

Chapter 4 Qualitative Research Methodology

Introduction

This chapter is concerned with the methodological problem of how to integrate qualitative and quantitative insights in developing an agent-based model of the e-commerce case study.

Much agent-based modelling is carried out with very sparse data collection procedures, often focussing only on quantitative data collection. However, qualitative techniques could be a very productive approach in this field of research, since they produce primary data much richer in meaning and – potentially – insight. Combining methods in this way produces philosophical problems relating to the ‘paradigm incommensurability’ debate, which require some reflection in order to guard against pitfalls hindering the methodological approach.

In section 4.1.1 these philosophical issues are discussed, and it is defined what is meant by ‘qualitative modelling’ and by ‘quantitative modelling’ and how these can be distinguished. The problems of making quantitative data amenable to the formal techniques of modelling are challenging ones: these issues will be discussed at length in chapter six.

Section 4.1.2 outlines some principles of case study research, and the particular considerations that need to be taken into account in a management/organisational context. The area of application is information systems (IS) and interorganisational systems (IOS): an area that is coming to be recognised by managers to be of key strategic importance. Starting from a broad problem definition - the question of how e-commerce impacts upon the supply chain – it is argued that the research methods were chosen because they suited the problem, and that this led to a novel multi-method design (described in section 4.1.4).

Section 4.2 describes how a suitable case study was identified and how the research objectives were established in collaboration with the industrial participants. The case study research design is presented, the data collection methods are outlined, and the

topics for the fieldwork interviews are briefly discussed. It is shown that the case study is well integrated with the wider objectives of the research.

Finally the stakeholder participation method, which was instrumental to the methodological approach, is discussed. The managers being familiar with the decision-making processes and with the participants involved, it was possible to sound out initial ideas and check their feasibility. They met the requirements of being interested in the research, and seeing its value in understanding the substantive e-commerce issues. The stakeholders are referred to in section 4.1.4 as well as throughout section 4.2. However, a more detailed discussion of their roles in the organisation and influence over the research agenda will be found in chapter six.

4.1 Qualitative Methodology

4.1.1 Qualitative Research Paradigms

This section reflects upon some of the philosophical problems of combining qualitative and quantitative approaches. It discusses the issues of this research at the epistemological and ontological levels, whereas the following sections will discuss more the methodological issues associated with the research.

The purpose of discussing the theoretical and philosophical assumptions is, as Garcia and Quek put it, *“to qualify the use of specific techniques in both the underlying assumptions guiding the research and in the theoretical framework”*. (Garcia and Quek 1997, pg. 5)

This level of critical awareness should ensure coherence over the research process and avoid the dangers of stereotyping or distorting the actual methods used. In this section the research paradigms adhered to by this investigation are stated and then assessed in terms of their feasibility for the research objectives, i.e. the objectives of incorporating qualitative and quantitative modelling of e-commerce in industry. Finally I will comment on my own background and the significance of any bias that this might bring to the research project.

The main objection stems from the ‘paradigm incommensurability’ problem (Kuhn 1970), which suggests that combining different research paradigms and comparing the results of each, is impossible.

Discussing the underlying philosophical assumptions of qualitative research, Guba and Lincoln (1994) argue that these questions of paradigm are a fundamental starting point to guide research inquiry, and should come before the choice of methods. The authors then set out four different research paradigms (positivism, postpositivism, critical theory and constructivism), compare them in terms of their associated ontologies, epistemologies and methodologies, and then question whether or not it is possible to accommodate these views within a single conceptual framework. Their

main argument is that, as far as subjectivists are concerned (i.e. critical theorists and constructivists) the basic beliefs of these paradigms are incommensurable.

In information systems (IS) research this debate has some significance because it often cuts across different paradigms. Although traditionally IS researchers have taken a natural sciences approach (i.e. positivistic), as they were working mainly in computer science, over the past ten years more interpretive methods have started to gain support in addressing questions about the sociological impacts of IS upon the individual, organisation or institution. There is a school of thought that believes that this paradigm incompatibility creates problems in identifying the nature of what is being investigated (ontology) and the nature of knowledge that can possibly be acquired (epistemology) (Nissen, Klein et al. 1991).

Basically this problem is rooted in the idea that although the technological capacity of IS can be evaluated in a positivistic way (i.e. by making objective measurements, testing theories and making precise predictions), it does not necessarily imply that the social impacts can be assessed by the same means. On the contrary it may be advantageous to retain subjectivity in trying to understand some of these phenomena. This is why qualitative methods are gaining popularity, since they are thought to promote multiplicity of viewpoints. For example, the introductory chapter of a text on methods in social research argues for research as engagement in the system under investigation:

“The position presented in this work challenges this notion of objectivity, for it emphasizes the crucial link between observer and observed, and by implication, questions the very nature of neutral observation or evaluation”. (Morgan 1983, pg. 14)

Qualitative is distinguished from quantitative research by its concern with interpreting meaning in textual data and the spoken word, rather than in numerical data through use of statistical methods. This approach aims to capture the multiplicity of perspectives of social actors, and the meanings that those actors assign to events. The issue of qualitative methodologies in IS will be returned to in section 4.1.3. The rest of this section will describe my own research background, the paradigms and

philosophical beliefs which underpin the approach taken, and will reflect upon how that might influence the outcomes of the research.

Considering my background as a researcher trained in mathematics, computer programming and formal modelling, I am more familiar with the positivist approach to scientific enquiry. Validity, assumptions about the existence of objective 'facts' and presupposed theory to 'test' would normally be part of this framework. It is therefore essential that aspects of these traditions should be upheld in carrying out the formal side of the research (e.g. running repeatable simulations and analysing the results).

However, it is clear to me that in trying to understand in any depth the social aspects of the case study there would also need to be flexibility in the research to incorporate subjectivist points of view. The necessity of subjectivity (in understanding social issues) is due to recognition that there might be several different alternative perspectives of reality, all of which may be 'valid' and should be explored. It can be argued that facilitating exploration of different perspectives is a common objective of subjectivist research, and in particular, that modelling them forces recognition (if not resolution) of these differences.

It is important to be aware of this subjectivity and to reflect on it throughout the research and remain critical. Subjectivity of 'worldview' also introduces bias in research. By bias it is meant the tendency to focus on certain points of view more than others (not the criticism that the research is not objective). One potential problem here is that the values of the researcher, i.e. the previously held ideology, influence the enquiry. These prejudices can not only influence the direction in which the research leads, but also open up the possibility of misjudgements or mistakes.

The main drawbacks of subjective approaches are that firstly, the validity of conclusions that identify 'emergent themes' of the research is harder to establish, and secondly, generalisability of conclusions is more difficult. Both of these protocols of research enquiry are more commonly associated with positivist tradition.

In reflecting on the need for at times objectivity, and at times subjectivity in research, it can be argued that there is not necessarily conflict created by differing viewpoints,

provided that the underlying philosophy and theory that is internalised by the researcher, and that develops throughout the research process, is critically reflected upon and is found to be a workable model in order to reason with the problem in hand.

In recent times there has been a move towards combining methods, including qualitative and quantitative methods, originating from different paradigms. This suggests that the incommensurability problem can be overcome simply by being aware of the ontological and epistemological positioning of the research, and being sensitive to any likely problems. Though it remains an issue of contention.

In ABSS modelling research the idea of combining qualitative and quantitative methods is a new concept that has, as far as this author is aware, very scant literature to guide it both in terms of theoretical discussion and in terms of published examples³. It is therefore essential at this stage to attempt to map this territory. Very heuristically, the qualitative and quantitative approaches can be distinguished by the type of data that informs the model, and the types of data that are produced in running simulations with the model. Following this definition, we can identify qualitative modelling as that which is informed by descriptive accounts (exemplified by ethnographic studies at the most qualitative level, but also by interview or observational data) and can produce simulation outputs that are interpreted as having a complex semantics. Quantitative modelling, on the other hand, involves numerical data as inputs and outputs of the enquiry (for example, time series and other statistical data, or probabilistic modelling and other numerical approaches such as game theory).

Qualitative and quantitative modelling therefore are aimed at understanding phenomena on very different levels of syntax and semantics, and are divided by their paradigmatic assumptions about the objectivity/subjectivity of the investigation. The target of an investigation which proposes to combine these approaches would be to (1) develop a model that captures the subjective views / interpretations of those participating in the study, and (2) investigate the consequences of those interpretations by analysing the behaviour of the model 'objectively' according to the positivist

³ See Moss' (1999) schema for characterising social enquiry and discussion of appropriate 'grain of analysis' for modelling, also reviewed in section 3.5.

tradition of experimental study. The behaviour of the model may be interpreted both in terms of its statistical (i.e. quantitative) properties, and in terms of the descriptive (i.e. qualitative) significance of those outputs to the person evaluating them.

Further reflection must go into how different methodological approaches can be combined, and what problems this might create on the paradigm level. The incommensurability debate takes place less on the level of the use of combined research methodologies than on the level of the philosophical questions of epistemology and ontology (Lincoln and Guba 2000). Even though criticism does not take place in the area of methodologies, it is worth noting that every method necessarily imports some kind of theoretical or philosophical assumptions into the research.

The current work is based on the philosophical perspective of interpretative enquiry which allows multiple perspectives of reality, whilst recognising that there are also 'over-arching' narratives about how the world works. In other words it is also possible to claim a stance of objectivity with respect to an external reality of objects and their relationships, in order to facilitate the measurement and explanation of that reality.

Having discussed the objectivist point of view in the approach to formal modelling and analysis, it is important to note that an interpretive approach is equally necessary in this research. This will be important during the qualitative data collection, during the analysis of the data, in inferring the conceptual model (theorising from the data), and in identifying the emergent findings in the case study. As interpretivists we must accept responsibility for our role and acknowledge our own influence on the research outcomes.

In the rest of this section an overview is presented of other methods that were employed during this project and are referred to during the course of the chapter. As it was central to providing the empirical basis of this project, case study research is described in detail in the next section. Here the methodology of stakeholder participation is introduced, and it is shown how this is placed alongside other methods incorporating qualitative and quantitative research in a multi-method design, described in section 4.1.4.

4.1.2 Case Study Research and the Interpretative Approach

According to Yin (1994), a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. The case study inquiry relies on multiple sources of evidence, with data needing to converge in a triangulating fashion. Case studies can be based on any mix of quantitative and qualitative evidence. As a starting point, we should first consider producing the case study research design. Yin proposes a list of five components required:

1. A study's questions. For case studies, the form of the questions will be "how" and "why" questions.
2. Propositions that suggest topics that should be examined within the scope of the study. Exploratory studies may not have any propositions.
3. Identification of the unit of analysis i.e. the "case", often an individual or an organisation but sometimes a less well defined entity such as a decision, a program or an organisational change, for instance.
4. Linking data to propositions by describing two or more potential patterns and then show that one matches the data better than the others.
5. The criteria for interpreting a study's findings when a statistical test is not possible.

We also need to consider the case study protocol, a document that describes the procedures and general rules that should be followed and is intended to guide the investigator in carrying out the case study. A protocol would contain a number of elements. Firstly, an overview (objectives, auspices, issues and relevant readings) made available to anyone who may want to know about it (including the stakeholders), rationale for selecting the sites, propositions or hypotheses being examined, and the theoretical or policy relevance for the inquiry. Secondly, it would contain the field procedures that describe access to key organisations and interviewees, and a schedule of the data collection activities. Thirdly, the case study

questions which the interviewer needs to keep in mind, table shells for arrays of data, and potential sources of evidence for answering each question. Fourthly and finally, a guide for the report is required, describing the outline, narrative format, sources of information, and intended audience.

Another important consideration is the scope of the study, i.e. do we intend to extend the research across multiple cases, or rather to focus on a single case study. According to Yin (1994), the single case study can be used to determine whether a theory's propositions are correct or whether some alternative set of explanations might be more relevant. It can represent the critical test of a well-formulated theory. The evidence from multiple cases is often considered more compelling and the overall study to be more robust.

The research approach used for case studies also depends on the nature of the field of study of interest. This thesis is concerned with research issues in commerce and industry, and the case study described in this chapter was carried out within an organisation where all of the stakeholders and interview respondents were managers. The focus on management issues in this study is in accordance with the aims of the project to analyse the implications of e-commerce for the management of supply chain processes and customer relations.

Management research often involves a number of qualitative techniques. These seek to describe and translate the meaning rather than the frequency of social phenomena. A case study may involve interviews, observation and diary methods. These are the devices whereby the researcher can gain insights into people and situations within an organisational context. According to Easterby-Smith, Thorpe et al. (2001) there are several special considerations for carrying out case studies in management environment:

- Managers are very busy people, and if they are to commit time to a project they need to be convinced of its value and feel they may gain from it. For this reason, access for fieldwork in organisations can be difficult: often time constraints mean that only short interviews can be conducted.

- Managers are powerful people: they have the ability to take action in the light of research results. In designing the case study therefore, we must always consider the practical consequences of this fact. We may also have the possibility to incorporate policy making into the research design.
- The issue of security is an important one, because we are often dealing with sensitive data. We must consider the identity, confidentiality and publication rights associated with a piece of research, and if necessary, take steps to protect an organisation that is wary of competitors, customers etc. obtaining their sensitive data. We also have to be careful about discussing changes that would impact the organisation in terms of its structure, number of jobs, power relations, etc. This is true of the current research: some managers see EC as posing a threat.

4.1.3 Methodology of Information Systems Research

This project is focused on issues related to two different types of business information systems: information systems operating within organisations (IS), and interorganisational systems operating between organisations co-operating in a supply chain (IOS). One of the primary research aims is to explore the impact of the introduction of new e-commerce technology such as EDI and the Internet on these systems and on the nature of the business relationships they facilitate.

The modern organisation has very large networks carrying information of all kinds among distant servers, PCs and terminals. These information systems are crucial to the functioning of the business and increasingly, managers see it as a strategic imperative that they have advanced information systems in place (Henderson and Venkatraman 1999). Understanding of some of the principles of IS, their potential, how to evaluate them, etc. is very important and therefore more research in this area is necessary. Indeed, nowadays much R&D into IS is funded by organisations themselves, for example a major study to measure the extent of Internet-based e-commerce was funded by Cisco Systems (Whinston, Barua et al. 2000).

There are a large number of case studies in the area of information systems. We have concentrated on reviewing some of these, especially those relating to e-commerce cases, in the literature chapter, chapter two. For a good overview of qualitative research in IS, a thorough list of citations, and resources available see Myers (2002).

In this section we shall focus on methodological papers in IS. Two such studies of methodological issues are those of Walsham (1993) and Klein and Myers (1999). Klein and Myers describe a set of principles for conducting and evaluating interpretive field studies in IS, which are intended to guide research carried out within a hermeneutic perspective. Walsham's book is concerned with how the *context* of the information system, i.e. the identification of the systems and structures within which the IS is embedded, is related to the *processes* of transformation and change of the IS and the organisation over time. His insight is that context and process must be considered in parallel because implementation of a change program influences and is influenced by the context of the information system. Walsham advocates the interpretive approach for practice-based problems such as those associated with IS in organisations, using longitudinal, in depth case studies and social theory to inform the analyses.

Mingers (2001) considers the question of which research methods are most appropriate for IS research. He argues that IS should draw upon a very wide range of disciplines that encompass different research traditions, and advocates 'strong pluralism' where "*all research situations are seen as inherently complex and multidimensional, and would thus benefit from a range of methods.*" (Mingers 2001)

He argues that:

- In adopting only one method, one is often gaining only a limited view of a particular research situation.
- Different research paradigms focus on different aspects of the situation and therefore a richer understanding of a research topic will be gained by combining several methods together in a single research program.

- A research study is a process that proceeds through phases posing different problems. Different methods are more useful in relation to some phases than others, and so combining a range of approaches may yield better results.

He identifies five different types of multi-method research design, and describes how the methods are selected in each type:

Table 4-1: Different types of multimethod research designs, adapted from Mingers (2001).

<u>Type of Design</u>	<u>Method Mix</u>
Sequential	Methods are employed in sequence with results from one feeding into the later one.
Parallel	Methods are carried out in parallel with results feeding into each other.
Dominant	One method or methodology as the main approach with contribution(s) from the other(s).
Multimethodology	A combination of methods, embodying different paradigms, developed specifically for the task.
Multilevel	Research conducted simultaneously at different levels of an organisation using different methods.

The case study can be viewed, within a management framework, as a complex and ill-defined business-reengineering project involving many social actors and dealing with difficult management issues. It can be argued therefore that this problem specification justifies a multi-methodology approach in order to explore and develop new understandings of the research situation.

4.1.4 Methods and Methodological Design

The methods outlined in Table 4-2 below each contribute significantly to the research design, and as it shall be argued, complement each other well in developing a richer understanding and meeting our research aims. By the definition of Mingers, this design is multi-method. The methods are listed with the corresponding research approach (underlying philosophical perspective of the research) and the data types:

Table 4-2: Summary of the research methods

Method	Data Type	Approach
1. In-depth Interviews & Analysis	Qualitative	Interpretive (emergent findings)
2. Formal Modelling & Statistical Analysis of Simulation Results	Qualitative & Quantitative	Grounded (interplay between data collection & analysis)
3. Stakeholder Evaluation	Qualitative	Interpretive
4. Mall Statistics & Analysis	Quantitative	Positivist

The arguments of Mingers can justifiably be used in the case of this research project, since different research methods were used within the case study framework. It is proposed that the research project, the selection of methods detailed here and the case study research design presented in the following section, is an appropriate methodology for the design of empirically based agent-based modelling projects.

The research aim was to combine the qualitative with the quantitative in the design of a representative agent-based model. The qualitative is encapsulated by the data provided by the case study fieldwork, and the quantitative by sales and other data. In the outputs generated by the agent-based modelling, we have both quantitative measures and qualitative interpretations. The key problem is to relate the quantitative to the qualitative, and vice versa, i.e. to translate the qualitative data into a form suitable to apply the formal methods of computer modelling, and to interpret numerical outputs of simulation experiments in terms of qualitative descriptions of modelled social phenomena.

Most importantly, note that the model-building process is not at all straightforward, but is rather carried out in a piecewise fashion, where there are several iterative steps and a blurring between data collection, implementation, and validation. This process is explained in more detail in section 4.2.4 of this chapter. The multi-method approach also permits triangulation of techniques, where more than one method may be used to validate a piece of research. In chapter six, it is discussed how several methods of validation were used to evaluate the plausibility of the model.

However, the ABSS modelling and stakeholder involvement in this project demand further clarification. Figure 4.1 (below) maps the stages of the project, and helps us to understand the interplay between data collection and analysis⁴. As described in the figure, the first stage is a review of existing literature on intermediation and e-commerce, concentrating upon qualitative studies but considering also the broader view of EC development, and identifying any pertinent research questions. Following this, an outline of the case study is developed and discussed with the stakeholders. Their input is instructive in defining the problem, identifying further research questions, and evaluating plausibility and practicality of the methodological approach. This is followed by the actual data collection. As will be explained, this consisted of semi-structured interviews providing the qualitative data, and statistical logs supplied by the stakeholders. Subsequently, these data are used to inform the model.

The primary aim of the model is to address or test the research questions: it consists of a set of assumptions regarding the behaviour of the modelled system, and a set of hypotheses that we wish to investigate with the model by means of scenario analysis. ABSS models can be used both for exploration and experimentation. Exploration aims to develop theory and allow the modeller to understand better the range of behaviour possible with each specification via trial simulations. It is less based upon empirical scenarios than upon building theory about emergent processes, and encourages a more creative approach to development. Experimentation on the other hand, is carried out to address particular hypotheses that we have in mind. It relies upon a scientific approach to simulation, where experiments are extensively replicated, and statistical analyses of the results are made and compared with the same tests on empirical data.

⁴ The numbers 1, 2, and 3 on Figure 4.1 identify the validation points where we are directly comparing the model with its target. We shall defer discussion of these points until chapter six.

After simulating, the model, the results, and their interpretation are explained to the stakeholders. This involves examining both the assumptions on which the model is based and the micro behaviour of the agents for plausibility. The critical evaluation of stakeholders is very important since they are the domain experts. Evaluation has the eventual goal of improving the model design and strengthening the validity of results. The model is subsequently redeveloped under the guidance of the stakeholders, linking back to the model specification in a cycle that can be repeated *ad infinitum*.

At the end of this process, some conclusions are drawn both upon the behaviour of the model and upon the researcher's interactions with the stakeholders (this latter may provide a valuable insight to the participatory method). These findings will address the initial research questions, and may also exhibit unexpected or emergent behaviours worthy of discussion. Further, it is necessary to discuss the generality of results, i.e. under what conditions are they applicable. This may involve a wider discussion of the research questions, linking back to other studies or literature.

It is important to note that in this methodological approach it is not always possible to know in advance of evaluation which data collection methods are appropriate. Method choice will be problem-orientated, i.e. depending upon the specification of research problem and questions. However, different stages of the project may require different methods. In particular, longitudinal studies such as this one are likely to involve different data collection methods at different times: which may often be difficult to foresee. Data suggest how we initially build the model, and later adjust its specification as new information becomes available. Conversely, the model building and evaluation process suggests what questions we need to ask about the case under consideration, may provoke re-assessment of existing data or further data collection.

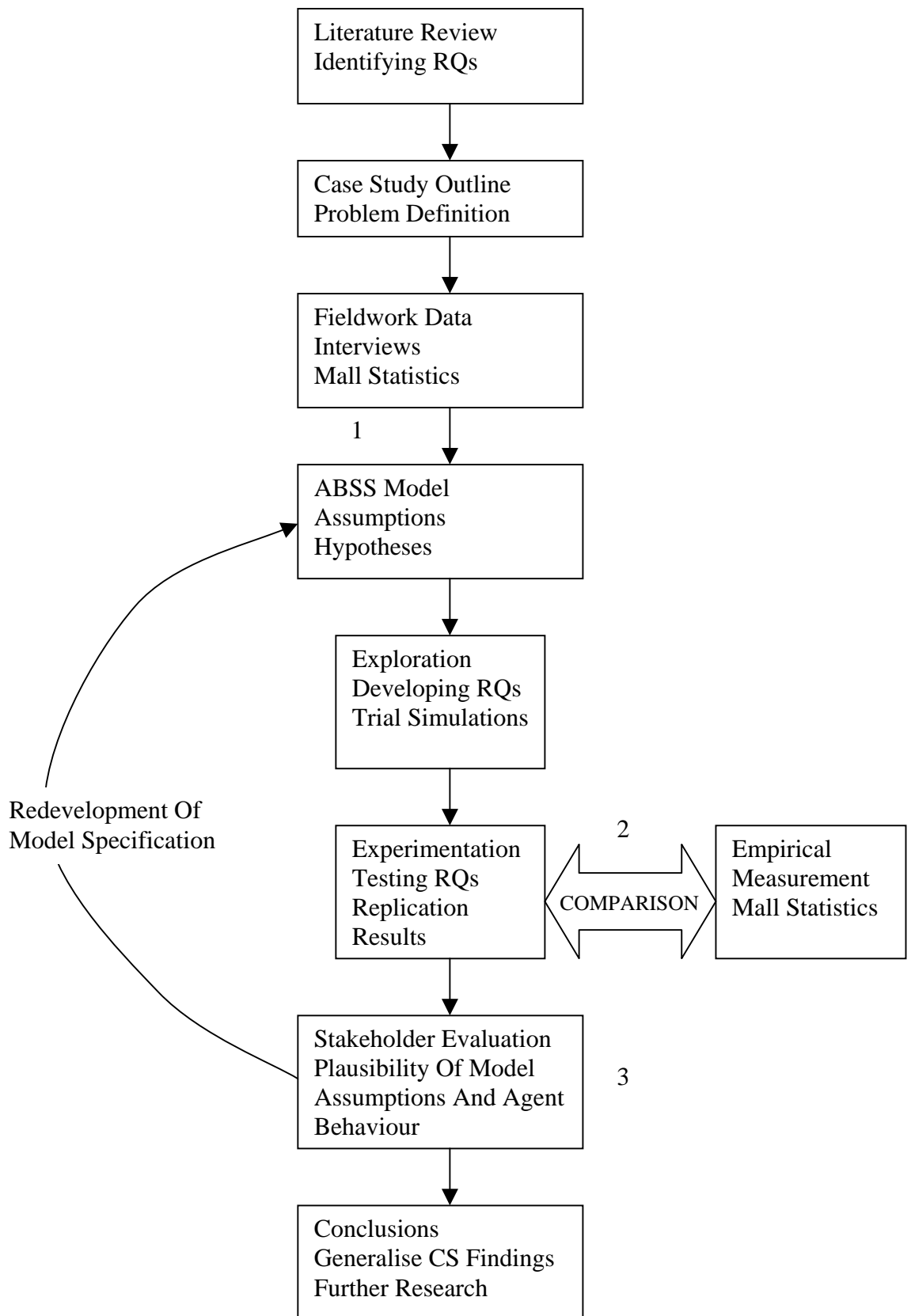


Figure 4-1: Methodology flow diagram

A PhD project itself requires much more than a single case study: one has to consider more carefully how it fits into the framework of previous research, how the analysis compares with findings from other cases (both historical and contemporary). In assessing the model, it is important to consider how it might be extended to other case scenarios, and how it can be compared to other models. The case study as outlined in the next section should include the following components:

- A set of research objectives or research questions.
- Fieldwork.
- Agent-based models developed for the specific case study.
- Analysis and conclusions of the case.
- A case study report available to stakeholders.

Some research questions will be left outside the scope of the single case study. These are the more general theoretical and methodological questions and the policy implications that will form part of the PhD thesis. The PhD thesis includes:

- A set of research questions.
- Literature review.
- One or more case studies.
- Conclusions and comparative analysis of models (including more general models that aim to develop theory applicable beyond individual cases).
- Methodological and theoretical findings, and implications for further research.

It should be clear from Figure 4.1 that the case study is central to this PhD research because it encompasses most of the stages in the methodological diagram from the formulation of the case study outline to the model evaluation process. Furthermore, the case study serves as a test bed for the methodology - the techniques of ABSS modelling and stakeholder participation. It allows the development of research experience and data from working in the field with industrial stakeholders, explaining the agent-based modelling approach to them, and collaborating to improve the accuracy and the focus of the models.

4.2 The Case Study

4.2.1 Overview of the Project

The overview was the starting point for the project, it is what was written in the introductory letter that was sent to the stakeholders, and was the basis of the first presentation made to the stakeholders outlining my proposed research, what it involved on the part of the organisation, and what were the expected outcomes:

Project Overview

The research project relates to the impact of electronic commerce on organisations, on the structure of markets, and on customer and supplier relationships. We are developing software systems that use DAI (Distributed Artificial Intelligence) to do processing tasks that provide useful information to the business user. The technologies that are developed may have applications to, for example, data mining or information filtering tasks. It is envisioned that business process reengineering projects within the organisation could very well be an appropriate topic for the research and for the development of simulation models and agent technology.

We would like to firstly talk to people within the organisation so that together we can identify those issues of e-commerce that are of concern to the company, and for which modelling can have value. Secondly we would like to collect relevant data from within the organisation, by interviewing members and taking written notes. To achieve this, we would need access to members of the company in order to gather data relating to how they are using and would like to use electronic commerce technology and, for example, the impact on the nature of the company's relationships with its business partners.

These discussions will be informal in nature, and it is anticipated will be fairly broad in scope, covering a number of issues that are relevant to the e-commerce strategy of the company, such as:

- Take-up of e-commerce
- Participation in electronic markets,
- The role of the intermediary
- Integration of the value chain

Thirdly, we need to consider how the models will be validated. It is envisioned that we shall periodically bring the results of the modelling back into the company, in order that members will be always involved in the evaluation of the work.

At this stage, the subject of the case study could broadly be defined as the management and development of IOS and e-commerce and the impact on supply chain. The methodological approach, as described in the figure in the previous section, had been decided upon. These aspects of the research agenda had been set by myself, before any contact was made with potential participating organisations, and before the stakeholders had been identified and invited to take part in the research.

As discussed in the previous section, the approach should incorporate qualitative methods, because of the complex nature of issues that will be addressed, and the need for penetrating techniques of enquiry to bring insight to those issues.

4.2.2 Targeting an Industrial Sector and Finding Potential Case Studies

One of the key decisions that had to be made at this point concerned the scope or extent of the project. It was necessary to choose between a research design incorporating a single case study versus one incorporating multiple cases: a single case study design was chosen for two reasons. Firstly, a large amount of work would be dedicated to implementing, testing and validating the model, analysing and reporting results of the simulation experiments. Also, a lot of time had to be spent in consultation with the stakeholders, to develop this partnership, to ensure that they understood the nature of the project, and were able to contribute to it and benefit from it. Secondly, this design was chosen because one of the project aims was to assess the modelling-as-replacement argument, which proposes that the modelling methodology can be used as a replacement for extensive qualitative fieldwork. Thus, if a model is developed based solely on the findings of a single case study, it is possible to then test the plausibility of this argument by assessing whether or not the model is useful in understanding similar cases. In this light, it was decided to carry out a single case study within just the one organisation, although the fieldwork may later be extended to a cross-sectional study including several companies.

The decision to carry out a longitudinal case study was dictated by the objective to

test the methodological approach of combining agent-based modelling with stakeholder evaluation, and the iterative process of data collection, modelling, and analysis of results that this entails. A further advantage would be that more empirical data about the actual uptake and usage of e-commerce systems could be collected as the project proceeded, and as it became available.

The choice of organisation was considered very important because it would affect the domain of the project (business-to-business or business-to-consumer markets, industry sector, available channels of distribution, opportunities for intermediation, etc). It would also determine the level of access for carrying out fieldwork (geographical location of the organisation, willingness to schedule for interviews, number of employees) and whether or not the company can supply market information (existence of potentially sensitive data, data collection methods used) for purposes of model validation. It was decided to make contact with large manufacturing companies, situated and operating in the North West of England, since they were highly likely to have several employees that would be familiar with these issues, access would be simplified because they are located in the near vicinity of MMU.

From this rationale for the research, a shortlist was produced of companies that would be potential partners in the project. The following companies were among those regarded as possibilities⁵:

AstraZenica

BASF Plc.

CIBA (Speciality Chemicals)

Siemens Power Transmission & Distribution

Initial phone calls were made, and these were followed up by a letter of introduction containing the project overview presented above. There was a very varied level of initial response from the companies. Several responded and showed an initial interest in the project, although ultimately they didn't wish to take it any further. For example, discussions with BASF reached the stage of an exploratory interview with a manager

⁵ The company who finally agreed to participate in the project is not included in this list. For marketing reasons, they did not wish to reveal their identity.

involved in e-commerce there. One of the main problems with finding a suitable case study was that e-commerce was not yet used by companies on a daily basis and in an integrated way (i.e. it was not a mature technology). It was found that strategic issues with e-commerce were often handled at a national or global level rather than dealt with locally by managers in the region.

The initial telephone calls were made between December 2000 and January 2001. An obvious and important first task was to identify the potential stakeholders, to determine the role of the people who were to be contacted, in this case the IT and, in particular, e-commerce managers. The names of relevant people were obtained from administrators by asking to speak to e-commerce managers. Secondly, I obtained as much information as much as possible about the company and about the role of the individuals working there before approaching them. One very useful resource for this purpose was the company website. Usefully, websites also provide an indication of the level of interest of the company in e-commerce. It was important to establish, through these initial investigations, whether the company's current business concerns could be framed in a context relevant to the objectives of the proposed research. In this case, I sought evidence of business process reengineering involving e-commerce.

In February and March, initial meetings took place where a presentation of the research approach was made, and the objectives of the project were discussed. On the 14th of March the project was given the go ahead by the company. Once the industrial contacts had agreed to participate in a case study, the project then proceeded as described in Figure 4-2.

Date	Stage Completed	Comments
June 27 th 2001	Meeting with stakeholders	Initial meeting to talk about e-commerce, discuss possible issues for the case study, and the objectives of the research.
July 2001	Writing a draft the project plan	Proposal for project plan was drafted by the researcher and circulated to the stakeholder.
July 30 th 2001	Meeting with stakeholders	Discuss the project plan draft and suggest potential interviewees. Timeframe was added.
October 2001	Topics for discussion and interview questions were drafted.	
October 8 th 2001	Meeting with stakeholders	Meeting to schedule interviews and seek advice on the topics for interview questions.
October 11 th /12 th 2001 November 19 th 2001	Carrying out interviews	Tape recordings were made of all interviews.
November 19 th 2001	Meeting with stakeholders	Demonstrating the modelling platform.
Nov. / Dec. 2001	Transcribing interview recordings.	
January 2002	Carrying out analysis of the data using Atlas.ti software.	Analysis of the transcripts.
March 2002	Publishing a case study progress report.	Report sent to the stakeholders and published on university web page
March/April 2002	Planning the model design	Focusing on the importance of customer attitudes towards e-commerce, attitudes towards intermediaries and the effect of specifying different communication processes.
May/June 2002	First simulations with the prototype model.	Analysis of the first results, and presentation.
August 2002	Write the model description	
August 20 th 2002	Meeting with stakeholders	Discuss the results of the modelling, validation of model assumptions by the stakeholders. Received the mall statistics.
August 2002	Sending a report of emergent findings of the interviews to stakeholders.	Modification and publication on web page.
September 2002	Preparing the survey of customer attitudes.	
Sept. / Oct. 2002	Amending the model	
December 2002	Writing up the model results	
March 2003	Final meeting with the stakeholders	Assessing the project. Discussing policy implications of e-commerce.

Figure 4.2: Project timeframe

4.2.3 The First Meeting: Establishing the Context for the Research

At the first meeting in June 2001, the stakeholders introduced background information describing the company and the context for the business transformation through the development of its e-commerce systems. They provided information about the extent of the organisation, the nature of its markets, its history and corporate philosophy, and the short- and long-term goals of the top-level management and its vision for the role of e-commerce.

At this stage I was keen to obtain as much contextual information as possible, in order to develop an understanding of the central issues that the company was facing, to become well-versed in any jargon used during the face-to-face interviews that would follow, and ultimately, to ensure that the agent-based modelling work would take account of the social context of the organisation and its activities.

The investigation of context in this section should also make it easier for the reader to understand the basis for the development of the model scenarios described in section 6.3. Furthermore, evidence of such a link between these two sections should also support the argument that the scenarios do have the required contextual depth.

Initial discussions with the stakeholders established that it would be appropriate to address issues within the Customer Services (CS) department of the company. CS is the area that was estimated to be the most affected in the short to medium term by the introduction of the electronic mall and by the changes in business processes arising from the business transformation programme.

The points below summarise the contextual forces that were explained:

- The company is implementing a programme with the aim of increasing their market share of sales by 10%. This is a very important context for the development of the electronic mall because management hope that e-

commerce will provide a competitive advantage to help them carry out the programme.

- The company aims to reorganise CS by switching some direct sales to their distributors. The company recognises that some customers would be more cost-effectively served by distributors. In order to carry out this strategy, it must both persuade the customer of the benefits of buying through distribution, and ensure the compliance of distributors to increase the amount of stock they hold.
- Within the timeframe of 18 months to 2 years, the company intends to increase the proportion of sales through the mall, until eventually nearly all orders will be placed electronically. This would largely avoid the need for duplicate systems and would hence improve efficiency. It also suggests that the company may eventually assume a 'mandate of adoption' policy.
- The company itself assumed responsibility for alerting customers and distributors to the possibility of using the Internet-based system, for disseminating information about it, and for providing support (both financial and technical) to encourage use of their systems. This was a significant undertaking for the company, involving dissemination through trade journals, through its Web page, and through personal visits by regional sales or e-commerce team members.

Following the first meeting, internal documents were given as supplementary background information. These data included an overview of the present organisation of the Customer Services department, the information technologies which currently were being used by the organisation and by its business partners, the roadmap for the introduction of Internet-based e-commerce, the anticipated impact upon the function of the department and the likely benefits and problems associated with the transition.

4.2.4 Case Study Research Design

The actual case study research design was defined through several meetings taking

place between June and October. This included: research questions, research objectives, propositions, some criteria for evaluating the project, and policy considerations. During the following meeting, the proposal was discussed and agreed upon. At this stage we also agreed upon the fieldwork methods and protocols, and a tentative time frame of 12-18 months for the duration of the project.

The initial set of research questions to define the lines of enquiry for the case study consisted of four questions. These were later extended to six research questions as the project progressed and new issues emerged that we recognised as being important (see section 6.2). These questions were drawn from different sources: they were based on certain propositions or hypotheses drawn from literature studies, or they were drawn from the interests of the stakeholders or from the interests of the author.

For example, hypotheses based on long-term views of changing market structures (i.e. vertical integration vs. market mechanisms) were discussed in chapter two. It can be argued that market systems are more effective when the product is considered to be generic (i.e. substitutable), and the market diffuse (in terms of the regional density of customers). As will be seen in chapter five, this describes quite well the traditional situation in the case study - where there are indeed many independent intermediaries operating. From this it can be hypothesised that market intermediation will remain a very important function.

Chapter two also considered theories of disintermediation and the IDR hypothesis, proposed by more recent work. This theory proposes that technological change may provoke reorganisation of the value chain where a traditional intermediary under threat of disintermediation adapts to a different role, by leveraging existing co-specialised assets or technical expertise.

In the case study described in the next chapter, particular attention will be paid to any evidence of disintermediation due to the impact of e-commerce, and also to the nature of any reintermediation processes. In particular, any change in the role of intermediaries will be documented, along with the identification of any mitigating factors that might separate the successful from the unsuccessful intermediary under these changing circumstances.

In the area of information systems (IS) several studies of technology diffusion evidenced the importance of social influence processes in adoption decisions. This brings into question the mechanisms by which such information is communicated in socio-technical systems. The specification of 'word of mouth' communication between agents in other simulation models produced some plausible outcomes that fit very well with those which have been observed in real markets. This form of communication should be equally important to customers participating in electronic markets because Internet-based networks also foster high levels of participation and informal communication processes.

The literature on trust in business relationships and trust in new technological systems (such as EC systems c.f. (Ratnasingham 1998)) and reports of several actual Website security failures interested me in modelling the impact of technological system performance upon adoption and usage. Two types of trust are distinguished: trust in business relationships and trust in new technological systems. Concerning the latter, one hypothesis would be that lack of trust in the security of e-commerce systems is expected to have greater impact than other types of system performance problems.

Finally, the stakeholders themselves raised other questions, both at inception of the project, and during the evaluation phase. For example they were interested in understanding better the impact of e-commerce upon internal productivity and upon the company's reputation amongst customers.

From defining the broad problem area, providing domain expertise, formulating the research questions, designing the fieldwork methods, to evaluating the results of the modelling, the stakeholders played a role in many aspects of the research programme. Their input will be considered in much greater detail in section 6.1.

These hypotheses will be returned to in chapter eight, and reflected upon at length along with the research questions defined in section 6.2.

There were several criteria for evaluating the project, for establishing how successful the project was and what lessons could be drawn from it:

1. One of the most important criteria was the validation of the model behaviour: do stakeholders regard model results as plausible and in accordance with their observations? Do statistical tests of model and empirical data exhibit similar characteristic patterns? If so, then the model should be relevant to the case.
2. A second criterion is whether the project and the software produced has been of value to the organisation in terms of improving its understanding of certain issues, highlighting some of the likely benefits or problems associated with those issues, and exploring certain policy implications.
3. A third criterion is how well the case study findings support or refute the existing theories discussed earlier about intermediation and markets. Do they allow a critical investigation of this theory and do they contribute to knowledge in this area? Do they fit with recent hypotheses about the nature of e-commerce, or do they suggest a new framework to understand events?
4. Fourthly, there is the criterion of the suitability of the methodology used to carry out the research. Did the data collection methods integrate well with the modelling work, and was the stakeholder participation technique appropriate?

Matters of e-commerce policy were also discussed from the beginning of the collaboration. The stakeholders wanted to know how they would be able to benefit from the software, whether or not there would be any policy conclusions upon which they might be able to act, or how otherwise the research might improve their understanding of the implications of e-commerce and its effects upon business processes and relations.

4.2.5 Carrying out the Case Study

The case study was exploratory and aimed at uncovering the EC issues concerning the managers and executives working at the company, and their understandings and perceptions of those issues. Interviews took place with nine employees in a variety of positions at the company, including members of the e-commerce team, order management and internal sales. The decision as to which employees to interview was

made by the stakeholders, who suggested people it might be worthwhile to speak to.

This group of respondents contained individuals occupying very different roles within the organisation: it was likely that they would have very different concepts of current business activities and different opinions about e-commerce issues (about why the company web site is or is not generating significant online presence or sales, about how best to develop customer relationships with e-commerce, or about the appropriate role for intermediaries, for example). The researcher must therefore be prepared to find methods to process the sometimes-conflicting information coming from them.

Prior to carrying out the interviews, the selected respondents were briefed on the nature of the project by email, preparing them for what to expect in the interviews. At the beginning of the interviews, the first task was to introduce the research, by explaining the objectives and briefly describing the modelling techniques.

The interviews were semi-structured but were conducted with a focus on a previously circulated list of key interview topics and questions drawn from the literature, and from some preliminary discussions with the e-business management team at the company. Interview 'datasheets' were used in order to structure the interviews and guide the respondent to discuss the following topics: the effect of EC on distributors; the referrals policy; adoption of EC; the company's reputation amongst customers, and efficiency gains due to EC. Within each focused topic, there were several issues on which the respondents' views were sought. This methodology was based on that described by Yin (1994): having some topics of discussion in mind rather than a fixed list of interview questions.

The interviews conducted lasted between forty-five minutes and one hundred minutes each. Data were collected using a tape recorder and transcripts were made. The data were thus qualitative in nature, and the ATLAS.ti (2002) software package appropriate for handling such data was used for organising and undertaking a detailed analysis.

According to Easterby-Smith, Thorpe et al. (2001), there are two basic ways to analyse qualitative data:

1. Content analysis involves studying the frequency of occurrence of key phrases in texts or interviews. Although the researcher will be able to understand what the key concepts are, he will be unlikely to understand why they occur.
2. Grounded theory recognises that large amounts of non-standard data produced by qualitative studies are difficult to analyse, and rather than imposing an external structure, it derives structure from the data (emergent themes and patterns). This structure is grounded in concepts used by the social actors themselves.

As will become clear in the later chapters, the research questions were addressed through a combination of methods: through an interpretative of analysis of fieldwork data, as well as by experimentation with an agent-based model.

In the interpretative analysis, the procedure used was to re-read the interview transcripts several times to become familiarised with the data, and then attempt to identify the key concepts and the relations between them. The next stage involves cataloguing occurrences of these concepts in the data, noting the sources, how often they occur, and what level of confidence we have in them. As cataloguing is carried out, recoding or redefining the concepts may be necessary. Eventually, by interpreting the respondents' views on these concepts and the relationships between them, it becomes possible to recognise clear patterns and emergent findings in the fieldwork.

In this approach there is a certain amount of blurring of data collection and analysis, which are therefore difficult to regard as separate stages. Fundamentally, this is because research issues are very loosely defined in this type of project. In order to improve the relevance and accuracy of the model specification, simulation results should be taken back into the field to involve stakeholders in the evaluation process. We therefore have a continuous interplay between data collection and analysis, and the success of the technique of ABSS modelling with stakeholder participation depends upon developing them in synergy.

Conclusion

This chapter presented the methodology for the case study and in particular highlighted the qualitative aspects of this investigation. It was defined (in section 4.1.4) as a multi-method approach consisting of four components: semi-structured interviews with qualitative interpretation, agent-based modelling, stakeholder participation, and statistical analysis of quantitative data.

It was argued that this methodological approach is appropriate to an investigation into the impact of e-commerce upon the value chain, and contributes to developing the methodology of representational agent-based modelling. In making the choice of research approach and selecting the methods, the aim was to start from the problem specification and allow a flexibility of method selection depending on the emerging lines of enquiry.

However this raised some philosophical issues concerning the ‘paradigm incommensurability’ problem. Inconsistencies were invoked on account of the fact that qualitative and quantitative approaches were being combined: methods that stem from different traditions with different assumptions about the nature of research inquiry. This problem was understood to generate conflict on the level of ontological and epistemological questions. Reflecting on these questions, it was found that the author’s assumptions involved recognising the subjectivity of different interpretations as well as the bias brought to the investigation by the researcher. However, it was also an important objective to be able to reflect critically on the case study by stepping back from the investigation and claiming a stance of scientific objectivity. The traditional positivist assumption of objectivity remained important in defining the criteria for carrying out the experimental investigation and analysis of simulation results.

Section 4.2 provided an introduction to the case study which detailed the criteria for choosing suitable industrial partners, the procedures for making contact with them and for jointly defining the set of initial project objectives. Section 4.2.3 detailed what took place at our early meetings, and the rest of the chapter described the design for

carrying out the case study, the objectives, the methods, and the criteria for evaluating it.

The role of the case study was to ground the modelling techniques being developed in real world issues, to provide the empirical data with which to inform the model, and to provide access to domain experts to evaluate and improve the accuracy, relevance, and utility of models. The participatory methodology being one main aspect of the original contribution to knowledge of this research, the design insights gained from combining qualitative and quantitative data collection techniques was the other aspect.

This chapter provided some definitions of qualitative and quantitative models, distinguishing them in terms of the type of data informing them, being manipulated by them, and in terms of how the simulation outputs are analysed or interpreted. However to argue convincingly that a model is qualitative rather than quantitative requires concrete illustration of how it works in terms of its key assumptions, rules of operating, and a sense of the data structures being manipulated. Chapter six returns to this issue of linking empirical data to formal models, and describes how it was done, with the cooperation of the stakeholders, in this case study.