups of over six people, wall projection becomes obligatory.

¹¹⁷Examples include CK Modeller for hexagon diagramming (Hodgson 1994), COPE for SODA (Eden 1991). Also in the system dynamics community the use of computerised group diagramming has been reported. The Decision Tectronics Group at S.U.N.Y at Albany has described the use of Ithink in this manner on several occasions (cf. Richardson, Andersen and Rohrbaugh 1992, Vennix et al. 1994), as have the consultants of High Performance Systems, the developers of the Ithink software (High Performance Systems 1994)

¹¹⁸A modelling guideline from High Performance Systems (1994).

¹¹⁹Richardson, Andersen en Rohrbaugh (1992) discuss a mixed approach, whereby most of the diagramming is done manually but the model coach demonstrates a simulatable version of this model at key points in the modelling process.

¹²⁰Please note that using a computerised projection of the model in learning-wheel-like policy experiments is an entirely different matter; there the use of a LED projector is more or less obligatory with larger groups.

¹²¹Wolstenholme (1983) was the first to make a plea for "qualitative simulation". Later Morecroft (1985) also noted that, in one case, the quantification stage did not really provide him with any new insights on system behaviour, but merely "revealed his limitations as an equation writer" (p.2).

¹²²Forrester (1994), Sterman (1991).

¹²³This is often no small matter, as the discussion on model validation later on in this section will illustrate.

¹²⁴See also Chapter 8 for a discussion of model confidence as a function of participation in the modelling process.

¹²⁵Please note that data availability is not the issue either. It may look hard to find quantifiable data on soft variables like "motivation" or "irritation", but in practice these can always either be found or be assessed by the client group.

¹²⁶In the past, discrete-event simulation was the technique used in mainstream Operations Research/ Management Science. In the 1960s and 1970s, system dynamicists and management scientists had several controversies, which are perhaps best understood from a historical, sociological perspective, i.e. in a Kuhnian manner (Kuhn 1962): these were two "subcultures", two groups with two different "paradigms" (cf. Meadows 1980), with different "cultural heritages" (cf. Lane 1993).

 127 However, please note that the four quantified simulation models created in the six cases described in this book displayed very little feedback indeed, although the consultants were on the lookout for possible feedback loops. (There was plenty of feedback in the two qualitative models.) This is a puzzling fact. Was it just a coincidence, or did it have got something to do with the kind of decision that was to be supported? The cliché would be that "clearly, more research is needed in this area".

¹²⁸This is not necessarily a comment on the technique itself. If you use DES, it may be that you are modelling the system at a more detailed level than if you are modelling it with SD. And if your model is more detailed, it will be bigger and hence need more data. So this drawback of DES versus SD is not entirely a fair one, although it was presented as one such in a recent comparative study of operations modelling techniques performed by Baines, Kay and Hamblin (1994).

¹²⁹The only exception to this rule may be when the process being modelled is actually a continuous process, such as in the chemical industry. That is why there is a (+) in the column for system dynamics with this point, next to a clear minus.

¹³⁰Notably Ithink from High Performance Systems.

¹³¹Of course if you want to conduct really in-depth multiple regression analysis is it better to turn to a specialised statistical software package.

 132 Goud, Haverhals and van Lierop (1993) mention as the main advantages of spreadsheets versus system dynamics (1) the ability to make complex calculations of clear relationships. (2) the possibility for in-depth modelling and (3) the compatibility with other software.

¹³³Meaning techniques such as hexagons, causal diagramming, graphical functions and stocks-andflows diagramming, which were all (except hexagons) developed in the field of system dynamics

 134 This also became apparent in the cross-case evaluations, where very few general relations could be established regarding an appropriate 'abstraction level' for models (See Chapter 7).

¹³⁵This table is based upon findings from consultants within Shell Petroleum. The first three rows were brought forward by Brian Marsh in a presentation at the 1991 Systems Thinking in Action Conference in Boston. The next three rows were published in a paper by Mat Byrne (Byrne and Davis 1991, p.76).

 136 This figure, as well as the associated modelling guidelines, were derived from an older version of High Performance Systems (1994).

¹³⁷Roberts (1978a).

¹³⁸In Case 6 this was done by sending each team member a copy of part of the Ithink manual. "Guidelines for the Modeling Process", and discussing this in the first workshop. Team members memorised these guidelines and referred each other to them at relevant instances during the subsequent modelling process.

¹³⁹Of course, another purpose of validation is to find flaws in a model and to correct them. But once these are corrected, confidence in the model should be higher than before validation.

¹⁴⁰Please note that model formalisation is not required for client validation; it is entirely possible for a client to validate a non-quantified conceptual model. External validation however, does require model formalisation.

¹⁴¹One therefore simulates a historical period and investigates whether the behaviour of the key model variables resembles that in historical time series. Normally one does not go so far as to use regression analysis to evaluate this 'fit' in system dynamics modelling (as is customary in econometrics, for example); one merely looks for correspondence in the overall pattern of behaviour. ¹⁴²Senge and Lannon (1990).

Notes to Chapter 5

¹As late as July 1993, Vennix, Scheper and Willems (1993) could justifiably write that "Although various model builders within the system dynamics community experiment with group model-building projects, almost nobody seems to pay attention to the impact of these procedures on the client organisation" (p. 534).

²Akkermans and Vennix (1990) gives the first full description of this project, although some software engineering issues were already discussed half a year earlier in Akkermans and Hoogeveen (1989). ³Cf. Akkermans and van Dijkum (1990).

⁴Akkermans and van Aken (1992), originally published as a paper in the 1990 proceedings of the 6th OMA conference in Birmingham.

⁵This questionnaire was first described in Vennix, Scheper and Willems (1993).

⁶This is a format which presents questions as propositions, like: "Communication in the sessions was open", to which the respondent can answer by choosing from the five categories: strongly disagree / disagree / neutral / agree / strongly agree.

⁷The questions for these interviews were open and exploratory, such as "What do you think of the discussion in the sessions?", "What do you feel are the main results from the sessions?", "How do you compare PBM with other methods?", and so on (for a full listing, see Rouwette 1993, pp.49-50).

⁸See also Akkermans, Vennix and Rouwette (1993) for a discussion of findings from the evaluation of Case 2.

⁹More specifically, the so-called "alpha-reliability" was too low (Segers 1983, pp.210-212). This α measures the correlation between responses to questions that refer to the same overall variable, e.g. three different questions that all inquire about consensus. If a questionnaire is sound, then there should be a high correlation between these different questions; often a value of $\alpha \ge 0.80$ is taken as the threshold. For the sample of 24 respondents described in Vennix, Scheper and Willems (1993), values of α never rose above 0.60 and were usually much lower. Of course, this is a somewhat different sample than the sample for the 11 respondents from Cases 1 to 3, but 6 of those 11 respondents were in both samples (the respondents from Case 2), and the questions were identical.

¹⁰Calculation of correlation measures like alpha-reliability calls for large samples of between 50 and 100 respondents. With an average of five respondents per case, that would mean conducting 10 to 20 additional cases (university students in a laboratory setting are not appropriate for this type of question, as discussed in Chapter 3). If that initial sample would reveal that the questionnaire was unreliable, then at least another 10 projects would have to be conducted and evaluated with a modified version of the questionnaire — still with no certainty of success.

¹¹Miles and Huberman (1984), Wester (1991), Hutjes and van Buuren (1993).

¹²The biggest difference from the earlier versions of the research model was that the new model made a distinction between organisational and content/model-related aspects of effectiveness: in terms of the current research model, between 'organisational platform' and 'model quality'. This distinction, which can be traced back to a research document dated 17-9-1992, was maintained in later versions of the research model. A research document dated 19-2-1993 already uses the terms 'platform for change' and 'decision quality', which are shown in a diagram to lead to 'implementation success'. Not until the autumn of 1993, however, was the fourth overall concept of the research model, 'process effectiveness', added explicitly.

¹³Additions to the research model in this phase included aspects such as 'willingness to cooperate', 'usability' and 'confidence'.

¹⁴These changes consisted mainly of pruning variables and relations. For instance, the dyadic concepts 'problem complexity' – 'problem scope' and , 'quantitative aspects' – 'problem tangibility' were unified, and the concept 'data availability' was added.

¹⁵Yin (1989, p.69), Hutjes and van Buuren (1993, p.20), Wester (1991, p.20).

¹⁶In qualitative research, or indeed in all case-study research, it is standard procedure to construct such a database and keep it separate from interpreted material (e.g. Yin (1989), Wester (1991), Hutjes and van Buuren (1992)).

¹⁷This particular interview was selected because it was originally conducted in English.

¹⁸Special, because these questionnaires could be seen as fulfilling a dual function as both interviews and questionnaires.

¹⁹The difference between an introspective observation and a reflectory memo, as presented next, is somewhat arbitrary, and not of much significance as both types of documents were grouped in one column in the case analysis.

²⁰The choice for a qualitative research approach was made just before the end of Case 4, therefore only Cases 5 and 6 systematically contained such observations by the author and his research assistant.

²¹It is this second kind of memo that Glaser (1978) talks about as he describes a memo as "the theorizing write-up of ideas about codes and their relationships as they strike the analyst while coding." Miles and Huberman (1984), where this quote comes from, agree with Glaser and go on to say: "Memos are always *conceptual* in intent. They do not just report data, but they tie together different pieces of data together in a cluster, or they show that a particular piece of data is an instance of a general concept." (p. 69).

²²For a brief overview of different branches of qualitative research, see e.g. Wester (1991, pp. 17-19).
 ²³Glaser and Strauss (1967), Wester (1991).

²⁴The software package that used for coding purposes in this research was Kwalitan (Peters, Wester and Richardson 1989). For an excellent Dutch-language overview of research procedures in grounded theory see Wester (1991).

²⁵In a grounded theory approach, one tries to develop a conceptual research model 'from the ground up', that is from the base data. The evolution of such a model is seen very much as an ongoing *process*: the theory keeps developing as data collection and data analysis progress. This cannot be said of this research project, where there was already a research model prior to data analysis. Although this research model has changed somewhat as a consequence of findings in data analysis, it would be untrue to say that it had been developed 'from the ground up'.

²⁶From this one example it will be clear that decisions as to what scenes to select may require some judgement calls. Wester (1991, pp.162-163) provides guidelines for this selection process, but ends by saying that the most important advice is "Initially, one should not take this process too bureaucratically. A new phase in the analysis may require new borders, and mistakes in the original selections can be corrected easily by comparisons" (p. 163).

²⁷In the coding process, the research assistant sometimes had to choose new labels for certain scenes, when these were not adequately captured by the existing set of labels. Such new labels and other coding problems were discussed with the author, and did, on occasion, lead to changes to the research model as described in Section 5.1.

²⁸Please note that these references are already somewhat condensed, since (parts of) sentences considered less relevant by the analyst have been left out or a scene may even be completely rephrased. Whilst this is recognised as a potential source of errors, this sort of editorial licence can hardly be avoided.

²⁹Miles and Huberman (1984, p.21).

 30 As described expertly by Miles and Huberman (1984) in their seminal work "Qualitative Data Analysis. A Sourcebook of New Methods".

³¹Miles and Huberman (1984, pp.21-22).

³²For the design of these displays, the author has relied heavily on the many inspiring examples contained in Miles and Huberman (1984). However, this particular combination of displays on different levels is his own specific interpretation of their general approach.

³³Miles and Huberman (1984, p.54).

³⁴Miles and Huberman (1984, pp.54-55).

³⁵Various deviations can still occur in this coding process. For one, it is hard to maintain consistency *over* cases. As one can see from Display Level 2, an initial assessment of '-' was changed into '--' by comparing this project with the five other cases and concluding that this was really a very bad process. Secondly, it is also hard to remain consistent *within* cases. If a '++' is not assigned to variable A because respondents were not truly very positive about variable A, then it is wrong to assign '++' to variable B if respondents were not *truly* outspoken there either. A third complication is that the conceptual model was still subject to development at the time. Sometimes the second pass by the author happened one or more months after the research assistant had performed the first pass. Subtle differences in interpretation must have been inevitable.

A more reliable approach would have resulted had there been several analysts, working with a fixed, well-described conceptual model, who independently coded on one or more texts sample texts, compared their assessments and discussed differences, and kept on repeating the process until the inter-coder reliability (Vennix 1990, pp.149-150), or researcher reliability (Segers 1983, p.212) was sufficiently high to start working on the full database. Thorough though it may be, this would also be a very time-consuming procedure; moreover, it offers no guarantee of achieving an acceptable level of inter-coder reliability. Apart from these considerations, such a procedure did not seem appropriate for an exploratory research project, where the conceptual model was both very large and rather fluid.

³⁶For instance, had we been focusing solely on aspects of communication patterns in sessions, such as conflict levels, or on distribution of session participation over different members, observation systems such as Bales's "Interaction Process Analysis" (Bales 1950, McGrath 1984 Chapter 12) might have been quite useful. Since the scope of the analysis was far wider than just these two elements, however, this type of approach was not considered feasible, given also such generally acknowledged difficulties with IPA as its requirement for extensive observer training and video recordings of the sessions (McGrath 1984, p. 143).

³⁷As with pre-interviews, this is not to say that such questionnaires were not instructive for the consultants in the cases where they were used: especially in the beginning of a project, all information is of value to a consultant. However, these particular documents were of limited utility for research purposes. One exception might be the pre-questionnaire in Case 4, which indicated very low consensus. But a devil's advocate might equally attribute this low score to confusion engendered by the very broad and vague problem scope.

 38 Another way of talking about this is to distinguish dependent and independent variables. But that might be misleading because, as we have seen in Chapter 4, many presumptively independent variables, such as 'problem scope', 'group size' or 'top management support', can to some extent be manipulated, or "managed", as we called this, by the consultant and are therefore not truly independent.

³⁹Miles and Huberman (1984, p. 132). This entire procedure of developing causal networks to explain case results has been based upon the work of these two authors. In particular their causal network on page 133 was a strong inspiration for this part of the case analysis.

⁴⁰Miles and Huberman (1984, p.132).

⁴¹The reader will notice that this very much resembles the way in which causal diagrams and stocksand-flows diagrams were used in conjunction with propositions to describe the full conceptual model in Cases 5 and 6.

⁴²Miles and Huberman (1984, p. 142).

⁴³Miles and Huberman (1984, p. 134).

⁴⁴Miles and Huberman describe the different start-up tactics of the two approaches as follows: "The deductive researcher would generate an initial conceptual framework from the best accumulated science and lore of the domain under study... By contrast, the inductive researcher would go for a more data-derived casual network — one that is dredged up progressively from the field. The ultimate model would *then* be confronted with the regnant science and lore of that domain." (1984, p.134)

⁴⁵This inductive approach was followed in the analysis of Cases 1,2, 5 and 6. Cases 3 and 4 were the first two to be analysed, so here there was not yet a detailed and explicit search for clues on causal relations in the case data base. Instead, the author presented his own overall understanding of what had happened in the case after reading the case evidence in the four causal networks.

⁴⁶This figure comes from the case analysis report that was made for Case 2 (all case reports available from the author at request).

⁴⁷For a discussion of different aspects of validity and reliability the reader is referred to Chapter 3.

⁴⁸E.g. Hutjes and van Buuren (1993, p. 57), Wester (1991, p. 186).

⁴⁹Hutjes and van Buuren (1993, p.212), translated from Dutch.

⁵⁰Guba and Lincoln (1982) call this process 'peer debriefing', Hycner (1985) speaks of 'consensual validation'. See also Hutjes and van Buuren (1993, pp. 56-57).

⁵¹An alternative option was to send respondents the data matrix displays. This option was rejected, mainly on the ground that to do so, all the displays would have to be sent, otherwise it might not have been clear how the researchers had arrived at their conclusions in the top level displays. Not only would this have meant a data overload for participants, it would also have represented an unethical breach of the interviewees' rights to confidentiality. The process would not have served much useful

purpose as respondents were hardly in a position to contest the fact that other colleagues had made the statements attributed to them, even if they did not agree with them, leaving them only the possibility of changing the assignment of values. However, those assignments had been made by the researchers in the light of their knowledge of all six cases, which meant that a '++' in Case X should be comparable to a '++' in Case Y, whereas respondents only had experience of one case.

⁵²The way in which Miles and Huberman verify causal networks with informants is far more elaborate. They specifically ask informants to assess each individual relation and value in detail (1984, pp. 142-143); not surprisingly, they pay their informants money to do this kind of work...

⁵³Once again it should be noted that the causal networks of Cases 3 and 4 did not contain such marked relations, because these cases were analysed in a more informal, implicit manner, not from direct clues in the displays.

⁵⁴As the first case started at the end of 1991, this meant that in some cases, the project had been conducted a long time previously. All the member checks were conducted in the spring and summer of 1994. In those circumstances it is virtually impossible for a respondent to recall in sufficient detail what precisely went on in the project.

⁵⁵"The transition from the analysis and interpretation of single case studies to a comparison of the cases is (..) without a doubt on of the most difficult assignments the case study researcher has to face" (Hutjes and van Buuren 1993, p.168).

 56 Yin (1984) is the first to acknowledge that "there are few fixed formulas or cookbook recipes to guide the novice" (p. 105), but he does not present clear guidelines on the multiple-case study analysis process himself either.

⁵⁷Yin cites as one clear exception the work presented by Miles and Huberman (Yin 1984, p. 105).

⁵⁸In descriptive cross-case analyses, saying that "organisational support was relatively high in most of the six PBM projects" is probably not a controversial statement. Few readers would immediately assume that the writer of such a sentence was making a statement about *every* PBM project in *every* organisational setting. The level of intended generalisation does not go beyond the six cases studied. ⁵⁹Yin (1984, p.38).

⁶⁰This is what Yin refers to when he talks about "level 2 and level 1 inferences" (Yin 1984, p. 38).

⁶¹Miles and Huberman also describe a more inductive approach for the construction of such a network. They try to identify recurrent 'streams' of causal chains in the various case-specific causal networks and try to reduce these to a limited number of main types, which they call "scenarios" (Miles and Huberman 1984, pp.197-203). In the current research, such 'streams' or sub-networks, were also identified, but here *after* the overall network had been established.

⁶²Miles and Huberman give the following four rules-of-thumb: (1) "Order the model temporally": (2) "Consider what variables might reasonably be expected to have a direct impact on other variables, (...) having a plausible direct connection"; (3) "Note what the people at the site say when asked for explanations" (cf. our procedure in single-case causal analysis); and (4) "Consider what available research and theory have to say about causal connections." (p. 193)

63Miles and Huberman (1984, p.193).

⁶⁴Whenever a causal relation was never found to be discussed in the literature, it became a candidate for closer scrutiny. Was this really an essential part of the process being described? Could the same content be expressed with fewer relations? In addition, those variables that were investigated in the displays but were not part of any of the causal relations were removed from the causal model. All this considerably reduced the number of variables in the final research model.

 65 If we look at this from a perspective of statistical generalisation, this becomes especially evident. There a good rule of thumb would be that, in order to investigate n variables, one would need in excess of 2n observations.

⁶⁶The interval between -/+ and +/- is 1.0, whereas the interval between all other adjacent values is 0.5. This makes unequal intervals, but all alternatives have their drawbacks. For instance, making +/- equal to -/+ and giving them both the value 2 would have meant changing the interpretations given by the researchers to these two assessments. To them, the assessment +/- meant 'mainly positive, but with some negative aspects'; that is not the same as 'mainly negative, with some positive aspects', which was the interpretation for the assessment -/+.

⁶⁷Miles and Huberman are alone in suggesting practical procedures for this process (1984, p.181).
 ⁶⁸Miles and Huberman, (1984, p.181).

69cf. Miles and Huberman (1984, p.196).

Notes to Chapter 6

¹This project is described at length in Akkermans (1993a).

²A simplified look-alike of hexagon brainstorming (Novi, year unknown).

³This project is discussed at length in Akkermans, Vennix and Rouwette (1993).

⁴In the original case analysis conducted for this case, which is summarised in Akkermans, Vennix and Rouwette (1993), the less positive remarks made by managers in the evaluation process were not picked up. Only a renewed, careful qualitative data analysis of the transcripts of the original interviews revealed the kind of nuances that are described here.

⁵This project is described more in detail in Akkermans (1993b) and Akkermans (1994).

⁶Described more in detail in Akkermans and Bosker (1994).

⁷Described at greater length in Akkermans (1995).

⁸This project has not yet been described by the author in any other publication, as it was ongoing at the time of writing this book.

⁹At least to the resondents the problem seemed intangible; in the author's view, however, it was more readily definable than the aims of several previous projects.

¹⁰What still had to be determined was whether this third phase should be positioned as a microworld or as a DSS.

Notes to Chapter 7

¹A complete discussion of all these relations can be found in an internal research report. "Cross-Case Analysis Results", which is available upon request from the author.

²In fact, the ups and downs suggested in the figure more or less correspond with the author's own overall impression of project succes (partially, but not completely, based upon Table 7.2.: Case $1 \approx ++++/+$, Case $2 \approx +/-$, Case $3 \approx +$, Case $4 \approx --$, Case $5 \approx ++/+$, Case $6 \approx +$).

³Eckart Wintzen, personal communication, 1994.

⁴As can be gathered from the author's memos in the original case evaluation report.

⁵It has to be said that the early success in Case 1 proved very helpful in convincing prospective clients of the strengths and promise of this new method.

⁶This becomes apparent from the more detailed analyses in the lower-level displays of the various Case Analysis Reports.

⁷The relation model quality—confidence was not investigated in the cross-case analysis, because only relations between operational variables were investigated. However, Relation 5: thoroughness— confidence was moderately confirmed and is discussed in Section 7.2.

⁸This has different causes, but the main reason is that, especially in Cases 5 and 6, evaluation interviews were conducted directly after the project was finished and before implementation could really take place, and certainly before any effects on business performance could be observed. In Case 3 the interviews were also held before any implementation took place.

⁹One can wonder about the degree of ownership with those participants who did not attend all sessions. In Case 3, these people were not interviewed afterwards, so their degree of ownership is unknown, although the internal project leader did indicate in his member check that it was OK. In Case 2, these participants (in particular, R5 and R6) were interviewed, and indeed their ownership was lower than that of the others (-/+ and -).

¹⁰For these and other questions, the reader is referred to Vennix (1990) and Verburgh (1994), who have conducted in-depth laboratory studies of learning as a consequence of participatory modelling techniques. These authors sketch a far less optimistic image of the learning effects of participatory modelling.

¹¹Relation 14b, communication→insight, was moderately confirmed in the cross-case analysis.

¹²For often the client is not interested in learning a new method; he or she wants an urgent problem solved and does not feel like attending some kind of training course first.

¹³Please note that these scores indicate *client perception* of the skills of the facilitators, not some form of 'objective' assessment of their skills. This implies that the converse reasoning might also apply. In other words, rightly or wrongly, the facilitator is praised if the modelling process goes well and blamed if it goes badly.

¹⁴Please note that whereas the conceptual model distinguishes between various aspects of facilitator skills, this was not done in the evaluation interviews or in the displays. However, judging from the remarks made by the respondents, it does seem acceptable to interpret "the role of the facilitators" as "the process facilitation skills" of the facilitators. Scores were not collected for conceptual modelling skills and client-specific knowledge.

¹⁵A more Popperian approach, more aimed at falsification rather than confirmation, would have been to focus on relations that were rejected by cross-case analysis (Popper 1974).

¹⁶One might argue that this relation can also be read the other way round. That is, if people communicate well, their discussions will proceed in an orderly and focused manner. It is quite possible that there is some kind of feedback going on, but the first version sounds more convincing and is also better supported in the literature (cf. Chapter 2).

¹⁷One could also say that this is a spurious relation, the real underlying cause being problem scope or problem tangibility. In both projects, the problem scope was very wide and tangibility was very low. This makes it hard to construct e.g. validation tests for a model. At the same time, problems of this type may also lack easy and directly usable solutions. But then again, Case 5 involved a very broad and soft problem as well but still yielded usable results.

¹⁸One thing should be borne in mind though, is that the author has had a substantial influence on the specific values that were assigned to both variables. In many cases, the number of references to these

variables in the evaluation interview texts is fairly small, especially in the first four cases, where no specific questions were asked regarding these two late additions to the research model.

¹⁹Forrester (1961, 1994).

²⁰Miles and Huberman (1984, pp. 196-197).

²¹In Case I there was also some initial political sensitivity but this was mainly outside the project team and there problem urgency made the situation more fluid.

²²This relation 'willingness to cooperate \rightarrow communication' would also have been confirmed, had it not been for Case 1, where there was some initial mistrust, which was rapidly overcome by top management support and extremely high problem urgency. Values for both variables: Case 1: (-/+,++); Case 2: (+,++); Case 3: (+,++); Case 5: (+,++); Case 5: (+,++).

²³This may also be one of several possible explanations for the surprising results from Verburgh (1994), who found that participants did not gain an enriched mental model of a policy problem through participation in a PBM-like session. This is surprising because it is commonly believed that if modelling helps you in anything, it is in learning about the problem you are modelling.

²⁴Colin Eden, personal communication.

Notes to Chapter 8

¹Some of the best known examples are Barry Richmond's pioneering efforts (Richmond 1987), the 'decision conferences' of the Decision Tectronics Group (e.g. Richardson et al. 1992). John Morecroft's high-standing work (e.g. Morecroft and van der Heijden 1994), the innovative work within Shell Petroleum (e.g. Byrne and David 1991, Lane 1994), David Kreutzer's "facilitation bridge" (Kreutzer 1992), Peter Senge's 'systems thinking for organisational learning' approach (Senge 1990, Senge et al. 1994), and Jac Vennix's 'participative' modelling' (e.g. Vennix and Gubbels 1994).

²This is what Flood and Jackson (1991, p.34) call "the unitary context", as opposed to a "pluralist" or even a "coercive" context. However, this is not to say that PBM or other system dynamics approaches cannot be used in a pluralist context, where there can be some divergence in values, beliefs and objectives. The author feels that Flood and Jackson, who limit the use of system dynamics to the unitary context, are not doing full justice to the process-oriented developments that have taken place in the field of system dynamics since 1991.

³It would however be unfair to label Case 5 an operations management case. Clearly this problem had a lot more to with client reactions to changes in one of the four P's (place) in the *marketing* mix than with operations proper.

⁴There is the PBM method itself of course, which has some remarks about this process.

⁵Several other comparable research models have been developed, especially in the field of GDSS (cf. Pinsonneault and Kraemer 1989).

⁶The only convincing attempt at this known to the author was that found in Miles and Huberman (1984). Even Yin (1993) does not describe such research designs in any detail, although he stresses the need for them and their validity.

⁷As was the comment by Joan van Aken on reading a draft of this chapter.

⁸Terry Hill, Faculty Workshop Operations Strategy, London Business School, December 1991.

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SUMMARY

Modelling With Managers: Participative Business Modelling For Effective Strategic Decision-Making

Henk Akkermans, 1995

This book describes the PBM method, or "Participative Business Modelling Method" – a management consulting method based upon modelling which aims to support strategic decision-making processes – its development and application in six case studies, and the findings from the evaluation analyses of these case studies. The main lines of argument in the various chapters are as follows:

Chapter 1

Strategic decision-making is getting more difficult as strategic problems become increasingly complex. Formal models may be well-suited to cope with this complexity, but in practice they are rarely used to support strategic decision-making. A central hypothesis of the book is that this non-usage results from the non-client-oriented, expert attitude of many model-builders. The solution has to lie in closer managerial participation in the model-building process. This calls not only for a different attitude on the part of model-builders, but also for techniques to facilitate effective management participation. The PBM method is a management consulting approach which integrates a number of such techniques.

Chapter 2

Implementation effects of strategic decision-making can be twofold: the participants in a decision-making process may have learned from it, and the decision itself may be implemented in their organisation. However, for a strategic decision to have actual effects, two conditions will have to be fulfilled: the decision itself must be perceived as being of good quality and there must be a strong platform in the organisation to support the decision. These conditions need to be combined with a decision-making process that has proceeded effectively, i.e. with willing participants, focused, fast, and with good communication. The challenge for the PBM consultant is, given the unique characteristics of each particular problem and organisation, to design a project, with the aid of the various techniques in the PBM tool set, that will realise all these goals simultaneously.

Chapter 3

The objective of this research has been to develop and evaluate the PBM method. But what are the appropriate characteristics of such a research project? Whilst it is designoriented research insofar as the goal is to design a method, it is also clear that it has a strong empirical component, for design and evaluation will have to take place in practice. Since there is little existing theory to guide one in this area, an exploratory research strategy seems appropriate. This, together with the importance that is placed on the personal opinions of participants in a project, makes a qualitative research strategy best suited for case evaluation. These evaluations are made on the basis of, amongst other things, post-project interviews with participants in the six cases studied. All in all this leads to a research design which seems to have fair research validity but which necessarily remains limited in its reliability.

Chapter 4

In PBM projects a group of stakeholders – usually managers – jointly develops a model of a strategic issue, guided by one or more experienced model-builders. Initially, these models are qualitative, graphical and conceptual, but gradually they can be quantified into simulation models which enable assessment of various alternative solutions and scenarios. The PBM methods can be conceptualised as consisting of four levels, the most fundamental being the PBM consultant's attitude. This attitude joins system dynamics, its central modelling perspective, with process consulting, its central consulting perspective. One level higher are the various basic techniques of the PBM 'tool set', ranging from structured brainstorming approaches to user-interface designs for simulation models. There is a generic phasing for PBM projects in which these techniques are applied according in a flexible, 'standard', order. At the highest level of the method reside a number of design guidelines for PBM projects. These give advice on how to deal with specific project contingencies as well as on a number of trade-offs in different PBM project designs.

Chapter 5

The six projects that were executed with PBM were comprehensively evaluated. Indepth interviews were conducted with as many project participants as feasible. After first collecting a great deal of material during the projects themselves, these evaluation interviews were fully transcribed and then analysed in a number of steps, from a detailed to an aggregated level. The evaluation was descriptive, in the sense of attempting to assess project success in terms of the PBM objectives described in Chapter 2. It was also explanatory, in that is sought for explanations for why each project proceeded in the way it did. These analyses were conducted for each individual case and also for the six cases as a whole, and the findings have in turn been discussed with the project participants.

Chapter 6

The six projects conducted within the framework of this research differ strongly in a number of aspects. The first project, still clearly exploratory in nature, was aimed at cycle time and cost reduction in international newspaper distribution operations. The core of the decision-making process was the development of a simulation model of the distribution process, which led to considerable savings in both areas.

The second project had no quantitative orientation at all. The aim here was to find explanations for the lack of collaboration between independent business units of a company in the service industry. The managers involved rapidly found those explanations, but were less able to reach consensus on adequate solutions for this problem. Nevertheless, the managers' attitudes towards collaboration changed as a consequence of their participation in the project.

The third project involved the development of a European logistics strategy for a US-based pharmaceutical company intending to market a new, life-saving drug. The fact that this drug had to be available to hospitals on demand throughout Europe within a few hours placed special constraints on the operation. The project was able to design a strategy and structure that satisfied these and several other business constraints, but implementation never happened because the medicine failed to meet the efficacy criteria set for the clinical trials that it was undergoing.

The fourth project had as its goal the development of an implementation plan for the new corporate strategy of an international professional services company. The project failed because participants were unwilling to discuss the problem openly in a group session, in view of the political sensitivity of the issue and the resulting career risks for the participants. The PBM consultants failed to discern this sensitivity and adapt their project design accordingly.

The fifth project, in contrast, was very successful. Here the objective was to develop a decision-support system to aid local bank managers in deciding whether or not possible changes in their branch office structures were appropriate. A remarkable feature of this project was the large percentage of 'soft' issues, such as 'level of customer irritation', that the team managed to capture in a quantified model.

The final project aimed to improve management insight into supply chain logistics in the semiconductor industry. Here the evaluation interviews took place half-way through the project, at a time when only a conceptual, (i.e. non-quantified) model had been developed which appeared to adequately capture the main supply chain effects involved.

Chapter 7

In the cross-case analysis certain recurrent processes in each of the projects were investigated, with three main findings. Firstly, it was confirmed that management participation in the modelling process does lead to greater commitment to implement the project findings, because there is higher ownership of the model developed and its implications. However, it is not sufficient for managers merely to be present at these sessions. There also has to be a genuine willingness to cooperate and communicate openly regarding the issue with other stakeholders. This willingness is reduced if the process involves increased career risks or if problem urgency decreases.

Secondly, openness of communication appears to be crucial to obtaining insights into the problem. In the perceptions of the participants, PBM projects are highly instrumental in obtaining such insights.

Thirdly, computer simulation does lead to better decisions, even for such hardto-quantify issues as those faced in some of the projects. This improved quality of the models, and their implications, gives rise to higher confidence in the decisions to be made and therefore contributes indirectly to organisational platform for implemention.

Chapter 8

The last chapter discusses the merits of the three main research deliverables presented in this book. Irrespective of its application in the six projects undertaken here, one may assume that the PBM method, as described in Chapter 4, is fairly robust, because of the success that model builders have found using variants of it all over the world. The theory of strategic decision-making supported by modelling developed in Chapter 2 appears to be at a far earlier stage and may be best viewed as a good starting-point for subsequent, more focused research. Much the same could be said of the evaluation procedure that is described in Chapter 5, which has produced the desired information but in an inefficient manner.

SAMENVATTING

Modelleren Met Managers: Participatieve Bedrijfs-Modellering voor Effectieve Strategische Besluitvorming.

Henk Akkermans, 1995

Dit boek beschrijft de methode PBM, "Participative Bedrijfs-Modellering", een op modelbouw gebaseerde organisatieadviesmethode ter ondersteuning van strategische besluitvormingsprocessen, haar ontwikkeling en toepassing in een zestal gevalstudies en de analyseresultaten van de evaluaties van die gevalstudies. De hoofdlijn van het betoog in de diverse hoofdstukken is als volgt:

Hoofdstuk 1

Strategische besluitvorming wordt steeds moeilijker omdat strategische vraagstukken steeds complexer worden. Formele modellen zijn in theorie uitermate geschikt om aan die complexiteit het hoofd te bieden maar blijken in de praktijk weinig gebruikt te worden. Een centrale hypothese in dit boek is dat dit geringe gebruik veroorzaakt wordt doordat de modelbouwers zich te zeer opstellen als alwetende modelbouwexperts. De oplossing moet dan ook gezocht worden in het nauwer weten te betrekken van managers bij het modelbouwproces. Dit vraagt niet alleen om een andere attitude van modelbouwers, maar ook om technieken voor een effectief verloop van die management-participatie. De methode PBM is een organisatieadviesmethode waarin een groot aantal van dat soort technieken geïntegreerd is.

Hoofdstuk 2

Implementatie-effecten van strategische beslissingen kunnen tweeledig zijn: de betrokkenen kunnen geleerd hebben van het besluitvormingsproces en de beslissing zelf kan geleid hebben tot wijzigingen in de organisatie. Echter, wil een strategische beslissing daadwerkelijk effect hebben in een organisatie, dan zal eerst aan twee voorwaarden voldaan moeten worden: er zal een kwalitatief goede beslissing genomen moeten worden en er zal ook voldoende draagvlak in de organisatie moeten zijn voor deze beslissing. Deze beide voorwaarden kunnen slechts dan gerealiseerd worden als het besluitvormingsproces zelf effectief verlopen is. De kunst voor een goede PBMconsultant is het nu om, gegeven een aantal unieke omstandigheden met betrekking tot het probleem en de groep betrokkenen in kwestie, met behulp van de technieken uit de PBM-"gereedschapskist" een zodanig project te ontwerpen dat bovengenoemde doelstellingen gerealiseerd kunnen worden.

Hoofdstuk 3

Het doel van het in dit boek beschreven onderzoek is het ontwikkelen en toetsen van de PBM-methode geweest. Maar wat voor kenmerken moet een dergelijk onderzoek hebben? Duidelijk is in elk geval dat het om ontwerpgericht onderzoek gaat, want het doel is het ontwerpen van een methode. Duidelijk is tevens dat er een belangrijke empirische component in het onderzoek behoort te zitten, want ontwikkeling en toetsing dienen in de praktijk te gebeuren. Daarnaast is er op dit onderzoeksterrein nog relatief weinig theorie beschikbaar, hetgeen een exploratieve onderzoeksopzet wenselijk maakt. Dit gegeven, gecombineerd met het belang van de persoonlijke meningen van de deelnemers aan de PBM-projecten, maakt een kwalitatieve onderzoeksbenadering voor de case-evaluaties het meest geschikt. Dat kwalitatieve onderzoek vindt plaats aan de hand van evaluatieinterviews naar aanleiding van zes gevalstudies van PBM-projecten. Al met al leidt dit tot een onderzoeksopzet die weliswaar behoorlijk valide lijkt te zijn, maar helaas qua onderzoeksbetrouwbaarheid beperkt moet blijven.

Hoofdstuk 4

In PBM-projecten ontwikkelt een groep van betrokkenen - meestal managers gezamenlijk een model van een strategisch vraagstuk, hierin bijgestaan door een of meer ervaren modelbouwers. Die modellen zijn aanvankelijk kwalitatief, grafisch en conceptueel, maar kunnen gaandeweg gekwantificeerd worden tot simulatiemodellen waarmee verschillende toekomstscenario's en alternatieven nagerekend kunnen worden. De methode PBM is te onderscheiden in vier niveaus, waarbij het meest fundamentele de attitude van de consultant is. Deze attitude kent als centrale modelleerperspectief de systeemdynamica en als centraal adviesperspectief dat van de procesbegeleiding. Een niveau hierboven komen de verschillende basistechnieken uit de PBM-"gereedschapskist", variërend van gestructureerde brainstormtechieken tot gebruikersinterfaceontwerpen voor simulatiemodellen. Er bestaat een generieke fasering voor PBM-projecten waarin deze technieken volgens een flexibele standaardvolgorde toegepast worden. Het hoogste niveau van de methode betreft een aantal ontwerpregels voor PBM-projecten. Deze ontwerpregels geven aan hoe men om kan gaan met specifieke projectomstandigheden en wat de voor- en nadelen zijn van verschillende projectontwerpen.

Hoofdstuk 5

De evaluatie van de zes projecten die uitgevoerd zijn m.b.v. PBM is vrij omvangrijk geweest. Er zijn evaluatieinterviews uitgevoerd met de projectdeelnemers nadat eerder al materiaal verzameld was gedurende de projecten zelf. Deze evaluatieinterviews zijn uitgetypt en vervolgens geanalyseerd in een aantal stappen, van gedetailleerd naar geaggregeerd. Enerzijds is deze analyse beschrijvend geweest: uitgezocht is in hoeverre de projecten succesvol zijn verlopen, in termen van de doelstellingen voor PBM projecten zoals beschreven in Hoofdstuk 2. Anderzijds is deze analyse ook verklarend geweest: achterhaald is wat verklaringen zijn voor de wijze waarop de projecten verlopen zijn zoals ze zijn. Deze analyses zijn uitgevoerd voor ieder project apart alsook over de zes gevalstudies heen. De resultaten zijn besproken met de betrokken projectdeelnemers.

Hoofdstuk 6

De zes projecten die uitgevoerd zijn in het kader van dit onderzoek verschillen onderling sterk. Het eerste project was nog duidelijk exploratief van aard en was gericht op het realiseren van doorlooptijdreductie en kostenbesparingen in krantendistributie. Dit project, waarin een centrale rol gespeeld werd door een gekwantificeerd simulatiemodel van het distributieproces, heeft geleid tot aanzienlijke besparingen en verbeteringen voor de cliëntorganisatie.

Het tweede project was juist niet kwantitatief van aard. Het was gericht op het vinden van verklaringen voor het niet tot stand komen van samenwerking tussen een aantal onafhankelijke bedrijfseenheden van een bedrijf in de dienstverlenende sector. Verklaringen voor de problematiek wist de groep van betrokken managers snel te vinden, oplossingen ervoor bleken moeilijker te formuleren. Wel heeft men de eigen instelling ten aanzien van samenwerking als gevolg van dit project veranderd.

Het derde project betrof het ontwikkelen van een logistieke strategie voor een Amerikaans farmaceutisch bedrijf dat een nieuw, levensreddend medicijn op de markt wilde brengen. Het feit dat dit medicijn binnen luttele uren in heel Europa beschikbaar moest zijn stelde bijzondere eisen aan deze logistieke strategie. Het project is er in geslaagd om structuren te ontwerpen die aan deze en vele andere eisen voldeden. Helaas is implementatie uitgebleven omdat, ten gevolge van tegenvallende testresultaten, het medicijn niet vrijgegeven werd.

Het vierde project was een duidelijke mislukking. Hier was het doel het ontwikkelen van een implementatieplan voor een nieuwe bedrijfsstrategie van een internationaal dienstverlenend bedrijf. Dit project mislukte omdat er geen bereidheid was om openlijk over de problematiek te communiceren, gezien de gevoeligheid van de problematiek in de organisatie en de daaruit voortvloeiende carrièrerisico's voor de betrokkenen. De PBM-adviseurs bij dit project hadden deze politieke implicaties niet onderkend en hun projectontwerp er niet op aangepast.

Het vijfde project verliep weer uitermate succesvol. Het doel was het ontwikkelen van een beslissingsondersteunend systeem met behulp waarvan het management van bankvestigingen kon beoordelen of bepaalde wijzigingen in het kantorennet gewenst waren. Bijzonder aan dit project was het grote aantal zogenaamde 'softe' factoren, zoals "niveau van klantirritatie", dat gevangen bleek te kunnen worden in een simulatiemodel.

Het laatste project had als doel het vergroten van inzicht in ketenlogistieke effecten in de halfgeleiderindustrie. De evaluatieinterviews vonden plaats terwijl dit project nog liep. Op dat moment was enkel nog een zgn. conceptueel, dus niet gekwantifeerd, model ontwikkeld dat deze ketenlogistieke effecten afdoende leek te kunnen beschrijven en verklaren.

Hoofdstuk 7

In de zgn. cross-case analyse is er gekeken naar bepaalde terugkerende processen in PBM-projecten. Drie van de belangrijkste bevindingen zijn de volgende. Allereerst is bevestigd dat managementparticipatie in het modelbouwproces leidt tot een grotere vastbeslotenheid om de aanbevelingen uit het modelbouwproces op te volgen, dit omdat men zich sterker mede-eigenaar voelt van het ontwikkelde model. Het blijkt echter niet te volstaan dat betrokkenen enkel aanwezig zijn bij de modelbouwsessies; zij moeten ook bereid zijn om openlijk met de andere betrokkenen van gedachten te wisselen, te communiceren. Die bereidheid is onder andere minder aanwezig naarmate de organisatie-politieke gevoeligheid van de problematiek, en bijgevolg het carrièrerisico voor de betrokkenen, toeneemt.

Ten tweede blijkt deze open communicatie ook een essentiële rol te spelen bij het verkrijgen van inzicht door de betrokkenen in de problematiek. Deelname aan PBM-projecten blijkt in de perceptie van de betrokkenen in sterke mate te leiden tot beter inzicht. Ten derde blijkt simulatie wel degelijk te leiden tot inhoudelijk betere beslissingen, ook voor zulke moeilijk kwantificeerbare vraagstukken als in dit onderzoek aan de orde geweest zijn. Deze betere inhoudelijke kwaliteit van de beslissingen geeft meer vertrouwen in hun juistheid en draagt daardoor indirect bij aan een sterker draagvlak voor de beslissingen.

Hoofdstuk 8

De vraag dringt zich op hoe 'goed' de in dit boek gepresenteerde kennisprodukten zijn. Van de PBM-methode zelf valt aan te nemen dat zij, ook los van dit onderzoek, redelijk robuust is, daar varianten van deze systeemdynamische methode door verschillende modelbouwers over de wereld succesvol gehanteerd worden. De theorie over modelmatig ondersteunde strategische besluitvorming, zoals die gepresenteerd is in Hoofdstuk 2, verkeert nog in een veel vroeger stadium van ontwikkeling, maar bevat in elk geval een aantal bruikbare uitgangspunten voor nader, meer gefocusseerd onderzoek. Iets soortgelijks valt te zeggen over de evaluatieprocedure die beschreven is in Hoofdstuk 5. Deze methode heeft weliswaar de benodigde informatie opgeleverd, maar tegen een relatief hoge inspanning.

CURRICULUM VITAE

Henk Akkermans was born in 1964 in Tilburg, The Netherlands. After attending the local gymnasium, he studied Japanese at the Rijksuniversiteit Leiden, and Management Information Systems at the Economics Department of the Katholieke Universiteit Brabant. After having worked at the corporate automation department of Philips Electronics for one year he became an assistant researcher at the Rijksuniversiteit Utrecht, where he started the research that is reported in this book. From 1990 onwards he has been an assistant professor at the Graduate School of Industrial Engineering and Management Science of the Technische Universiteit Eindhoven, teaching operations management. For the past four years he has combined this position with a position as consultant with BSO/Origin, first with their Management Support branch, later with the management consulting group, BSO/Advies. It is here that he has developed his own blend of system dynamics modelling and group knowledge elicitation techniques called Participative Business Modelling, or PBM, the management consulting / modelling method which is described in this book. Presently he works for McKinsey & Company in Amsterdam as a business dynamics specialist. Henk Akkermans is married and has a son.

STELLINGEN

behorende bij het Proefschrift

MODELLING WITH MANAGERS Participative Business Modelling For Effective Strategic Decision-Making

van

Henk Akkermans

Het nog altijd geringe gebruik van wiskundige modellen ter ondersteuning van strategische besluitvorming wordt niet zozeer veroorzaakt door tekortschietende kennis of vaardigheden bij de beslissers, door een tekortschieten van de wiskundige theorieën of de gebruikte computerprogrammatuur, als wel door een te weinig op cliëntparticipatie gerichte attitude bij de modelbouw-experts.

Dit proefschrift, Hoofdstuk 1

Π

De PBM-methode leent zich bij uitstek voor strategische vraagstukken van een aanzienlijke complexiteit, die zowel kwantificeerbare als zgn. "zachte" elementen bevatten en waarvan de organisatie-politieke gevoeligheid relatief beperkt is.

Dit proefschrift, Hoofdstuk 4 en 8

III

- a) Cliëntparticipatie in het modelbouwproces leidt ertoe dat participanten zich in sterke mate mede-eigenaar voelen van het geconstrueerde model en de hieruit voortvloeiende beleidsaanbevelingen.
- b) Hoe hoger dit gevoel van mede-eigenaar zijn, des te sterker zal de wil zijn om deze beleidsaanbelevingen ook daadwerkelijk uit te voeren.
- c) Echter, enkel aanwezig zijn bij de modelleersessies is niet voldoende. De participanten moeten ook echt bereid zijn om mee te werken aan het modelbouwproces, wil een open en effectieve communicatie tot stand komen.

Dit proefschrift, Hoofdstuk 7

IV

Het is wel degelijk nuttig om gekwantificeerde simulatiemodellen te ontwikkelen voor strategische vraagstukken. Niet alleen leiden dergelijke modellen tot grondiger analyses van de onderzochte vraagstukken en zodoende tot kwalitatief betere beslissingen, maar ze leiden ook tot een sterker draagvlak voor deze beslissingen, omdat managers meer vertrouwen plegen te hebben hebben in beslissingen gebaseerd op grondige kwantitatieve analyses, vooropgesteld dat zij voldoende geparticipeerd hebben in het modelbouwproces.

Dit proefschrift, Hoofdstuk 7

V

De effectiviteit van logistieke adviseurs zal sterk toenemen als zij hun inhoudelijke expertise meer koppelen aan procesbegeleidende vaardigheden. Deze constatering behoort consequenties te hebben voor het opleidingstraject van dergelijke adviseurs.

VI

Nog altijd menen veel lezers én schrijvers van wetenschappelijke literatuur dat de mate van leesbaarheid van een wetenschappelijk boek of artikel negatief gecorreleerd is met de wetenschappelijke kwaliteit ervan. Dit geldt waarschijnlijk ook voor de vorige zin. Scott Armstrong, J. (1980) "Unintelligible Management Research and Academic Prestige",

Interfaces Vol 10 Nr. 2, pp. 80-86.

Als we de hoogte van een beschaving afmeten aan de mate van geestelijk geluk of gemeenschapszin van de bevolking, dan lijkt de westerse beschaving sinds de periode van de jager-verzamelaars er alleen maar op achteruit te zijn gegaan.

Tacitus, Germania.

VIII

De blijvende aanwezigheid van een Nederlandse handelsvestiging op het eiland Dejima in de achttiende en negentiende eeuw kan beslist niet enkel uit economische factoren verklaard worden, aangezien die aanwezigheid voor beide partijen enkel in de zeventiende eeuw duidelijk winstgevend was.

Klein, P.W. (1986) "De Verenigde Oostindische Compagnie in de Japanse Wereldorde", Erasmus Universiteit Rotterdam.

IX

Weinig bevordert het kunnen waarderen van twintigste eeuwse klassieke muziek meer dan het aanschouwen van het engagement en het speelplezier van de musici die deze muziek ten gehore plegen te brengen.

Х

De tendens om het praktische nut als hoofdcriterium te gebruiken voor het beoordelen van bijdragen van wetenschappen is te betreuren. Immers, uitermate praktische wetenschappen als Bedrijfskunde, Geneeskunde, Werktuigbouwkunde or Rechten zorgen er weliswaar voor dat wij kunnen bestaan, maar de letteren, muziek en de beeldende kunsten zorgen er voor dat dit bestaan de moeite waard is.

Dead Poets Society

XI

Het is vreemd dat, in een tijd waarin zoveel aandacht is voor de noodzaak van een uitmuntende mentale conditie voor het leveren van fysieke topprestaties, er zo weinig oog is voor de voordelen van een optimale fysieke conditie bij het leveren van intellectuele topprestaties.

XII

Van enige afstand bekeken lijken Nederlanders en Duitsers sprekend op elkaar in uiterlijk, taal en gedrag. Wellicht is dat een verklaring voor de moeite die veel Nederlanders doen om de verschillen tussen Nederlanders en Duitsers te benadrukken.