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## Information support for the sense-making activities of managers

Helen Hasan

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Helen Margaret Hasan  
*University of Wollongong*

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# INFORMATION SUPPORT FOR THE SENSE-MAKING ACTIVITIES OF MANAGERS

A thesis submitted in fulfilment of the  
requirements for the award of the degree

DOCTOR OF PHILOSOPHY

from

THE UNIVERSITY OF WOLLONGONG

by

HELEN MARGARET HASAN

BSc (UNSW), MSc (Macquarie), DipCompSci (Wollongong)

DEPARTMENT OF INFORMATION SYSTEMS

2000

## DECLARATION

This is to certify that the work presented in this thesis was carried out by the author in the Department of Information Systems at the University of Wollongong, Australia, and is the result of original research and has not been submitted for a degree at any other university or institution.

HELEN HASAN

## SUMMARY

This thesis addresses the problem of how computer technologies and associated systems can be used effectively to provide information, in particular organisational performance information, to support managers in their strategic activities, with particular reference to managers in public, professional bureaucracies such as universities.

The objective of the thesis is to answer the following questions:

1. What do different disciplines and bodies of knowledge currently say about this problem?
2. Is there a theoretical approach that can provide a holistic, contextual and dynamic understanding of this problem?
3. Can this theory be used to develop a holistic, contextual and dynamic model of the problem?
4. Can the model provide guidelines or methodologies that can be of general use to real organisations faced with this problem?

The approach taken is one of a qualitative, interpretive epistemology and the theoretical basis is that of the Cultural Historical Activity Theory (CHAT) based on the work of the Russian psychologists Vygotsky (1978) and Leontiev (1981). Following a review of the literature, a study was conducted of five projects aimed at the provision of information to management at a single site. This study used the historical research methodology of Mason et al (1997). From this study a new holistic model was developed of the use of computer technologies and associated systems in providing information to support managers in their strategic activities. This model is contrasted with a model of the same problem based on the current literature. A framework, derived from the model, is presented.

The new model and framework were applied to a project concerning the creation of a prototype enterprise information system for research output performance in a university. This project, guided by the model, captured the imagination of management and is a significant improvement on previous attempts, thus verifying the validity of the model and the CHAT approach.

## **PUBLICATIONS OF THE CANDIDATE**

### **Books and edited volumes:**

- Hasan H, Gould E. and Larkin P. (2000) *Information Systems and Activity Theory: a Second Volume* in preparation
- Hasan H. Tibbits H. Haglund P. and Macgregor R. (2000) *Electronic Commerce: Opportunities for Accountants* to be published by the IT Chapter of the Institute of Chartered Accountants
- Hasan H, Gould E. and Hyland P. (1998) *Information Systems and Activity Theory: Tools in Context*, Wollongong University Press
- Hasan H, Gould E and Tibbits H (1997) *Executive Information Systems: A Guide for Accountants* Published by the IT Chapter of the Australian Institute of Chartered Accountants.

### **Book Chapters:**

- Hasan H. (1999) An Overview of Different Techniques for applying Activity Theory to Information Systems accepted for Hasan H, Gould E. and Larkin P. (eds) *Information Systems and Activity Theory: a Second Volume* in preparation
- Hasan H. (1999) A Holistic Approach to the Study of Executive Information Systems using Activity Theory accepted for Hasan H, Gould E. and Larkin P. (eds) *Information Systems and Activity Theory: a Second Volume* in preparation
- Hasan H. (1998) Activity Theory: a Basis for the Contextual Study of Information Systems in Organisations. In Hasan H, Gould E. and Hyland P. (eds) *Information Systems and Activity Theory: Tools in Context* Wollongong University Press. 19-38

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## CHAPTER 1 INTRODUCTION

This thesis is a contribution to the emerging field of information systems (IS). The object of *information systems* research is to “study, or improve the effectiveness of design, implementation and use of *information systems* in organisations and to assess their impact on individuals, organisations and society at large” (Garcia & Quek 1997). From this definition it can be seen that the term “information systems” can be used to denote both a field of study and a set of computer-based artefacts. As both uses of the term will occur throughout the thesis, the field of study will be differentiated by the use of the acronym, *IS*, and the words, “information systems”, used to denote the artefacts.

Organisations have always had systems to store, process and communicate information, but it is only with the advent of information technology (IT) that such systems have attracted much interest in their own right. Land (1992) echoes the commonly held view that information systems are “essentially social systems of which IT is but one aspect” and that they “need to be considered not just as artefacts but from the perspectives of the people who may wish to use those artefacts to support their activities and decisions in a more informal manner”. This broader view of information systems will be assumed throughout the thesis. The research described here will therefore touch a range of traditional disciplines.

IS has variously been described as multi-, inter-, or cross-disciplinary. Davies and Ledington (1991) describe IS as “a hybrid field attached to many other disciplines”. Others state that there is no single framework which encompasses all the domains of knowledge needed for IS study and its research frameworks and techniques are mostly borrowed or imported from other disciplines (Land 1992, Garcia & Quek 1997). It follows that there is a great deal of variety in the theories on which IS research is based, as well as the topics studied and the methods used. As expressed by Bertelson (1998), IS has become “an intertwined field of praxis, research and theory” with research based on “a multiplicity of research methods and strategies”.

This is both a challenge and an opportunity. Without a strongly established tradition in the field, the IS researcher is, to some extent, free to choose the methodology and

theoretical basis for any given piece of research. Consequently the rewards of IS research are not only increased knowledge in the topic area but often new applications of established theories from other disciplines. To be successful in this latter endeavour, the researcher must have the ability to identify the philosophical and theoretical assumptions, which lead to the choice of the appropriate methodology and theoretical basis. For this reason the choice, and justification, of the research methodology and theoretical basis form an important part of this thesis. In particular, the identification and adaptation of a well established theory from a traditional discipline, is an explicit goal of the research.

Bertelson (1998) has described the IS field as “by nature a pragmatic one, directed to establishing relevant design knowledge, rather than establishing universal, disinterested but also irrelevant, *truth*”. The pace of change is such that elements have no time to stabilise before the next innovations and new areas of application come into play. In addition information systems are socio-culturally phenomena and are, for the most part, only meaningful in their context of use. For all these reasons, complexity is an essential property of information systems although the complexity is different from of other fields of engineering and science.

The topic of this thesis embodies all the complex, dynamic, pragmatic and contextual aspects of the IS field and thereby should be an interesting and worthwhile contribution to the field. The thesis begins with a statement of the research problem, questions and objectives.

## 1.1 THE RESEARCH PROBLEM, QUESTIONS AND OBJECTIVE

### **The Research Problem:**

How computer technologies and associated systems can be used effectively to provide information, in particular organisational performance information, to support managers in their strategic activities, with particular reference to managers in public, professional bureaucracies such as universities.

### **The Research Questions:**

1. What do different disciplines and bodies of knowledge currently say about this problem?
2. Is there a theoretical approach that can provide a holistic contextual and dynamic understanding of this problem?
3. Can this theory be used to develop a holistic, contextual and dynamic model of the problem?
4. Can the model provide guidelines or methodologies that can be of general use to real organisations faced with this problem?

### **The Research Objective:**

In the context of the Research Problem and Questions enunciated above, to:

- find the holistic contextual and dynamic theory,
- develop the understanding and the model, and
- investigate the general applicability of the model in real organisations.

## 1.2 BACKGROUND TO THE CHOICE OF RESEARCH PROBLEM

The research problem arises out of work carried out by the author from 1991 to 1996 concerning Executive Information Systems (EIS) in Australian public organisations. This work resulted in the publication of a book (Hasan, Gould & Tibbits 1997), six journal publications (Hasan & Gould 1994a/5, Hasan & Lampitsi 1995, Tibbits & Hasan 1997, Hasan & Hasan 1997, Hyland & Hasan 1997) and ten refereed conference papers (Hasan 1991/2/5/6/7, Hasan & Cheung 1993, Gould & Hasan 1994/5, Hasan & Gould 1994b/6). The work arose from a project with the IT department of a local public utility where research was undertaken into the Human-Computer Interaction (HCI) of senior managers' use of computers. An executive of the company had seen a demonstration of a low-cost, PC-based, EIS package at a trade show and acquired an introductory copy of the software. Impressed by the apparent capability of the package, but unwilling to allocate resources to an internal EIS project, he took the opportunity provided by my presence to get the project underway without using internal staff. His instructions were "firstly to interview all senior managers (except the general manager) to ascertain their information requirements, secondly to locate the data sources of this information in company operational systems and then use the package to extract the data, load it into its multi-dimensional database (MDDB) so that the managers could view the information via the friendly graphical user interface (GUI)." Two months were spent carrying out the executive's brief in the organisation, keeping a record of proceedings for my research. The course of this project was recorded for over four years, resulting in two publications (Hasan & Gould 1994a, 1996), which reported problems encountered with interview methods used for gathering executive information requirements, as well as the problems of finding authentic sources of data and of managing the politics of cross-functional EIS teams. As a consequence of these results, the research began to include organisational management issues, in addition to the traditional systemic EIS issues, and hence evolved into the research problem stated above.

The longitudinal study was followed by a multiple case study (reported in Hasan & Lampitsi 1995) and then extensive empirical studies of EIS in both the local government

sector (Hasan & Hasan 1997) and the accounting profession (Tibbits & Hasan 1997, Hasan, Gould & Tibbits 1997). Broader lessons learnt from this research have been presented in several conference papers, as listed above, resulting in the emergence, during 1997, of the research questions and objective of my thesis.

The topic of the thesis is strongly influenced by three issues: firstly, recent trends in the literature which include a growing concern with “knowledge management” and the softer, people and social, aspects of EIS, secondly, the capabilities of the latest trends in information technology, including data-warehousing and the internet, and thirdly, the accumulated research experience of the author in organisational management. There is a gulf between, on the one hand, the output of research from the fields of management, organisational and decision sciences on how senior executives manage in contemporary organisations and, on the other hand, output from IS research on systems designed to provide organisational information and knowledge, which are such vital resources for senior managers. The latter, IS research, seems to focus on providing accurate information, with little thought to how it is used, and the former alludes to the need for information support for management decision making but provides little detail on its content and presentation that would be of use to those charged with the tasks of building systems to provide the information.

This thesis aims to find an appropriate theoretical approach to bridge that gulf. Bannon (1999) warns that trying to “initiate a dialogue between two research communities that appear at times to be oblivious to one another” is “fraught with difficulties”. He goes on to contrast a field of study, DSS that “relies too heavily on overly rationalistic assumptions about human behaviour in organisations” with a field, CSCW, that is seen as “relying too much on either political-sociological or ethnomethodological approaches to the study of phenomena”. This contrast has influenced my choice to use an interpretive qualitative research approach to my study, which crosses traditional discipline boundaries.

### 1.3 THE QUESTION OF EPISTEMOLOGY AND ONTOLOGY

Garcia and Quek (1997) imply that whenever researchers feel the need to explain their epistemological stance it is highly unlikely that they are following the positive tradition. As already mentioned, an explicit goal of the research of this thesis is to choose and justify a methodology and theoretical basis suited to the research problem. It follows therefore that this research definitely is non-positivist, being *interpretive* by Walsham's (1995a) definition, that it "adopts the position that our knowledge of reality is a social construction by human actors". It will also *qualitative* by Myer's (ISWORLD 1998) definition, that it "involves the use of qualitative data to understand and explain social phenomena". This approach is supported in a recent article in the IS Journal by Silverman (1998) who advocates the qualitative study of *subjective meanings* in contrast to quantitative studies of *objective variables*. He asserts that the particular strength of qualitative, interpretive research is its ability to focus on actual practice in situ. In the words of Miles and Huberman (1994 p 4) research of this thesis is an instance of "see(ing) the world with more pragmatic, ecumenical eyes".

It should be noted that, although interpretive research often employs qualitative data collection methods, Klein and Myers (1999) make the point that the word *qualitative* is not a synonym for *interpretive* and that qualitative research can be done with a positivist or an interpretive stance depending on the philosophical assumptions of the researcher. They assert that "IS research can be classified as positivist if there is evidence of formal propositions, quantifiable measures of variable, hypothesis testing and the drawing of inferences about a phenomenon from a representative sample to a stated population". From this it can be deduced that a researcher with a non-positivist epistemology is more likely to employ a qualitative methodology, as is the case here.

There has recently been a surge of interest in the interpretive approach which is now viewed as a legitimate alternative to the predominantly positivist tradition of IS research. Introna (1997) is eloquently critical of positivist attempts to "produce neatly packaged answers to messy real world problems that spiral in complexity" stating that it is now "time for a new story". However this complexity introduces difficulties in

defining and evaluating interpretive research. Whereas positivist research is well understood and easily defined, definitions of the interpretivist approach are more descriptive, encompassing all that is non-positivist.

Walsham (1995b) describes interpretive research as simply the antithesis of the positivist approach where the epistemology is one where facts and values are distinct and where scientific knowledge consists only of objective facts. Likewise he describes the non-positivist ontology as the antithesis of the positivist's view where reality exists independent of our construction of it. It seems that, in IS, the positivist approach is the benchmark of "good" research and if one adheres to a non-positivist epistemology, where facts and values are intertwined, and a non-positivist ontology, where each person or social group construct their own reality, there is an obligation to validate the approach.

Interpretive research, in the words of Klein and Myers (1999), "can help IS researchers to understand human thought and action in social and organisational contexts; it has the potential to produce deep insights into IS phenomena including the management of information systems and information systems development". Based not only on their own work but also that of Boland (1991) Hirshheim (Hirshheim & Klein 1989), Mumford (Mumford et al 1985), Orlikowski (Orlikowski & Baroudi 1991) and Walsham (1995a, b) Klein and Myers (1999) go on to describe what they mean by the interpretive epistemology as follows:

*"IS research can be classified as interpretive if it is assumed that our knowledge of reality of gained only through social constructions such a language, consciousness, shared meanings, documents, tools and other artifacts. Interpretive research does not predefine dependent and independent variables but focuses on the complexity of human sense making as the situation emerges; it attempts to understand phenomena through the meanings that people assign to them. Interpretive methods of research in IS are aimed at producing an understanding of the context of the information system and the process whereby the information system influences and is influenced by the context."*

It should be noted that much of the language used in this description of interpretive research, (consciousness, tools, sense making, context) will be evident later in the thesis when the theoretical basis of the research is discussed.

The qualitative, interpretive research approach is well accepted in the social sciences but there is still a need “ to convince reductionists/positivists that naturalistic inquiry/qualitative research methods are not any more biased or inaccurate or imprecise than their methods”(Miles & Huberman 1994 p277). These eminent social scientists assert that the “goodness” of the research is assured by “explicit systematic methods that are credible, dependable and replicable in qualitative terms” (*ibid* p2). With such methods qualitative data are “a source of well-grounded, rich descriptions and explanations of processes in identifiable local contexts” (*ibid* p1) They describe methods that enable the drawing of good quality conclusions from qualitative research which are “approximations to the truth that have a firmer warrant than common sense” (*ibid* p277).

The research of this thesis will closely follow the approach of Miles and Huberman (*ibid* p6) where they prescribe that qualitative research:

- is conducted through an intense contact with a life situation,
- has the role of gaining a holistic (systemic, encompassing, integrated) overview of the context under study,
- attempts to capture data from the inside,
- may isolate themes but must keep the data their original form (in context),
- has the task of explicating the ways people in particular settings manage their day-to-day life,
- interprets data on grounds of internal consistency,
- does most analysis with words, which are organised in some way, to permit analysis.

The research is also guided by the set of principles for conducting interpretive field research in IS as enunciated by Klein and Myers (1999) and shown in Table 1.1. In the concluding chapter of the thesis, the research will be evaluated against these principles.

<div>Table 1.1</div> <div>The Seven Principles for Conducting and Evaluating Interpretive Field Research in IS</div> <div>(Klein &amp; Meyers 1999)</div>
<div>1. The fundamental principle of the hermeneutic circle</div> <div>This principle suggests that all human understanding is achieved by iterating between considering the interdependent meaning of the parts and the whole that they form. This principle of human understanding is fundamental to all the other principles.</div>
<div>2. The Principle of Contextualisation</div> <div>Requires critical reflection of the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged.</div>
<div>3. The Principle of Interaction between the Researchers and the Subjects</div> <div>Requires critical reflection on how the research materials (or "data") were socially constructed through the interaction between the researchers and participants.</div>
<div>4. The Principle of Abstraction and Generalisation</div> <div>Requires relating the idiographic details revealed by the data interpretation through the application of Principles 1 and 2 to theoretical, general concepts that describe the nature of human understanding and social action.</div>
<div>5. The Principle of Dialogical Reasoning</div> <div>Requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings ("the story which the data tell") with subsequent cycles of revision.</div>
<div>6. The Principle of Multiple Interpretations</div> <div>Requires sensitivity to possible differences in interpretations among the participants as are typically expressed in multiple narratives or stories of the same sequence of events under study. Similar to multiple witness accounts even if all tell it as they saw it.</div>
<div>7. The Principle of Suspicion</div> <div>Requires sensitivity to possible 'biases' and systematic "distortions" in the narratives collected from the participants.</div>

## 1.4 THE CHOICE OF RESEARCH SITE AND DATA

The previous discussion justifies the qualitative research method, using an interpretive phenomenological approach that is appropriate to meet the research objective of the thesis. The use of this method has resulted in my choice of a single site to be the object of my study. The data collected from this site has come from in-depth studies of several projects and events in the one organisation. Organisational context plays such a critical role in the research problem that there is a considerable advantage in keeping it constant and not collecting data from more than one organisation.

The organisation chosen for the study was the university of the researcher for two reasons. Firstly, it is an organisation where the information is rich and complex and where managers are determined to make best use of IT in the provision of information to support the management of the organisation. Secondly, it is the organisation with which the researcher is most familiar and hence is aware of the subtle organisational factors that might not be apparent to an outsider.

There are two potential disadvantages to this choice. Firstly the choice of a single site could be seen to limit the generalisability of the results. Walsham (1995a) has discussed this issue, stating that, rather than generalisations, the value of qualitative research comes when explanations of particular phenomena, derived from interpretive research in a specific setting, are valuable to other organisations and contexts in the future.

Secondly the choice to study my own organisation raises the issue of objectivity. Miles and Huberman (1994) insist that interpretive researchers are “no more detached from their objects of study than are their informants”. Indeed the point is made that all research, even empirical positive studies, are influenced by the biases of the researcher who chooses which issues to study and which data to collect. Interpretive research involves two sets of interpretations those of the informants and those of the researchers, and it is important to recognise this when carrying out the analysis of the data. However if every effort is made to take the position of the interpreter into account, then the results of the research are valid.

In this case the position of the researcher is that of an academic staff member in the IS Department of the University being researched. Because of this, the interpretation could appear to be compromised by the fact that the researcher, while not an active participant in any of the projects being analysed, was affected by some of their outcomes. In fact the opposite view is taken, that this research has the advantage of being done by an objective researcher, independent of the actual projects, but with the understanding of the context that comes from a being member of the organisation.

## **1.5 ARRANGEMENT OF THE THESIS**

This thesis is deigned around the answers to the research questions posed above and aims to meet the stated research objective as follows:

### **Chapter 2: Literature review**

In this chapter the term EIS will be interpreted to mean executive or enterprise information systems, in a generic sense, as systems which provide enterprise information to executives. Using this interpretation, the EIS literature will be reviewed and include literature not only from the fields of IS and management but also from decision and organisational sciences, organisational and human behaviour and other related disciplines. Drawn from this cross-disciplinary literature, a model is presented of the current understanding of the way in which information is provided to management in organisations.

### **Chapter 3: The Theoretical Approach**

The need of a suitable theoretical approach has already been revealed. This chapter outlines the requirements for the theory, based on the literature review in Chapter 2, and analyses possible candidate theories. The choice of the cultural historical activity theory (CHAT) is made and justified. CHAT concepts are described in detail, together with examples of the work of researchers who have applied CHAT to problems in organisations.

### **Chapter 4: The Research Methodology and Plan**

Previously it was stated that this work uses a qualitative research method, with an interpretive phenomenological approach, and involves the study of a single organisation,

my own university. This chapter will outline the historical methodology of Mason et al (1997a) that is used for the study and give reasons for this choice. The steps of this methodology are used to form the research plan, and schedule for the collection of data, together with a description of the way in which CHAT is used for the interpretive analysis of qualitative data. This chapter concludes with a description of the context of the research site, that of an Australian University.

### **Chapter 5: The Study**

This chapter presents the results of an historical university study involving five projects concerned with my research problem, information support for managers. According to step six of the historical method of Mason et al (1997a), the story of the five projects, as discovered by the qualitative analysis based on CHAT, is told in this chapter.

### **Chapter 6: The New Model**

This chapter presents and describes the new model of information system support for managerial decision making which emerges from the study. The model is augmented by a description of CHAT concepts that relate to the model and which are necessary for a full understanding of the richness of the model. A framework, derived from the model, is presented that can be used to guide EIS development in organisations, such as universities, which have complex information requirements.

### **Chapter 7: Verification of the model**

In this chapter the model and framework, developed in the previous chapter, are applied to a project concerning the creation of a prototype EIS for research performance data in the university where the other projects took place. Unlike the previous five projects, this one, guided by model, captured the imagination of management and appears to be a significant improvement on previous attempts, verifying the validity of the CHAT approach.

### **Chapter 8: Implications of the research**

This chapter begins with a summary of the research together with an assessment of how the research would be assessed on Klein and Meyers' (1999) seven principles for evaluating interpretive field research in IS. The chapter includes some observations on

the emergence of software products that support the CHAT model. It also notes the increasing popularity of concepts, such as organisational memory and knowledge management, which indicate that there is growing concern to improve information support for managerial work in complex organisations. Then follows a discussion on the future directions of research into this problem.

The chapter and thesis concludes with a discussion on the use of CHAT as a theoretical basis for the IS discipline.

## 1.6 EXPECTED CONTRIBUTIONS OF THE THESIS

It is anticipated that the results of this research will be of interest to the following:

- **For the IS research community:** a greater understanding of the development and use of EIS in rich contexts
- **For IS practitioners:** methods and guidelines to assist EIS development teams
- **For senior managers:** a greater understanding of the possibilities that EIS offer to support the management of enterprise information (and knowledge) so that it can best be used as an organisational resource
- **For members of the Higher Education Industry:** some lessons learnt to help them better understand the complexities of performance measurement in their organisations.
- **For the CHAT community:** a modern adaptation of the theory to encompass the use of computer technology in organisations

In conclusion it is particularly interesting to note that there are obvious parallels between the qualitative research process of gathering and processing data, and the process being studied, namely the conversion of data to information to support managerial decision making. Qualitative research data and organisation performance data in universities have many similarities. In particular, both are complex and open to multiple interpretations.

## **1.7 PUBLICATIONS RESULTING FROM THE WORK OF THE THESIS**

Section 1.2 of this chapter, listed the publications of the author leading to the work of the thesis. Resulting directly from the thesis are the following works: two books (Hasan, Gould & Hyland 1998, Hasan, Gould & Larkin 1999), three book chapters (Hasan 1998, 1999c/d), four journal articles (Hasan 1999a/b/c and one under review) and six conference papers (Hasan 1998, Dodds et al 1999 and four under review). The author has also conducted two tutorials on *Activity Theory and Information Systems*, at the ACIS98 and ISDSS99 conferences, and has been invited to give three seminars on the topic at other research institutions. The full list of publications by the author is included in the preface to the thesis.

## CHAPTER 2 LITERATURE REVIEW

### **The Research Problem**

How computer technologies and associated systems can be used effectively to provide information to support managers in their strategic activities.

### **Research Question 1**

What do different disciplines and bodies of knowledge currently say about this research problem?

This chapter contains a review of a wide body of literature relevant to the research problem of the thesis. As stated in the introduction to this thesis, IS research is concerned not only with the technology itself, but with the effectiveness of information systems in practice. There is a sharp contrast between the objectives of IS in practice and those of IS research. In practice, IS is in a continual state of change and must keep up with the latest technology to support the business. In contrast IS research looks for constant themes and concepts that endure across the changing technology. In practice, organisations continually face the trade-off between IT processing power, human effort and different investment decisions in order to best meet organisational objectives and opportunities (Galliers 1991). Companies have not always been successful in managing the changing demands of IT from the self-contained business support units of the sixties to the distributed strategic business functions of the nineties (Selig 1991, Hasan & Cheung 1993). One task of the IS researcher is to analyse IS practice over time and provide insights that give practitioners a more stable basis on which to make decisions concerning their information systems.

The chapter is divided into three main sections. The first presents a comprehensive review of the EIS literature and has an IS focus, the second presents a selection of significant work from a broad range of non IS disciplines on issues concerned with the nature of information, information processing and managerial decision making in organisations. The third section draws on the literature discussed in the two previous

sections to present a cross-disciplinary model of the provision of information to management in organisations.

## 2.1 THE EIS LITERATURE

The field of IS has two prominent characteristics: it has emerged only recently (over the past 30 years) and it deals with a technology that is rapidly changing. Any review of the literature must therefore take into consideration the consequences of change and the historical context of any piece of research. The language of the field is also evolving as new terms are invented at will and only over time does their accepted meaning stabilise. In the context of the research problem of this thesis, the IS literature uses a variety of acronyms containing words such as *executive*, *management*, *decision*, *support*, *system* and more. (i.e. EIS, DSS, ESS, MSS, MDSS). However any attempt to define and use such a variety of terms would become unwieldy and the acronym EIS will be used, in a generic sense, to mean executive or enterprise information systems, in other words, systems which provide enterprise information to executives.

### 2.1.1 Defining EIS

The term EIS can be used to generally denote those information systems that support the work of senior managers. EIS will be used throughout this thesis to denote these types of systems even though it may not appear in some of the articles reviewed in this section. For example, Rockart and de Long (1988), in their seminal work in the area, suggest that the term executive support system (ESS) is more appropriate. Bannon (1999) prefers the term decision support system (DSS), extending the view that DSS includes MIS and EIS applications that *support* people in making choices about what actions to take in organisations. (see also Millet & Mawhinney 1992, Whymark 1991). However, of all the candidates, EIS is the mostly commonly used term in practice, varying in its meaning from a narrow range of IT products to its broad generic sense, i.e. any system providing information to executives.

This understanding of the notion of EIS is similar in nature to the definition of Leidner and Elam (1994) “a computer-based information system designed to provide senior managers access to information relevant to their management activities” although their insistence that an EIS must be computer-based, is problematic. Conceptually EIS can exist without IT and in fact did exist, in some form, before the computer era. However, the growth of IT has increased the need to formally design and manage such systems and, in most medium or large scale organisations, EIS would be highly inefficient without the use of computers.

EIS normally serve as the top-layer of a larger information systems infrastructure containing databases of information about particular domains. The EIS provides support for the manager to *drill-down* into the data and examine relationships between aspects of the data in interesting ways (Bannon 1999). The core of an EIS is status information about the organisation's performance (Leidner & Elam 1994) as an EIS integrates information from multiple sources across functional areas of an organisation. An EIS should be easy to use and should meet the need for high quality, easily accessible information (Leidner et al 1995). They differ in essence from knowledge-based systems (KBS) or expert systems (ES) in that EIS are designed to support the work of decision makers not replace them.

2.1.2 The History of EIS

Though the term EIS came later, forms of EIS have been the object of IS research since the late 1960s when it was recognised that a large amount of data was being collected by transaction processing systems (TPS) and that this data could be processed to provide useful management information. An historical view of such systems is seen in Table 2.1

Table 2.1 - An historical view of systems to provide information to managers					
Terminology	Management Information Systems (MIS)	Decision Support Systems (DSS)	Expert Systems (ES)	EIS / ESS	Knowledge Management (KM)
Year	'68+	'75+	'80+	'84+	'96+
Technology	reporting from TPS	modeling + database	Rule-based, using AI techniques	OLAP + GUI	Internet + data-warehouse

Management Information Systems (MIS) have been around since the late 1960s as reporting facilities of the operational TPS. In the 1970s it was envisaged that MIS would provide managers with all the internal information they required, automating the work of many middle managers. The inadequacy of formal information, provided by MIS, for senior managers, has been well documented by Minzberg (1989 p 73) and the predicted decline in role of middle managers did not occur. In the late 70s and early 80s DSS and ES were introduced and also touted as suitable systems to support senior managers. All three types of systems continue to be used but do not fulfil the role of supporting the work of senior managers. MIS mainly serves the supervisory, middle management levels of an organisation with reporting functions from the operational TPS. In contrast DSS and ES usually have a narrow scope, focussing on a particular issue such as a DSS for market forecasting or an ES for medical diagnosis. DSS provide a set of models (usually mathematical) together with databases and permit the user to manipulate the model and data to test the possible outcomes of alternative decisions. ES capture the knowledge of experts, often as a set of rules, and provided an engine by which the user can apply these rules to a specific problem. Neither DSS or ES integrate the broad spectrum of organisational information required by senior executives.

It was not until well into the 1980s that there was any real sign that a significant number of senior managers were actually gaining any direct benefit from computerised information systems. The target users of EIS are at the higher management levels of organisations. An EIS should provide current information on the progress of the organisation towards the attainment of its goals and indicate where the organisation stands in relation to its competitors and its environment both now and into the future. In contrast to DSS or ES, EIS usually have a broad focus and are designed to support work rather than replace the human manager.

The term EIS was first used in the 1980's by Rockart and Treacy (1982) and, a few years later Rockart and de Long (1988) argue, based on a number of case studies, that organisations were at last producing systems that met the information needs of (ie were being used by) senior management. They debunked the ideas of Minzberg, and others, who claimed that computerised information systems were quite unsuited to the work of senior managers who made such unstructured decisions and had such individual work styles. It could be argued that the anti-EIS camp were constrained by their experiences with inflexibility and *unfriendly* pre-80s technology, as well as the traditional IS development methods which viewed computerised information systems as the automation of work-practices at the operational level. With modern, flexible EIS the benefits of computer-based information systems become accessible to senior managers, even those with limited computer literacy skills.

EIS of the 80's were purpose-built, in-house projects mostly in large private organisations with well-defined products and bottom lines. They processed large amounts of performance data into a form that was useful to senior management. EIS became a buzzword among practitioners, software manufacturers, senior managers (and sometimes lower-level managers) who wanted to tap into their organisations data resources. Whymark (1991) describes a first wave of EIS as expensive, specially built systems, on large mainframes that drew data from various operational databases and produced comparative summaries on performance. (for example Armstrong D.A. 1990, Goldfarb 1990, Moynihan 1993, Murray 1992) Then a second wave of less expensive packages appeared, some PC based, which used multidimensional databases with Graphical User Interfaces to display production and sales data across several dimensions, such as product type, market location and time period. (Hasan et al 1997). These EIS suited the type of performance information of profit-oriented firms with clearly identified products and continue to be popular.

The traditional EIS literature, including the work of Rockart and De Long (1988), Thierauf (1991), Burkan (1991), Volonino and Watson(1992) and Barrow (1992)

describe EIS development as starting with the identification of an executive champion or sponsor and then determining the Critical Success Factors (CSF) and Key Performance Indicators (KPI), either of individuals or of the corporation, to establish the initial requirements of the EIS. A multi-disciplinary EIS team is set up and an evolutionary prototyping method is used to continue the development process.

### 2.1.3 EIS Research

Following their use in organisations, EIS became a topic of IS research, reports of which started to appear in the literature by the end of the 1980s. Most research has concentrated on the private sector, using short-term case studies (for example Whymark 1991, Suvachittanont et al. 1994, Barrow 1992) or empirical methods (for example Singh et al. 1994, Watson et al. 1991, Fitzgerald 1992, Watson et al 1992). Leidner and Elam (1994) also cite similar work saying that “initial research of EIS has consisted of descriptions of current implementation in organisations and empirical examinations of the important characteristics and purposes of EIS”. There have been many articles on EIS in the popular journals (Datamation, MIS, Computing Executive), mainly of EIS success and there have been some special issues of journals devoted to EIS (Journal of DSS Volume 8, 1992, Journal of Decision Systems Volume 3 1994). Several books have appeared (Burkan 1991, Paller & Laska 1989, Rockart & de Long 1988, Thierauf 1991, Watson et al 1992) and the International Journal of IS commissioned reports of surveys in the US by Watson, and in the UK by Fitzgerald, and published in their second issue of 1992.

This body of research has been useful from an IS practitioners point of view as it has uncovered collections of factors that appear to affect EIS success. One frequently mentioned factor is the use of an evolutionary prototyping methodology for EIS development (Guimares & Saraph 1991, Rainer et al 1992, Watson et al 1991, Wetherbe 1991). When this was first proposed, the use of prototyping was disparaged in the traditional IS community as producing *quick and dirty* computer programs that gave the developers a bad name. However there are now computerised development tools which

support a prototyping approach to development and produce high quality prototypes that can evolve into *real* systems. With an evolutionary prototyping development methodology, executive user involvement can be sustained throughout the life of an EIS project, ensuring that their changing information requirements can continue to be met.

Van Gigch and le Moigne (1990) found that an EIS needs to be a part of an efficient overall organisational information system with data that accurately reflects the current organisational status. Lederer and Mendelow (1988) discuss the need to anticipate the requirements of an EIS when building TPS as, only too often, executive information needs were only considered after the systems were in place.

A further discerning list of factors contributing to EIS success, published by Nandhakumar (1996), summarises the findings of a number of well-known researchers in the field. This list echoes the findings of the research background to this thesis (published in Hasan and Lampitsi 1995) and includes:

- the importance of an executive sponsor
- the availability of technical and other resources
- the establishment of links to business objectives
- the need to plan for development and spread
- the management of data problems and resistance

It is interesting to note that Nandhakumar's own research (*ibid*) involves "describing and analysing an in-depth study (in one organisation) to develop rich insights and specific implications". His argument for using this approach is similar to the one used in this thesis and is indicative of an important direction EIS research is taking in the late 1990s.

EIS research has also dealt with the effects and benefits of EIS. The literature on benefits of EIS, again mainly in the private sector, is well summarised by Suvachittanont et al. (1994). These benefits include improved decision making, improved communication, decreases in paper flow and easier access to information. Holthan and Murphy (1994) discuss the effect of EIS in flattening organisational structure, fulfilling the predictions in the 1970s that MIS would eliminate the need for

middle managers. Leidner and Elam (1994) conducted an empirical study in 23 companies of the impact of EIS on decision making with results showing that frequency and duration of EIS use increased problem identification speed, decision-making speed and the extent of analysis in decision making. Another less tangible outcome attributed to EIS in some reports is the way it improves the accuracy of the manager's mental model of the organisations (Rockhart & de Long 1988, Singh et al. 1994). Singh et al. (*ibid*) report that the thinking processes of senior executives are highly inferential and intuitive in nature and that they make decisions based their own internal cognitive representation of the world and their place in it. These aspect of EIS are highly relevant to the current research problem and will be discusses further in the second section of this chapter

The literature has also reported a high rate of failure with EIS. Crockett (1992) says that at least half of the EIS developed in the nineteen-eighties have not lived up to expectations and Murray (1992) claims a 70% failure rate world wide. There is some work published on general IS failure (Sauer 1993, Lyytinen & Hirshheim 1987) but this is of little relevance to the success or failure of EIS which are built to satisfy senior management and thus are rarely subject to the same cost-benefit analysis of other IT systems or have any evaluation criteria set in their systems specifications (Gould & Hasan 1994). Adelman and Donnell (1986) have defined three types of evaluation procedures for IS: objective measurement, expert observation and subjective judgement and it may be argued that subjective evaluation is the only way that the success of EIS can be judged. Indeed EIS are usually considered successful if they continue to be used (Leidner & Elam 1994), whether or not it has been established that they serve any useful purpose.

#### **2.1.4 Public Sector and Australian EIS**

There is a scarcity of literature on EIS in the public sector. Most of the EIS surveys already mentioned include responses from very few public companies and there are few public-sector case studies. The work of Mohan et al. (1990) is an exception but they

observed that advances in computerised systems, which provide performance information, have predominantly occurred in the private sector with far less progress in the public sector. Reflecting this trend, a report of a 1988 study by Kraemer et al. (1993) concludes that, despite the importance of Computer Based Information (CBI) for most public managers, there was little use of computers by the executives themselves. Access, analysis and reporting of CBI was left to intermediaries and, where this was the case, the managers' involvement with the information environment was relatively unchanged and had no specific impact on the organisation. The work by the author of this thesis (Hasan & Gould 1994a, Hasan & Lampitsi 1995, Hasan & Gould 1996, Hasan & Hasan 1997) on EIS in public sector organisations indicates that, while the public sector may lag the private sector in this area, it is rapidly catching up and by the late 1990s there is probably little difference between public and private sector EIS.

Other Australian literature on EIS should also be mentioned. The first and most often quoted Australian EIS case study is that of Whymark (1991). Pervan and his colleagues at Curtin University have conducted a number of surveys on EIS (Pervan 1992, Meneely & Pervan 1994, Pervan & Phua 1995) while Arnott and others at Monash University have published work in the area (Suvachittanont et al 1994, Shanks et al 1997, Shanks 1997) These publications indicate that Australian organisations, in both the private and public sectors are avid users of IT, and interest in EIS is high. Bartos (1995) for example states categorically that, "performance information is crucial to effective management in the Australian Public Service for two reasons: it helps people do a better job and it underpins the system of accountability".

### **2.1.5 EIS Research in the early 1990s**

By the early-1990s most of the groundwork in EIS research had been accomplished and the number of new significant articles, discussing factors related to EIS in organisations, was declining. EIS became part of mainstream IS demonstrated by the fact that it is now listed in topics for IS conferences, described in IS textbooks and, along with TPS, MIS, DSS and ES, EIS has become part of the curriculum taught to IS majors in

universities. As already mentioned, a number of factors necessary for EIS success have been identified and frameworks for EIS development were available (Watson et al 1992, Volonino & Watson 1992, Hasan & Gould 1996). It was generally agreed that EIS development follows a simple process that begins with the setting of organisational goals and is followed by the setting of key performance indicators (KPI), for achieving these goals, that become the basis of the data fed to the EIS.

This standard EIS approach works particularly well in those for-profit organisations, which sell clearly defined products and where the performance indicators are quantitative and easily identifiable. As more and more IT power becomes available at lower and lower cost, such organisations are planning bigger and better EIS. However EIS are also being designed for many other types of organisations which require accessible performance information to support managerial decision making. Such organisations could be smaller or not-for-profit and have much less obvious quantitative performance indicators. So EIS researchers are moving into different directions, some focussing on the technical problems of handling gigabyte of data across varieties of organisational TPS, while others addressing the softer and diverse issues of information support for managers in complex or non-traditional organisation.

For those focussing on the technical problems, the mid 1990's saw massive advances in EIS technology such that it has become feasible for organisations to built massive data-ware-houses, based on organisational data models, with an EIS front-end. Powerful online analytic processing (OLAP) systems have been developed to enable end-user access to organisational performance information stored in MDDB with *friendly* graphical user interfaces. While the slice and dice, and drill down capability of these systems enabled managers to view their data in a new light most interest was on the issues involved in developing the technology, on its performance in handing gigabytes of data and its ability to integrate with client-server arrangement. Most of this literature is in the form of *white papers* from OLAP vendors (Creeth & Pendse 1995, Gentia 1997)

on topics such as definitions of OLAP (Codd et al 1993, Kimball 1994,7), the merits of ROLAP and MOLAP (Hasan et al 1999) and on the concept of data mining.

While this recent, technically oriented literature is of only passing interest to the current research topic it would be incomplete not to mention it in this literature review, because to many IS practitioners this is the heart and soul of EIS. There is one issue here that has been addressed by the author of this thesis (see Hasan et al 1999, Dodds et al 1999) and that is the conceptual difference between information drawn from the relational data model underlying most TPS and information stored in the dimensional format of most EIS. The latter appears meaningful to managers but poses enormous difficulties for most IT professionals trained on the relational model. The concept of a data-warehouse raises awareness of the structural problem of organisational data, generated from business transaction, being stored and processed into meaningful information for management on their terms.

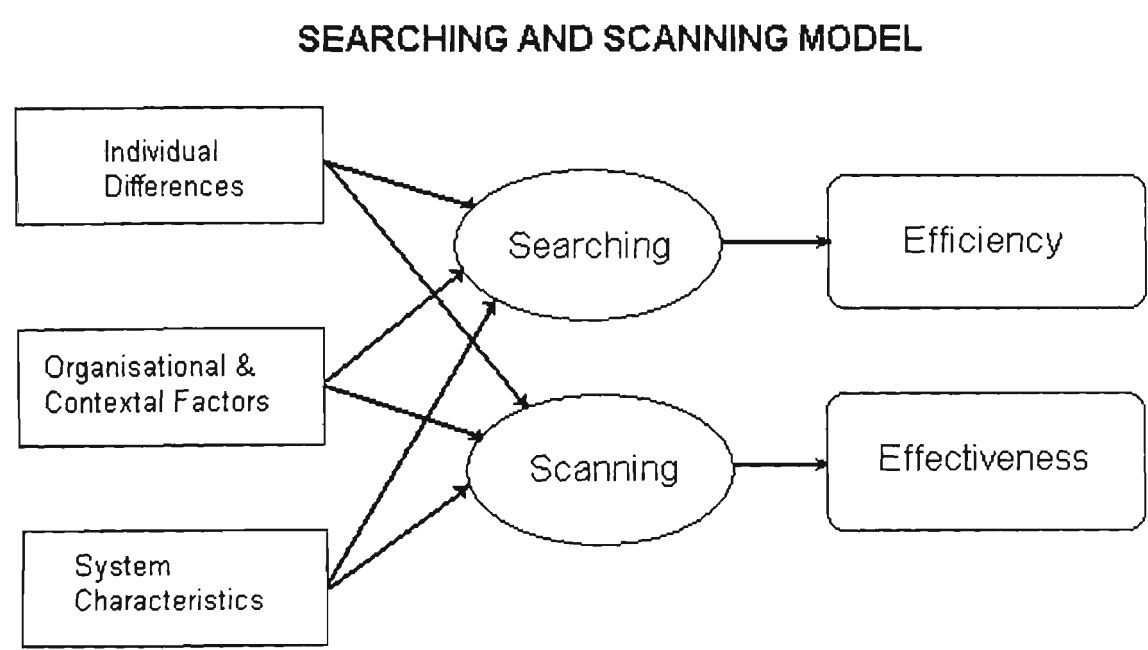
### **2.1.6 Recent Directions in EIS Research**

Leidner and Elam (1994) lamented that EIS research “has not extended beyond the descriptive phase to a theoretical based inquiry into the effect such systems can have when used by senior managers.” Since the mid 1990s EIS research has produced only a few significant articles addressing the complex issues of human and organisational issues of EIS. Leidner’s recent interest in knowledge management systems (Alvari & Leidner 1999) is an interesting development in this direction.

In his editorial to the Special Issue on EIS of the Journal of Decision Systems Courbon (1994) observes that technical aspects of EIS building are no longer an issue but it is the link between EIS and an executive's decision process which is most controversial. He also talks of the “decmocratisation” process of EIS, which were once the sole province of executive but are becoming Enterprise (or Everybody's) IS

Vandenbosch and Huff (1997) interviewed 26 executives to determine how EIS are actually used by executives. They discovered that there were two modes of use: 1)

focussed searching for specific information and 2) general browsing or scanning. Their paper is based on a model (see Figure 2.1) which looks at three factors (individual differences, organisational context and system characteristics) that influence which of the modes a particular executive will use. They concluded that while focussed searching improves efficiency, scanning improves both efficiency and effectiveness of organisational performance.



**Figure 2.1** How executives obtain information (Vandenbosch & Huff 1997)

Grimshaw et al, (1997) have studied role of context in decision-making on the design of databases. They observe that although the idea of information as a corporate resource is not new, the implications of sharing data are only just “dawning on the corporate mind”. They claim that context acts as a filter between the user (decision maker) and the database and have investigated ways to mediate the interaction of the user with the database in such a way as to accommodate this difference in context.

Levitin and Redman (1998) have produced a thought provoking summary of the issues concerned with the way managers think about and manage data as a corporate resource.

They say that data not only support managerial and professional work but that data implicitly define common terms, such as *customer*, and so contribute to organisational culture. They define concepts associated with the terms *data* and *resource*, concluding that, “unless the data resource is developed as an enterprise-wide resource, no technological wizardry will guarantee efficient access to the organisation’s data”.

Shank’s work on strategic data planning (Shanks 1997) echoes this theme and laments that the inability to respond to cross-functional questions limits an organisation’s potential to respond to business problems and take advantage of opportunities. His study focussed on the interactions of systems development professionals undertaking in strategic data planning within the social and organisational context of the organisation. The results of his study showed the benefits of incremental development to the success of EIS as it encourages the growth of a mutual understanding between stakeholders and enables a balance between short-term and long-term goals thereby sustaining management support.

Leidner et al (1995) looked at the perceived impact of EIS and at the way cultural factors impact on why and how EIS are used. Their study of EIS gives unique insights into how senior managers use information and IT in decision making. Their findings confirm the notion that “IT is used by executives to reinforce the decision-making behaviours valued in their culture”. They report that EIS have been seen to enable executives to focus more on analysis rather than accuracy of data. Executives perceive that EIS contribute to faster decision-making and action, more comprehensive analysis of a problem, greater confidence in solutions and a more complete mental model.

From an empirical study of 23 companies Leidner and Elam (1994) observed that there is an obvious relationship between continuation of use and the perceived impact of the system, a consequence of the fact that executives are discretionary users of the system. In the conclusion to this paper the authors suggest that future research should consider “more decision-making variables” to determine whether the “impact observed in this study actually lead to better or more effective decision making”. It appears that they

have not yet conducted studies of the wider issue of the contribution of information systems to the quality of managerial decision-making.

While the empirical approach has merit it is limited when dealing with issues of quality and that EIS research has reached a stage where in-depth, interpretive studies of single organisations can contribute richer understanding. The Nandhakumar study (1996) reported above and previous research by the author of this thesis, are examples of this.

## 2.2 INFORMATION AND STRATEGIC DECISION MAKING IN ORGANSIATIONS

Table 2.2 Disciplines relevant to the human and organisational aspects of EIS	
Discipline	Relationship to aspects of EIS
Human-Computer Interaction	Users: computer literacy and style of managers
Management Sciences	Context: political and economic factors
Organisational Behaviour	Motives: Lack of IT staff understanding of business needs conflict of motives, data ownership
Accountancy	Data Quality
Decision Sciences	Aspects of decisions
Cognitive Psychology / Science	Mental processes of individuals
Anthropology	Organisational behaviour, Managing Dynamics and Change
Human Resources	Knowledge Management, Business Intelligence?
Philosophy	Theoretical Basis
Information Science	The management of information
Sociology / CSCW	Organisations and Group work

As has already been stated, IS research is in essence multi-disciplinary and EIS research appears to have reached a point where the contribution from other disciplines or field of study is warranted. Table 2.2 summarises some of these and the following section discusses literature from these areas that have impacted on my work. The topics of particular interest are related to questions such as: what is information, how is it used when making decisions, how are decisions made in organisations and how can the process of management be improved through the use of information systems?

Bannon (1999) describes information as not merely an intellectual commodity but a political resource whose redistribution throughout an organisation, via new information systems, affects the interests of all its members. Broadbent et al (1992) observed that the process of management is becoming more information intensive and that

organisations are not only having to make changes to their Information Systems (IS) in order to meet the information requirements of managers at all levels but also to better understand the organisational consequences of these changes. Researchers must now study a wide range of issues: not only the production of information but also the context in which the information is produced and the political nature of the information. They must study not only the presentation of the information on the manager's computer screen but also the nature of information itself, the mental process of those using information to gain an understanding of complex situations and the relationship of that understanding to processes of managerial work.

Selected literature from the disciplines listed in Table 2.2 will be discussed in this section of the chapter and used to provide an understanding of these issues. However before proceeding it should be noted that the word strategic has been introduced into the title of this section and will be used in the discussion. This word is used in at least two senses in IS. In many cases a strategic information system is one, usually an operational TPS, that gives an enterprise a strategic advantage. EIS on the other hand are systems, which support the organisations at the strategic, or top, managerial level of the organisation where strategic decisions are made. It is in this second sense that the word strategic is used throughout this thesis. Some further discussion of what this means is included below where appropriate.

### 2.2.1 Data, Information or Knowledge?

Traditionally IS research has paid considerably more attention to the concept of *system* than to the concept of *information* and the majority of so-called information systems are TPS which automate work practices rather than produce real information. Zuboff (1988) makes a useful distinction between computerised systems which *automate* as opposed to those which *informate*. IT was first introduced into the operation levels of organisations, which required systems which *automate*. In contrast EIS are systems which *informate* and have arrived later on the IS scene, after the concept of IS as *systems which automate*, had become firmly entrenched. The growth of EIS is

compelling IS researchers to reevaluate the importance of information. In the words of Boland (1987) “the problem that has plagued IS research from the beginning ..... is the elusive nature of information itself, and the way we as researchers have failed to address the essence of information in our work”. To further research on EIS there is a need to better understand the concept of information, as well as those of data and knowledge, with which the concept of information is often confused.

There has recently been a resurgence of debate in the IS community on the IS distinction between data, information and knowledge (see for example Myers ISWORLD 1998). The discussants in this debate agreed that data are the raw facts, events and figures, in fact, the carriers of information and knowledge. There are several definitions of information but most implied that information is data, which has been sufficiently processed as to be immediately useful and thus is relative to its use. There was even the suggestion that, in common usage, information is simply the output of a computer.

Introna (1997) defines data as things that we know (we have in mind, have learnt or can recall, but are relatively unimportant) where as information is things that we know and are of importance or noteworthy. He then suggests that we need an answer to the question “What does it mean to know?” before we can adequately understand a system that is for, or about, information.

In IS parlance data are facts usually entered into a database, via a TPS, and stored for later use by other TPS. There are processes in place to ensure its quality and integrity, and to ensure the smooth running of the business, for example fulfilling customer orders, dealing with suppliers and paying employees. When this same data is manipulated and summarised for reports to management, there is interest in quality aspects of the data, such as those shown in Table 2.3, extending beyond the simple correctness of the facts.

Table 2.3 Data Quality Aspects taken from Collier & Dixon (1995)			
Timeliness	Content	Format	Visibility
Currency	Accuracy	Medium	Feedback
Response Time	Relevance	Order	Motivation
Frequency of Reporting	Completeness	Design	
	Conciseness		

Just as the meaningfulness of information can vary depending on when, where and how it is presented, its richness varies with the communication channel. Traditional information channels are compared in the list of Table 2.4 and there is debate as to where electronic forms of communication such as email and video conferencing fit in this hierarchy.

Table 2.4 Channels of Information Browne (1993)	
Information Channel	Information Richness
Face to face	Highest
Telephone	High
Written Informal	Moderate
Written Formal	Low
Numeric Formal	Lowest

Table 2.5 contains a comprehensive list of characteristics of information and shows how each characteristic varies with the level of organisational decision making at which it is used, using the categories of Anthony (McCosh & Scott Morton 1978) which are discussed in Section 2.2.2 of this chapter.

Table 2.5 Information Characteristics by Anthony's decision category (McCosh & Scott Morton 1978)		
Characteristic of Information	Operational Control - Management Control - Strategic Planning	
Source	Largely internal	External ?
Scope	Well defined, narrow	Very wide
Level of aggregation	Detailed	Aggregated ?
Time horizon	Historical	Future
Currency of database	Highly current	Quite old ?
Units	Largely others	Costs and other ?
Required accuracy	High	Low ?
Frequency of occurrence of information change	High	Low ?
Frequency of use of information	Very frequent	Infrequent ?

In IS textbooks the concept of knowledge sits above that of information in much the same way that information supercedes data. Nass (1994) for example suggests that

knowledge involves “the possession of ready-made information”. In the ISWORLD debate mentioned above, knowledge was defined in a number of ways such as, “information which has been internalised and results in enhanced operations”, “the application of a combination of instincts, ideas, rules and procedures that guide actions and decisions” and “that which normally causes some change in your internal *mental map* of the external world”. The claim was also made in the discussion that the field of IS should no longer be concerned with data processing or information processing but *knowledge management*. Other participants in the debate were concerned that *knowledge management* is just another buzz word that adds nothing new to the field and that data processing, information systems and knowledge management are just reinventions of the same concept with more sophisticated technology.

Nonaka’s seminal paper on organisational knowledge creation (Nonaka 1994) is a milestone in this area and is cited by most subsequent publications on knowledge management. While traditional organisational theory conceptualises an organisation as a system that *processes information* and *solves problems*, he talks of a *knowledge society*, stating that “while new knowledge is developed by individuals, organisations play a critical role in articulating and amplifying that knowledge”. Nonaka asserts that innovation and strategy making depend not only on the ability to process information but, more importantly, on the ability to define problems and then actively develops new knowledge to solve them. He goes on to describe how new knowledge is created through “a continuous dialogue between tacit and explicit knowledge”.

Blackler (1993) throws out an interesting challenge to conventional rational-cognitive assumptions about management and organisations citing recent developments in the theory of knowing from sources in sociology and organisational behaviour. He emphasises the importance of *knowledge workers* and describes how specialised knowledge has become an essential ingredient for business success. Blackler reframes management by revealing the active nature of knowledge, highlighting the “opportunities for individual and collective development that engagement and dilemma

can provide”. His framework integrates matters of central concern to management: expertise, co-operation, technology, planning and learning and observes that, in the context of organisations, knowledge is both individual and collective.

On the individual side, cognitive research shows that people use map-like structure to make sense of information (Fiol 1992) and cognition can be defined as the activity of knowing, that is the acquisition, organisation and use of knowledge (Neisser 1976). Introna (1997) uses the term “the always involved manager” to describe how the manager makes sense of the world (information) and acts in ways that make sense of the situation (management). Norman (1991) states that managers have working mental models of their organisation and Fiol (1992) argues that the broad strategic concerns of managers require a portfolio of different kinds of cognitive maps which are used as a decision aid. She contends that the interaction among these maps is important, as is the recognition that many of these maps are in the form of ingrained, and taken-for-granted, assumptions. Wagner (1995) observes that decision makers in organisations continually face *messy*, wide-and-open, non-quantitative problems and proposes techniques that rely on the human problem solver to “make sense” of the problem in a structured way.

On the collective side, a concept, used by Kuutti and Virkkunen (1995), Randall et al (1996) and others, is the term *organisational memory*, a metaphor relating to the collective memories of an organisation’s members. The need for *organisational memory* may be a consequence of restructuring and downsizing when organisations discover that much of the organisation’s *knowledge* leaves with sacked or released employees. Kuutti and Virkkunen (1995) propose that there should be methods and systems, which can capture this *knowledge* and make it available to new members of the organisation.

The implication of these concepts for EIS is that they should provide information that enhances the accuracy of managers *mental maps*, support the solution of *messy* problems and captures organisational memory. It should be relevant to the management styles of real people in the roles they play and the activities in which they engage (Hasan

1999). Tricker (1992) suggests that the notion of organisational knowledge and its management could be useful as an alternative conceptual framework for information system developments and that such a system facilitate an understanding of the issues, threats and opportunities without being oriented towards specific decisions.

### 2.2.2 Information Processors

The concept of information processing has been synonymous with computers since the early 1960s. The seminal work of Newell and Simon (1972) presented a general and abstract theory of the human as “a processor of information” adding new meaning to the “long established and highly general notions of information and processing” (p5). Their theory emerged from a broad consideration of an historical and cultural view of the human systems along dimensions of task, development and individual difference. Simon and Newell were concerned with “integrated activities that constitute problem solving in intelligent adults” and aimed to introduce a suitable abstract information processing system to describe how humans process task-oriented symbolic information. They then claimed that their model could be used “to represent, in some detail, a particular man at work on a particular task”.

The laboratory experiments on which the model was based involved observations of people solving a narrow range of problems, including games and algebra-like puzzles. While the model has gained acceptance for structured problem solving in control environments it is difficult to justify the model for the messy, unstructured world of senior managers. In their rational approach to human problem-solving activity, Newell and Simon make an analogy between the human and the computer as instances of information processors. Logical consequences of this analogy are, on the one hand, to attribute *artificial* intelligence to computers and, on the other, to ignore those aspects of human activity, that do not fit the rational model. However this view of humans and computers` as similar information processors has found acceptance in cognitive psychology and is the basis for a whole field of study in cognitive science.

A convenient summary of the rational approach to management, decision-making and information is provided by Introna (1997 p6) in the following steps:

- making decisions is what managers do
- decisions are directed towards objectives
- decisions need and define facts
- information consists of facts that describe the current state of affairs
- computers are very efficient at making decision, applying facts to rules
- the task of decision-making is best divided between the manager and the computer, with the computer being preferred
- the human and the computer are both essentially computing systems for rational decision-making

With the advent of the personal computer in the 70s and 80s, computer technology moved from the confines of the IT department to the general population. This exposed the *unfriendly* design of computer interfaces, previously only used by technical experts, to non-technical novices. The field of Human-Computer Interaction (HCI) emerged in response to this problem, attracting researchers from ergonomics (human factors), cognitive psychology and computer science. HCI research is concerned with the interface between the user and the machine and has traditionally relied on the information processing model of cognitive science. This approach has made considerable progress for example the currently popular windows, direct-manipulation interfaces are the result of HCI research carried out at Xerox Parc (Smith et al 1982). However the HCI model of people using computers as an equal partnership between two information processors, is often inappropriate in particular the use of computers by senior executives (Gould 1998).

In the early 1990s, a group of prominent HCI researchers, realising the limitation of the information processing model for the users of modern computer systems, have proposed alternatives, and have published these in a volume resulting from a think-tank on the issue in 1991 (Carroll 1991). Norman (1991) uses the term “cognitive artefact” to

describe a computer system and suggests that the real *interface* of interest is that between the artefact and the task. Carroll et al (1991) likewise propose a dynamic “task-artefact cycle” that serves the needs of the human user. These researchers imply that EIS research should focus, not on EIS as a computer system with which executives interact, but rather on the tasks performed by the executive, and how these tasks could be supported by an EIS. The roles, tasks and activities performed by executive will be discussed in the next section of this chapter.

Another approach to the study of information processing is to analyse it in terms of various factors or dimensions. The remainder of this section describes studies that look individual differences, the effect of experience and the balance between individual and organisational information processing.

As shown in Table 2.6 McKenney and Keen (1974) observe that there are two phases to information processing: information gathering and information processing. Their two categories of information gatherers are: *perceptive* individuals, who filter information and look for relationships between items, and *receptive* individuals, who tend to focus on detail. On the information evaluation dimension, there are: *systematic* individuals who impose structure and method on a problem and *intuitive* individuals who are more likely to use trial and error methods. The 2 x 2 combinations of these characteristics are possible among managers and should be taken into consideration in the design of an EIS. This emphasises the variability in the ways in which people process information as opposed to the more rigid constrains of technical information processing systems.

Table 2.6 The 2 x 2 matrix of Cognitive Styles of Information Processing McKenney and Keen (1974)		
Information Gathering:	Perceptive	Receptive
Information Evaluation:	Systematic	Intuitive

Nass (1994) studied four aspects of information processing performance that could cause problems for administrators:

- Need for breadth of information

- Need for depth of information
- Receiving more information than needed
- Receiving less information than needed

This author then looks at information-processing performance of administrators, comparing the effects of skills (information processing abilities gained from learning by doing) and knowledge (the relatively formal and established facts, rules, policies and procedures within an organisation). His work challenges the established belief that skills are more than knowledge in predicting how experience affects administrator's information-processing performance.

Corner et al (1994) describe a parallel process model of strategic decision making that integrates individual and organisational level information processing perspectives. They cite empirical evidence for a stages concept for individual decision making as follows:

- Paying attention to information about a choice situation
- Encoding or Assigning a meaning to the information (often referred to as interpretation or sense-making)
- Storing the encoded information
- Retrieving the information when face with a choice
- Making the choice and achieving outcomes

These authors make the claim that decision-making at the organisational level exhibits the same structure as at the individual level so that they can be combined into the parallel process model where an implicit shared consensus underlies individual decisions which take place within the context of the organisational level. They maintain that the model:

- provides a framework for identifying biases that affect strategic decisions,
- increases the understanding of decision-making activities by explicit recognition of the dual level influences on them and

- by viewing strategic decision-making as a “very complex, multilevel process of sense-making” important influences are identified that might otherwise be missed.

2.2.3 Management Roles and Activities

Despite the recognition that senior managers have very individual styles, Mintzberg's roles (Mintzberg 1973), listed in Table 2.7, have influenced much of the research on managerial work and are taught to students of management world-wide. The criticism sometimes leveled at Mintzberg is that he based his conclusions on a study of only five senior executives but his results are authoritative, I believe, because these were real executives, studied in context and because of Mintzberg’s skills as observer, analyser and interpreter. It is interesting to note that two of the column headings in Table 2.7 are *Informational Roles* and *Decisional Roles*, indicating the importance of information related activity in the management process in the seven key areas in those columns.

Table 2.7 Management Roles Mintzberg (1989)		
Interpersonal	Informational	Decisional
Figurehead	Monitor	Entrepreneur
Leader	Disseminator	Disturbance Handler
Liaison	Spokesperson	Resource Allocator
		Negotiator

A more descriptive look at what managers are, and do, was published by Mintzberg under the heading “Some Folklore and Facts about Managerial Work”. A summary is shown in Table 2.8.

Table 2.8 Managers’ Jobs: Fact and Folklore (Mintzberg 1973)	
Folklore	Fact
The Manager is a reflective planner	Managers work at an unrelenting pace. Their activities are characterised by brevity variety and discontinuity, strongly oriented to action.
The effective manager has no regular duties to perform	In addition to handling exceptions managerial work involves performing a number of regular duties including ritual and ceremony, negotiations and processing soft information
Senior managers need aggregated information, which a formal MIS best provides.	Managers strongly favour verbal media
Management is, or at least is quickly becoming, a science and a profession	The manager’s programs - to schedule time, process information, make decisions and so on, remain locked deep inside their brains

Another well known set of categories of managerial activities are those of Anthony listed in Table 2.9. Anthony see these as a continuum rather than fixed categories and does not see a relationship between the three categories and the traditional three levels of management, but believes rather that managers at all level can take part in each of the activities to varying degrees.

Table 2.9 Anthoy's 3 categories of managerial activities (ref McCosh & Scott-Morton 1978)	
Strategic planning	Deciding on objectives for the organisation and on the resources to be used in meeting these objectives
Management Control	The process by which managers assure that resources are obtained and used effectively and efficiently in the attainment of objectives
Operational Control	The Process of assuring that specific tasks are carried out

Fidler and Rogerson (1996) have published a summary of a number of views of what managers do, categorised as activity, people or role oriented. These are summarised in Table 2.10, together with definitions and references.

Table 2.10 Approaches to Management (Fidler and Rogerson 1996 p 20).		
View	Definition	References
Activity-Oriented	Management is the direction of the enterprise through the planning, organising, ordinating and controlling of its human and material resources towards the achievement of pre-determined corporate objectives	Fayol (1916), Drucker (1961), Brech (1963), Timms (1967), Murdick & Munson (1986) Lucey (1991), Armstrong (1992)
People-oriented	Management is a body of executives collectively responsible for the effective running of an enterprise.	Anthony (1965) as above
Role-Oriented	Any management activity may involve a person adopting one or more roles depending on the requirements of the management position that is held and individual styles and motives	Minzberg (1973) as above

### 2.2.4 Managerial Decision Making

It appears that there is a wide variety of things that managers do, but the concern here is for those activities or roles that they do with the support of information and information systems. Nass (1994) claims that the primary function of an administrator is to produce and distribute information and administrative activity is the driving engine of the “information economy” and “information society”. However the common perception is that managers require information to make informed decisions. Both Minzberg, a

management researcher, and Leidner (Leidner & Elam 1994), an EIS researcher, define a manager as a decision maker. More probably, what managers do involves a complex set of decisions.

This inevitably raises the question of “What is a decision?” A decision has variously been defined as: an answer to a question, a choice between alternatives, a solution to a problem, a commitment to action, the end point of a series of actions which are primarily of a cognitive nature. Should we distinguish between the decision itself and the decision process?

Together with his information-processing model, described in a previous section of this chapter, Simon’s work on rational decision-making has been used as a basis for most research on the topic. His three phases of decision-making is shown in Table 2.11 together with the subsequent terminology introduced by McCosh and Scott-Morton (1978).

Table 2.11 the 3 Phases of the decision-making processing	
Simon’s Phases - (Newell & Simon 1972)	McCosh & Scott-Morton (1978)
Searching the environment for conditions calling for decision	Intelligence
Inventing, developing and analysing possible courses of action	Design
Selecting particular course of action from those available	Choice

Simon distinguished between decisions which are “programmed” and those, which are “unprogrammed”. The terms structured and unstructured are now more widely used for these concepts following the work of McCosh and Scott Morton (1978). Structures decisions are those that are repetitive and routine to the extent that a definite procedure has been worked out for handling them so that they do not have to be treated as new ones each time they occur. Decisions are unstructured to the extent that they are novel and that there is no cut-and-dried method for handling them. (McCosh & Scott Morton 1978 quoting Simon) A fully structured problem is one in which all three phases are structured and it is here that Simon’s approach is most appropriate.

Bannon (1999) observes that much of the work in the DSS area has tended to rely on the conception of individual problem-solving and decision making heavily influenced by

ideas from cognitive psychology, especially the work of Herbert Simon in collaboration with James March and Allen Newell. In this approach people are viewed as information processing mechanisms and decisions are made by people making rational choices between differently weighted alternatives. Bannon describes practitioners who claim that their experience does not fit with the models and expectation of researchers. Decisions simply get made in organisations due to a variety of reasons that are poorly accommodated within the standard model of ratiocinative behaviour.

Newell and Simon (1972) admitted that in our Western culture, the supposedly ideal decision is a rational one, but, in reality, a decision is rarely entirely rational, that is, where all alternatives are discovered and evaluated and the best alternative chose. Instead, each manger's perceptions are coloured by experience, values and motives. In particular the work of strategic decision-makers has always been inherently complex and "unstructured" (Mintzberg 1989), but more so today than ever, as the political, economic and social climate is constantly changing.

In subsequent work Simon did develop the concept of "bounded rationality" to account for the fact that human decision-makers could not always be modeled as having perfect information or utilising optimal strategies. Browne (1993 p22) summarises Simon's descriptions of non-routine decisions as those where:

- not all alternatives are know, not all the consequences are known and goals are constantly changing,
- problems are so complex that only a limited number of aspects of each problem can be attended to at any one time,
- maximising of outcomes (as in the rational approach) is replace by satisficing of outcomes (good enough)
- the discovery of one suitable solution is enough to stop the search for others,
- organisations may have 2<sup>nd</sup> or 3<sup>rd</sup> alternatives that may be implemented if feedback indicates that the 1<sup>st</sup> choice is not producing a desirable outcome.

Both Mintzberg and Simon agree that effectiveness in management depends ultimately on the coupling of analytic and intuitive processes (Mintzberg 1989 p 61). There is a place for analytical decision-making but most top level decision-making is done under pressure where dynamic factors call for quick intuitive decisions. While intuition is considered a critical factor in the work of senior managers it is a *soft* topic and a difficult object of scientific research. Mintzberg (*ibid* p 43-55) talks at considerable length about the role of intuition in management under the descriptive title “Planning on the left side, managing on the right” and claiming a neuro-physiological (ie scientific) explanation for intuition.

Mintzberg’s argument draws on biological evidence that the left side of brain appears to be the site where linear information is processed sequentially (language being an example). The right side of the brain appears to specialise in simultaneous processing in a holistic, relational way and is hence dominant in creative artists. He cite a number of pieces of convincing evidence such as the fact that we are sometime surprised by the obvious, that is when what we intuitively *know* (right brain) is articulated (left brain). He also describes the *dilemma of delegation* where managers are well-informed but do not communicate well so that it is easier to “do the job themselves” than explain the problem to a subordinate.

The difference between the hemispheres of the brain is likened to a number of fascinating dichotomies: explicit/implicit, spatial/verbal (related to male/female), argument/experience, intellectual/intuitive, analytic/gestalt, lightness/darkness, western psychology (logical, rational, scientific) / eastern (mystical) psychology and perhaps positivist/qualitative research epistemology. In particular Mintzberg contrasts formal (left brain planning) with the informal (right brain) management styles of senior managers. He reports that effective managers have more right-brain dominance, reveling in ambiguity, using complex mysterious systems with little order, synthesising rather than analysing and favouring oral communication, where the manager can get a holistic message from the gestures and expressions of the informer. However truly great

managers can couple the effective processes of the right (hunch, intuition and synthesis) with effective (and efficient) processes of the left (articulateness, logic and analysis)

Mintzberg's belief is that strategy making is a right brain activity and that the phrase "strategic planning" is an anachronism. In this context he argues that strategy is complex and holistic, representing the mediating forces between a dynamic environment and a stable operating system. Of the two steps in strategic decision making, diagnosis of the decision situation and design of custom-made solution, he describes the former as crucial and yet he observes that very little is written about diagnosis. Mintzberg (1989 p56) contends that computers are rational information processors and therefore inherently unsuited to the work of strategic managers. He uses the older term MIS in this context and appears to take a view of computers as systems, which automate rather than informate. It would be interesting to have his opinion on the new wave of highly interactive and flexible EIS. His criticism of the "rule of the tool" is however a valid one where many IT systems are concerned. Often the computerised information system holds centre-stage rather than take its place as a support for a manager's real tasks.

Another view of the managerial decision making process comes from Harrison and Pelletier (1995) who describe a cycle which commences with the setting of an objective and culminates when the objective is attained and a new objective initiates a new cycle. These authors claim that only a few really strategic decisions are made and are rarely the work of one individual but the product of the top management team. For them truly strategic decision are characterised by novelty, complexity and open-endedness and are only made after a long, groping, recursive process with lots of different steps and a host of dynamic factors.

More politically aware models of organisational decision-making have been proposed, one of the best known of these being the garbage can model. (Cohen and March 1974, in Browne 1993 p 36). In this case the process and choice opportunities in an organisation are seen as being located in a large garbage can into which various problems and solutions have been dumped by participants. Choice opportunities are defined as

occasions on which an organisation is expected to produce a decision. In the garbage can situation a decision is an outcome (or an interpretation) of several relatively independent streams within an organisation such as problems, solutions, participants and choice opportunities. Cohen and March claim that this model is particularly appropriate to universities, as these institutions are greatly affected by ambiguity of goals and lack of clarity in educational technology and transient nature of participants in decision groups. The model has some supporters who believe that the model is useful for understanding the process and can make participants aware of the evolution of problems, the effects of changes in the participants and the environment and the time phasing of changes. Other writers however criticise the model for its lack of applicability to bureaucracies and its vagueness.

### 2.2.5 Information and other Support Systems for Managers

In the previous section it was recognised that decision making one of the most important roles of executives and the availability of reliable information sources is a key component of executive decision making (Leidner & Elam 1994). Minzberg (1973 p58) describes the manager as an input-output system in which authority and status give rise to inter-personal relationships that lead to inputs (information) and these in turn lead to outputs (information and decisions). In section 2.2.2 it was seen that information has the capability of enhancing the manager's mental model of the state of the organisation. A good *information system* should make that model as close to the real world as possible but little research has been done in that area.

According to Kaye (1995) making good strategic decisions requires an understanding of the internal workings of the business and its ability to respond to its environment. Wrapp (1995 p42) contends that a good manager has a special talent for keeping himself informed about a wide range of operating decisions being made at different levels in the company, develops a network of information sources and seeks more than one version of a situation. This author also observes that top level managers are frequently criticised for continuing to enmesh themselves in operating problems rather than withdraw to the

*big picture* and that they insist on making too many decisions. He warns however that the manager also needs to avoid the sterility often found in those who isolate themselves from operations and then find themselves subsisting on a diet of abstractions. He is concerned that “the purpose of the hierarchy is to prevent information from reaching higher layers”.

Table 2.12 summarises Minzberg’s work on the use of information by managers and exposes some home truths. However he has always claimed that computerised systems are not able to fulfil the information needs of senior managers and there is little advice here that is of direct use in creating a suitable information system.

Table 2.12 Use of information by managers (Minzberg 1989)	
1-4 Inadequacies of formal IS	
1. Formal information is often too limited	Not sufficiently rich, precludes much that is non-quantitative and non-communicable
2 Formal information, by aggregating data,	Is often too general for the manager
3 Much formal information is too late	It takes time for events to become facts
4 Some formal information is unreliable	Some statistical information lacks meaning
5-7 Functioning Problems in organisations	
5 Rigid, dysfunctional objectives	can encourage the use of inappropriate information
6 Politics	can cause distortion of information
7.The nature of managerial work	introduces a bias in favour of oral channels of information at the expense of documented sources
8-10 Limitation of the human brain	
8. Cognitive Limitations	Restrict the amount of information that people consider in a complex decision process
9 Experience	The brain systematically filters information in line with its established patterns of experience
10.Psychological failures	impede the brain’s openness to information

Nass (1994) notes that a great deal of attention has been paid to ways in which organisations can actively change the efficiency of information tasks. These include focussing on IT, as well as making changes to organisational structure and culture, often undertaken in the name of Business Process Re-Engineering. There is however little evidence of the success of these activities or of their influence on the effectiveness of the information systems.

Todd and Benbasat (1991) sought to explain decision-making behaviour, when assisted by a computerised DSS, by the use of the cognitive effort model of decision-making.

Their empirical studies of preferential choice indicate that decision-makers are highly adaptive in selecting strategies for decision-making. Their results show that there is a trade-off between accuracy and effort in decision making, with implications for the designers of systems that support decision making. Bannon's work (1999) in the area of computer-support cooperative work (CSCW) also reports the need for flexible systems for managers that support work rather than just provide information for decision making. He questions whether decision is the most appropriate concept to focus on when talking of support and whether academic notions such as problem, information, decision, plan, representation and goal, bear much relation to the everyday mundane realities of how people think and act in the world. With regard to the use of information by managers he remarks that most work activity involves sense-making, interpretation and on occasions decision-making.

Browne's dissertation, "Organisational Decision Making and Information" (Browne 1993), deals with a research problem very similar to that of this thesis but approaches it from the decision-making side. She agrees that not much work has been done by researchers encompassing both participants, the organisational decision-maker and the information providers. Her research approach, like mine, has been to focus in-depth on one organisation although using a methodology based on questions arising from a comparison of decision science models.

On completion of her study Browne concludes that managers are not conscious of their own decision-making and information. They can manage on a day-to-day basis without reflecting too deeply on how they make decision or collect information, much to the chagrin of management theorists. Browne reports divergent views on the importance of information between decision-makers and those they employ to provide information to them. From insights gained through her dissertation she aims in the book to appeal to both managers and IS people and provide a basis for the necessary shared understanding between managers and information providers so that the information resources of the organisation can be effectively harnessed to support decision making activities. From

my perspective she concentrated too much on the provision of information and IS support for the decision-making process of specific problems and not on the management of the high-level information systems to support the work of strategic management. She does however conclude (p222) with a very rich, descriptive list of specifications for an information system to support high-level decision makers in terms of processes and outputs but admits that this falls far short of specifications that could be handed to the IT department to implement. Her specification list does have considerable merit and relevance for EIS development and is reproduced in Appendix 1 of this thesis. However there remains a gap between her (management decision-making) research culture and that of IS, as she ignore issues, normally of concern to IS researchers, such as data quality, data ownership, integration across organisational systems and communication difficulties between IT, management and users (Hasan & Gould 1995, Hasan & Lampitsi 1995).

This raises two issues that are often mentioned, but rarely studied in detail: the political nature of information and the context in which it is produced and used. It is my contention that there is no point in studying the complex nature of information support for managers unless it is done in context. As Bannon (1999) observes, different groups, professions and subcultures embody different perspectives and communicate in different jargon. It is imperative to allow for these difference in EIS projects a shared databases do not guarantee shared interpretations of the data but actors must locally and severally, jointly construct shared meaning of the data. Bannon states that too often an assumption is made that information is a neutral concept whereas in truth most information is subject to strategic misrepresentation or unconscious bias. Browne (1993) also states that it is impossible to deal with the biases and distortion of information unless the context is known. Mintzberg (1989 p64) goes further in discussion individual and cultural differences with respect to information, stating that facts become impregnated with value when they consistently line up behind a single set of goals implying that the use of information for decision making is not a one-way process but that the

consequences of decisions, based on organisational knowledge, in turn influence and distort that organisational knowledge.

## **2.3 A MODEL OF INFORMATION PROVISION FOR MANAGERIAL DECISION MAKING FROM THE EXISTING LITERATURE**

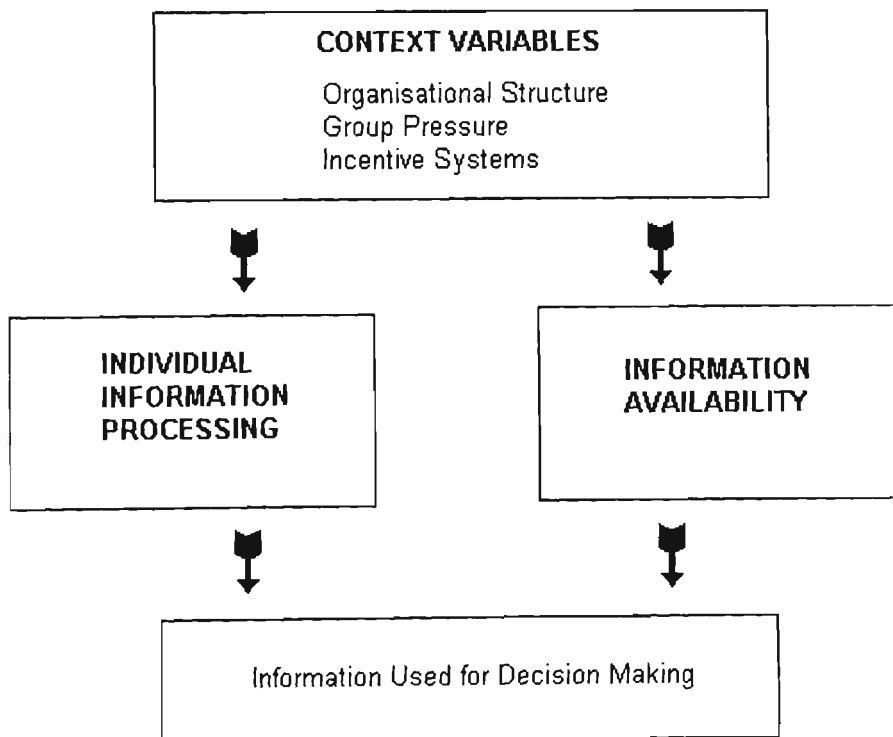
The previous sections of this chapter reviewed selected literature related to the research problem of this thesis and answered the first research question, namely “What do different disciplines and bodies of knowledge currently say about this problem?” The second and third research questions concern the identification of a theoretical basis and the development of a model. In order to clarify the requirements for a suitable theory and to design a piece of research that will help to build a new model, a model of the research problem, based on the above analysis of the current literature, is now presented.

### **2.3.1 A Rationalisation of the Concept of Models**

In any multi-disciplinary area, such as IS, the interpretation of what is meant by the term *model*, varies with the discipline. For this thesis the interpretation is that used by Bannon in his work on CSCW (Bannon 1999). He says that much work in CSCW has come to “re-appraise the role of models and has begun to pay attention to ways in which people use these models as guides for behaviour rather than prescriptions”. He goes on to say that models are seen as “interpretations, as constructions, which for some purposes, under certain conditions, used by some people, in certain situations may be found useful, not true or false”. He therefore sees the modelling process as one of reframing rather than describing or abstracting.

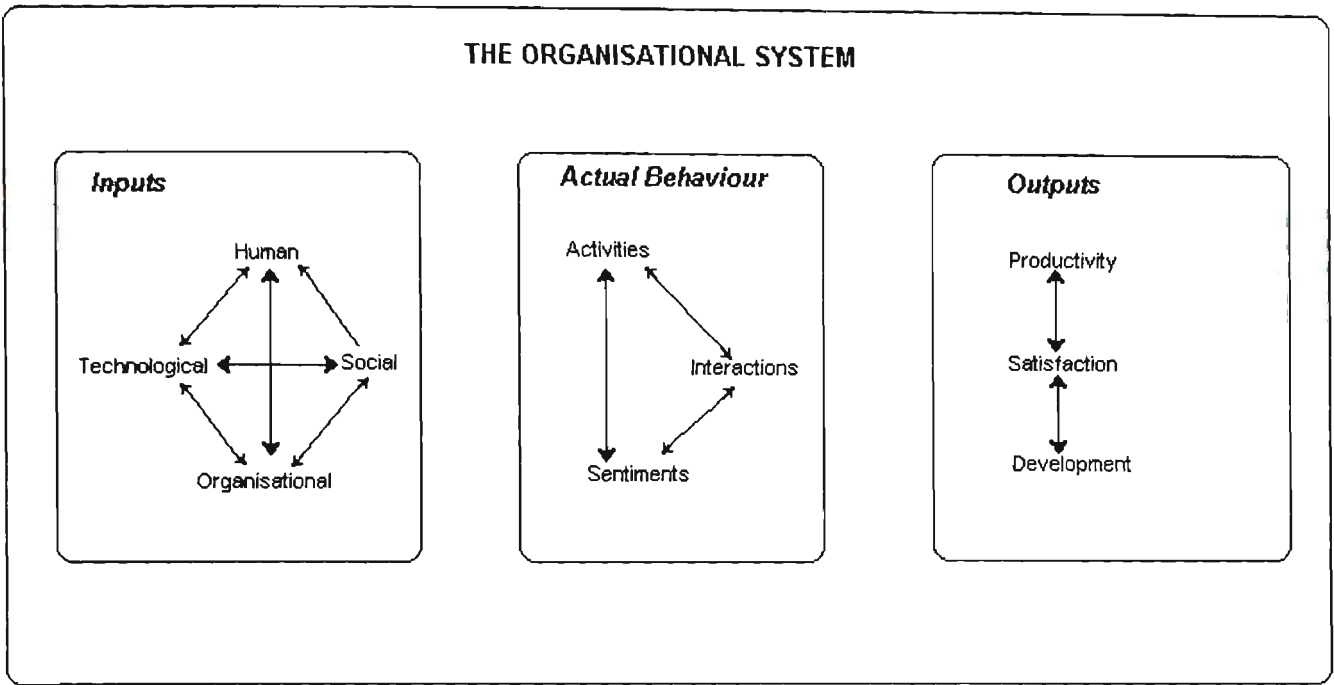
Some models of this kind have been developed in areas related to the current research problem. For example Figure 2.1 is a model of the way executives obtain information from the work of Vandenbosch and Huff (1997). Two other models, taken from the literature cited above, are presented here in Figures 2.2 and 2.3. Browne’s model (Figure 2.2) depicts the effects of three variables, context, individual information processing characteristics and information availability, on the use of information in the

decision-making process. McCosh and Scott-Morton's model (Figure 2.3) depicts an organisation as a system that takes inputs and processes them into outputs. At the input phase they have incorporated Leavitt's four forces model. Leavitt (1964) suggested that at any given moment in an ongoing and reasonably stable entity four forces were in a state of balance: the demand of the task, the quality and size of the staff, the nature of the technology in use and the design or structure of the organisation. According to McCosh and Scott-Morton the "actual behaviour" phase represents decision-making, which produces the outputs listed.



**Figure 2.2-** Variables affecting the use of Information (Browne 1993 p50)

THE ORGANISATIONAL SYSTEM



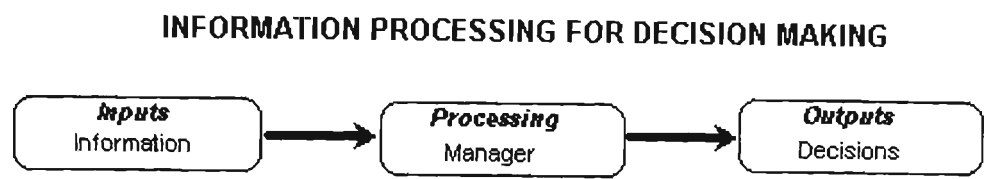
**Figure 2.3** - A Model of the Organisational System (McCosh & Scott Morton 1978 p190)

These models capture some of the realities of real people in real organisations, reframing parts of the whole issue of information production and use by decision makers. The creators of the models have relied on substantive work by other scholars as well as their own research. What I will now do in this chapter is to present a model, or reframing, of the research problem based on the literature review above. Then, following the identification of a suitable theory in Chapter 3, and using the results of this research, presented in Chapters 4 and 5, a new model of the problem will be presented in Chapter 6.

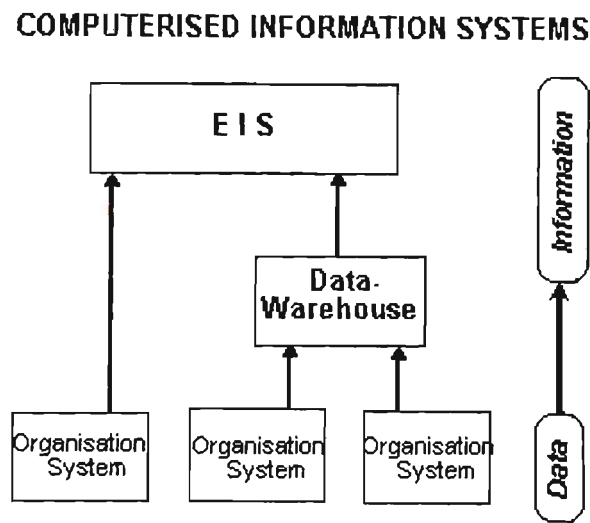
2.3.2 A Holistic Model based on Existing Literature

The introduction to this thesis discussed the gulf between, on the one hand, research in the fields of management, organisational and, on the other hand, decision sciences and IS research, on systems which provide organisational information and knowledge. In order to develop a model of the current view, the essence of these two processes is captured in Figures 2.4 and 2.5. Figure 2.4 simply represents the management view of rational decision-making, heavily influenced by the work of Newell and Simon (1972), where the manager processes information as input to make decisions as output. Figure

2.5 depicts a typical IS diagram of systems at different management levels of an organisation, with data at the operational level feeding into an EIS at the top.



**Figure 2.4** Managerial Decision-Making and Information Processing

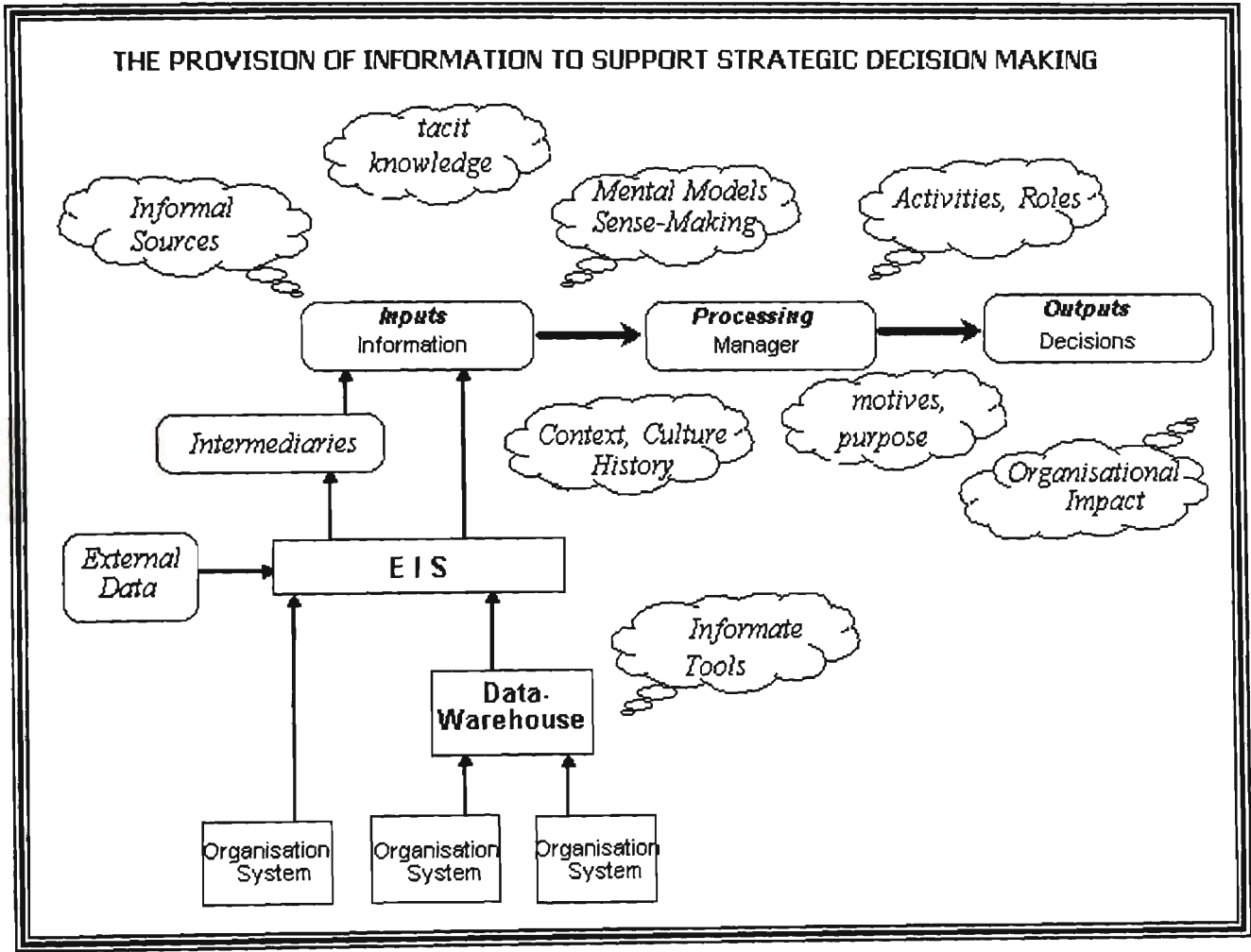


**Figure 2.5** Organisational Information Systems Feeding an EIS

To produce an integrated view of the research problem on how computer technologies and associated systems can be used to provide information to support managers in their strategic activities, Figures 2.4 and 2.5 have been combined into the backbone of Figure 2.6. The clouds surrounding the backbone contain issues, described in the literature cited above, that are critical to the integrated model but are difficult to fit neatly into the basic structure.

Following the diagram of the model in Figure 2.6, these difficult issues are listed in Table 2.13, together with those researchers cited in the literature review as having identified them as problems. Questions relevant to a holistic approach to the problem

are also listed in the table. These will be addressed in the new model, derived from the research described in Chapters 4 and 5, and discussed in Section 6.2.



**Figure 2.6** The Current Model of the Research Problem based on the Literature

**Table 2.13** Difficult issues to fit into a rational model of my research problem

Issues	Work Cited	Questions Raised
1. activities and roles	Mintzberg (1989), Fidler & Rogerson (1996)	What do managers do that need EIS?
2. motives and purpose	Mintzberg (1989)	Why would managers use EIS?
3. mental models, sense-making	Norman (1991) , Fiol (1992), Introna (1997)	How can EIS enhance the managers' mental processes?
4. integrating information provision and decision making	Vandenbosch & Huff (1997), Browne (1993)	How to integrate the processes of development and use of EIS?
5. informate, support	Zuboff (1988), Bannon (1999)	How to view technology as a supporting tool?
6. tacit knowledge, messy problems	Nonaka (1994), Wagner (1995)	How to provide knowledge with messy, complex and soft information?
7. organisational impact, memory	Kuutti & Virkkunen (1995), Leidner & Elam (1994)	How to ensure that the impact of EIS has a positive effect on the organisation and enhances organisational memory?
8. procedures for EIS development	Watson et al (1993)	Can technical staff have methods for EIS development that better incorporate managers' needs?
9. context	Mintzberg (1989), Bannon (1999)	How can EIS be better suited to the context of its organisation?

## CHAPTER 3 THE THEORETICAL BASIS

### **The Research Problem**

How computer technologies and associated systems can be used effectively to provide information to support managers in their strategic activities.

### **Research Question 2**

Is there a theoretical approach that can provide a holistic, contextual and dynamic understanding of this problem?

This chapter will introduce the theory that will be used as the basis of the research. The chapter begins with a listing of the requirement of the theory, summarised from the literature review in the previous chapter. The theory is then introduced and justified in terms of the requirements. The theory is then described in more detail and compared to other theories that could be considered for my purpose. Finally an outline will be presented of the work of those researchers who have applied this theory to similar research problems to my own.

### **3.1 THE REQUIREMENTS OF A SUITABLE THEORETICAL APPROACH.**

Figure 2.6, at the conclusion of the previous chapter, represented a model of the current state of research into the problem area of this thesis. The backbone of the model depicts two accepted premises: firstly that information systems take data in underlying organisational TPS and databases and transform them into information for senior management by means of an EIS. Secondly senior managers take information as input and use it to make decisions, which are the output of their management tasks. Surrounding this backbone are a number of issues that have been researched individually and impinge upon the basic problem. From the literature review in Chapter 2 these are:

- the expressed need for a theory that is well-established and robust with the evidence of history behind it, and which faithfully reflects how people behave in the real world. (Leidner and Elam 1994, Tricker 1992, Carroll 1991)

- the limitations of current theories, and models, which suffer from the fact that they are built to support only part of the problem (for example those of Browne, Newell & Simon, Leavitt, Vandenbosch & Huff shown in Chapter 1 of this thesis) This is perhaps due to the very nature of western scientific research and the requirement of journal editors (Walsham 1995).
- the need to incorporate both hard (technological) and soft (management) approaches into a coherent whole. (described in Mintzberg's left and right brain arguments where he describes strategy as complex and holistic - a right brain activity). The theory does however need to produce something of IS developers, more than Browne's (1993) list of specifications and more concrete than the garbage can model of Cohen and March 1974)
- the need to allow for dynamics as shown in the task-artifact cycle of Carroll et al (1991) and the cyclic process of Harrison and Pelletier (1995)
- the need to acknowledge the flexibility both of the newer technologies, and of people, with their different mode of information processing (McKenney and Keen 1974, Nass 1994)
- the need to focus on the welfare of the organisation and not to "focus on the tool (Mintzberg 1989)
- the need to support the broader activities of managers, not just rational-cognitive information processing for decision making. (Fidler & Rogerson 1996, Corner et al 1994)
- applicability to all organisations, not just big private companies (Mohan et al 1990, Kraemer 1993)
- increasing support for problem identification as well as problem solving (Nonaka 1994, Leidner and Elam 1994))
- understanding individuals' sense-making and mental models (Fiol 1992, Introna 1997, Bannon 1999, Corner et al 1994, Kuutti & Virkkunen 1995)

- coping with messy unstructured work (Minzberg 1989, Wagner 1995)
- dealing with managers both as individuals, with individual management styles, and as members of the organisation (Corner et al 1994, Tricker 1992)
- enhancing organisational knowledge (Nonaka 1994, Kuutti & Virkkunen 1995)
- the importance of context (Vandenbosch & Huff 1997, Blackler, 1993 and others)
- the integration of technology and people (Bannon 1999, Corner et al 1994, Blackler 1993)

### **3.2 THE CHOICE AND JUSTIFICATION OF THE CULTURAL HISTORICAL ACTIVITY THEORY (CHAT)**

The theory chosen as a basis for this research is the Cultural Historical Activity Theory (CHAT). It is often referred to as *Activity Theory*, but the longer term will be used throughout the remainder of the thesis as it is more descriptive and in common use by many of those applying the theory to similar research problems. Using the acronym, CHAT, will also avoid confusion with the individual words, *activity* and *theory*, which will be in constant use throughout the thesis.

CHAT originated within Soviet psychology of the early 20<sup>th</sup> century, in particular from the work of the Russian psychologists Vygotsky (1978) and Leontiev (1981) who formulated a completely new approach to psychology based on the concept of artifact-mediated and object-oriented human action. This theory provides a rich language for identifying the main domain elements in a complex, dynamic situation and for describing the relationships between them. It examines the nature of practical human activities, their social origins, and the nature of activity systems within which people collaborate. It explores links between thought, behaviour, individual actions and collective practices (Blackler 1993). According to Kuutti (1996) CHAT is “a philosophy and cross-disciplinary framework for studying different forms of human practices” and offers a set of concepts, structures and terms that are eminently suited to research undertaken within the communities of practice. Blackler (1993) eloquently

describes his reasons for adopting a CHAT approach by stating that it offers a way of synthesising and developing various notions of knowledge, organisations and management and it deals with the messy problems by “attributing significance to incoherency and dilemma”.

Confirmation of the suitability of CHAT for this research comes from Kuutti (1996), working in the field of IS, who observes that “today there is an emerging multidisciplinary and international community of scientific thought united by the central category of activity - a community far beyond the original background”. Outside Eastern Europe, researchers in the field of education and linguistics were the first to recognise the merits of the CHAT approach. There is a relationship between these fields and issues of information and learning in organisations, which are central to this research.

Before presenting a detailed description of CHAT concepts in Section 2.3 below, a brief summary of the main points of the theory follows, in order to justify the use of CHAT as the research’s theoretical basis.

- **A Holistic Unit of Analysis:** In CHAT the smallest unit of analysis is an *activity*, which usually takes place over an extended period of time and is driven by motives. In contrast the focus of most other research approaches is on short-term, goal-oriented actions. The holistic, comprehensive approach of CHAT treats the whole activity as more than just the sum of its component actions and operations.
- **The Computer as a Tool to Support Work:** The CHAT principle crucial to IS research is that of the asymmetry between humans and the technology, the latter being relegated to the role of tool. Using the CHAT approach, an information system is viewed as a tool which supports the human decision-maker not as a systems designed to automate work and replace the human worker.
- **The Internalisation and Externalisation of Information:** In CHAT there is a unity of consciousness and activity obviating the need to study human information

processing as purely internal and mental. The CHAT principles of internalisation and externalisation relate to the way managers develop mental models, based on information received and make decisions based on those models.

- **Dynamics and Change:** A CHAT approach assumes that activities are under continual change and development, adjusting to cultural and environmental influences. Activities are dynamic, being mediated by tools and their social environment.
- **Studying IS in Context:** CHAT directs the researcher to recognise that most issues cannot be usefully studied outside their context and the researcher should begin by acknowledging the richness of the context and its impact on the issues to be studied. In the words of Nardi (1996) by studying practice in context, CHAT obviates the need to distinguish between pure and applied science.

### **3.3 AN OVERVIEW OF THE CULTURAL-HISTORICAL ACTIVITY THEORY**

Any theory, which can be applied to real people in a real world situation, is necessarily complex, and CHAT is no exception. It requires a paradigm shift for most western researchers and it is not easily comprehended on a first encounter. The following overview of the theory is by no means complete but covers the essence of the main concepts as they apply to this research.

#### **3.3.1 The Roots of CHAT in Vygotskian Psychology**

The foundation of CHAT was laid by the Russian psychologist L.S. Vygotsky during the 1920s and 1930s, and based on the idea that human activity is mediated by cultural signs: words and tools, which cause changes in that activity, and thus its internal mental reflection (Vygotsky 1978). Vygotsky's inspiration came from eighteenth and nineteenth century German philosophy, in particular the work of Hegel. This tradition emphasised the idealistic role of mental activity (*Tätigkeit*) in constituting the relationship between subject and object. The concept of activity was brought into

materialistic philosophy by Feuerbach, who introduced the notion of objective reality. Marx then developed the concept of practical-critical activity, the central aspect of which was the transforming of material objects (Kuutti 1996).

Marxism is often referred to as *dialectic materialism*. *Materialism* asserts that the material world, the world outside of consciousness, is the primary source of thought, especially in relation to the question of knowledge. For *materialism*, thoughts are pictures or reflections of something outside of mind, which existed before mind and independent of thought. The *dialectic* concept stems from Hegel's philosophy that only the whole is true, and there is a *totality*, in which is preserved each of the ideas or stages that it has overcome or subsumed. In discovering the *totality* it is necessary to reveal negations or contradictions within any category or identity. His approach, known as dialectical thinking, is depicted in a triadic structure of *thesis*, *antithesis* and *synthesis*. This triad involves the affirmation of a *thesis*, which on reflection proves itself unsatisfactory or incomplete. This propels the affirmation of its negation, the *antithesis*, which also on reflection proves inadequate. The *synthesis* then overcomes and preserves the *thesis* and its *antithesis* to emerge as a higher rational unity. In Hegel's view, dialectic reasoning is concerned with reality as a totality, and therefore gives true knowledge. (Spencer and Krauze 1999) This is the basis of the holistic nature of CHAT.

A fundamental concept of Vygotsky is the dialectical relationship between the development of the individual and the society in which the person exists. According to Blunden (1999) *subject* and *object* are crucial concepts which are needed in order to understand dialectics. *Subject* refers to the active, cognising individual or social group with consciousness and/or will, while *object* refers to that on which the subject's cognitive or other activity is directed. In dialectic materialism, not only is the *object* altered through interaction with the *subject* but knowledge by the subject, develops only through the interaction of the *subject* and *object*.

While the classical German tradition was overtaken in the West by the emerging empiricism that later became the foundation of twentieth century, Anglo-American scientific thought, it remained active in Russia where Vygotsky developed his cultural-historical psychology. Vygotskian psychology treats the individual's personality as an outgrowth of social forces, rather than the autonomous being of the Western rationalist model (Bødker 1991) where the human child is abstracted from the social-historical body of which he/she is part (Blunden 1999). Vygotsky applies the dialectic method to the analysis and synthesis of concepts thus avoiding "the dichotomies between thought and action, and between individuals and society which have characterised Western theory" (Blackler 1993).

Vygotsky's life goal was to create a psychology adequate for the investigation of human consciousness and psychological functions (Gould 1995). In the mid 1920s Vygotsky (1927) writes that "voices are heard proclaiming that the problem of (the old) general psychology is a problem of the first order". These voices were not philosophers or theoretical psychologists but "psychological practitioners". He goes on to say

*"Out of such a methodological crisis, from the conscious need for guidance in different disciplines, from the necessity - on a certain level of knowledge - to critically coordinate heterogeneous data, to order uncoordinated laws into a system, to interpret and verify the results, to cleanse the methods and basic concepts, to create the fundamental principles, in a word, to pull the beginnings and ends of our knowledge together, out of all this, a general science is born."*

Vygotsky (1934) noted that although the "old psychology" accepted the "premise of unity of consciousness and the interrelation of all psychological functions" it was "taken for granted that the relation between two given functions never varied; that perception,

for example, was always connected in an identical way with attention, memory with perception, thought with memory.” He goes on to say

*“Because the relationships remained in fact inconsequential, the development of consciousness was seen as determined by the autonomous development of the single functions. Yet all that is known about psychic development indicates that its very essence lies in the change of the interfunctional structure of consciousness. Psychology must make these relations, and their developmental changes, the main problem, the focus of study, instead of merely postulating the general interrelation of all functions. This shift in approach is imperative for the productive study of language and thought.”*

Vygotsky (1978) believed that the higher psychological functions found in humans could not be understood as an extension of principles derived from animal psychology. He launched a series of investigations in developmental psychology, pedagogy and psychopathology and came to the conclusion that human consciousness is “constructed through a subject's interactions with the world and is an attribute of the relationship between subject and object”. Vygotsky saw consciousness as an integral part of practical activity in which states and processes, such as attention and memory, are functionally related both to behaviour and to each other. He claimed that “any higher mental function necessarily goes through an external stage in its development before becoming an internal truly mental function because it is initially a social function”. This led to his notion of externally mediated activity and the idea that mental processes could only be understood by realising the tools and signs that mediate them. Because thought and speech are such tools and signs, consciousness is inseparably linked to language and communication with others. It is through communication that the habits of practical activity are acquired. It is also through communication that individuals are able to assess their actions by social standards held in common with other people. (Gould 1995)

It is widely recognised that the concept of mediation is Vygotsky's most important and unique contribution. Vygotsky draws an analogy between the way psychological tools are directed towards the mastery of behavioural processes and the manner in which technical tools allow humans to master and control the processes of nature. He then uses the hypothesis of psychological tools to explain how the specific properties of the higher mental functions (possessed only by humans) arises from the lower ones, (possessed by all animals) through mediation. This leads to the basic idea that the genesis, structure and contents of the human mind is determined by historically evolving practical activity, carried out by humans, mediated by tools. It is because human subjects treat objects with understanding and knowledge that their attitude to the world is called conscious and differs from the preconscious psyche of animals. According to Vygotsky, all tools, psychological and physical, that are developed artificially by humanity, are the elements of culture and are used to transmit the culture from generation to generation.

Vygotsky's works were only published in Russian after his death untimely death in 1934 at the age of 38. They were subsequently suppressed in 1936 and were not known in the West until 1958. Publications in English followed in 1978 and 1981. He is best known for initiating the modern theory of language in the early 1930s and for his approach to the development of concepts in early childhood and youth, tracing the transition through a series of stages of human development, based on the development of the child's social practice. However Vygotsky's work has more general applicability as a theoretical framework which assumes that the cognitive functioning of individuals emerges out of social interaction and that mediated activity is the foundation for the structure of all forms of human behaviour.

This aspect of Vygotsky's work was continued by his students which included Leontjev who developed the conceptual framework for the theory of activity (Leontjev 1981) that has been widely used in education, linguistics, anthropology, cultural research and more recently HCI (Kaptelinin 1994), computer science, (Bødker1991), CSCW (Bannon

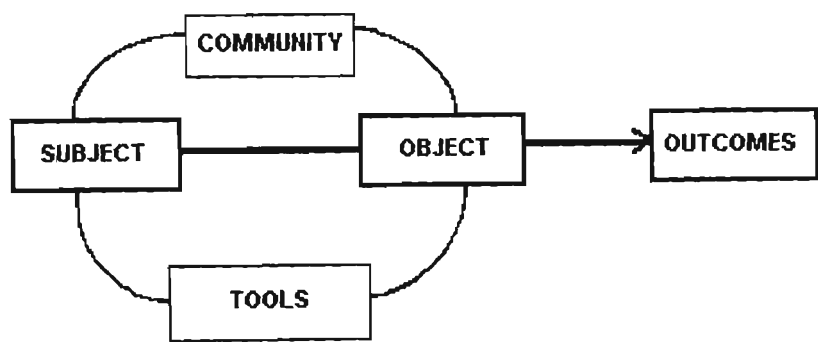
1999) and IS (Kuutti 1990). The work in each of these disciplines has had an influence on the way CHAT is viewed today. The best known contributions made to the theory outside Russia are those of Yrjö Engeström in Finland, particularly his work on collective activity that is discussed in Section 2.4.7 below. The following section describes the concept of activity, adapted from the work of Leontjev, and applied to the problem of computer support for senior managers. Following that, those CHAT concepts that apply to my research problem will be discussed in more detail.

### 3.3.2 The Concept of Activity

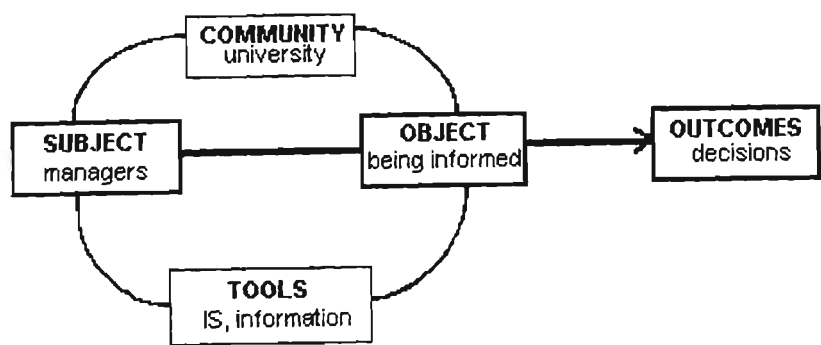
CHAT takes as its starting point human activity, which is the basic component in purposeful human work. An activity is a form of doing directed towards an object, which distinguishes that particular activity from another. According to Leontjev (1978) the expression “objectless activity” is devoid of any meaning and one should always uncover the object when studying an activity. Human activities are driven by certain needs and usually mediated by one or more instruments or tools. (Bannon & Bødker 1991). Kaptelinin (1996) recalls the work of Vygotsky in saying that the most fundamental CHAT principle is the unity of consciousness and activity, where “the human mind emerges and exists as a special component of human interaction with the environment”. The mind therefore “can be analysed and understood only within the context of activity” (*ibid*). Activities can be individual or collective and those in organisations usually comprise a number of people working on something shared in an organised way to produce a joint outcome. Such activities are usually identified by looking at what are the shared objects of work and jointly produced outcomes.

The CHAT framework of an individual activity is shown in Figure 3.1. An *activity* is undertaken by a human *subject* motivated towards an *object* producing *outcomes* and mediated by *tools* and *community*. Activities are distinguished from each other according to their objects where the word *object* is used in the sense of the “object of the exercise” and is related to the motive driving the activity. Transforming the object into an outcome motivates the existence of an activity. The CHAT framework places the

technology to one side of the main activity viewing it as a mere tool and provides a structure that enables the identification of the mediating effect of the tool (Kuutti 1996). This enables the researcher to compare the effectiveness of different technological solutions to the problems of making sense of information in organisations. For example the CHAT elements of the sense-making activity of managers are shown in Figure 3.2 and illuminated in Table 3.1.



**Figure 3.1.** The CHAT Framework for the Structure of an Activity



**Figure 3.2.** The CHAT Framework applied to the Sense-making Activity of Managers

In the depiction of an activity, Figures 3.1 and 3.2, I have avoided the use of triangles, as used by many workers in this area, for two reasons: firstly, to avoid the appearance of formalism and rigidity and secondly, to provide a compact framework to enable several activities to more easily fit together in a model.

Table 3.1 – CHAT elements of the Sense-Making Activity of Managers

CHAT Element:	As used in sense-making activity of the study
the activity of interest:	information system support for the planning and management of the organisation.
the object of the activity:	variously described as: “understanding the situation”, “being informed”, “knowing where the organisation is going”, “getting the picture” or just “sense-making”.
subjects:	administrators and academic-managers from many disciplines
outcomes:	decisions, strategic plans
tools:	data, information and knowledge and the technological systems which provide them
community:	a modern public university with an academic tradition which is internationally focussed and discipline based and often at odds with its modern business administration which is locally focussed and responsible to the government.

3.4 CHAT CONCEPTS THAT CAN BE APPLIED TO ACTIVITIES

The cultural historical tradition of Vygotskian psychology forms the basis of the theory of activity, CHAT, that had been developed by Leontjev and others. The research approach to be used in this thesis will be described in more detail in Chapter 4. Briefly, CHAT is used firstly, by treating the objects of study as activities in the CHAT sense and secondly applying the richness of the theory to the analysis of the activities. What follows is an explanation of eleven CHAT concepts that will be used in this analysis. Their application to my research problem will be dealt with in Section 3 of Chapter 6.

3.4.1 An Activity as a Comprehensive Unit of Analysis

In CHAT the basic unit of analysis of all human endeavour is *activity*, a broader more embracing concept than individual goal-oriented actions. The word *activity* has been chosen in English to be the best, but not perfect, equivalent of the Russian word, *deyatelnost* roughly meaning human *doing* (performing or operating both physically and mentally). *Activity* is the minimum meaningful context for individual human actions and unless the whole activity is the unit of analysis, the analysis is incomplete. An *activity* is more than just the sum of its component actions and so should not be decomposed into submodules the way tasks are normally decomposed hierarchically in IS analysis and design.

3.4.2 The Object-Orientedness of Activity.

An activity is defined by its object, which may be one of two kinds:

- real, physical (material) objects or
- ideal (mental) objects, present in the subject's mind

The motive of an activity is always objective whether real or ideal. CHAT considers social and cultural properties of the environment to be as objective as the physical and biological ones.

There is no activity without an object, that is activity is always purposeful although sometimes even the subject is not fully aware of that purpose. Activities can be polymotivated, an issue that must be addressed in EIS. The motivation for an EIS may include the desire to be better informed and make better decisions but may also be for status, to impress one's competitors or a variety of other reasons.

### 3.4.3 The Use of Tools

Central to CHAT is the concept that all human activity involves the use of tools and that this distinguishes human activity from the activities of animals. Three kinds of tools mediate human activity:

- Primary Tools: (artefacts, instruments, machines, computers etc)
- Secondary Tools: (language, signs, ideas, models etc)
- Tertiary Tools: (cultural systems, scientific fiction, virtual realities)

Primary tools are physical, material tools, secondary and tertiary tools are psychological tools. While primary tools produce changes in the material object, psychological tools influence the psyche and behaviour of subjects. CHAT opens up the concept that, together with the physical EIS, the information and knowledge it provides should be viewed as tertiary tools. This is related to the concept of internalisation that is discussed below.

Tools specify modes of operations and are historically developed in social terms possessing an evolutionary cultural component. The use of these culture-specific tools shape the way people act and tools carry historical and cultural knowledge. This aspect

of CHAT can be applied to the design of systems to capture and manage organisational memory (see for example Kuutti & Virkkunen 1995).

3.4.4 The Hierarchical Structure of Activities

The CHAT hierarchy (Figure 3.3) is one of the most widely used concepts of the theory. One difficulty that many newcomers face is in accepting that there are just three levels and that each is fundamentally different in concept. Within the levels of actions and operations there could certainly be several sub-layers formed by decomposing an action or operations into smaller units, but they would still be actions or operations.

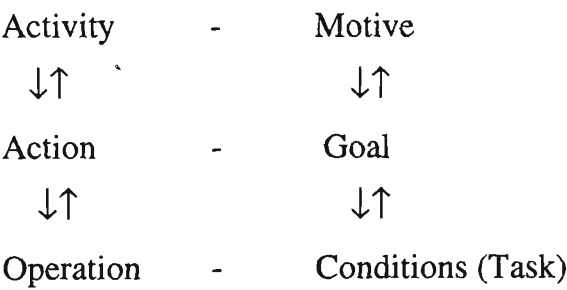


Figure 3.3 The Hierarchical Structure of Activity

At the top half of the hierarchy, participation in an activity involves performing a number of conscious actions that have an immediate and definite goal. Whereas activities are always related to motives, actions are always related to goals. At the bottom of the hierarchy, where goals are always conscious, the operations, which make up actions are usually non-conscious and automatically performed. Most importantly, although an activity can consist of many actions and operations in context, it is more than the sum of these.

The Hierarchical Structure shown in Figure 3.3 is a dynamic one. One activity is usually performed by several actions and operations. The same activity can be performed by different sets of actions. The same action can be used in different activities, as most subjects are often engaged in several concurrent activities.

Leont’ev (1978, p. 66) gives an example of this dynamism from learning to drive a car:

*“Initially every operation, such as shifting gears, is formed as an action subordinated specifically to this goal and has its own conscious ‘orientation basis’. Subsequently this action is included in another action, ... for example, changing the speed of the car. Now shifting gears becomes one of the methods for attaining the goal, the operation that effects the change in speed, and shifting gears now ceases to be accomplished as a specific goal-oriented process: Its goal is not isolated. For the consciousness of the driver, shifting gears in normal circumstances is as if it did not exist. He does something else: He moves the car from a place, climbs steep grades, drives the car fast, stops at a given place, etc. Actually this operation [of shifting gears] may, as is known, be removed entirely from the activity of the driver and be carried out automatically. Generally, the fate of the operation sooner or later becomes the function of the machine.”*

The example of learning to drive is useful to illustrate all three levels of the CHAT hierarchy. Initially for someone who is learning to drive a car, changing gears can be an *activity* of its own made up of conscious *actions* of moving clutch-pedals and gear-stick, even before the motor is switched on. Soon the learner is driving on the street and changing gears becomes one of the *actions* that make up the *activity* of learning to drive the car. For the accomplished driver, driving a car is rarely an *activity* in itself, but an *action* as part of a more meaningful *activity* such as going on holidays. By this stage, changing gears is a mere *operation* that is performed without conscious effort, unless of course something goes wrong with the gears or clutch and then it may again become a conscious *action*.

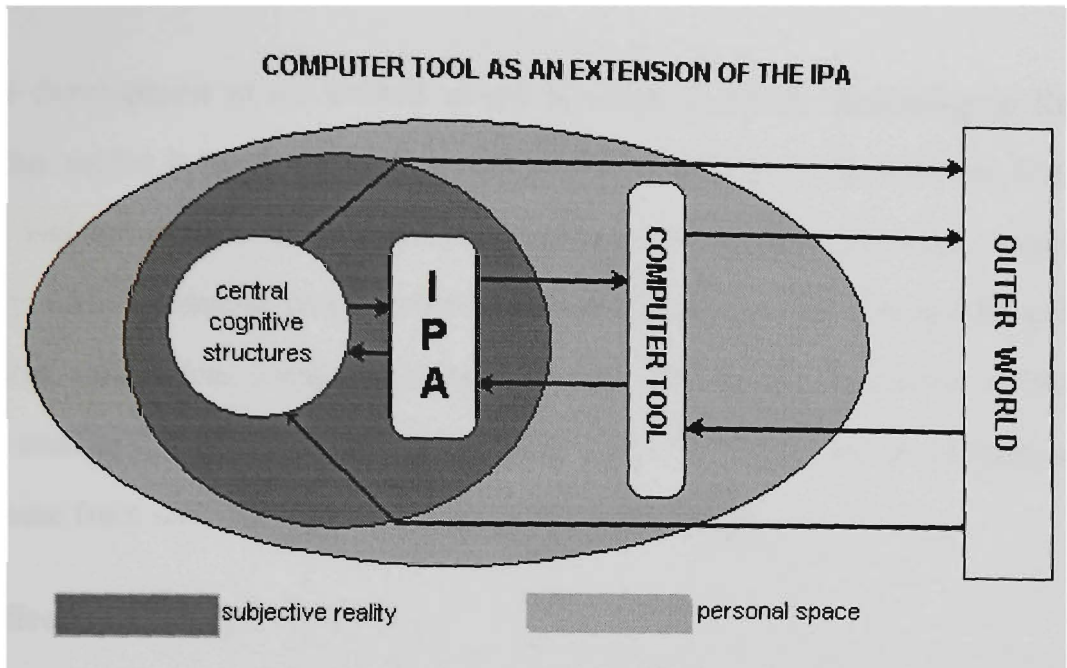
The interplay of *actions* and *operations* is important when considering the difference between novice and expert computer users in the field of HCI which seeks to create more usable, transparent computer systems. The aim, in interface design, is to allow the user to concentrate on conscious *actions* that are a significant part of their work *activity* and relegate the use of the machine to the realm of unconscious *operations*. For example an executive looking for a particular piece of information should be unaware of

the *operations* performed on the computer and focus on the information it provides. The introduction of direct-manipulation, graphical user interfaces have allowed the production of intuitive systems that are transparent to the user and have been the main reason for the rise in popularity of personal computers in the 1990s.

### **3.4.5 Internalisation / Externalisation and the IPA**

A fundamental principle of CHAT is the unity of consciousness and activity, where consciousness is considered to be the human mind as a whole and activity is considered as the interaction of human with objective reality leading to the object oriented model of the subject's interaction with the environment.

The concept of internalisation is described by Vygotsky (1978) as the underlying mechanism for the origin of mental processes. Mental processes are derived from external actions through the course of internalisation. This is in apposition to conventional cognitive psychology, which emphasises the mind as the source of action. It is through activity that we learn and internalise concepts that then become a psychological tool that is manipulation in the Internal Plane of Action (IPA). The IPA is a concept developed within CHAT that refers to the human ability to perform manipulation with an internal representation of external objects before starting actions with these objects in reality (Kaptelinin 1996). IPA is more general than the cognitive concepts of working memory and mental models and is well suited to the analysis of the processes of dealing with the "messy", unstructured problems of senior managers. Kaptelinin views the computer tools as an extension of the IPA as shown in Figure 3.4.



**Figure 3.4** The computer's relationship to the Internal Plane of Action. (Kaptelinin 1996)

While the process of internalisation has been a constant topic of study, particularly in the field of education, the process of externalisation has received less attention. It is exemplified by the way a performer, such as a spring-board diver, will rehearse their act in their mind, for example seeing themselves perform the perfect dive, just before they externalise it, that is carry out the actual performance.

### 3.4.6 Context

CHAT provides a model of what humans do in their social and organisational context. Many western researchers adopt the CHAT approach because they realise the limitations of the dominant positivist ontology, which favours isolation from, or control, of environmental factors in research projects. The work of Lucy Suchman (1987) and Hutchins (1994) has been instrumental in raising awareness that there needs to be a body of research that specifically studies the role of context in the areas of work and IT.

In HCI research, for example, one of the main criticisms of the current cognitive science bias is that it does not provide an appropriate conceptual basis for a computer use in its wider social and organisational context. Most research in human-computer studies takes goal-oriented human action as the unit of analysis, the most well known example

being the development of the GOMS model (Card et al 1983). According to Kuutti (1996), this makes it relatively easy to design precise laboratory experiments, but the study of isolated actions is not always meaningful to real-life situations outside a laboratory. CHAT demands that activities are always studied in situ, taking into account the political, economical, social and cultural realities. Ethnographic research techniques are often used in CHAT studies and many of the people who have become interested in CHAT come from sociological or anthropological backgrounds.

### 3.4.7 Collective Activity

The basic activity structure of CHAT applies to an individual subject. However as Kaptelinin (1996) observes the cultural-historical tradition, which led to CHAT emphasises the social nature of human beings and it would be natural to expect that CHAT would support the study of group activities. Indeed many of those currently applying CHAT to human-computer studies are in the area of computer supported cooperative work.

In the 70s and 80s the concept of collective subject was introduced into CHAT in order to account for the processes of communication between individuals. It was proposed that the structure of activity would be the same for both individual and group and, although this has been useful in analysing group activity, Kaptelinin (1996) states that it is not clear if all the concepts of CHAT can be directly applied to a collective subject.

For this reason, additions have been made by researchers of work and IT in organisations to the original Russian versions of CHAT to deal with group activities, in particular the scheme of Engeström (1987) as shown in Figure 3.5. In this scheme the entity of community is added to those of subject and object in the structure of activity. Here the subject-object relationship is mediated by the tool, and the community-subject relationship is mediated by rules. The relationship between community and object is labeled “division of labour” but this term may need rethinking outside the Scandinavian tradition. This model of activity offers promise for the study of computerised

information systems, which are used in organisational contexts for strategic decision-making.

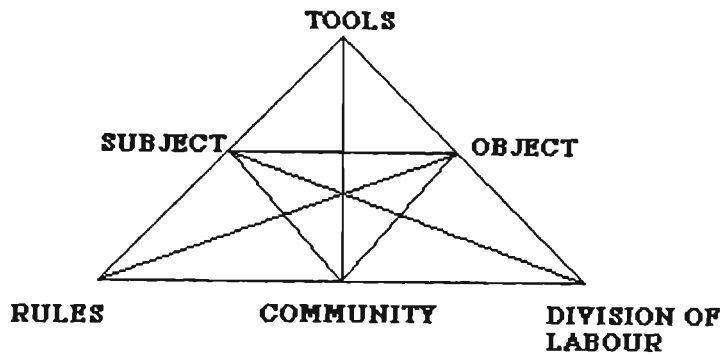


Figure 3.5 (Engeström, 1987)

### 3.4.8 The Dynamic Nature of Activity

CHAT considers all human endeavour not as given or static, but as dynamic, always changing and developing. The hierarchical framework of CHAT provides one way to make sense of the dynamic nature of activities. The one activity may be undertaken by many alternative sets of actions and operations. A subject may be concurrently involved in multiple activities consisting of goal-oriented actions, which may serve those different activities. The CHAT concepts of tool and societal mediation also represent a dynamic aspect of the theory.

Coping with the dynamics of activities and how they change over time is always difficult. The most well-known method of allowing for change, is the work of Engeström who uses the term *activity system* when dealing with work in organisations. This approach will be discussed in more detail below in section 2.6.1.

### 3.4.9 Tool Mediation

As mentioned previously, the concept of mediation is central to the psychology of Vygotsky on which CHAT is based. The structure of activity is strongly cognisant of the power of the tool and the community to mediate and change the activity it supports. The mediating property of the tool modifies existing activities and opens the

possibilities for new ones. Developers rarely consider how the tool they design will mediate activities, changing work practices as well as social and cultural norms.

An EIS is a good example of a tool, which mediates the activity it is designed to support. Most of the EIS literature warns that interviewing or surveying executives will not elucidate a very comprehensive list of requirements for an EIS. It is common that, only as users become familiar with the system, can they come to terms with the possibilities it offers. This is an example of the mediating effect of the tool and why an evolutionary prototyping method of development is recommended for EIS.

#### **3.4.10 The Active Nature of Subject**

Another dynamic addressed by CHAT is the active nature of the subject of an activity. A person brings with them a whole range of baggage that will affect how they approach the activity: previous experience, cognitive skills, personality and culturally determined traits. These will continue to evolve as the person undertakes the activity but are rarely taken into account as a complete picture. Most published research in this area will look at one set of factors, experience or cognitive skills or personality on performance in the workplace, but not combinations of these. These factors must surely interact and change over time, affected by the activity, which is the object of the study. One of the corner stones of CHAT is the existence of active actors who create and construct their own environment building on their cultural and material heritage (Kuutti 1992).

#### **3.4.11 The Zone of Proximinal Development (ZPD)**

This principle is widely used when CHAT is applied to child development and learning and is clearly explained by Bellamy (1996) thus.

One way that children interact with the world they do not understand is by mimicking adult activity. Adults can also provide a secondary means of mediation or a social scaffold between the child and the world so that with the aid of an adult, children are often able to perform tasks that as individuals they would be incapable of. The child thus has two levels of performance: the level that she can achieve alone and the level

that she can achieve with the help of a more experienced individual. Vygotsky referred to this latter performance ability as the zone of proximal development.

### **3.5 THE RELATIONSHIP OF CHAT TO OTHER APPROACHES**

Table 3.2 lists the activity theory principles, together with some of their implications for executive information systems. The third column lists some research paradigms, methodologies or theories that may be considered alternatives to the adjacent activity theory principle. In this table activity theory principles are compared with some currently used alternatives in a systematic way. A brief discussion of each of these alternates follows.

#### **3.5.1 General Systems Theory**

General systems theory assumes that life in society is organised around complex systems which, when studied, should be treated as whole entities. In the discipline of information systems the computer technology, its human users and any relevant part of the organisation are treated as one whole, integrated, purposeful system. Systems are open, living entities where the whole is irreducible and is more than the sum of its parts. Such systems are goal-oriented (consequences are important) and they resist trends towards disorder by importing energy from the environment and processing information.

#### **3.5.2 The Situated Cognitive Artefact**

Computers have been described as cognitive artefacts (Norman 1991) in a system composed of the person, the artefact and the task (Carroll 1991). What is needed is a better scientific understanding of the role played by the artefact and how it affects the person and the task. This approach emphasises the enabling effect of the artefact distributing actions across time and people, as well as affording to the user the possibility of undertaking tasks different from the one originally planned.

### 3.5.3 Distributed Cognition

This approach has been developed by Hutchins (1994) and his colleagues to explain cognitive activities as embodied and situated within the work settings in which they occur. The theory can be used to study the dynamics of collaborative activity in situ. Distributed cognition takes as the unit of analysis, a cognitive system composed of individuals and the artefacts they use. It is concerned with representations both internal to the individuals and those created and displayed in artefacts, as well as the way in which information, and knowledge, is propagated across the different representational states in terms of various communication pathways. It thus aims to contribute to systems design and implementation.

### 3.5.4 Situated Action or Situated Cognition

Here the basic unit of analysis, according to Lave (1988), is the activity of persons acting in settings, the relationship between the individual and the environment. The central tenet is that the structuring of an activity does not precede it but grows directly out of the immediacy of the situation. Lucy Suchman's published PHD dissertation (Suchman 1987) is a seminal work in the area.

Proponents of situated cognition claim that cognitive science over emphasises the importance of plans in shaping behaviour and fail to recognise the opportunistic, flexible way people engage in real activity. In the artificial intelligence field Proponents of situated cognition assert that symbolic descriptions elicited prior to direct experience are less important than functional units developed via direct experience with the current problem.

### 3.5.5 Grounded Theory

In applied fields of study, such as information systems, there is conjecture about the role that basic science should play in its research direction. There is an inherent dilemma between basic science and application; whereas science values generality, application is very much in and of a particular context, which must encompass human motivation,

action and experience. In the classic scientific method application follows theory whereas in information systems theory is being derived from the study of applications. Grounded theory (Glaser & Strauss 1967) provides systematic procedures for the discovery of theory from data systematically obtained from social research. The method is extremely useful in developing context-based, process-oriented descriptions and explanations of the phenomenon.

### **3.5.6 Role Theory**

In his very popular article *Human Factors to Human Actors* Liam Bannon (1991) describes people in organisations as social actors. People act, not just behave or perform tasks, with partial autonomy striving after their goals. Actors interact with and explore their environment. In the actor-environment interaction strategies, and even goals themselves, change during the development of the interaction. The role concept can be used to explain social systems and their relationships with individual behaviour. The concept of role helps explain patterns of behaviour and actions of specific categories of people in particular situations. People are often classified by their role expectations and it is often helpful to see both ourselves, and others, in our work place not as individuals but as role-playing subjects.

### **3.5.7 Cognitive Psychology**

Cognitive psychology models the human being as an information processor with input, output and central processor. The human computer interface is therefore the meeting of two like information processors the output of one feeding the input of the other. Unlike western cognitive psychology, CHAT does not allow for an equal status of people and artefacts but relegates the artefact to serve the relationship between the subject and object (Gould 1998).

### 3.5.8 Other Theories Considered

Two other theoretical approaches, that are emerging in the literature as a basis of IS research, are Structuration Theory and Hermeneutics. Structuration Theory, as theoretical basis for organisational information systems research, was clearly articulated by Orlikowski (1991) and has been used by a number of other researchers (for example DeSanctis & Poole 1994 and Shanks 1997). This approach is concerned with the ways in which the actions of individuals are related to the structural features of the societies of which they are a part (Shanks 1997). DeSanctis & Poole (1994) use the theory to characterise the deep structure that exist within technological artefacts and work environments.

Introna's work (1997) takes a hermeneutic view of knowledge and information for the "always involved", in contrast to the rational, manager. Klein and Myers (1999) describe the hermeneutic circle as the first principle of interpretive IS research where an understanding of a complex whole comes from the meanings of its parts and their interrelationships.

There are obvious similarities between the focus of both these approaches and the CHAT approach. They come from different, rich philosophical traditions and a complete discourse on each is beyond the scope of this thesis. Adherents of both these traditions have expressed an interest in the CHAT approach and a continuing dialogue between members of these communities can only benefit the future of qualitative / interpretive research in IS.

**Table 3.2** CHAT Principles: Application and Alternatives

CHAT Principle	Implications for Executive Information Systems	Comparable Alternatives
A Comprehensive Unit of analysis	Many executive information system projects pervade the whole organisation. They may require an integrated organisational data model. The impact of the executive information system on the organisation must also be considered.	General Systems Theory. Many problems can only be solved using a holistic approach. The whole is more than the sum of the parts
Structure of Activity (Subjects & Object)	Executive information system activities include the creation, use and maintenance of the system. For each activity the subjects, objects, tools and outcomes should be identified.	Role Theory: actors and their roles are determined and described in an ongoing narrative
Object-Orientedness (Activities are defined by their objects)	Those designing an executive information system should remain focussed on the object of its use not distracted by technical issues. It should be recognised that activities can be poly-motivated often by political and personal ambitions.	General Systems Theory -all systems are purposeful
Use of Tools	ESS is probably a better concept than executive information systems. This emphasises the tool nature of such systems as opposed to traditional DP systems which automate work.	The Task- Artefact Cycle
Hierarchical Structure of Activities	Two issues are important here: 1. The top level of this hierarchy, activity, is usually ignored in most analyses which focus on goal-oriented actions. 2. Good design relegates interaction with the tool to the level of operations allowing users to perform actions solely related to the activity.	?
Internalisation and the Internal Plane of Action (IPA)	Managers make decisions based on information from the external world which is internalised and manipulated in the IPA using mental models or maps	Cognitive Psychology Grounded Theory: Theory is developed from data gathered from the real world.
Context	Executive information systems must be appropriate for the political, economic and cultural climate	Situated Action, Ethnography
Collective Activity	Executive information system projects are normally team-based.	Distributed Cognition
Dynamic Nature of Activity	An executive information system must be designed for change. Executive information system projects must include processes for user feedback and implementation of new requirements	General Systems Theory, Distributed Cognition,
Tool mediation	The organisational impact of executive information systems can involve issues of data ownership, inter-department cooperation and higher visibility of information.	?
Active nature of subjects	Senior managers have individual characteristics that play a significant role in their reaction to executive information systems. Their management styles, cognitive skills and personalities should be considered	Role Theory, Cognitive Psychology and Human Computer Interaction

## **3.6 RESEARCH WHERE CHAT HAS BEEN USED TO STUDY COMPUTER-BASED SYSTEMS AND ORGANISATIONS**

Over the past decade there have been numerous applications of CHAT throughout the world to the study of work and computer technology in organisations. Most of these applications of CHAT are descriptive, involving real work projects, and researchers have found that CHAT is very useful in determining why projects have followed the path they have, to success or failure. As CHAT has traveled across the globe and across disciplines, researchers have been selective in which aspects of the theory they have adopted. They have added to the theory or used CHAT as the basis of new theories and models. It seems to take a long investment of time coming to an appreciation of the riches of CHAT and to understanding how useful it could be to complex organisational issues but more and more researchers are making that investment.

There are three research areas that are using CHAT that relate to my research problem, these are work in organisations, HCI, and IS and what follows is an overview of the work of researchers in these areas who have influenced my approach.

### **3.6.1 Work in Organisations**

The researcher who has most influenced the transition of CHAT out of Russia to the West is **Yrjo Engeström**. In his groundbreaking paper "Learning by expanding: An activity-theoretical approach to developmental research" (Engeström 1987), he describes the basic motive for the direction of his research as a need to overcome the dichotomy between the societal and the psychological in theory and in practice. According to this dichotomy, people are described either as powerless elements of society or as self-contained individuals, detached from the historical evolution of societies. His interest stems from problems of learning where he argues that learning is a societal activity where individual and collective development are closely entwined. His main tenet is that through learning there is an expansion from old forms of work activity to new ones.

There are three main theoretical principles, which Engeström has developed that are widely used:

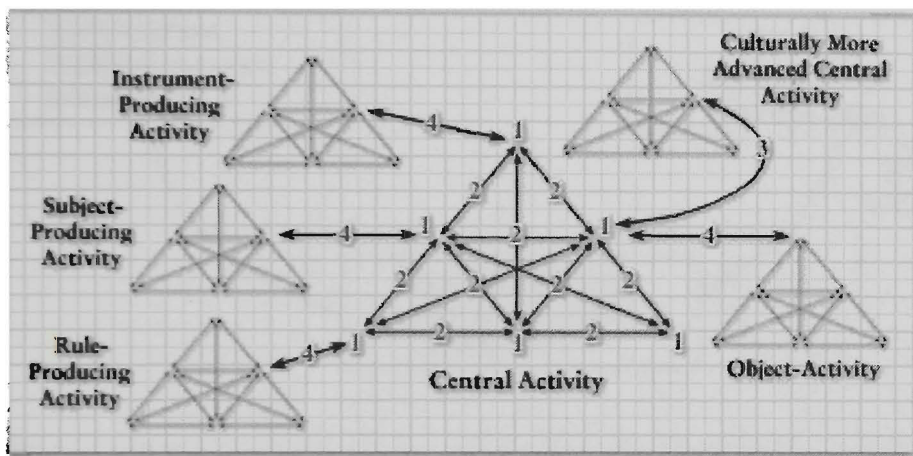
- the socially distributed activity system as the unit of analysis, depicted in Figure 3.6
- the principle of self-organising systems, causality and inner contradictions depicted in Figure 3.6
- the depiction of evolution and change as cycles of expansive reorganisation depicted in Figure 3.7

The first of these, his model of a collective activity system, has already been discussed in Section 3.3.7 above. Using the original two dimensional structure of Vygotsky, the Engeström model adds the social infrastructure of activity to the lower part of the model. By this means he places activity in an organisational setting, showing the role and influence of the community in the mediation of “rules” and “division of labour”. Engeström introduced the notion of an *activity system* in which the activity structure is applied to work activities involving groups

Engeström’s principle of self-organising systems was developed to explain the surprising events and changes that often take place in activities. According to this Engeström principle, activity systems work through contradictions within and between its elements. He also sees contractions emerging from conflicts between different, but related, activity systems in organisations. He classifies these contradictions into four levels, which are placed in appropriate locations in a schematic network of activities presented in Figure 3.6 and explained as follows:

- At Level 1 are primary inner contradiction (double nature) within each constituent component of the central activity, often between the exchange value and the use value within each ,
- at Level 2 are secondary contradictions between the constituents of the central activity,

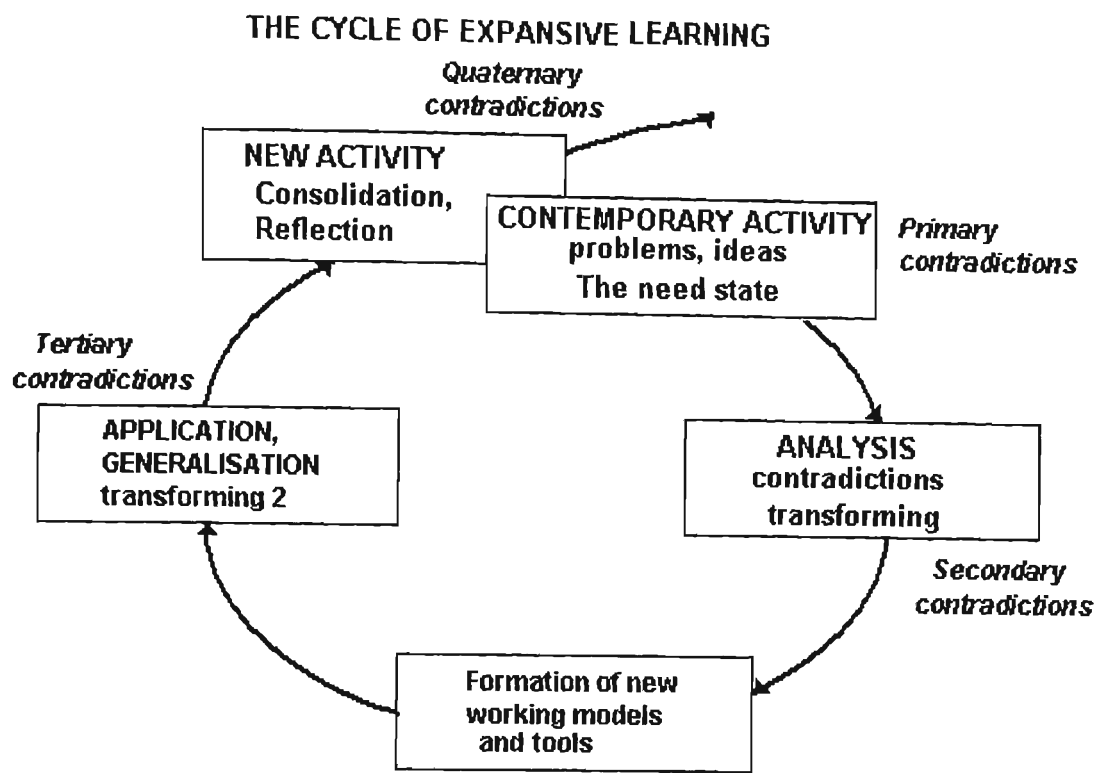
- at Level 3 are tertiary contradiction between the object/motive of the dominant form of the central activity and the object/motive of a culturally more advanced form of the central activity, and
- at Level 4 are quaternary contradictions between the central activity and its neighbour activities.



**Figure 3.6** Four levels of contradictions in a network of human activity systems (Engeström, 1999)

The third Engeström principle concerns evolution and change in activities, which he depicts as cycles of expansive reorganisation, where new qualitative forms of activity emerge as solutions to the contradictions of the preceding form (Figure 3.7). This takes place in the form of “invisible breakthroughs” or innovations, where a phenomenon, which later becomes universal, originally emerges as an individual, specific phenomenon, as an exception from the rule. Thus, any new improvement of labour or new mode of man's action in production, first emerges as a certain deviation from previously accepted and codified norms. Having emerged as an individual exception from the rule in the labour of one or several men, the new form is then taken over by others, becoming in time a new universal norm.

This particular application of CHAT has been called developmental work research (DWR) and combines organisational, educational, technological and work-process interventions into a systemic whole. The DWR approach has been widely used for both research and practice including the work by **Capper's** group in New Zealand.

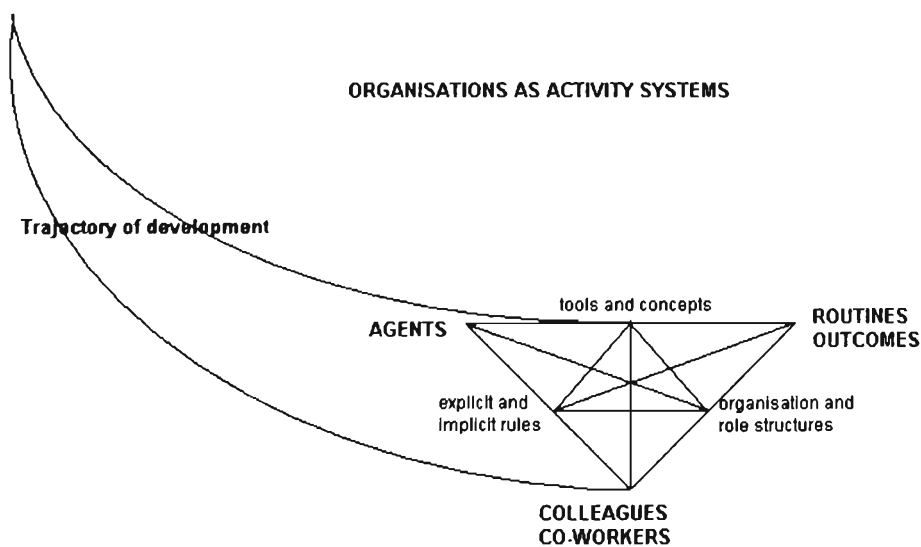


**Figure 3.7** Engeström’s cycles of expansive reorganisation or learning

**Laufer and Glick** are also concerned with transformation in the working practice from a CHAT perspective. In their article “Expert and novice differences in cognition and activity: a practical work activity”, (Laufer & Glick 1996) they focus on what is involved in being and expert in a community of practice. They demonstrate how the analytic concepts developed within the CHAT framework afford an analysis of work practices that bridges the individual-societal dualisms.

**Mike Cole**, Director of the Laboratory of Comparative Human Cognition, UCSD is also well known, for his interest is in the role of culture in human development (Cole 1988). His current research is focused on the design and implementation of activity systems in community settings that combine play, education, and peer interaction. Participants in these systems include elementary-age school children and undergraduates. The systems are studied as microcultures and have been used to implement the cultural-historical principle that development always involves the simultaneous operation of several genetic domains simultaneously.

**Frank Blackler** has taken the concept of collective activity and used it to develop an application of CHAT to the level of the whole organisation. He believes (Blackler 1993) that collective activities take place in small group settings where overall coherence is provided by an expectation that there is some level of agreement on the object of their shared activities. He claims that in large organisations there is a plurality of diverse interest groups, who favour a range of goals and priorities. The effective functioning of an organisation does not depend on people agreeing on why they are doing something: all that is required is that there is agreement on the procedures for determining what should be done. He proposes “a theory of organisations as activity systems” but extends Engeström’s concept of activity systems for group work to *routines* as the “unifying mechanism of the overall system” in organisations. He observes that “organisational practices lie less in rationality and more in their economic and social histories” His *routines* are pragmatic and provide the actual basis for co-ordination within an organisations and a socially constructed context for actions. In Blackler’s model of organsiations as activity systems the primacy of the relationships in Engeström’s model have been reconfigured and a time-based dimension has been added. His diagram, reproduced in Figure 3.8, incorporates an historical aspect and allows for change.



**Figure 3.8** (Blackler 1993)

### 3.6.2 Human-Computer Interaction

The previous chapter described the growing disenchantment of the HCI community with the cognitive model of human-computer interaction and a number of HCI researchers have adopted CHAT as an alternative. HCI is a multidisciplinary field and the backgrounds of researcher in the area are varied. The works of Susanne Bødker (1991), a computer scientist from Denmark and Victor Kaptelinin (1992), a Russian psychologist, have led the HCI interest in CHAT together with work presented at several HCI conferences, held in Russia under the title of East West HCI (EWHCI).

**Victor Kaptelinin** is a Russian Vygotskian psychologist and a pioneer in the development of the CHAT approach to HCI research as a radical shift from the cognitive model. His general conceptual position of activity theory is that it can influence human-computer interaction in four ways. It can help orient research and development by indicating new directions, which have been overlooked or underestimated by the HCI community. It may allow for the formulation of new questions. It may provide support for solving actual problems of HCI and it can contribute to self-reflection within the HCI community and thus lead to a better understanding of its values, intentions and social context (Kaptelinin 1994).

Kaptelinin (1992) identifies four points which he proposes are of central importance to the CHAT perspective. They are:

- the identification of the specific psychological functions of computer tools and how they differ from other kinds of artefacts,
- consideration of the psychological nature of the functionally equivalent processes involved. More specifically whether they are activities, actions or operations since this can affect the design and training strategies,
- an analysis of the development of users from novice to expert as they develop new skills and abilities with experience,

- the relationship between computer tools and cultural influences which can render successful systems in one social setting ineffective in another.

Kaptelinin believes that integration of a tool into the structure of activity enhances the natural ability of a person and empowers them by extending some pre-existing structure be it motor or cognitive. As depicted in Figure 2.4, he sees computer tools as extensions of the internal plane of actions, the cognitive structure whose function is to perform *actions in the mind* before their actual realisation. Kaptelinin suggests that our mental structure can be extended by delegating to the tool all or some of its components. This leads to two methods by which computers can be integrated into the structure of activity. The first is by creating tools that support functional components of the IPA and the second is by designing systems that substitute for it. However Kaptelinin warns against this substitution as it implies that humans do not need mental models at all and can function in a state of complete dependence on a tool and completely independent of the structure of human activity. He suggests that at the very least, some preliminary knowledge would be required in order to know whether to use the tool at all.

**Susanne Bødker** comes to HCI from a computer science background and is well-known world wide since the publication of her doctoral thesis “Through the Interface: a Human Activity Approach to User Interface Design” (1991) where she brings CHAT to bear on user interface design. In this book, she argues that any theory of user interfaces must be part of a larger theory of human work and that designers must build systems that have interfaces that are transparent to the user because humans use computer tools to reach meaningful goal, which exist beyond the situation of human-computer interaction. She has subsequently produced a large body of work describing how this can be done, building on the notions of participatory design, using scenarios, prototyping and simulations of future work action to engage users in the design process. Her research emphasises the importance of the relationship between the design activity and the use activity discussed in her article with Kaj Grønboek, “Users and design in mutual activity: an analysis of co-operative activities in systems design”.

**Olav Bertelsen**, a doctoral student of Bødker and Kyng has completed his Ph.D. thesis entitled “Elements of a Theory of Design Artefacts: a contribution to critical systems development research”. The thesis points to CHAT as a possible basic vocabulary in systems development research; integrating the relevant and necessary aspects involved in designing computer artefacts. The argument of the thesis is based on the CHAT tenet that human praxis is mediated by artefacts and is continually changing in the process of socio-cultural development; as well as the notion of historical crystallisation of praxis into artefacts.

Olav’s work begins with a general CHAT perspective based on a dialectical materialist approach coming mainly from Engeström. He then applies the notion of primary, secondary and tertiary artefacts from Wartofsky (1979), stating that design artefacts are, or belong to, clusters of primary, secondary and tertiary artefacts, each class simultaneously mediating different elements of the design. This concept is complemented with the notion of boundary objects as defined by Star (1989), where artefacts mediate design in a boundary zone, where heterogeneous praxes meet to create the new. An interesting observation that he makes, relevant to my study, is that computer artefacts are changing during use without being altered technically.

**Bonnie Nardi** is one of a small number of North Americans who have become interested in what CHAT can offer HCI. In her EWHCI’94 paper, Nardi explains her position by saying “As an anthropologist committed to naturalistic study, yet searching for analytic richness and rigor, I have become an enthusiastic student of activity theory.” In this paper, concerning a study of whether end-users preferred task-specific or generic application software, she observes that her analysis would have benefited from a CHAT treatment. She believes that the application of some basic concepts from activity theory would have made immediate sense of her data.

In a published workshop discussion (Hasan et al 1998) Nardi states that the language and concepts of CHAT are practical tools that should be used support the activity of ethnographic research providing at the very least a *shared vocabulary*. She has worked

with Victor Kaptelinin to produce a CHAT-based checklist (Nardi & Kaptelinin 1997) to be used during the design process to evaluate usability of artefacts. Nardi is however best known for her book “Context and Consciousness: Activity Theory and HCI” (Nardi 1996) which has become a must for anyone interested in the area.

Two other notable examples of HCI researchers using the CHAT approach are **Steve Draper**, a student and colleague of Don Norman at UCSD, and **Brad Blumenthal** who was closely involved in the organisation of several of the EWHCI conferences. Their best known publications are Draper (1993) and Blumenthal B (1995).

As CHAT has a long history of acceptance in the field of child development, it is to be expected that researchers would apply the CHAT tool concept to the uses of computer technology in education. Linard and Zeiliger (1995) and Bellamy (1996) are excellent examples of this.

### 3.6.3 Information Systems

Although some of the following comes from publications in other areas such as HCI and CSCW, the main message comes from researchers whose roots are in the field of IS. IS is generally not well understood by those outside the field, so there is a special understanding of IS issues that is apparent in the work of the researchers whose ideas are presented in this section. However other influences can be seen, in particular the work of Engeström and the usability and design concerns of HCI.

**Kari Kuutti**, from the IS Department at Oulu University, Finland, and **Liam Bannon** from the Department of Computer Science and IS at University of Limerick, in Ireland have been the most prominent IS researchers to adopt CHAT. Kuutti had worked with and was influenced by Engeström’s ideas before spending some time at Limerick with Bannon. Both have an in-depth understanding of the complex problems facing IS research and practice and have produced several articles persuasively arguing the case for CHAT solutions to these problems.

**Kuutti**, in particular, discusses these issues in three papers (Kuutti 1990, 1992, 1996). He recognises three levels of research in IS: a technical level, a conceptual level and a work process level. As shown in Table 3.2 he categorises some current approaches to IS research at each level in the second column and the corresponding CHAT concepts in the third column. In his view all levels are important as well as the relationships between them, a fact often overlooked. He proposes that CHAT may be the only existing theory that can manage these relationships based on the maturity of its theory of learning activity.

In Kuutti’s more recent work he has studied organisational memory (Kuutti & Virkkunen 1994) and the provision of information system’s support for networked organisations (Kuutti & Molin-Juustila 1998). Here, work activities are viewed as historically developing systems with different types of connections between the activities. Kuutti also suggests that IS can help in actions that are directed towards sense-making and provided a *window* to look at the object of work in order to understand it better.

Table 3.2 Kuutti’s (1992) IS research levels		
IS Research level & Practice Object Area	Current Background Theory	Corresponding CHAT Objects
Work Process: Contextual, situated, active actors, constuctivity	multidisciplinary approaches, studying social contexts.	Activities giving context to actions and consisting of them
Conceptual	Information processing psychology: studying mental models	Conscious actions containing orientation with mental models and chains of operational
Physical / Technical	human perceptive abilities and motor skills and corresponding technical devices	Internalised and automatic operations, triggered by suitable conditions in situation

Kuutti has observed that there are several connections between work activities that make them a coordinated network. Three of these are:

*the value-chain type*, where the output of one activity will be used as the material in another;

*the support and development type*, where one activity develops new tools and process steps for another;

*the supervision and management type*, where one activity defines and rearranges rules and division of labour for another.

These connections are illustrated in Figure 3.9. and can be found in any organisation.

Kuutti and Molin-Juustila (1998) describe a network organisation where such connections are visible but where also some other form of coordination is needed. These authors believe that “if the members of the networked activities could see themselves as participants in a broader work activity, and their actions contributing not only to the object of their own activity, but also to the overall object of the whole work activity, then they would enhance their ability to coordinate themselves by reflecting their actions against this overall object of work and the status of the overall transformation process”. They suggest that “a popular theme in the current business literature is that the existence and publication of company's ‘business mission’ would help workers to align their efforts better with the ideals of the company and this can be seen as an unarticulated version of this idea”.

Figure 3.10 shows a two-level structure from the work of Kuutti and Molin-Juustila (*ibid*) allows a collective vision to develop, as participants in each lower level activity sees the object of their work against the background of the object of the overall work activity and so align their actions with those of others. Because of this shared understanding about the common field of work, there is less need for tight coordination mechanisms between the lower level activities, thus allowing local flexibility. In general they believe, an activity can greatly benefit by making its object more visible and comprehensible, and information technology can have an important role in that.

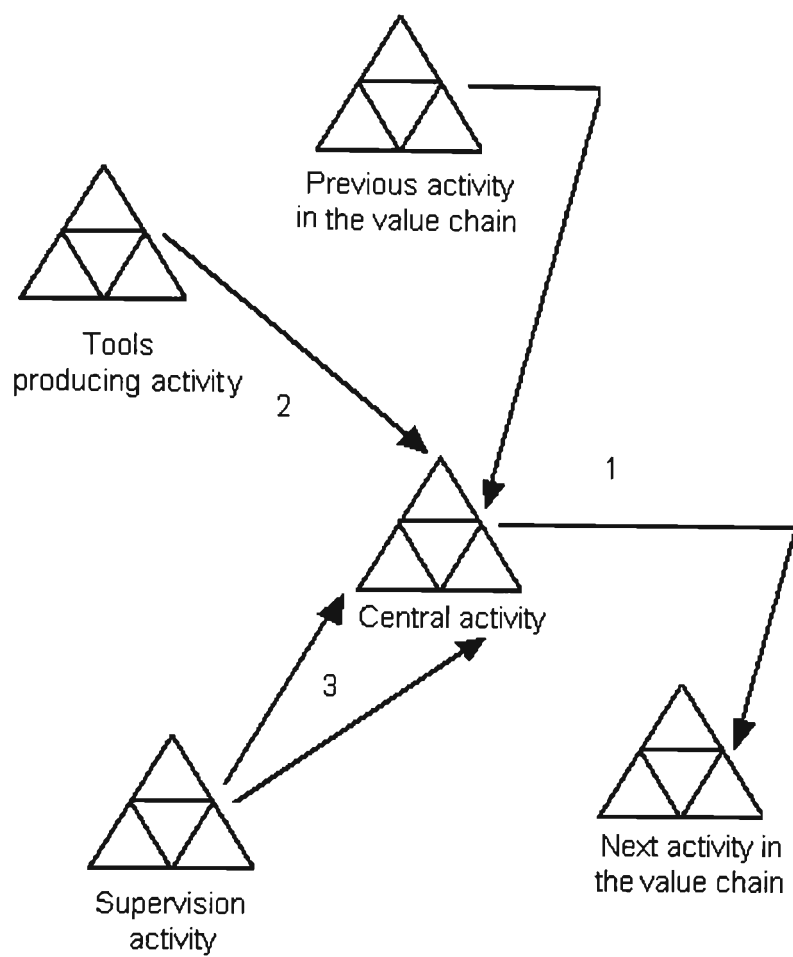


Figure 3.9. Different types of connections between activities

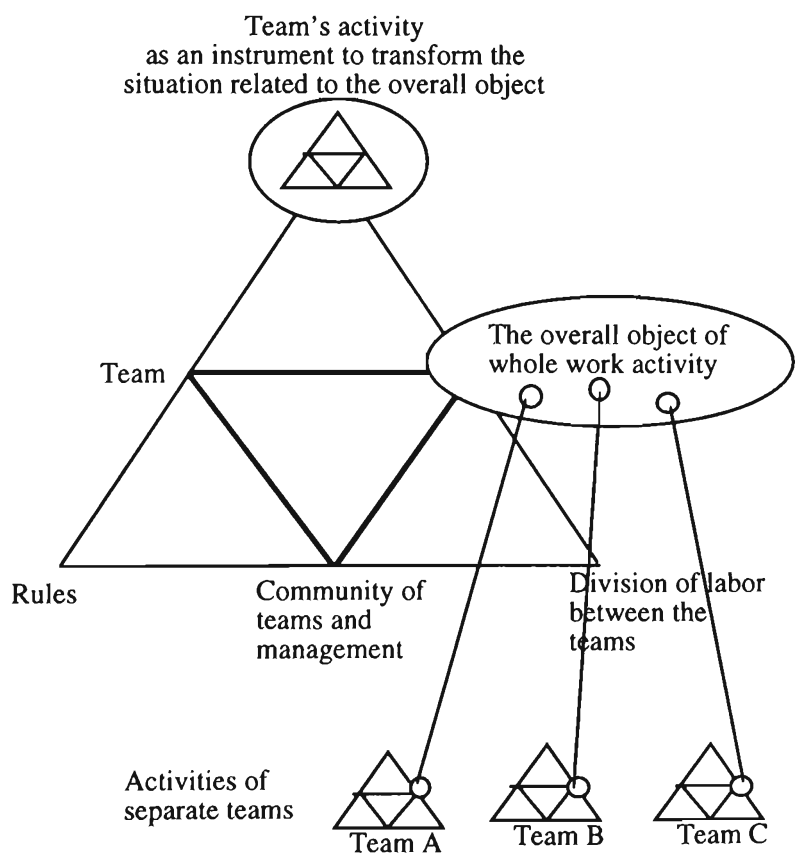


Figure 3.10 Two-level activity structure of a networked organisation.

**Liam Bannon's** (1991) often quoted paper, "From Human Factors to Human Actors", presents a set of problematic research issues that should be remedied:

- from product to process in research and design
- from individuals to groups
- from the laboratory to the workplace
- from novice to expert
- from analysis to design
- from user-centred to user-involved design
- from requirement specification to iterative design

Kuutti (1994) suggests that a common denominator for this list of demands could be called "better contextuality" as each one aims for better account of some aspect of real-life situation. Bannon also calls for a more constructive relationship between *users* and *systems*, such that "users are designers as well".

Two other articles by Bannon (1990, 1999) are particularly useful as philosophical guides to IS-CHAT researchers and have been discussed in the previous chapter of the thesis.

**Susan Leigh Star** is another of the small band of North Americans who have been attracted to CHAT. As she explains (Star 1996) she "grew up" as a symbolic interactionist, learning about distributed artificial intelligence and became interested in its heuristics for understanding knowledge. She notes two trends in the modern world, the "failure of rationalism to account for or to prescribe people's behaviour" resulting in a large interdisciplinary movement in the sciences and secondly the rapid rise of information technologies which are "insinuating themselves into the conduct of work" and integrated into new kinds of international networks.

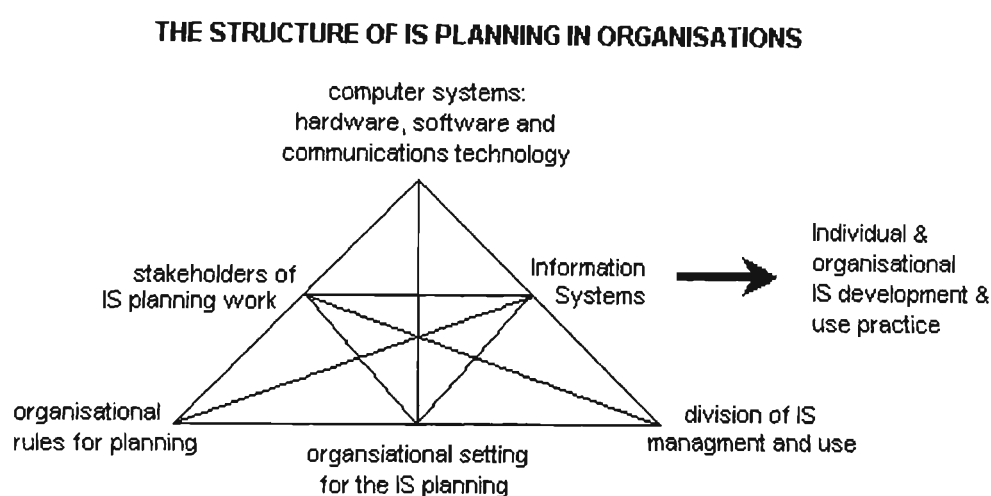
She sees CHAT as offering "the most sophisticated approach ... towards understanding the historical and material specificity of cognition and a way to do away with arguments about perception and cognition that are either idealist or determinist". She quotes the

words of Jean Lave, saying that “cognition, observed in everyday practice is distributed, that is stretched over and not divided among, mind, body activity and culturally organised settings which include other actors”.

Star applies this notion to IS research saying that it is also about the pragmatics of the stretch, concerned with how to make heterogeneous databases, organisation and machines talk to each other in a timely and coherent fashion. She sees IS as a critique of the dominant metaphors of computer science which are “either too closed, and therefore irrelevant to the real world, or too much based on a priori, hyper-rational assumptions about human behaviour that do not hold up to investigation, especially investigation of collective or organisational phenomena”. Her most recent work, reported at ISCRAT’98, looks at the mediating effects of formal systems of classification and standardisation, which are increasingly permeating the worlds of work and bureaucracy. Her paper questions how categories become attached to people and their activities, raising issues of membership, naturalisation and scope.

**Mikko Korpela’s** doctoral dissertation (Korpela 1994) contains a thorough look at using CHAT in IS. He begins by noting that information is not an end in itself but a means of producing some outcome, service or impact. Work is facilitated by both information and by better manipulation of symbols. He defines information systems, or “computer-based symbol-manipulation artifacts used for information-related human activities”, as the material products of the systems development profession”. Korpela compares the CHAT approach to Checkland’s soft systems methodology where “a human activity system is a systemic interpretation given to a real-world situation by attaching a meaning to it, starting from some world view”. From the developmental work research of Engeström he proposes a three dimensional methodology for developing collective work activities. viewing organisations as a network of activities containing multiple themes and theories. His model features *subtriangles* and the ability to zoom in and out of the network.

**Mikko Ruohonen** also quotes Checkland's soft systems methodology in IS, saying that it is important to study the linkages between the technical, social and management elements of the human activity system. (Checkland 1981). His paper at the IRIS94 conference (Ruohonen 1994) looks at the history of IS/IT planning and discusses a number of commonly used theoretical approaches involving stages (eg Nolan) and IS success factors. He then applies Engeström's CHAT framework to IS planning and development as shown in Figure 3.11. Here CHAT is used as a framework to unify the existing IS theories and as, Ruohonen points out, "a lot of action research studies are needed to reveal (IS) development guidelines after the activity-theoretical analysis".



**Figure 3.11** The application of Engeström's framework to IS planning (Ruohonen 1994)

Several of my own IS colleagues recognise the relevance of CHAT for their projects but are wrestling with how to apply it in a fruitful way. **Gould** (1998) contrasts the cognitive science and activity theory approaches to information systems while **Hyland** (1998) has applied the CHAT hierarchy to a study of casual users of information retrieval systems. However while there have been many excellent explanatory studies of systems using CHAT, IS practitioners are crying out for a prescriptive theory, one which can be used to plan or guide projects or to develop a methodology for system design and implementation.

## CHAPTER 4 RESEARCH PLAN AND METHODOLOGY

### **The Research Problem**

How computer technologies and associated systems can be used effectively to provide information to support managers in their strategic activities.

### **Research Question 3**

How to develop a holistic, contextual and dynamic model of the research problem?

The principle aim of this thesis is to develop a holistic, contextual and dynamic model of the complex research problem based on the cultural, historical activity theory, CHAT. To facilitated the development of the model it was considered necessary to conduct an in-depth study of a complex organisation where all the issues identified in those chapters would be encountered. CHAT, as the name implies, demands both a cultural and an historical approach. A suitable method for this study must have a means of dealing with the richness of culture, in context, and the passage of time. To deal with the time factor, an historical research methodology was chosen for the study and, as was stated in the Chapter 1, a single, familiar organisation was selected as a research site, in order to fully appreciate the influence of context.

### **4.1 WHY AN HISTORICAL METHODOLOGY**

A possible approach to a study that must deal with time and context would be to undertake a longitudinal case study or use an ethnographic method. In IS research, it has been common to use a longitudinal case study order to incorporate a time dimension but this is normally limited to a single project over one or two years at most. The richness of the organisational context could be captured by an ethnographic method, but this not easily undertaken by someone with no basic training in sociology. The historical method of

Mason et al. (1997b) is a sensible alternative and so was chosen for this study. It provides a broad perspective on events and brings to light recurring and generic problems that might not become apparent in short-term studies. In describing the method the authors claim that “in the final analysis, the principle product of historical research is context - an understanding of the organisational, individual, social, political and economic circumstances in which MIS phenomena occur”. This statement provides confirmation of the appropriateness for their method for my research problem.

In a companion article to the method itself (Mason et al 1997a), the authors speak of the need to develop a tradition of historical IS research. They believe that any field of study must provide to the world four kinds of knowledge:

- empirical data, observations and facts,
- theories and paradigms,
- ethics and
- history

The study of history is necessary to provide a temporal and contextual meaning for each of the other three. Mason claims that IS research has concentrated on the first two, done some work on ethics but that to date the field has generally lacked an historical perspective.

Mason et al (1997a) note that traditional IS research has a short time-frame, where even most longitudinal studies are at most a few years. However IS developments are forces which change businesses and are themselves affected by changing organisational conditions. History gives a valuable perspective on what works and what doesn't, incorporating the richness, complexity, intricacy and unpredictability of an organisation and its information systems. The advantage of IS history is that it is relatively recent and most of its participants are still available to the researcher.

Kieser (1994) bemoans the fact that organisational researchers rarely look at their history. Historians stress the uniqueness of organisations while organisational theorists stress the general dimensions of organisations, which lack any sense of difference in culture or time. He goes on to say that historical analyses enrich our understanding of present-day organisations by reconstructing the human acts which created them and quotes Weber who was “convinced that in order to understand contemporary institutions one has to know how they had developed”. Kieser gives four reasons why historical analyses should be revitalised within organisational research.

- Structure of, and behaviour in, present organisations reflect culture-specific historical developments
- The identification of organisational problems is often not free of ideology. By confronting “fashionable” trends in current theory and practice with similar developments in the past, we can overcome prejudices that characterise the presentation of these trends
- Historical analyses teach us to interpret existing structures, not as determined by laws, but as the result of decisions in past choice opportunities, some of which were made intentionally and other more implicitly
- By confronting theories of organisational change with historical developments, these theories can be subjected to a more radical test than when merely being confronted with data on short-run change.

In Goldman’s critique of Kieser (Goldman 1994) he agrees that “we will inevitably be prisoners of our time, subject not just to its fads, but to its larger spirit as well”. This is true both of the researcher, studying decision-making an organisation and of the members of that organisation. Cohen and March (1986 p215) advocate that people “interpret history” as a powerful rule in attempts to manipulate decision-makers in organisations. They

believe that decision-makers strive to be consistent but have no time to check the appropriateness of the interpretation. Cohen and March observe that “the belief in the .. legitimacy of history as a basis for action is fairly strong”. Both the researcher and her subjects, the executives of the organisation, have a stake in learning about the history of the organisation and so the problem of getting them to participate in the research is not an onerous one. As expressed by Mason et al (1997b) “an understanding of history helps executives avoid their natural human tendency to view their present circumstances in idiosyncratic, traditional narrow or shallow ways because reading history stimulates the imagination and reveals new possibilities”.

## **4.2 THE HISTORICAL METHOD OF MASON ET AL (1997B)**

Mason et al (1997b) place their method in a research ontology, which assumes and that people and events are unique and that the method is idiographic, involving the intensive study of just a few subjects:

They identify three products of historical research:

1. an account of a significant fragment of the past, describing event of importance
2. the resulting account may be used as datum in an inductive reasoning process that may reveal the possibility of events that may occur in the future
3. the research may serve as the source of new research hypotheses, (much in the same way that an good EIS allows executives to identify problem areas as much as provide solutions).

The steps of the historical method are shown in Table 4.1.

**Table 4.1.**A summary of the steps of the historical method of Mason et al (1997b)

<b>1. Begin with focussing questions:</b>	This must be done for any research.
<b>2. Specifying the domain:</b>	The domain is determined by the questions, in Mason’s example it was a single firm, fixed in time and bounded in context
<b>3. Gather evidence:</b>	An history study requires the gathering and processing of a large number of facts, collected from as many primary sources as possible: written documents, site visits, eye witnesses and stories from secondary sources. Mason recommends a time line to organise data
<b>4. Critique the evidence:</b>	Evaluate and analyse the data
<b>5. Detect patterns:</b>	Interpret the facts using a suitable conceptual framework
<b>6. Tell The Story:</b>	Ideally the account is written in an interesting yet factual way
<b>7. Write the Transcript:</b>	Place the story in a wider context

Following the article in which the authors describe and justify this historical method they published the results of a study using the method (McKenney et al 1997). Their research was directed at an organisation in which the use of IT which was particularly successful due to the opportune formation of a group of people, whom they labelled a leader, a maestro and a supertech. The historical account described the story of the group who came together at an opportune time and produced a “dominant design” for a system, which gave the company a strategic advantage and set the standard for the Industry.

Although such firms make fascinating objects of study, they are not typical of many *ordinary* organisations that successfully adopt their industry’s “dominant design” and whose IS history is less spectacular. There are also business activities, which as yet have no dominant design and which remain a challenge for current IS technology. These are often *informate* type systems, to use Zuboff’s term, in industries which have complex IS requirements. A prime example of this would be information systems to support decision-making in Universities. Having studied the progress of EIS projects in a number of organisations, the author of this thesis is convinced that the information requirements for university management are as complex as those in any organisation, and a great deal more complex than most. Here the IS history can be a fascinating tale but often without the triumphant successes that are declared in some large private organisations.

For these reasons, this thesis will recount a study of the history of projects, concerned with computer systems to provide information support for strategic activities of management, in a university. The account of this history is a remarkable one and will be told in Chapter 5. It has enabled the building of a model, described in Chapter 6, that satisfies the objective of the work as stated in the Chapter 1.

A detailed description will now be given of the application the seven steps of Mason's historical methodology to the study.

#### **4.2.1. Step 1: Begin with focussing questions:**

This is a necessary step in any research. The research problem and questions were declared in the Chapter 1 and the research problem elaborated in Chapter 2 with a review of the literature.

#### **4.2.2. Step 2: Specifying the domain:**

Universities are like most organisations in the current competitive environment, needing to better understand how different technological can provide enterprise information and knowledge to support strategic management. Universities are knowledge intensive enterprises in the knowledge business and, as such, are a particularly suitable environment for research into this issue. They engage in the production of knowledge (research), the distribution of knowledge (teaching) and the management of knowledge in running the organisation (administration). University resources include expert knowledge workers and an abundant supply of advanced technology. It was therefore thought that a university would be a suitable site for an investigation into the way a complex organisation managed its information and knowledge with advance technology.

Having chosen a university as the research site, it was then necessary to decide upon the scope of the study. It was judged most appropriate to focus on a number of projects, that have taken place in the university from 1991 to 1998, which were aimed at developing

systems to provide information, mainly on the university's performance to academic and administrative decision makers. Among these were a formal set of IS development projects, managed by officially constituted teams and some less formal endeavours undertaken by small groups and individuals. The criteria for inclusion in my study were that one purpose or even unintended outcome of the project was concerned with the provision of organisational performance information to managers even though this was often mixed with other internal and external information and at times overlapped with systems for the university's business of teaching and research.

Organisational context plays such a critical role in my research problem that there is a considerable advantage in keeping it constant and knowing as much about it as possible. However Kieser (1994) warns that the selection and interpretation of events is in danger of reflecting the ideologies of the researcher so that, when performing an interpretive analysis of the data, it is important to specify the position of the interpreter, and to make every effort to ensure that the interpretation is a valid construction of the facts and events. As the interpreter of this study, I have never been an administrative decision-maker and was not a member of any of the project teams or on any of the committees related to the projects. However as a member of the university community, I would be affected by the decisions made based on information that could potentially be provided by systems produced by the projects I was studying. I believe this has given me both the advantages of being an independent outsider with the understanding of the context that comes from a member of the organisation.

A general outline of the university context as an industry in the business of higher education and research is given in Section 4.3 below.

### 4.2.3. Step 3: Gather evidence.

Within the qualitative research domain there are a number of approaches to the collection of data. I will follow that of the interpretive, phenomenologists as defined by Miles and Huberman (1994 p8). In this approach, an interpretive approach human activity is seen as text, ie “a collection of symbols with layers of meaning to be interpreted” and this “text” is collected as organisational documents, transcripts of interview and notes from observations. Phenomenologists work with text but are dubious about condensing it, not using any formal coding, but assume that with continual reading and reviewing of the source material one can “capture the *essence* of an account”. In my case, data was collected in the form of organisational documents, records of interviews and observations, minutes of committee meetings, and documentation of systems. As observed by one of the interviewees, an IT manager who had worked in the private sector, the university culture is one of openness of information and it is a place where managers are sympathetic to researchers. This greatly assisted the process of data collection for the purpose of this research. Lists of those interviewed and major documented collected are contained in the Appendix 2.

### 4.2.4. Step 4: Critique the Evidence

According to Kieser (1994) an appropriate strategy for historical sociology involves the use of general models i.e. models that were conceptualised independently of the phenomena to be explained. Such model can be applied as explanatory frames to historical data and provides a means of selecting historical facts that will fit together to form a coherent story. In my case I have used the CHAT framework of an activity as shown in Figure 3.1 in order to select a set of coherent facts. Each of the projects alluded to in Step 2 was treated as a collective activity and analysed according to the CHAT framework. The evidence was critiqued, in other words the data was collated, filtered and analysed, using the elements specified by CHAT and listed in Table 3.1 as follows:

- activity: For each project, considered an activity, the motives and contextual elements were identified
- subjects: academics and administrators, usually members of a team or committee
- objects. The intention and purpose of each project was identified,
- outcomes were determined even for those projects that were not successful
- tools: the technology and methods used by each group
- community: The university tradition, values and structure will be addressed in this context

These elements will be described for each project in detail in Chapter 5.

#### 4.2.5. Step 5: Detect patterns

At this step Mason et al (1997b) recommend the use of a conceptual framework to “organise facts and generate broad plot lines”. To do this here, I have applied a full range of CHAT concepts to the activities that were identified and modelled in Step 4. Particularly useful at this point are the CHAT hierarchy and the concepts of internalisation and tool mediation.

Through this analysis it becomes apparent that the projects themselves are not the only activities of interest in my data. Building on the ideas of Bødker and Grønbaek (1996), the two related activities, *systems design* and *system use*, were detected as relevant to the projects. Many of the participants in the project activities were primarily concerned with the *design activity*, that is the production of technological solutions to a problem, whereas others were concerned with the *use activity*, where the technology would be a tool to support the management activities. The relationship between these two activities are explored further in Chapter 6 leading to the presentation of a new model of the research problem.

#### **4.2.6. Step 6: Tell the Story**

The story is told in Chapter 5 and concerns a public university which, over a number of years, has responded to pressures from the community to become more accountable. This has resulted in a more commercially oriented organisation with the adoption of private sector management strategies for quality assurance with the support of information technology. In the early 1990s the university became part of a consortium to develop a range of information systems, including an EIS, for Australian universities. As it became clear that these products would not be available for many years, the university has attempted several projects of its own to provide performance information for management.

#### **4.2.7 Step 7: Discussion and Write the Transcript**

In this concluding step the story is placed in a wider historical context based on the assumption that the lessons drawn from this story can be applicable to other organisations in similar circumstances. Both Walsham (1995a), in IS, and Miles and Huberman (1994), in the social sciences, agree that this can be done successfully. Walsham argues that the value of qualitative research comes when explanations of particular phenomena, derived from interpretive research in a specific setting, are valuable to other organisations and contexts in the future. Miles and Huberman argue that the use of a reputable theoretical framework enhances the generalisability of the results of a single site study.

After telling the story in Chapter 5, the CHAT framework will be used to construct a model of the research problem base on my study in Chapter 6. Chapter 8 contains a discussion of the wider applicability and generalisability of this model in two ways. Firstly, it will investigate what the model implies for methods of EIS development, both from a technical and a managerial perspective. Secondly, it will look at the capabilities of a small group of new integrated and sophisticated technological systems that are attempting to address the identified problems.

4.2.8 Qualitative Data Analysis and the Historical Method

In summary the research approach is to follow the seven steps of the historical method using the CHAT theoretical framework both to critique the data (step 4) and to detect patterns (step 5). This theory provides a rich language for identifying the main domain elements in a complex, dynamic situation and for describing the relationship between them.

To further guide the data analysis the iterative model of Miles and Huberman has been followed as shown in Figure 4.1. Steps 3 to 5 of the historical method correspond closely to this model which incorporates the four phases of data collection, data reduction, data display and the drawing, and verification, of conclusions. The CHAT framework is ideal for each of these phases but particularly for the data display phase and it will be used extensively.

In this view, qualitative data analysis is a continuous iterative enterprise. Issues of data reduction, of display and of verification successively come into play as analysis episodes follow each other. Miles and Huberman claim that this process is essentially the same as the analysis modes that quantitative researchers use and, conceptually speaking, no more complex.

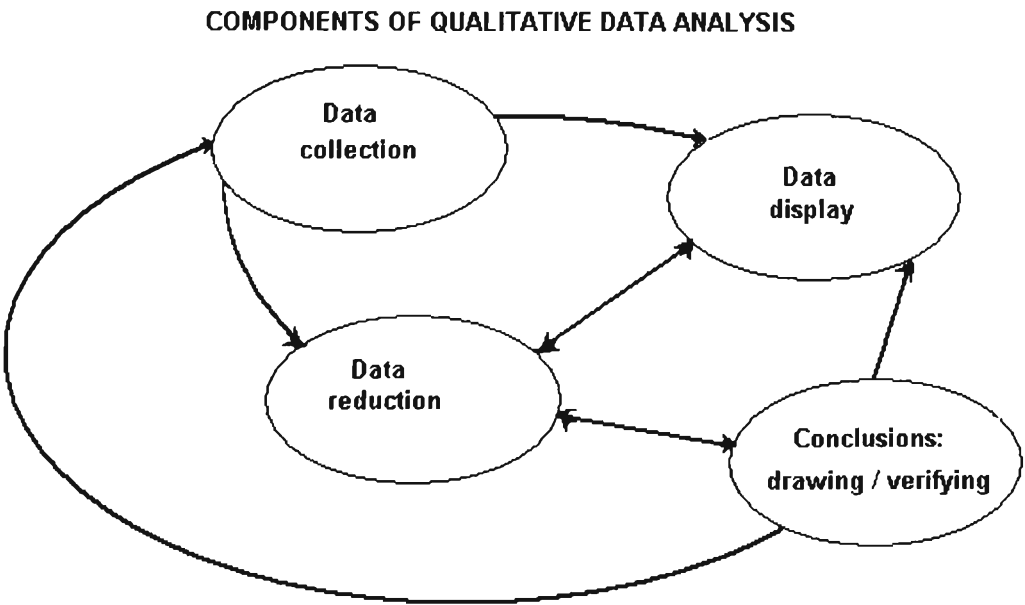


Figure 4.1 The iterative data analysis model (Miles & Huberman 1994 p 12)

## 4.3 THE CONTEXT OF UNIVERSITIES

Speaking from his experience as the Vice Chancellor of an Australian university, Don Aitkin (1998), originally an historian, warns that trying to impose new direction without awareness of the university's history is to invite early failure. He describes myths, legends, symbols, ideas and ideologies that give intellectual and emotional reassurance, intimating that "there is a proper and honourable place for them in a university in a world that often seems short-sighted, materialistic and ungenerous". This is a universal concept, applying to universities throughout history and across the globe. Universities are distinctive organisations and their general characteristics will now be discussed.

### 4.3.1 Universities as Professional Organisations

Managing an institution of academics, or any other professional body, has always been a difficult task. Mintzberg et al (1995 p173) describe the nature of professional work as complex, quoting examples in law and accounting firms, medical practices and universities. Such organisations have operating cores populated by highly trained professionals, coordinated by the similarity of their skills and the standardised from their extensive training, supplemented by on-the-job training and indoctrination. These authors note that other forms of standardisation, such as the hierarchical authority common in many businesses, do not work in professional organisations, because the actual business of a professional is too complex.

Mintzberg (1989 p 173) proposed the notion that universities are professional bureaucracies, combining a professional, democratic, academic tradition with a hierarchical, bureaucratic, administrative structure. While granted professional autonomy, public universities are strongly accountable to governments and the community. This conflict of interest is a source of inherent tension among two groups of managers, academic leaders and administrative personnel. According to Chambers (1981) there should be a

balance between the decision-making responsibilities of the two groups. While there is a need for the specialist knowledge of the professionals, this should only be limited to their field of expertise and there is a need for collective knowledge to be managed by generalist administrators. More recently McInnis (1998) observes that there is now an expanding array of specialist administrative staff in universities, resulting in a renewed unease and ambivalent relationship between academics and administrators. The new breed of administrator has the power to redefine academic work and there is concern over the sustainability of academic values and the control over knowledge.

Mintzberg, (1995 p282) claims that when complex work is carried out by professionals with standard operating products or services, an organisation can be bureaucratic without being centralised. He describes the management structure of professional bureaucracies as the inverse of the usual pyramid i.e. the professional operating core on top served by administrators. What normally happens is that parallel and separate administrative structures emerge - one (the professionals) is democratic and bottom-up, and the other (for support staff) is machinelike and top-down. Because the top administrators have few sources of power with which to direct professional, they tend to perform a lot of disturbance handling and work a lot at the boundaries, a key role being the contact with government and community outside the organisation. When times are economically difficult they can gain power by means of controlling the distribution of funds.

Universities consist of a number of sub-units, loosely coupled to the rest of the organisation (Rae 1998). There is a great deal of professional autonomy within disciplines of the academic profession, while there is at the same time consistency of behaviour among the professionals. For most academics, recognition of their work by their peers in the international community within their academic discipline, takes priority over local institutional acclaim. Aitkin (1998) categorises academics as either “discipline-oriented” or

“college-oriented” but says that the truly collegiate academic is rare and not often appreciated.

On the other hand, university administrators, like private sector managers, have multiple corporate goals to achieve locally and are not concerned with the international perspective (Kennerley 1992). Mintzberg et al (1995 p277) state unequivocally that the central mission of any professional bureaucracy is the provision of the profession's basic service, which in the case of universities is education and research. This service is significantly controlled by the professionals. To successfully carry out this mission, university managers rely on a system of rewards to successful teachers and researchers, in particular promotion and the provision of resources. According to Mintzberg et al the outputs of professionals cannot easily be measured but in the current competitive climate academic rewards are being linked to sets of performance indicators, which supposedly represent quality measures in both teaching and research. This has important implications for information systems and the issue will be discussed further in Chapter 7.

In most universities, both academics and administrators can identify a number of strategic objectives not directly contained in the central mission. Mintzberg et al (*ibid.*) identify three ways that strategies form in such organisations- decisions made by professional judgement (related to the basic mission), decisions made by administrative fiat (usually restricted to issues not related to professional work), decisions made by collective choice (both collegiate or politically by self interest). These decisions made by collective choice are usually about the boundaries between programs and departments, about conditions for hiring and promotion, and about budgeting. Universities are considered conservative organisations and not known for innovative management. New initiatives usually have a champion but there also needs to be a democratic process, often involving several layers of committees.

Aitkin (1998) comments that “universities are specially given to meetings, which are collegial life in action”. This is compatible with the garbage can model describe in Chapter 2 and often appears to consist of non-purposeful and random behaviour. This suffers from three problems, lack of coordination, discretion, innovation and would seem from outside to need more control. Marginson (1996) recognises this as a conflict between management and democracy and observes that new systems of governance are required in universities that “encourage debate without retarding efficiency or responsiveness”.

Tilley (1998) is more positive and notes that universities are “long surviving historical organisations” and that somehow in practice, “effective policy formation continues to recognised a balance between managerial direction and the collegiate environment in which the policy is proposed, discussed and formalised”. He goes on to extol the importance of distinguishing between different kinds of policy making in universities:

- corporate policies: concerned with the mission and external accountability,
- strategic policies: concerned with the institutional strategy, including academic policies in teaching and research,
- academic policies: concerned with academic standards, performance and academic freedom, and
- organisational policies: concerned with the implementation and support of strategic policies.

Tilley observes that the practice of policy making will necessarily, and appropriately, involve some or all of these but the broad responsibility for different types of policies should be taken, democratically, by different levels of governance.

In summary McInnis (1998) declares “The university has long been regarded as a remarkably stable institution with a powerful set of core values kept in place despite social and political pressures over the centuries”. In the current volatile economic and social

climate, “maintaining a balance between the traditional goals of the universities and the contemporary demands is vital to their continuity and their contribution to society”.

#### 4.3.2 Universities as Businesses

Over the last decade, university planning and policy development has been affected by reduction in public expenditure, increases in emphasis on efficiency of resource utilisation and management and a strengthening of the policy and planning role of individual institutions (Ritter 1998). This trend has been observed in most industrialised countries. Stensaker (1998) talks of the Norway experience saying “In universities recent government funding changes have led to tightened coordination and control systems and the development of new policies for research and education, with decentralisation of authority, results-oriented planning and quality assessments”

Universities, traditionally havens of higher learning and research away from the pressure of the *real world*, have turned into commercial businesses, as students become *customers*, course become *products* and research becomes more applied and self-funded. With this change to a market-driven orientation, universities are adopting management strategies and technologies that appear to have been successful in private, profit-making companies, particularly in the manufacturing and retail industries which sell *products to customers*.

These management strategies and technologies from the private sector have made demands on the information systems of organisations, which have been of particular interest to my study. The impact of information technology and globalisation is assuming critical importance in the current transformation of universities (McInnis 1998). It may be that the experience of these systems in a complex environment such as a university will help us better understand IS support for strategic planning and concepts of quality back in the private sector. There has been as great deal of scrutiny of the changes that have occurred in

university as they have become more competitive and business-like and this sets the context for my study of the development of information system support.

Marginson (1996) is one such scrutineer of the immense change that has taken place in management and organisational systems of Australian universities in the last ten years. He even observes that the pace of change seems to have quickened over the last three to four years. According to Marginson, universities are undergoing a process of perpetual reform the common elements of which are economic and cultural.

In economic terms Marginson believes that the growing competition is not inevitable but the result of deliberate government policies based on economic rationalism, the dominant language of public policy. The economic rationalist imagines that the university can become a competitive and profit making concern, based on measurable inputs and outputs. This does not work in practice because the objectives of a university are more than mere economic objectives and if it were completely rationalised along economic lines it would cease to be a university. This is obvious to most of those who work there but every effort is made to press the university into the mould as far as it will go using faddish management theories and forcing profound changes in institutional administration. The outcome is a hybridised, semi-corporate organisation.

In cultural terms Marginson observes that while many of the old collegiate structure remain, management requirements and managerial discourse increasingly dominate the internal life of institutions. Academics are locked in by performance reviews and the resulting performance anxiety and are responsible to departmental managers. They in turn are locked in by budgets and quality assurance and to faculty managers and so on up the organisational hierarchy. At the same time the new kind of professional academic management is spreading downwards to faculties, research centres and departments. A common strategy is the devolution of management to tasks and responsibilities to

departments but this means that heads of departments have new pressures with devolution of power and line management responsibilities (McInnis 1992).

In Marginson's view the university community seems to have been defined by the demands of government and big business and this is creating a trend towards cultural homogeneity. Social responsibility is largely defined and practiced in economic and managerial terms with a deterioration in student staff ratios and at the same time quality assurance appraisals are making staff work harder to compensate. The following is an interesting quote from an interview by McInnis (1998). "There is a deep antipathy to viewing universities as large business which need to serve their clients (students) effectively and efficiently. Students seem at most a necessary evil. This lack of real client focus is very disturbing given the trend to increasing charges".

Miller and Pincus (1998) have assessed the economic efficiency of higher education by considering it as a form of investment whose costs are concentrated in time and whose benefits are diffuse over time. They suggest the best approach to attaining efficiency is to use decentralised voluntary decision-making and to improve its results by shaping public policy appropriately to alter the incentives facing individual decision-makers. (The alternative, is to use public policy to pre-empt the individual's decision through central controls, prohibitions and commands and this would be undesirable and inefficient.) They observed, however, that public financial policies in higher education have implication for equity as well as for efficiency and criticise the policies of the current Australian government, saying that most of their incentives do not promote efficiency let alone equity and diversity.

Universities are a highly dynamic knowledge system of research, teaching and administration in a rapidly evolving society (Wilson 1996). Into this system has come management techniques and technologies from commercial organisations including the use of performance indicators, personal appraisal and institutional evaluation facilitates, social

and institutional discipline. These processes have place new demands on university staff and have heightened tensions. There are conflicts between the cultures of academics and administrators and between decentralised and centralised decision-making (McInnis 1992). Key concepts in for success in business are efficiency and effectiveness but in universities quality is currently said to have replaced concepts such as effectiveness and efficiency (Stensaker 1998). Because of the implications of quality assurance for information systems, the following discussion is included here.

### 4.3.3 Quality and Performance Information

According to Middlehurst (1992) the concept of quality management comes from the private sector which advocates the centrality of the customer, with company-wide commitment and participation in process quality improvement, led by top management and designed to align the mission, culture and work-practices. Although the total quality management (TQM) movement is no longer as fashionable as it was a decade ago, its concepts are prevalent in university management processes. The advantage of TQM is that it treats quality is not as a thing but an event or a series of events, ie a process.

Billing (1998) believes that the TQM recipe gives hope for managerial improvements within institutions of higher education where the current definition of quality is *fitness for purpose*.

Some of Billings recommendations, based on TQM, are:

- in the current environment deliberate management strategies are needed,
- centralisation may be more effective in professional service organisations with small subunits but in universities the most effective decision-making process is political and participatory,
- assuring consistency of process is more important than controlling variation of product,

- service quality in universities should include *adding value* and *delighting the customer* and socialisation of the user (student) is vital
- people are the organisation so that individual learning is the basis for organisational learning:
  - capitalising on continual learning,
  - facilitate information sharing,
  - provide good horizontal and vertical communications, challenging manager's mental models and
  - use short-term problem -centred task-forces to increase participation
- none of this is possible without data-based decision-making requiring specification, gathering, analysis, management and communication of reliable, rapidly processed and useful data. (quoting Deming 1986)

Marginson (1996) warns that while transparency and accountability are desirable, it is not sensible to embrace a particular system of accountability and social responsibility without qualification. In his opinion the narrowness of most of these systems is a problem. It is important to carefully decide what performance information is collected and for what purpose.

Currently in Australian universities the main reason for research assessment is to enable the limited resources to be allocated selectively by quality and the main reason for assessing teaching quality is accountability for the large government expenditure. For the latter is not unreasonable for the government to take steps to satisfy itself that financial support is being properly expended. However teaching assessment is less well accepted because of the inherent difficulty of establishing what is being assessed and, as mentioned previously, because staff are conscious that the assessment process is designed to make them work harder in light of increasing student-staff ratios. Ritter (1998) notes however that quality of

teaching does not seem to have suffered with the increase numbers of students, as staff found that they received job satisfaction in performing well in one area where they felt they still had control.

Research assessment criteria have been clearly established as quality of output including research income, publications and numbers of staff and students. The direct effect of these assessments is an increase or decrease of funds and the ability to attract good research students. As a result of the assessment research is becoming a more managed activity with strategic decisions about what to strengthen and what to leave. An unintended outcome of the assessment is that the research exercise has become something of a *game*, which individuals play to maximise their returns, for example by splitting one paper into several or by appointing staff with an established publications record rather than young inexperienced ones. (Wilson 1996)

Assessment exercises, of teaching and research outcomes, supply information to managerial decision-makers but the issues that are addressed in this thesis are not the assessments themselves but concern the relevance and suitability of the information collected and how it is used. There is much scepticism about the way this is currently done. In her study Ritter (1998) states that collection and analysis of information at the local level was irrelevant as the decision to change was made externally. "Data became filtered through talk-fests and staff felt they had no information although information was there". Rae (1998) observes that, "nowhere is the dichotomy between collegialism and managerialism more evident than in the process of arriving at a strategic plan for the university". and that there is resentment from the ranks that "the strategic plan is a con job by management and therefore symptomatic of a breakdown in the collegiate nature of university governance".

Finally it is pertinent to read the conclusions from Ritter's (1998) historical analysis:

*“Organisations are not inanimate structures with objective realities, rather they are living organisms with political realities. The human factor will always challenge the inorganic model that works on paper. The individuals, the entire system, the technological aspects and the environment interact in often unpredictable and turbulent ways. Planned change itself is an oxymoron. Change as a contained process also assumes that organisations are closed systems. They are not. They are part of a larger environment and even in the most controlled circumstances an unpredictable external shift can produce dire results. Management responds to external pressures by focussing on the big picture. Staff react to management pressures by focussing on micro-politics.”*

## CHAPTER 5 THE HISTORICAL STUDY

### **The Research Problem**

How computer technologies and associated systems can be used effectively to provide information, in particular organisational performance information, to support managers in their strategic activities, with particular reference to managers in public, professional bureaucracies such as universities.

***An interpretive study, from an historical perspective, of IS projects in a university using the framework of the Cultural Historical Activity Theory.***

An interpretive study of IS projects in one university has been conducted using the historical method of Mason et al (1997b) described in the previous chapter of this thesis. Step 1 of this method involved the identification of the research questions, which was done in Chapter 1 of the thesis. Steps 2 to 5 of the method were discussed in Chapter 4, which described the domain of the study as well as the procedures for data collection and analysis. The story, presented in this chapter of the thesis, is required by Step 6 of the method.

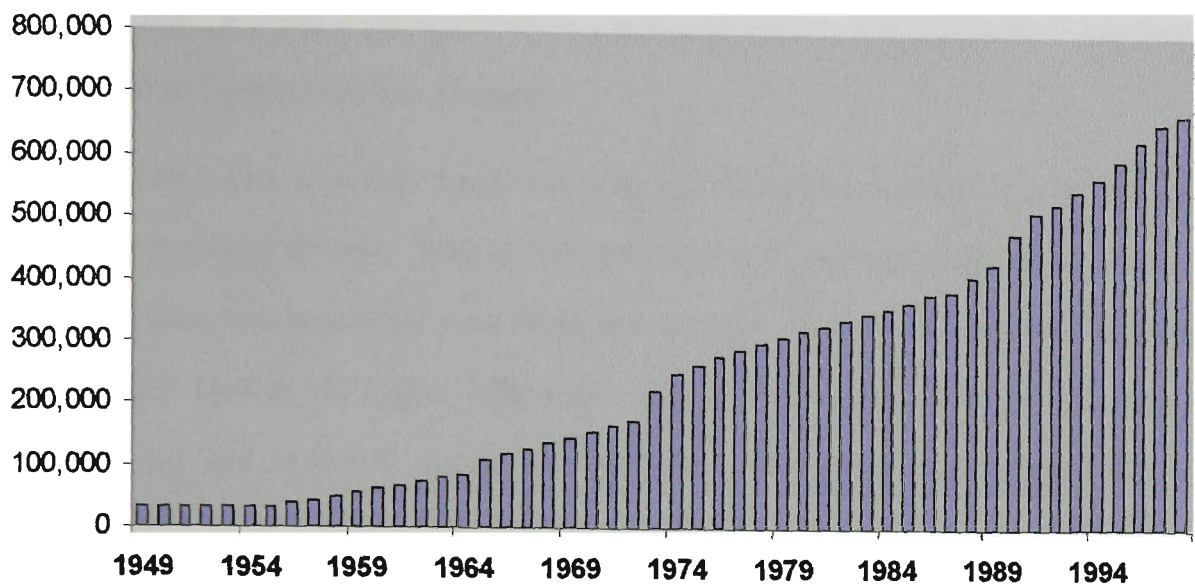
As stated in the previous chapter, the framework of the Cultural Historical Activity Theory (CHAT) has been used for the analysis. Section 5.4 of this chapter will treat each of the projects in the study as an activity, identifying the CHAT elements *subject*, *object* and *outcome*, before describing them in detail. A CHAT approach also directs the researcher to take particular note of context. It recognises that most issues that cannot be usefully studied outside their context and the researcher should begin by acknowledging the richness of the context and its impact on the issues to be studied. It is for this reason the first three sections of this chapter will outline the Australian university, historical and cultural context before the story of the projects themselves is told.

## 5.1 PREHISTORY OF AUSTRALIAN UNIVERSITIES (UP TO THE 1970s)

Prior to the Second World War, accessibility to universities was restricted to a relatively small elite group in the population. Universities were poorly funded for research and limitations of communications technology and travel, hindered the exchange of information (Wilson 1992). The Second World War stimulated immense progress in transportation, wireless communication and the automation of computations to aid navigation and decode the enemy's encrypted messages. These advances, together with an increased demand for university places after the war, saw the birth of the modern university.

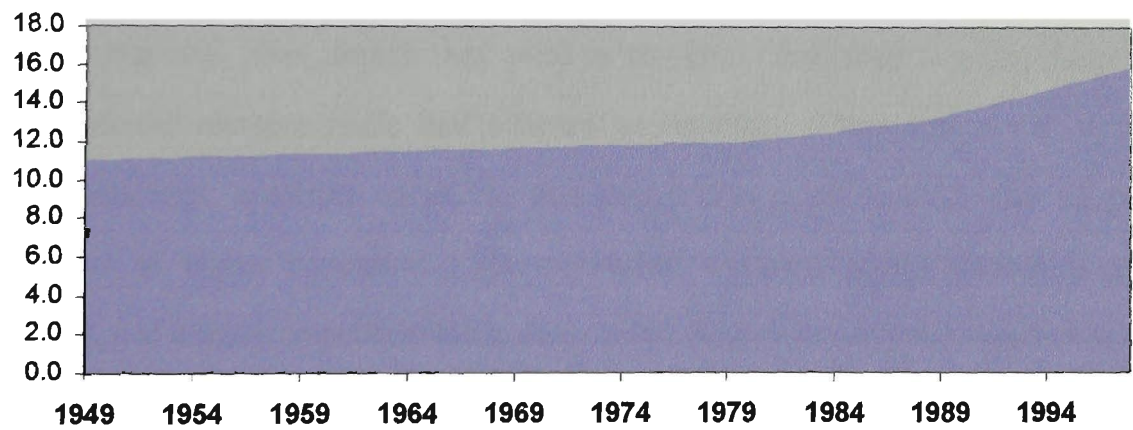
As can be seen from university student populations since 1948, shown in Figure 5.1, there are spurts in growth every decade or so. Apart from the increase around 1963 when the post war baby boom hit tertiary education age, most of the marked changes in student population have been due to changes in federal government or government policies. While granted professional autonomy, public universities are strongly accountable to governments and the community. Although most of the older universities in Australia were set up by state governments, the federal (national) government has gradually taken over the public funding of universities, and consequently has had considerably more influence on their progress in recent years. The public higher education sector has always been responsible to some federal government agency. At one time it was the TEC (Tertiary Education Commission), then DEET and now the current name, DEETYA (Department of Employment, Education and Training and Youth Affairs), which will be used throughout the thesis to refer to this agency whatever is actual name in a particular era. Professor Lauchlan Chipman, the Vice-Chancellor of Central Queensland University and a philosopher, also notes that every decade since the 1950s, there has been a national inquiry into higher education in Australia. (Chipman 1997)

**Student Numbers 1949-1998**



**Figure 5.1** (DEETYA 1999)

**Staff-Student Ratios**



**Figure 5.2** The average increase in Staff-Student Ratios 1949-1998

The 1950s the federal government introduced a system of (merit based) Commonwealth Scholarships to cover course fees, which were around 15% of actual cost. At this time there were only 6 universities in the country, one in each of the major cities and the national university in Canberra, which was the country’s research centre. These are now known as the “sandstone universities” with connotations, on their part, of a long tradition entitling them to a special privileged status in today’s competitive climate. At

that time they had a fairly exclusive catchment area as Australian students traditionally attend an institution close to home.

The 1960s saw a sudden expansion in the number of universities to cope with the baby-boomer school leavers. This meant that cities such as Sydney and Melbourne now had more than one institution competing for students. The federal government promoted a two-tier system of higher education: universities which provided the top level of teaching and research across the traditional disciplines and colleges of advanced education (CAE) which satisfied the demand for more vocationally oriented education where staff had little opportunity for research. During this decade government research funding became generally available to universities. In 1962 teaching first began at the campus that was to become the university of my study although at that time it was a satellite campus attached to one of the new universities in the state capital.

In the early 1970s a federal election brought in a labor government for the first time since the war and, even though they were in power for less than 3 years, there were some profound changes made that affected universities. Their policy was to make tertiary education available to all, so that course fees were abolished in all public institutions of higher education. The commonwealth scholarship scheme was also abolished, and a non-competitive but means-tested, tertiary education assistance scheme (TEAS) was introduced to provide students with financial help during their studies. TEAS aimed to lower barriers to educational participation for students of low socioeconomic backgrounds and brought to the fore issues of equity and diversity.

It was in 1972 that the university, the domain of my study, became an independent institution and, though starting small, developed into a reputable university, serving its own region. The university is situated in an industrial city of around 200,000 residents set on the east coast of New South Wales between the larger state capital Sydney and the national capital Canberra. It developed initially as a port for the local coal mines which were the stimulus for constructing the mammoth iron and steel works that now dominate the town. The university has built on this industrial base, with strengths in

engineering and science, serving the local community, of which a significant component, are working-class immigrants.

Throughout Australia, the late 1970s saw a change in the culture of student population. During the 60s and the Vietnam War protests students had been radical and politically active but then became more conservative and serious as jobs became scarcer. It was at this time that the accountability of institutions began to assume importance.

## **5.2 THE 1980s - SETTING THE STAGE**

The early 1980s saw the return of a labor federal government and heralded the so-called Dawkins era, named after the relevant government minister. It was a period of abrupt transformation when the previous two-tier system of higher education was formally abolished in favour of the Unified National System (UNS) where all institutions including former CAEs would become universities.

Whereas in the 1970s the government had required university management to be more accountable, the focus of the government's review of higher education in 1986 was efficiency and effectiveness. One outcome of this review was an assumption that, to be effective and efficient, universities needed a critical mass. To reach this critical mass there was much time and energy devoted to the amalgamation of some CAEs to become new universities and to the amalgamation of other colleges with appropriate universities. Merging organisations is never an easy process but in many of these cases it was made more difficult by inter-institutional rivalries and the clash of culture between the two types of institutions. The University of Wollongong merged with a Teaching College CAE on an adjacent campus in 1982. Although there was a difference in culture between the two organisations, the merger was advantageous to all concerned. Good leadership, a positive attitude of the staff, the early timing and geographical proximity all contributed to a successful merger before the impact of disruptive changes in the late 1980s.

In the desire to be efficient and effective the new institutions were pressured into becoming more enterprising. In 1986 new, streamlined overseas student entry procedures were introduced, permitting the marketing of Australian courses overseas on a full cost-recovery basis. As can be seen from Figure 5.2 student-staff ratios, a common measure of teaching workload, began to increase notably just as many former CAE staff were embarking on new careers in research. In addition 1987 saw the designation of the higher education sector as an industry and the consequent unionisation of academics, further altered the relationship between academics and university management. In 1989 course fees were reintroduced for student but with a scheme (HECS) whereby the fees would be collected as a tax on income once the student was earning above a prescribed threshold. Although these fees were less than 20% of actual costs they did have the effect of making students more discerning customers.

In 1988 the White Paper containing the Dawkins Higher Education Policy Statement was released. This policy aimed at putting universities on a business-like footing with new funding arrangements based strictly on performance not on the traditional formulae that had evolved historically based on reputation. In 1991 the Relative Funding Model was introduced whereby all public universities were funded on numbers of effective full-time students (EFTSU). Both the HECS charges and EFTSU funding were weighted according to estimated service costs in different disciplines. For research funding a research quantum was established (the NCRG index) which included income from competitive grants, and output measures such as publications. Much time and effort has been expended by university staff in the discussions leading to these decisions. The research funding issues at stake were the composition and the relative weight of the components of the research quantum. In the area of teaching there was the establishment of student quotas in the courses of each institution to balance the numbers of (Australian) HECS funded students against those from overseas who paid the full fee directly to the university.

A consequence of the new funding policies was an increased burden on universities to collect, store and process huge amounts of student and research data. With universities responsible for self-reporting of the information, burdensome procedures were put in place to ensure its correctness. The government requirement to provide and manage this performance information has been a stimulus for IS departments within universities to produce systems with these capabilities as will be seen in the projects described in Section 5.4 below.

### 5.3 THE CONTEXT OF THE STUDY (1990s)

By the early 1990s the changes, brought about by the Dawkins White Paper, were in place and the Australian government turned its attention to making the new system work. The catch-cry of the day was *quality assurance* and it was felt that this could best be achieved through the use of a set of well-researched *performance indicators*. There was considerable overlap between the concepts of identifying indicators as measures of quality and the establishment of formulae for performance-based funding, mentioned above. As a result there has been considerable confusion in the motives for data collection and in the interpretation of the performance information that is derived from that data.

In the 1990s several academic committees were formed to establish performance indicators that could be used to evaluate both teaching and research (see Linke 1995, Ramsden et al 1995). In 1994 a government working party, set up to find an appropriate and verifiable set of Higher Education indicators, came up with a list of 68 indicators grouped into 4 categories of students, staff, resources and research (DEET 1991). Later the categories became Broad context, Staff, Finance and Outcomes as shown in Appendix 3.

Quality of university management was also under review (Piper 1993) and the committee for Quality Assurance in Higher Education was established. This committee undertook visits to all Australian universities between 1993 and 1995 where institutions

were required “to demonstrate, in the context of their mission and goals, the effectiveness of their quality assurance policies and priorities, the excellence of their outcomes and the efficiency and effectiveness of their operations” (Mikol 1996). The committee advocated the establishment of ongoing monitoring processes and corporate information systems to provide evidence of outcomes. To set up their own quality assurance programmes, institutions could apply through DEET for grants from the National Priority Reserve Funds. At this time similar quality reviews were experienced in universities across the western world. However whereas most other countries concentrated on discipline base reviews, the Australian approach has been the evaluation of academic themes across the whole university.

Since the completion of the quality reviews there has been less attention paid to issues of quality assurance and performance indicators. The Hoare review published in 1995 focussed specifically on the management of institutions of higher education. This review gave recommendations (listed in Appendix 4) for making more explicit the roles of university principals (usually called vice-chancellors) and of governing bodies (usually called councils and including representatives from within the university and the wider community). However in 1996 there was a change of federal government. Under the banner of economic responsibility, the new conservative liberal government set about to reduce the national account deficit that had accumulated during the time of the previous labor administration. This included cut backs in funding to higher education and few of the recommendations of the Hoare report were implemented. The new government conducted its own review of higher education and the resulting report (West 1998) says little about either quality assurance or organisational governance.

There have however been a number of studies of issued concerned with the management of Australian universities in the 1990s. Probably the most comprehensive of these (Meek and Wood 1997) reports that there are trends to highly devolved decision making, to the precedence of managerial prerogative over collegial decision making and to the fact that institutions are held more directly accountable for the

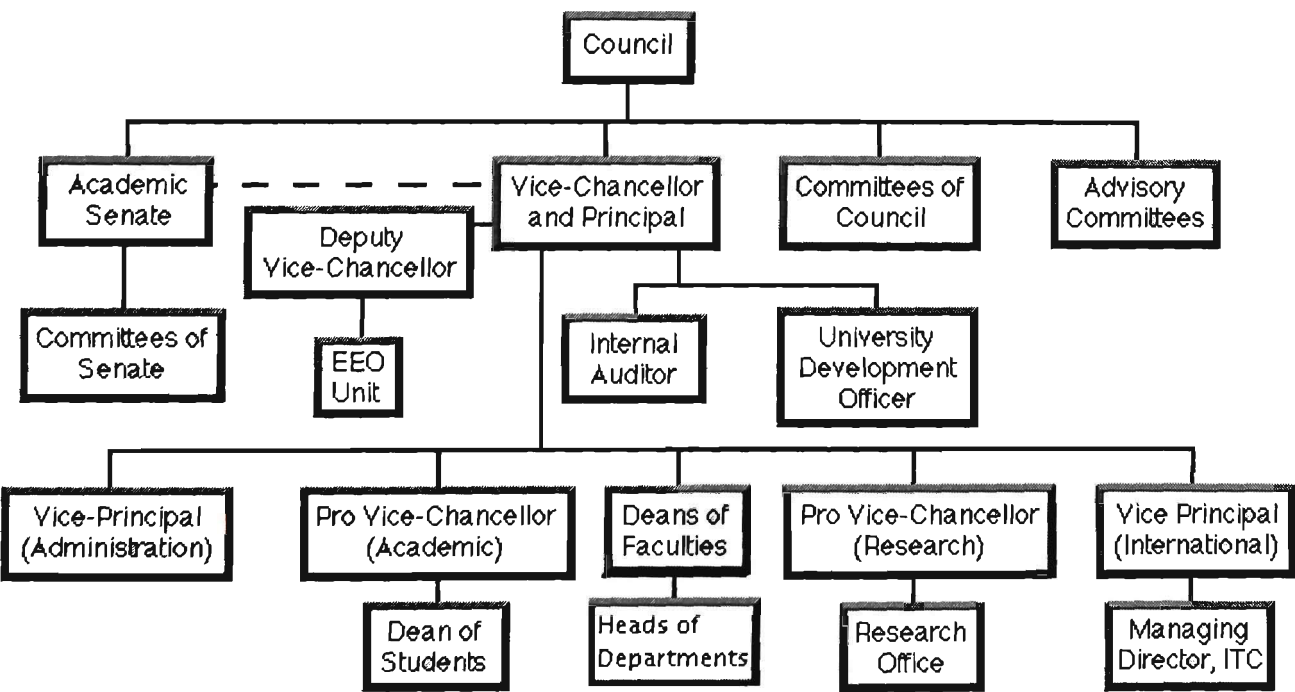
effective and efficient use of funding. These authors observe that, while academic staff perceive that promotions are predominantly related to research performance, teaching is considered that central activity when it comes to institutional evaluation and support of institutions by the government. Pressure has been placed on universities to strengthen management and become more entrepreneurial and corporate like. Meek and Wood (*ibid*) warn that institutions must respond quickly and decisively in order to take advantage of market opportunities.

The university used in the study has been in a better position than many to prosper in the environment described above. An early and trouble-free merger with the local college heralded a period of rapid expansion and the university more than doubled its student population in the 1980s. Towards the end of the decade the university was successfully promoting its course to the full-fee paying overseas market and was well on the way to becoming a business-like enterprise. There was a determination to do well in the government's quality reviews and to be competitive with the more established, so-called "sandstone", universities. To this end, the university's quality initiative began with a two year consultative process culminating in the publication in 1992 of a document "Toward 2000". This contained the university's mission statement, the desired profile of a university graduate together with specific annual goals up to the year 2000 for the university as a whole, and for each department and unit within the institution. By the time of the quality appraisals in 1994 it had attained a level that placed it high on the national list, outranking many of its older and more prestigious rivals.

The growth of the University was assisted by the down turn in the global economy at the end of the 1980s. The loss of jobs at the steelworks and in the mines had a severe impact on the city of Wollongong and the newer industries of tourism and education became the regions biggest export earners. With the growing importance of tourism and education to the local economy, the profile of university changed from predominantly science and engineering to an expanding emphasis on the Commerce, Education and IT

Faculties. The number of student attending the university increased dramatically due to four factors: the lack of jobs for school leavers, the electrification of the train line to Sydney pulling students from the southern areas of big city, the attractiveness of a small town university for overseas students and the growing reputation of the university.

As the university doubled in size in a matter of a few years changes were made to the management structure. At the institutional level, the two basic functions of the university, teaching and research were clearly delineated and top management was augmented from a vice-chancellor with one deputy to the structure shown in Figure 5.3. Teaching evaluations by student survey were introduced as a response to the government insistence on self-evaluation procedures. For a more business-like approach the Office of Planning was expanded to include Marketing and an International Office was created to promote the universities products (courses) to customers (students) in the international market. Research groupings were encouraged and made more formal while a new Office of Research coordinated allocation of resources and collection of performance data



**Figure 5.3** The enlarged university management structure of the 1990s

## 5.4 THE FIVE PROJECTS AS CHAT ACTIVITIES

The fifty or so university managers shown in the chart of Figure 5.3 are obliged to perform very different roles to that of their predecessors of just a decade ago. With budgetary, and other management, responsibilities devolved down to the level of Department Head, there is a climate of competition and uncertainty. This is compounded by the burden of increased teaching loads, the pressure for more directly applicable research output and more time-consuming management activities, including performance evaluation. Government funding cuts and the Asian economic crisis has lowered morale just when there is a need to be innovative and entrepreneurial. Politicians are pushing the university to be an international leader in the use of modern technology including the use of IT for organisational information management. Although they are apparently drowning in information there seems to be more uncertainty and disagreement between managers as to the current state and future prospects of the university. At the same time the university's administrators and academic managers are required to balance the traditional democratic collegiate styles of decision making with the managerial approach of big business.

This is the area, which has already been identified as the research problem for this thesis and it is where a CHAT theoretical approach can be particularly useful. Researchers who have used CHAT, (for example Kuuti 1996, Engestrom & Escalante 1996, Bødker & Grønbeek 1996) have identified the importance to managers of the "sense-making activity", which refers to managers striving to make sense of the overwhelming quantity of information provided to them by various technological systems. It views the technology, not as an end in itself, but as a tool, which supports and mediates the sense-making activity and any other tasks the manager must perform.

The following section of this chapter will recount an historical study of five projects, carried out in one university during the 1990s using different technologies aimed at information management. The projects were: a Quality Assurance Initiative (QAI), a series of Data Warehouses (DWs), a Campus-Wide Information System (CWIS), an

Intranet and an Executive Information System (EIS). The CHAT framework was applied to the five projects, each of which can be viewed as a separate activity whose object is to provide a tool for the sense-making activity. Table 5.1 lists the main CHAT elements for these activities and a timeline is shown in Figure 5.4. Salient features of each project will now be recounted followed by a summary placing the five projects in perspective and relating them to other event that took place during this time.

Table 5.1. The CHAT framework applied to the five projects			
Project (Object)	People (Subjects)	Outcomes	Technology
1. The Quality Assurance Initiative	Education/ Management Academics	A Research Report An “Information Needs Audit” A prototype to display the information identified in the audit	HyperCard
2. Data-Warehouse	IT Services	Separate DWs for student, staff and financial information Several attempts at end-user Interfaces	Oracle relational database with Excel, Oracle Forms and the Web interfaces
3. Campus-wide Information System	ITS / Administration	MIS reports on the OLTP systems Email systems Storage of Text Documents	Various Various MacIntosh File Server
4. Intranet	Administration/ Marketing	Some internal information mixed with the Extranet on Web Pages	Web servers and browsers
5. Executive Information System	UniOn Consortium	The EIS dimensional view of data	HOLOS MDDB on top of an Oracle DW

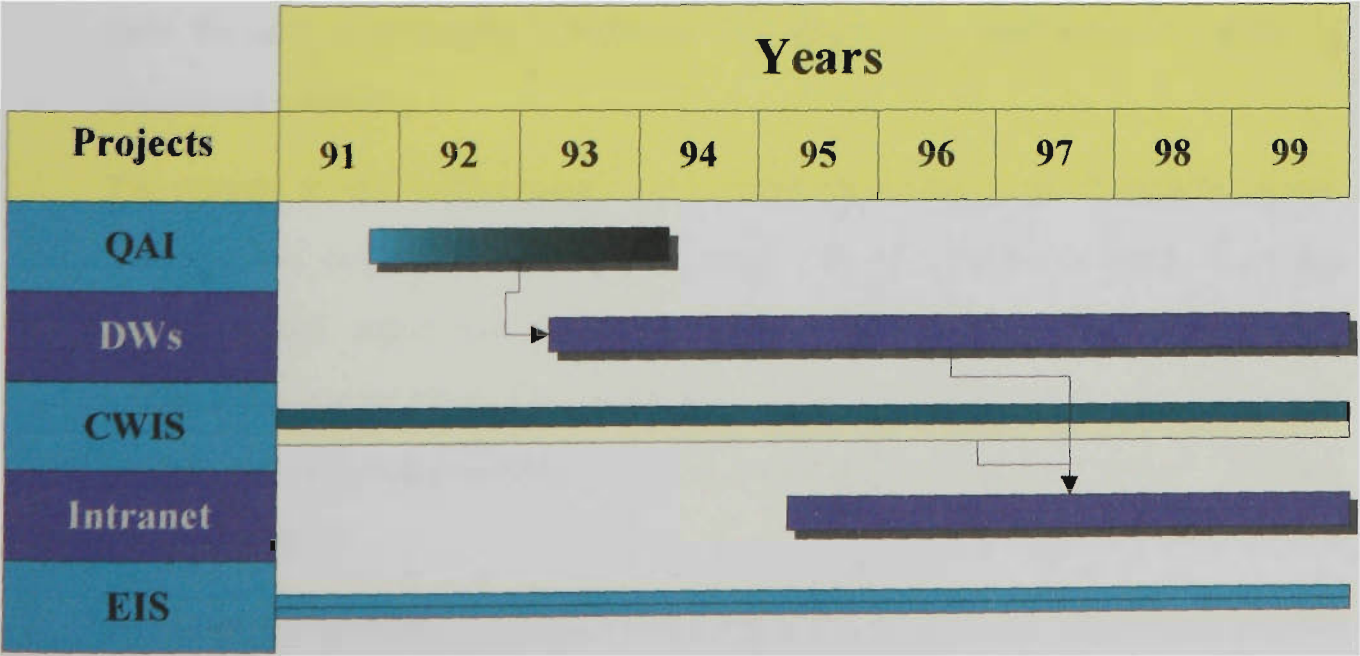


Figure 5.4 The Timeline of the Five Projects

## 5.5 THE STORY OF THE PROJECTS

### 5.5.1 The Quality Assurance Initiative (QAI)

The QAI project began in early 1993 when a group, coordinated by the head of the Education Policy Research Program, was awarded a DEET grant for the investigation of Institution-based Quality Assurance. The motivation for the project came from the federal government quality policies and the research interests of the group coordinator. The project team included representation from senior university management, but there was no permanent representative with IS development expertise and only occasional representation from the university's Administration Information Systems (AIS) Department, who maintained the student database and other operational systems.

The team was controlled throughout the project by academics, from the Departments of Education and of Management, who had expertise in Total Quality Management as well as performance evaluation. They focussed on establishing detailed information needs of academic and administrative managers within the university and a series of interviews were held with representative managerial staff to accomplish this. The QAI team was also concerned with providing an easy-to-use computer display of this information and gave the task of developing a prototype to a small group experienced in producing educational software.

The outputs of this project were: (1) a report containing a set of research papers, reflecting the research interests of the team, (2) an Information Needs Audit for university staff, which was quite a formidable document, and (3) a "user-friendly system prototype to display the information identified by the audit for managers, in academic as well as administrative units, to support informed decision-making" (Fasano 1994, page v).

Unfortunately this prototype lacked credibility, and was never fully developed, because the technology, and IS development expertise, used for the prototype was restricted to the authoring systems that were used in the Education Department for computer-aided

learning applications. There was little thought given to the sources of the data. When the project team disbanded after two years, AIS engaged a group of computer science students to try to integrate the Hypercard interface to live data. However the attempt was short lived as it was judged that it would not be feasible to do the job properly with the resources available. According to the manager at the time the task was “just much more complex than anyone had realised”.

AIS's main concern was for internal organisational performance information whereas the Information Needs Audit contained both internal and external information. A useful spin-off from this project was the setting up of a small unit within the university's administration that would download government statistics collected from all universities into an Oracle database. This unit continues to collect these statistics and manipulate them with a statistical package to provide information for management

The Information Needs Audit was recognised by AIS as a useful document. A member of the AIS staff was given the task of producing a diagram showing links between internal sources of data and the information identified in the audit. This diagram looked like an extensive maze and was not directly useful for systems designers. It was, however, evidence that the most useful outcome of the QAI project was the realisation of the complexity of the information needs of university management at all levels. The project's conclusion highlighted the need by all decision-makers in the university to access information “well beyond what is provided by pre-established lists of indicators” and that there is a “need of staff to access information processing capabilities, as well as just information, allowing individual and specialised reporting” (Fasano 1994, page 91).

### **5.5.2 The Data Warehouse (DW) Project**

In 1994 the university's mainframe computer was upgraded to an AS400. Before the upgrade, it had been assumed that management needs for internal performance information would be met by the reporting functions of the existing OLTP systems transported to the AS400. This included student, financial and human resources data.

The limitations that became apparent in these MIS, led to a decision by the IT services unit (ITS) to create a number of data warehouses in an effort to meet the rapidly growing need for easily accessible financial, human resources and student information.

ITS was directly responsible to senior management although its policies were officially set by an IT committee with representation of interests across campus at all levels. Such heterogeneous committees are common in the university in an endeavour to provide professional academics and general staff in various university units, with a forum to participate in management decision-making processes. However, the existence of the IT committee did not alter the technical nature of ITS and its primary focus remained the acquisition, installation and maintenance of hardware and software.

The data warehouses were successfully implemented, using ITS's technical expertise, and continue to be regularly updated, usually over-night, from the on-line transaction processing (OLTP) systems on the AS400 mainframe. Because this part of the project was left in the hands of ITS technicians, the data structure of the data warehouses reflects the structure of the data in the underlying on-line transaction processing systems with some filtering and consolidation. There was initially little involvement in this project by end-users and their information needs were not met.

There have been three attempts to create extensive user-interface to the data warehouses. These were:

- 1) downloads into Excel spreadsheets, based on a false assumption that potential users of the information were reasonably accomplished with spreadsheets,
- 2) sets of web browser pages and
- 3) a suite of Oracle queries and reports.

None of these systems have succeeded in satisfying end-user requirements beyond a few simple queries and standard reports of low-level operational information such as student class lists and financial account transaction. Programmers are still required to generate

ad hoc reports from the data warehouses, in response to specific requests from management, and for the annual government reporting.

The data warehouse project demonstrated that there is an inherent conflict between the complexity of data and the need for uncomplicated, yet flexible, query systems. Even if the data warehouses contained all the required data at the right level of granularity, the possible permutation and combinations of the data, required as performance information, is prohibitively large. This means that no set of predefined reports would satisfy all possible requests and this is what each of the user-interfaces attempted to do. With this type of data truly flexible, ad hoc queries could only be made by a programmer with full knowledge of the database query language, SQL.

### **5.5.3 The Campus-Wide Information Systems (CWIS)**

Following the establishment of the university's mission and vision statements in 1992, each organisational unit within the university was asked to review its own mission and vision. ITS was no exception and there was a push from senior management to raise the profile of the use of IT within the university. This resulted in the establishment of the CWIS project to coordinate all uses of IT across campus including teaching, research and administration and a CWIS committee was established, consisting of representative IT users across campus. From my viewpoint the most relevant aspects of this initiative were in the areas of electronic communications and text document management in contrast to the data warehouse project which dealt exclusively with structured, predominantly numeric data.

The relative autonomy of university departments and units with diverse sources of funding had allowed independent decisions to be made on IT purchases by different user groups. As a result the campus had a complex mix of networked PCs, Apple Macintoshes and Unix machines as well as other multi-user systems, used by AIS. Overcoming the problems caused by the different platforms was a huge task.

The CWIS team looked at improving the campus IT infrastructure, setting up the campus-wide LAN to integrate all machines on campus and the smaller departmental networks. The need for universal access to email was recognised but technical limitations at the time meant that separate systems for Mac and PC users were established. This caused a marked information division across campus between those units (including all the administration) using MACs and the remainder using PCs that was eventually bridged in 1995 when one seamless system was put in place. In 1996-7 the CWIS committee first looked at adopting Lotus Notes to provide communications and support for group-work across campus. After an extensive trial it was rejected and they decided instead to adopt Network Communicator as a web browser, email system and calendar for the university.

From an information management perspective, the most enduring work of the CWIS was to identify a need to provide access to an increasing number of text documents being produced in electronic form and being continually updated. These included: minutes of meetings, the management handbook, policy documents, guidelines and forms for all manner of things. As all university administrative staff used Macintoshes it was decided to make these significant university documents available on the administration's MAC fileserver. To structure this information they simply placed these documents in a few MAC folders with no facility for searching. Until the advent of the Web in 1995, there was no direct access to most of these documents for non-MAC users. The electronic versions of these documents on the file server were popular and were recognised as a valuable up-to-date resource of organisational information.

#### **5.5.4 The Intranet**

By 1995 the university's ITS recognised the potential of the Web for flexible information delivery and its use was rapidly growing in popularity across campus. Initially internal access was over 90% of use, but external access was steadily increasing. A Web steering committee was set up consisting of technical staff, one representative from Planning and Marketing and academics from the IT disciplines.

The mission of this committee was to cater for the university's information needs into the new millennium with "equity of access, richness of content and ubiquity of service", to quote a memo from senior management.

For two years the committee concerned itself with the university's external image and the management of the university's Web pages, setting policies for style and delineating responsibility for accuracy and currency of the information published not only by central administration but also by departments and individuals. The committee acknowledged that central control of all Web information within the university was impossible and that the Web catered for a wide range of potential audiences both internal and external. Often initial enthusiasm by page developers was not maintained so pages quickly became outdated and it was felt important to set standards and procedures to ensure that information contained in pages remained correct and up-to-date.

Up until 1997 information for this varied audience was arranged in a somewhat haphazard function. The Web committee then persuaded senior management to fund external consultants to redesign the first few levels of the university's main Web pages with an emphasis on the visual image that it portrayed to the external market. There was adverse reaction from within the university to the introduction of the new pages due to two factors. First, the use of highly paid external designers when the university was cutting back on other funding and the fact that there was plenty of expertise in this area within the university. Second, the new pages were introduced with little internal consultation or participation. Many people who were accustomed to accessing certain pages for vital information found that these pages had move or completely disappeared. A year later the pages were again redesigned by an internal group with much the same format but in wide consultation with internal users.

The university's home page was organised around a number of themes one of which catered specifically for internal staff use and could be considered an Intranet. Standard reports from the data warehouses, such as class lists and account balances, were put on

the Web but the range of facilities was limited and there was no capability for advanced or ad hoc management queries. Text documents from the MAC fileserver have increasingly been made available on the Web together with on-line forms for processes such as staff leave and grant applications. This Intranet has been well received and is currently widely used. The main criticism is still that most of the information, of interest internally, has an external focus and that the priority use of the university's Web pages is external marketing not the provision of information internally.

### **5.5.5 The Executive Information System (EIS)**

By the early 1990s most universities in Australia had legacy OLTP systems that had become hopelessly inadequate to handle the quantity and diversity of data in the current climate and failed miserably to provide the sets of performance information, required by management and by the government. The sets of data on which planning was based, had to be extracted by IT staff by means of ad hoc database queries or had to be gathered manually. As all Australian universities faced the same problems, a consortium of universities was formed in 1993 to create a suite of applications for an integrated management and administrative computing system. By the end of 1993, members of the universities consortium were divided on the preferred mode of implementation. A sub-group, UniOn, was formed, of which the university in this study is a member, and whose preferred solution is based on the Oracle RDBMS, together with its fourth generation language and tools.

The university was involved in drawing up specifications for all of the UniOn systems, which included an EIS. For the EIS module, the HOLOS package was adopted which has a multi-dimensional database structure. As espoused by Rockart and De Long (1988), this representation of the data has proven far more meaningful for senior managers than the relational data model of the OLTP systems. EIS packages such as HOLOS provide an easy to manipulate, graphical user interface that enables the manager to analyse performance data and stands in sharp contrast to the difficulty in constructing queries on relational databases.

Although promised by 1995, the EIS has only partially been implemented in one university by late 1998. The project was continually beset by problems, partly due to the political tensions between the participating universities and partly due to the size and complexity of the task. This has frustrated the university IT staff who were involved in intensive HOLOS training courses in 1995, ready for implementation then, and have since lost these skills.

It is generally agreed that the resulting system developed by the UniOn consortium is comprehensive and of high quality but there is reluctance on behalf of the technical staff in the university to adopt it. Three reasons have been given for this. First, as the development time for the UniOn EIS dragged out the university AIS created other means of collecting and presenting much of the same information. People in AIS are reluctant to throw away these systems for an unknown quantity. Second, there is concern for the design of the UniOn EIS which is a HOLOSs MDDb sitting on top of an Oracle data warehouse which in turn draws data from the relevant OLTPs. From the experience that AIS staff have had building their makeshift systems, they are skeptical that the Oracle/HOLOS interface will work, as the structures are so different. Third, because the input of AIS to the UniOn was so long ago and all recent developments were done by a rival university, there is no sense of ownership of the new system and there is resentment of the extra work that they perceive it will involve.

On the other hand senior management have been very impressed with demonstrations of EIS, particularly the manner in which it presents internal performance information in multidimensional form. It is unsure at this stage whether they fully appreciate the technical staff's concerns with the difficulties of integrating the EIS with the underlying OLTP systems. IT staff do not believe that the perceived benefits of the EIS will justify the effort that would be involved in overcoming the integration problems.

### 5.5.6 A Summary of the Projects in Perspective

Placing the five projects described above in perspective, it could be said that the QAI performed the groundwork for the others. Not that the other project teams referred specifically to the QAI output but that some of the same people were involved and having already been exposed to the issues were better able to perceive a way to proceed. This process of general internalisation will be discussed further in Section 5.6.2 below. The DW and EIS project both dealt with well-structured and mostly quantitative data where as the CWIS and Intranet projects were more concerned with human communication using unstructured, mostly textual data. Each of the latter four projects was related to a particular information technology and the mediating effect of the technology will be discussed further in Section 5.6.1 below.

During the 1990s, while the five projects were underway, events took place that influenced the course of the projects. These included changes in personnel and in the structure of the senior executive and ITS, change of government, economic pressure, the increasing capability of IT and an increase in the general computer literacy of all university staff. 1993 saw the retirement of the vice-chancellor (the senior executive), who had successfully led the university through its tremendous growth in the turbulent 1980s. His strong leadership, energy and vision (McKinnon 1986) was widely acknowledged as well-suited for the tasks of taking the university from a small provincial institution to one highly regarded around the country. The task of consolidation and management through the competitive and economically constrained times of the 1990s was left to his deputy who enlarged the top executive to the structure, seen in Figure 5.3, of over 50 people, not including those co-opted to committees. This meant a much wider spread of strategic decision-making and the need to keep these very different people informed in their areas of responsibility.

Throughout the 1990s there were several changes to personnel at all levels in ITS and several changes in structure. AIS, for some time, reported directly to the senior

executive with a rather tenuous relationship with ITS before being placed in its current position as part of ITS. As is not unusual with public sector staff, many highly skilled IT professionals left the unit, many after completing part-time study at the university. Those that have stayed are a valuable source of organisational IT knowledge, although it is doubtful if this is always appreciated by management.

A particularly stressful event for the university was the change in federal government in 1996 and the ensuing 5% cuts across the board in university operating grants. The new vice-chancellor passed these cuts on to all university units who were advised to rationalise expenses by combining or closing departments. An example of problems caused by this rational approach was the national outcry that followed a decision to close the Physics Department on the grounds that from an economic view it was the least cost effective. The general academic consensus was that, with no Physics Department the institution would cease to be a proper university and so what seemed rational from a business perspective would cause havoc for the broader future position of the organisation. In the end the Department stayed, but relocated to the well-endowed Engineering Faculty, which could afford to subsidise it. This issue demonstrates the difficulty that managers have in interpreting performance information in a broad context.

Over the period of the 1990s the universities' IT capability increased enormously and there was a continual and concerted effort to both use IT effectively in all aspects of the organisation and to bring all staff to a high level of computer literacy. This meant that there were many other smaller IT projects underway, in addition to the five I have mentioned and that there was considerable overlap, particularly in personnel between projects. Early in the 1990s a special unit was set up to develop and manage IT for teaching. The library manages a large amount of its information electronically and most researchers retrieve and manipulate huge quantities of data and information via computers. Three other smaller projects are:

1. a small independent group who download government statistical data mostly from DEETYA and provide management with comparative information on all universities in Australia,
2. a database of course information set up by the university's student admissions centre to assist inquiries from prospective students, and
3. a list of data collected by the research office to calculate the research quantum

Each of these projects are small but could well have been included as relevant to the research problem. The first was omitted from the study as it deals mainly with external data and produces only written reports to managers. The second of these projects, together with those will use it, are being currently run by a company affiliated with the university but a separate enterprise financially. Members of this company were not open, as were the participants in the other internal projects, to interviews concerning the project. However many people within the university are interested in this project as a potential source of information on the university's teaching products. However they are concerned as to whether this external company will keep the database up-to-date and give correct information to inquiring students.

The third of these projects is very much of interest to the study, but from a technical view is very primitive. Data, collected on grants received and research output from all research staff in the university, is stored in a single list for each year and clerks in the research office calculate the relevant research quantum. The data is not generally available in electronic form. Chapter 7 will describe a project, which demonstrates how this data could be made available in an executive information system based on the model developed in Chapter 5.

Arising from these three, as well as the initial five projects, is the following summary of issues that will be considered in developing and using this model:

- determining the university's objectives and knowing that they are being met
- matching information type and need with the available technology,

- providing a shared knowledge of how the organisational units are currently performing,
- managing organisational information / knowledge as a resource
- using IT to enhance the management of the organisation
- helping university administrators and academic managers balance the collegiate, with the managerial, style of decision making.
- enabling fast and appropriate managerial response to changing circumstances

## **5.6 APPLYING THE CHAT CONCEPTS OF MEDIATION AND INTERNALISATION**

Before proceeding to step 7 of the historical method, where the knowledge gained from this story of the university projects is placed in a wider context, it is important to see how the CHAT concepts, in particular those of tool mediation and internalisation / externalisation, have been manifest in the story.

### **5.6.1 The Mediating Roles of the Technology**

*“Tools specify their modes of operation, that is those developed over the history of the society. The use of these culture specific tools shapes the way people act. Tools are the carriers of cultural knowledge and social experience”. (Kaptelinin 1996 p109).*

In CHAT terms the various technological information systems highlighted in the five projects are considered tools for the sense-making activity of university managers. Despite the fact that they all took place in the one organisation, each of the five projects focused on the use of a different technological solution to the problem of providing management information. The basic technologies used for information systems come with the culture of North American big business and this mediates the way organisations use them. They can however be molded for use in other settings as is evident in the projects described here. IT systems are very complex tools and tend to

demand the centre of attention in any information system development. Evidence of this is the fact that each of the projects described here is tied to a particular technology.

The CHAT research approach looks for the mediating effect of the various tools supporting the main activity of interest: in this case the sense-making activities of managers. These are listed in Table 5.2 together with a summary of the technological outcomes of the projects.

**Table 5.2** The Mediating Effects of the Tools on the Sense-Making Activity

Project	Technology	Summary of the Technological Outcomes	Mediating effects
QAI	HyperCard	Technologically simplistic resulting in a lack of credibility. Integration with sources of the data was not feasible. Restricted to the Macintosh platform	Over simplifies the problem: More emphasis on data presentation than authenticity of information
DWs	Oracle relational database with Excel, Oracle Forms and the Web interfaces	Data structured in relational tables SQL complexity makes access difficult for end-users Contains the main operational data of the organisation	Technically well structured Impedes ad-hoc access by end-users but can provide complete information by SQL experts
CWIS	MIS reporting Email MacIntosh File Server	MIS from legacy systems technically oriented Problems communicating across MAC / PC / Unix platforms Documents on the file server were structured in directories (folders) with no search capability Electronic forms of text documents were considered important	Allows access to both structured numeric data and free textual information But inflexible and constrained by technical platforms
Intranet	Web servers and browsers	Flexible and popular, with a proliferation of pages. Requires discipline: clear procedures to keep pages up-to-date and guidelines for style Permits some searching and flexible structuring of text	Allows flexible presentation and access to both numerical and textual information. Requires discipline on the part of information providers
EIS	HOLOS MDDB on top of an Oracle data warehouse	Imposed from outside the university meant lack of acceptance Complex system needing combined resources to build. Clash between the relational structure in OLTP systems, the Oracle DW and the HOLOS MDDB. The multi-dimensional informational structure suits management	Multi-dimensional presentation of data suits managers The large effort required for construction mediates against approval for such projects

From the mediating effects in Table 5.2, a number of issues can be identified as critical to the mediating effects of each technology. These include complexity, flexibility, structure, form, availability, discipline and focus. These issues are listed in Table 5.3, with a brief summary of their relevance to the technologies used in the five projects. When developing a new model of the research problem, in the following chapter, a means of considering these issues must be incorporated.

Table 5.3: Issues Critical to the Mediating Roles of Information Technology

Issue	Observations from the projects
Complexity: (both of the technology and the information)	While the QAI was too simplistic, the relational structure in the DWs has a complexity that limits access by the lay person requiring SQL knowledge to make all but simple queries. The EIS moves data from the complex relational model to the simpler multi-dimensional one but the overheads in doing this requires an enormous investment that was only possible by the consortium of universities
Flexibility: (to access and manipulate the data)	Hyper-linked web pages, for textual information, and EIS hyper-cubes, for numeric data, are representations of information which allow the user the flexibility to browse and manipulate the data. The other technologies are limiting because of their lack of flexibility
Structure: (of the data or free-text)	Well structured data can be more easily manipulated by computer applications (eg queries on relational tables in the DW) however the unstructured nature of information on the Web has great appeal to most users of IS
Form: (whether the data is text or numeric, heavily processed or not)	The CWIS and the Intranet handled mainly text documents, where as the QAI prototype and the DW were principally concerned with numeric indicators of performance. The EIS and the Intranet are able to integrate numeric and textual information to give more complete and meaningful information.
Access: (availability to end-users)	The Intranet and EIS projects showed that direct access to information is a great benefit to users. Only top managers seem happy to let others collect information on their behalf (normally by querying the data warehouses)
Discipline: (style, maintainability, currency)	Whereas most forms of IT such as databases impose discipline, an important issue for the Intranet was to set in place procedures and guidelines for Web page designers.
Focus: (ease of access or accuracy of data)	The QAI project focussed on the content and presentation of data whereas the DW, EIS and CWIS projects were more concerned with procedures to collect accurately and process that data. The EIS attempts to focus on all aspects but this proved to be a mammoth task.

5.6.2 Internalisation / Externalisation, IPA, Mental Models and Messy Problems

*“Through a process of internalisation of external activities, artefacts such as instruments, signs, procedures, machines, methods, laws, forms of work organisation and accepted practices affect the kinds of mental processes that develop. In turn, humans can control their own behaviour by using and creating artefacts”. (Bellamy 1996 in Nardi p124)*

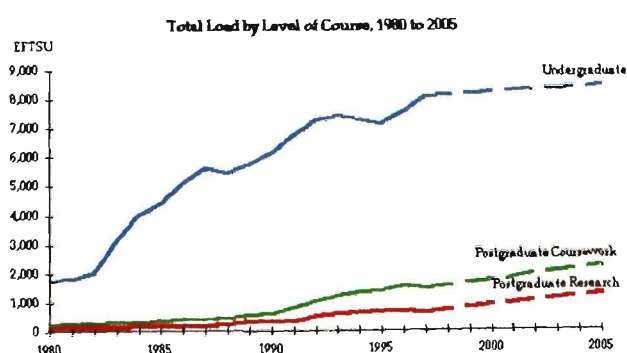
*“The IPA is a concept developed within Activity Theory that refers to the human ability to perform manipulations with an internal representation of external objects before starting actions with these objects in reality. It is similar to the cognitive concepts of working memory and mental models, but refers not to specific mental models but to the general ability to create and transform them” (Kaptelinin 1996 in Nardi p51)*

It is not difficult to apply this quote by Bellamy to information systems. Most of the items on his list (procedures, methods, instruments, machines, forms of work) are recognised components of the information systems as described in textbooks. Bellamy states that mental processes are affected by such artefacts and that human behaviour can be controlled by using and creating artefacts. CHAT assumes that there is a balance between the internal and the external and that artefacts contribute to this balance. In CHAT the IPA is a model of internal processing and in Kaptelinin's view this can be assisted by computerised systems as shown in Figure 3.4. The CHAT concepts of internalisation / externalisation can be applied to the way information is internalised by managers and used in the decision-making process.

In Chapter 2 it was observed that experienced managers are intuitive decision-makers and not particularly conscious of the processes by which they take in and use information. There has long been debate as to the degree of processing of the data, and the level of detail, that managers require in their information (see for example Rockart & de Long 1988). This literature claims that executives want only a brief summary of their organisation's performance. However information about how a university is performing is inherently complex, requiring a mixture of quantitative and qualitative data. In my research it was observed that senior executives in the university liked to focus on a single simple indicator to gauge enterprise performance, just as private companies have their bottom line. (as shown Figure 5.5a). Figure 5.5b shows a university equivalent, a graph of numbers of effective full-time students over time.



**Figure 5.5a** The bottom line.



**Figure 5.5b** Student numbers over time

Senior executives wanted a similar set of indicators from which to gauge relative performance of individual units within the university both for the allocation of resources and to develop strategic plans for the organisation as a whole. It is well known in the university that the number of students, the number of research publications and the amount of external research grants are used as the main indicators of performance, and the basis of rewards. There are two major problems with this. First, as these indicators were tied to the allocation of resources, maximising them became a goal in itself, and the quality performance, of which they were only the indicator, often got lost. If five mediocre journal articles count five-times more than one top quality article, there will be a tendency to produce quantity in place of quality. Second, indicators of past performance are not necessarily an accurate guide to potential and future performance. It would be much more useful for senior management to know which units and individuals are likely to perform best in the future.

Finding a balance between the complex, structured nature of an organisation's transactional data and the flexible information requirements of senior managers is reminiscent of the question as to whether data, information or knowledge is needed to support the sense-making of managers. In reality there is no single acceptable quantitative performance indicator from which to gauge the well-being of a university but the desire for one suggests that those running the university have simple needs from a technological support system, more akin to data rather than detailed information or broader knowledge. The conclusion to draw from this is that information systems must simplify but not lose or distort information.

There appears to be a considerable gap between what information managers believe they want and what those providing information think they should have. It may be that neither group understands what information would give the best view of the truth and best supports the mental processes by which decisions are made. It often seems that managers want clear information on which they can justify a decision and are not particularly concerned with the accuracy of that information. Those who provide

information are often more concerned with what information can be extracted from the data that is readily available and not what data should be collected to give a complete picture.

An issue raised repeatedly by interviewees was the difficulty of assessing quality with quantitative performance indicators. The CWIS and Internet projects showed how difficult it is to use IT to manage large amounts of non-quantitative data in a meaningful way. In the opinion of many academics this is an unresolvable issue. They have no faith that quality is being recognised and rewarded and they feel the cost of the qualitative initiatives is unacceptable, both to the individual and to the institution. Further research is needed into ways in which information systems can be built to coordinate the hard numeric data of performance indicators with qualitative performance appraisals to give more meaningful and acceptable measures of the quality of teaching and research within a university to assist its strategic decision makers.

An ideal information system should enhance the accuracy of managers' mental maps, support the solution of messy problems and capture organisational memory. It should be relevant to the management styles of people in the roles they play and the activities in which they engage. In this regard there is much to recommend the approach, used in the QAI project, of compiling an Information Needs Audit by interviewing representative members of the organisations. The follow up exercise of mapping these needs back to their relevant data sources was also worthwhile but did not produce a design capable of implementation using standard IT development methods. Zuboff's (1988) distinction between computerised systems which "automate", as opposed to those, such as the ones at issue here, which "informate" sheds light on this issue. The IT industry has had much more experience with operational systems, which automate business processes, than with systems which "informate" and IT development methods reflect this. The most consistent advice in the EIS literature is to use evolutionary prototype development methods but many IT professionals are either biased against these or are not confident in their use.

All the projects of the university study wrestled with the problem of managing huge quantities of data, ensuring accuracy, currency and correctness, while at the same time converting it to information that is meaningful, useful and accessible to a wide range of managers. The EIS project has come closest to success but it is years overdue, required the resources of a number of universities and will still require a considerable effort if it is to be implemented in the university. It seems more likely that the Intranet will continue to grow and incorporate some access to the data warehouses, and the facilities of the CWIS project. This trend has been strengthened by the adoption of Netscape Communicator as the web browser and email system throughout the university. There is now an expectation by both academic and administrative staff that the flexible access to information that this system provides will grow to become a complete enterprise “informat” system.

## CHAPTER 6      THE MODEL EMERGING FROM THE STUDY

### **The Research Problem**

How computer technologies and associated systems can be used effectively to provide information to support managers in their strategic activities.

### **Research Question 3**

Can the theory (CHAT) be used to develop a holistic, contextual and dynamic model of the problem?

The previous chapter told the story of the historical course of five separate attempts to produce information systems to support managers in a university. Based on a CHAT approach to the research, each of these five projects was viewed as a collective *activity*. Engeström (1987) points out that this type of collective, purposeful activity performed by workgroups has essentially the same elements and characteristics as the individual activities originally described in CHAT. However, it is useful to distinguish between collective and individual activities. Collective activities are performed by collaborative groups with rules and processes by which the group is coordinated, whereas individual activities are performed by one person but are often typical of that particular set of individuals. These individual activities of executives may be generalised to the whole group, for example we may study the sense-making activities of executives *in general*.

In this chapter the five collective activities will be analysed to identify generalised individual activities that could be related to form a generalised model of my research problem. It should be noted that the process of identifying generalised individual activities, grounded in the collective activities, is quite a different from that of hierarchical decomposition, as would be done as part of functional or structural analysis in IS, where modules are broken into sub-modules. It is important at this stage that genuine, motive-driven activities are identified and not goal-oriented actions at a lower level, which will be established later. Once the activities have been determined, their

elements are specified and the relationship between the activities is determined by noting any elements shared by the different activities.

The most common example of related activities is the design-use relationship (Bødker & Grønboek 1996) when the output of one (the design activity) may be the tool for another (the use activity). The resulting activity-based model, developed in this chapter, will be contrasted with the model based on the existing literature portrayed in Figure 2.6. The model will also be used to verify a framework for the process of EIS development, which will be used in the next chapter to demonstrate the viability of the model in a new project.

## **6.1 DEVELOPING THE NEW MODEL**

### **6.1.1 Identifying the Principal Activity of Interest**

The principal activity of interest to the research problem concerns those tasks that necessitate executives to be informed about the way their organisation has performed, is performing and will perform. The identification of this activity is grounded in the historical study of the five projects described in Chapter 5 and in the literature review of Chapter 2. Although there is considerable support in the literature for the idea that the prime task of an executive is decision making, this is questioned by Bannon (1999) who believes that most executive work activity involves “sense-making, interpretation and on occasions decision-making”. Kuutti (1996) also supports the idea that the most significant activity in which executives engage is that of sense-making, and this sense-making activity could be supported by an appropriate information system.

This sense-making activity was therefore chosen as the principal activity of interest to the research problem. Using the structure of a CHAT activity shown in Figure 3.1, the sense-making activity was depicted as an example of an activity in Figure 3.2 and is shown in more detail in Figure 6.1. Executives and managers are the subjects of this activity, being informed or sense-making is the object which defines the activity. Plans and decisions are common outcomes of this activity. The sense-making activity is

mediated by the community, which in the case of executives includes factors both internal and external to the executive’s organisation. In the university this would include the university, government, local, national and international academia and industry. An activity is also mediated by tools which in this case could include an information system, which will henceforth be called an EIS for simplicity and to emphasis that it is an *informate* type system for senior managers. It is worth noting also that the information itself could be considered a secondary tool for this activity.

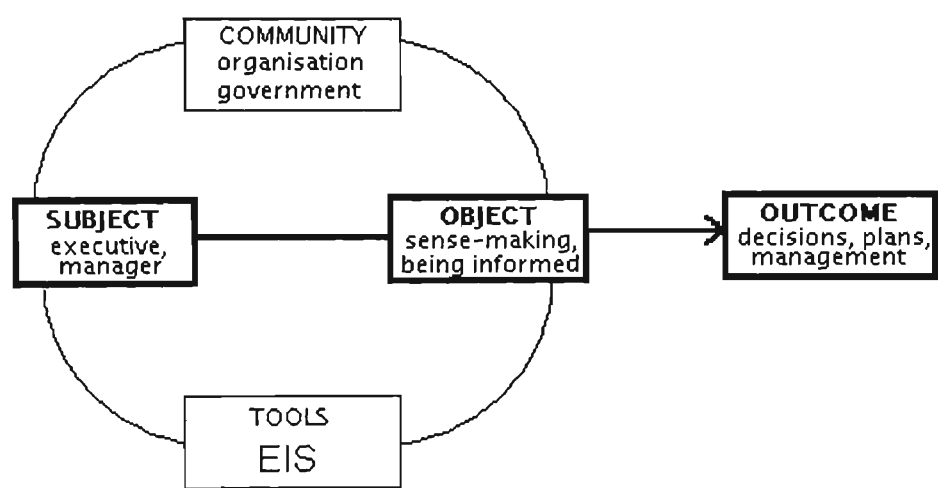


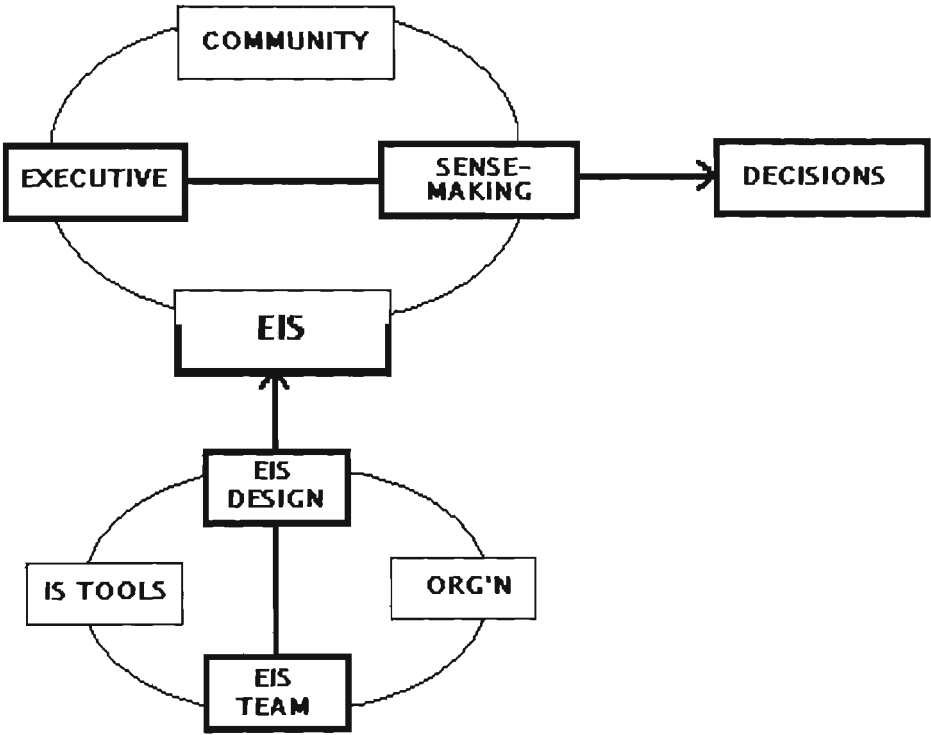
Figure 6.1 The sense-making activity

6.1.2 The Design and Use Activities

Guided by the work of Bødker and Grøn­bæk (1996), it is clear that there are at least two activities (design and use) in each project: first, the principal *use* activity of sense-making (or being informed), which uses the EIS as a tool as shown in Figure 6.1, and second, the *design* activity of creating the EIS, for which the EIS is the outcome. The term *design* is often given to this latter activity, consistent with the emphasis of Bødker & Grøn­bæk’s work, but in the IS community this activity involves many phases including those of analysis, implementation and maintenance as well as design.

The design and use activities are interrelated, as shown in Figure 6.2: the top activity is the activity of EIS use and the lower activity is the activity of EIS design, the outcome of which is the creation of the tool for the upper activity. Communication between designers and users of information systems is often a difficult process, particularly when

the users are senior executives (Hasan & Cheung 1993). Much of the work of HCI researchers has gone into the study of this problem in order to develop ways of involving users in the design process. Bødker & Grøn­bæk are advocates of the Scandinavian method of participatory design (PD) and have used CHAT to extend PD into techniques of *future scenarios*.



**Figure 6.2** The two activity model showing the design and use activities

6.1.3 The Three Activities

While the diagram shown in Figure 6.2 is useful, an analysis of the five university projects reveals that there were many subjects of these collective activities that were not either mangers, who would use an EIS, or IS staff, who would design an EIS. There is no representation in this *two-activity* diagram of the concept of managing data and information. To fill this void a third activity was added as shown in Figure 6.3. This third activity, which is called *data collection* for convenience, is really much more than this and is concerned with the identification of sources of data throughout an organisation, of ensuring the quality of data and of setting up processes by which it can



in this activity, for example the technical developers of the DW to the administrative staff who decided which documents to put on the CWIS file server.

The diagram of Figure 6.3 provides a holistic view of the research problem. My interpretation of the five university projects is that the majority of the problems were due to a lack of this holistic view by the participants in both a horizontal and a vertical dimension. In the horizontal dimension, shown in Table 6.1, three of the projects of the study seemed to concentrate on one of the three activities and ignore the others. In the QAI project the emphasis was very much on the sense-making activity and the *outcome* was a useful “information needs audit” but a weak computer system and no understanding of where the data would come from. The DW project concentrated on the EIS design and had a successful *outcome* in the Data Warehouse, which automated the transferal of data and gave it structure. However there was no attempt to collect data for the system other than what was already in the underlying OLTP systems and three attempts at meaningful interfaces for sense-making executives were unsuccessful. The CWIS file server collected data in the form of text documents but made no attempt to provide search tools to make much sense of the material. The Intranet and EIS projects did have a broader scope with the potential to provide a more holistic solution to the problem and these will be discussed further in Chapter 7.

Table 6.1 The involvement of the 3 activities in the 5 university projects			
Project	Sense-making activity	EIS design activity	Data collecting activity
QAI	✓		
DW		✓	
CWIS			✓
Intranet	✓	✓?	✓?
EIS	✓	✓	✓

The holistic view of the three activities in Figure 6.3 exposes limitations people currently experience in the vertical dimension. These can be expressed by assessing each of the three activities in Figure 6.3 on the CHAT hierarchy as shown in Table 6.2. According to the work of Browne (1993), discussed in Chapter 2, there are few

conscious goal-directed *actions* undertaken by executives. They work intuitively so that their sense-making is relegated to the level of *operations* while they focus on the *big picture*, at the level of *activities*. The design and development of an information system takes place by performing goal-directed *actions* as part of a prescribed methodology. Many steps in these methodologies drop to the level of *operations* for experienced IT staff. One aspect often difficult to maintain in an IS project is an awareness of the overall purpose of the system at the *activity* level. The data collection activity could have a similar problem in organisations, like the university, who have no Chief Information Broker who is responsible for managing the organisation’s information resources (not just IT). There are inevitably plenty of *actions* that are undertaken to satisfy specific information gathering goals, very much like the ad hoc queries on the DW prompted by specific requests from senior managers. However at the *operations* level most data collection is automated in OLTPs and many information brokers just assume that this is done correctly.

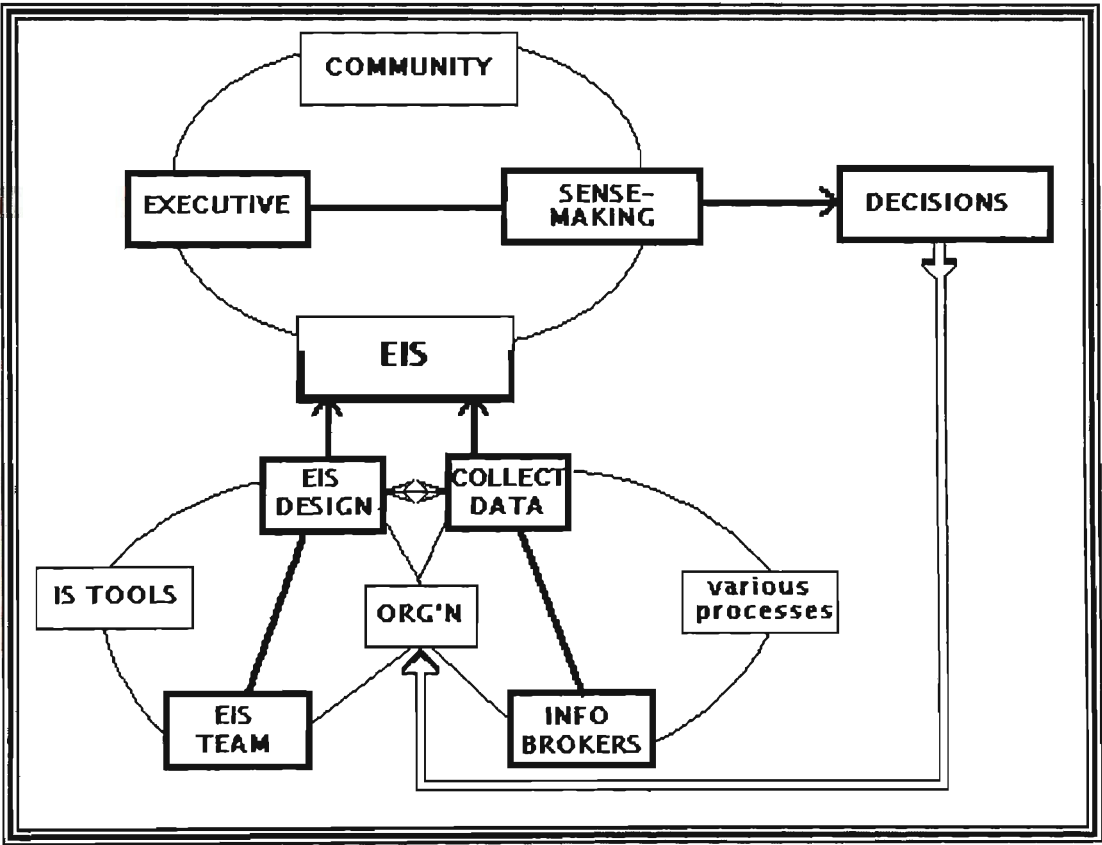
Table 6.2 The involvement of subjects in the 3 activities assessed on the CHAT hierarchy			
CHAT Level	Sense-making activity	EIS design activity	Data collecting activity
Activity	✓	✓?	✓?
Actions		✓	✓
Operations	✓	✓	

6.1.4 Adding Dynamics to give a Holistic, Contextual and Dynamic Model

The representation of Figure 6.3 gives a holistic view of the research problem and is based on activities as determined by a sound theory (CHAT). The analytical process by which the representation was developed is grounded in the historical study, giving it contextual validity. It is however relatively static and so further refinements are needed in order to emphasise the dynamic nature of the situation as shown in Figure 6.4.

A link between the objects of the two lower activities, EIS design and data collection, is included in this figure to represent the communication and cooperation that is needed if

the EIS is both to be technically sound and provide the right information. A feedback loop has been added from the outcome of the top activity to the community of the other two activities. This represents the impact of EIS on the organisation, as described in previous research (Hasan & Lampitsi 1995) where decisions made by management based on information from an EIS affects those who supply that information. This link is particularly important when the decisions concern the allocation of resources.



**Figure 6.4** The complete model with a feedback loop and interaction between the two lower activities.

Figure 6.4 now represents a holistic, contextual and dynamic model of how computer technologies and associated systems can be used effectively to provide information to support managers in their strategic activities. It is a model in the sense that Bannon (1999) describes “as constructions, which for some purposes, under certain conditions, used by some people, in certain situations may be found useful, not true or false”.

Bannon also sees the modeling process as one of reframing rather than describing or abstracting although in most cases all three have occurred.

The model has been developed through a process of describing the progress of five projects that tackled the problem portrayed by the model and a process of abstraction has resulted in the inclusion in the model of three general, interrelated activities. However it is the reframing of the problem in terms of CHAT activities that gives the model originality, posing the problem in a new light to guide those interested in providing solutions.

6.2 A COMPARISON OF THE OLD AND NEW MODELS

In this section a comparison will be made between the old model of the research problem, (Figures 2.6) based the existing literature discussed in Chapter 2, and the new model (Figure 6.4), based on CHAT activities and grounded in the results of my research. The old model was built on a rational backbone surrounded by a number of issues, represented as clouds, that are difficult to fit into the rational backbone. These issues were listed in Table 2.13 and are used to inspire the following comparison between the old and new models.

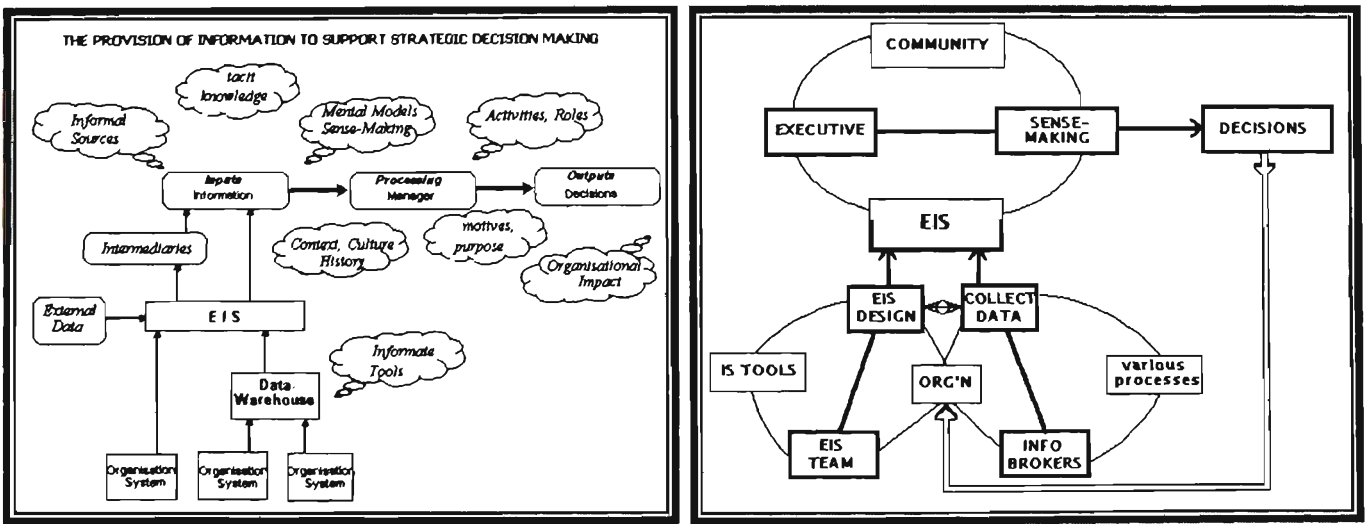


Figure 6.5 The Old and New Models reproduced from Figures 2.6 and 6.4

1. **Activities (what people do):** The main point of departure of the new model, from the old one, is its basis on dynamic activities, as opposed to the rational input/output processes on which the old model is based. The executives' sense-making activity is intuitive and messy, certainly not well represented by the rational input/output model. An activity-based model, as interpreted by CHAT, is a much more suitable concept in this respect.
2. **Motives and purpose:** In the new model the purpose (object) of each activity is made visible so that stakeholders can identify the true purpose of those activities in which they are participants. In particular those creating EIS should be aware that its purpose is to support the work of managers, not replace them. Each stakeholder in an EIS project can also appreciate that others may not be involved in the same activity as themselves. For example IT staff, are involved in an activity to produce a technical system while others are involved in the activity of gathering information. The model makes clear the connection between the activities of participants while recognising that those involved in different activities belong to different communities, which use different tools and probably speak their own technical jargon.
3. **Mental models and sense-making:** The backbone of the old model was based on the assumption that a technical information system was used to convert organisational data into information which was then the input to a manager's information processing capability which produced decisions. The new model focuses on the sense-making activity of managers, and the processes by which they internalise information to create a mental model of their organisation and its environment. Any EIS should be designed to give managers an organisational view that is accurate and up-to-date and to ensure that all managers in the organisation share the same accurate and up-to-date view.

4. **Integrating information provision and decision making:** Whereas the old model consists of a relatively simple uni-directional flow of data to information and then information to decision, in the new model a complex interdependence of activities is apparent. This view is much more realistic and useful particularly in complex organisations such as professional bureaucracies.
5. **Technology as a supporting tool:** In the new model the position of technology as a supporting tool is made explicit. In the old model the technology is itself as much a focus of interest as the work of the executive.
6. **Organisational impact, memory:** The new model makes explicit the organisational impact of EIS in the form of a feedback loop. The dynamic holistic approach, of viewing an organisation's information management as a set of integrated activities, is in accord with the concept of an organisational memory. In a rapidly changing environment there is a need to provide for the storage and retrieval of historical organisational information to aid decision-makers of the present. To produce a computerised system that would act as organisational memory there must be good communication and cooperation between the activities of system designers and data collector as shown in the model.
7. **Tacit knowledge for messy problems:** In the old model there is no clear distinction between the two roles of information provider and information system developer, and the important role of information broker was not recognised. In the new model, the activity of information provider is logically separated from the technological development although there is usually a strong link between the object of the two activities.
8. **EIS development:** The EIS literature has always recommended a process of evolutionary prototyping for EIS development and many members of the traditional IS community have had difficulty adapting to the development of systems that evolve rather than go through a rational process of development from requirements

to implementation. An activity is an on-going entity and is a suitable concept from which to begin the development of better methods for the process of evolutionary prototyping. Section 6.5 below will describe ways by which the model can be of more direct help for EIS developers

9. **Context:** Although context is critical to the new model there is still a need to make context explicit so that it can be taken into account. This always poses a problem as, by its very nature, it is context that makes every problem of this nature unique. It is rarely possible to take a system that works well in one organisation and transfer it without change to another. This is particularly true when taking EIS developed for private sector organisations and attempt to implement them in a university setting. The new model does explicitly show the community that mediates each activity and it is most important to realise that the community for the executives is often dominated by events and circumstances external to the organisation whereas subjects in the other activities are only aware of a mediating community internal to the organisation, often just their own unit or department.

**Table 6.3** The Application of CHAT Concepts from Section 3.4 to the Model

CHAT Concept	Explanation	Guidelines
<b>1 Activity as a Comprehensive Unit of Analysis</b>	The model can be used by different stakeholders in an enterprise to recognise how their perspective on enterprise information relates to that of other stakeholders. In Chapter 2 the “democratisation” process of EIS was mentioned, where people throughout an organisation appreciate the usefulness of the Executives’ IS which then become Enterprise (or Everybody’s) IS. The model provides a comprehensive means of analysing information.	▷ Keep the big picture in mind.
<b>2 The Object-Orientedness of Activity.</b>	The model can be used by project leaders to get across an image of a purposeful activity for the benefit of the whole organisation, where the object of each activity is clear and closely related to the that of other activities.	▷ Identify the real purpose of the activity.
<b>3 The Use of Tools</b>	Mintzberg (1989) uses the phrase the “rule of the tool” when stating that computers are unsuited to the work of strategic managers. CHAT puts the tool in its place as support for human endeavour. This view of IT is essential for EIS development which differs from the life cycle approach used for OLTP systems.	▷ Technology exists as a tool to support work, not as an end in itself
<b>4 The Hierarchical Structure of Activities</b>	<b>Actions:</b> Once an activity is identified, the subject can evaluate various sets of ‘actions’ that could combine to carry out the activity. CHAT allows that there could be different valid sets of actions that could make up an activity and that some actions could be part of other activities.  <b>Operations:</b> Where computer systems are involved in an activity it is relatively easy to identify those actions which can be ‘operationalised’, depending on the conditions. In fact HCI research shows that the most appropriate use of computers is to automate those tasks which are routine and repetitive and hence error prone and boring for humans.	▷ The actions used to carry out an activity may vary or already be part of other activities.  ▷ Let the computer do what it is good at - repetitive, computations and manipulations
<b>5 Internalisation / Externalisation and the IPA</b>	This aspect of CHAT relates to the way in which information is internalised by subjects as a mapping from the external world. This concept should be used to guide the design of information structure and presentation in an EIS so that it will adequately support the formation of mental maps of the organisation’s performance in the minds of executives.	▷ Managers interpret information based on their existing mental models and biases
<b>6 Community and Context:</b>	In general executives, the subjects of the upper activity of the model, work in a wider context than the other subjects, of the 2 lower activities of the model, whose community is limited to their functional unit within the organisation. Government, competitors and their own organisations make up the community in which executives work. These different communities can have different mediating rules and can be a source of mis-communication and needs to be addressed.	▷ The contexts within which an EIS is used may differ and be quite difference from the context where it is produced.
<b>7 Collective and Individual Activity</b>	The myriad of activities taking place in organisations can be individual or collective. An executive using an EIS is an individual activity whereas the other two activities of the model are usually collective and carried out by teams. There is usually more organisation and structure to a collective activities where subjects are assigned roles and rules of engagement are made explicit. In other respects however individual and collective activities are alike.	▷ Treat a collective activity the same as an individual one, being aware of its real object and motives.
<b>8 The Dynamic Nature of Activity</b>	Activities are continually in a state of historical development affecting and being affected by their environment. The CHAT approach assumes this. The technology, information needs and the whole organisation are constantly changing. This aspect will be dealt with in more detail in Section 6.5.	▷ There should be a team to manage, not just maintain, an EIS
<b>9 Tool Mediation</b>	The CHAT concept of tool mediation anticipates that changes will take place in an activity through the use of the tool. Participants in an EIS project usually focus on what sort of system would be useful for the activity as it is now. The question should be: what sort of system would adapt with the users as they became more competent and reliant on the tool.	▷ Novice users today become expert users tomorrow.
<b>10 The Active Nature of Subject</b>	The subject of an activity takes an active position and develops through participation in the activity. Managers are particularly proactive when it comes to computer use and will not use a system that is not of value to them	▷ Managers are discretionary users of EIS

## 6.3 AN INTERPRETATION OF THE MODEL USING CHAT CONCEPTS.

### 6.3.1 Applying CHAT Concepts to the Model

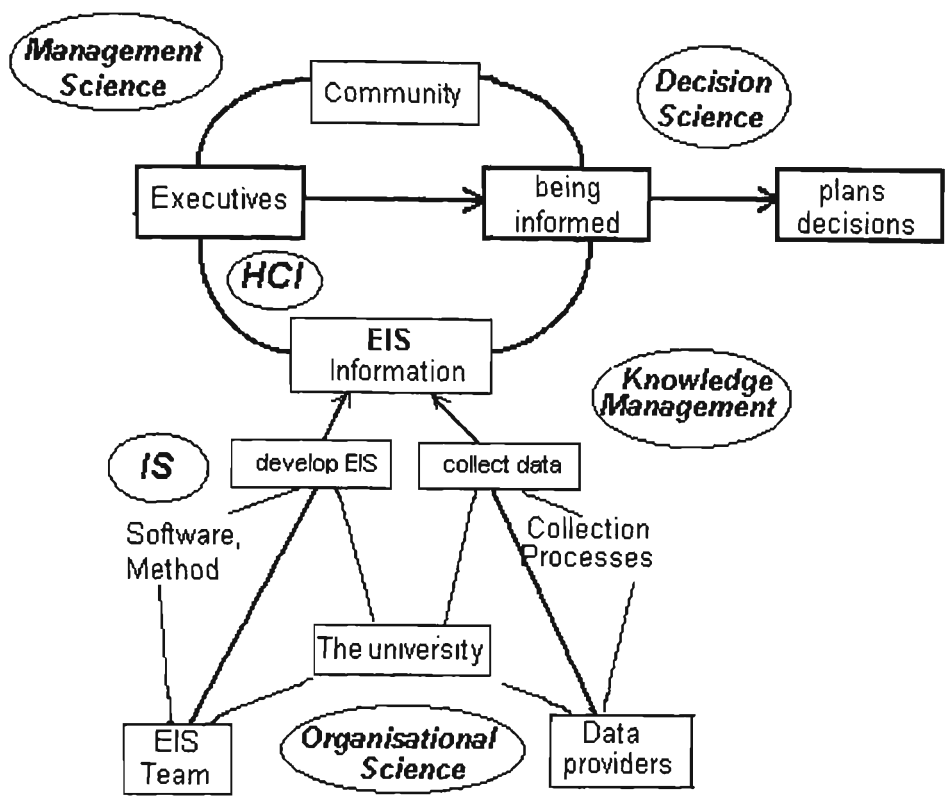
As described in Chapter 3 CHAT is a well-developed theory, emanating from Vygotsky's cultural-historical psychology and enhanced by the work on activity by Leontjev and others. My research approach, begins with the identification of the activities of interest and their interactions, resulting in the model described above. Once this has been done, the richness of the CHAT concepts, described in Section 3.4 can be applied to the analysis of the activities. This is done in Table 6.3 which displays for each CHAT concept an explanation of its application to the model together with a practical guideline for EIS.

### 6.3.2 The Model itself as a Tool

In this research the CHAT concept of activity has been applied to the object of the study and used in the development of the model shown in Figure 6.4. The CHAT philosophy can be used for all human endeavour so that the model can be viewed as the *output* of the research *activity* and also a *tool* that can be used for future EIS research and practical IS *activities*.

### 6.3.3 Contributions from Different Disciplines

The model has already been useful in explaining to fellow EIS researchers how knowledge from different disciplines can be integrated into EIS research. While space limits the completeness of this picture, Figure 6.6 shows where a number of relevant disciplines can contribute to the interpretation of the model.



**Figure 6.6** The contribution of different disciplines to the model of Figure 6.4

**6.4 THE PROCESS OF EIS DEVELOPMENT**

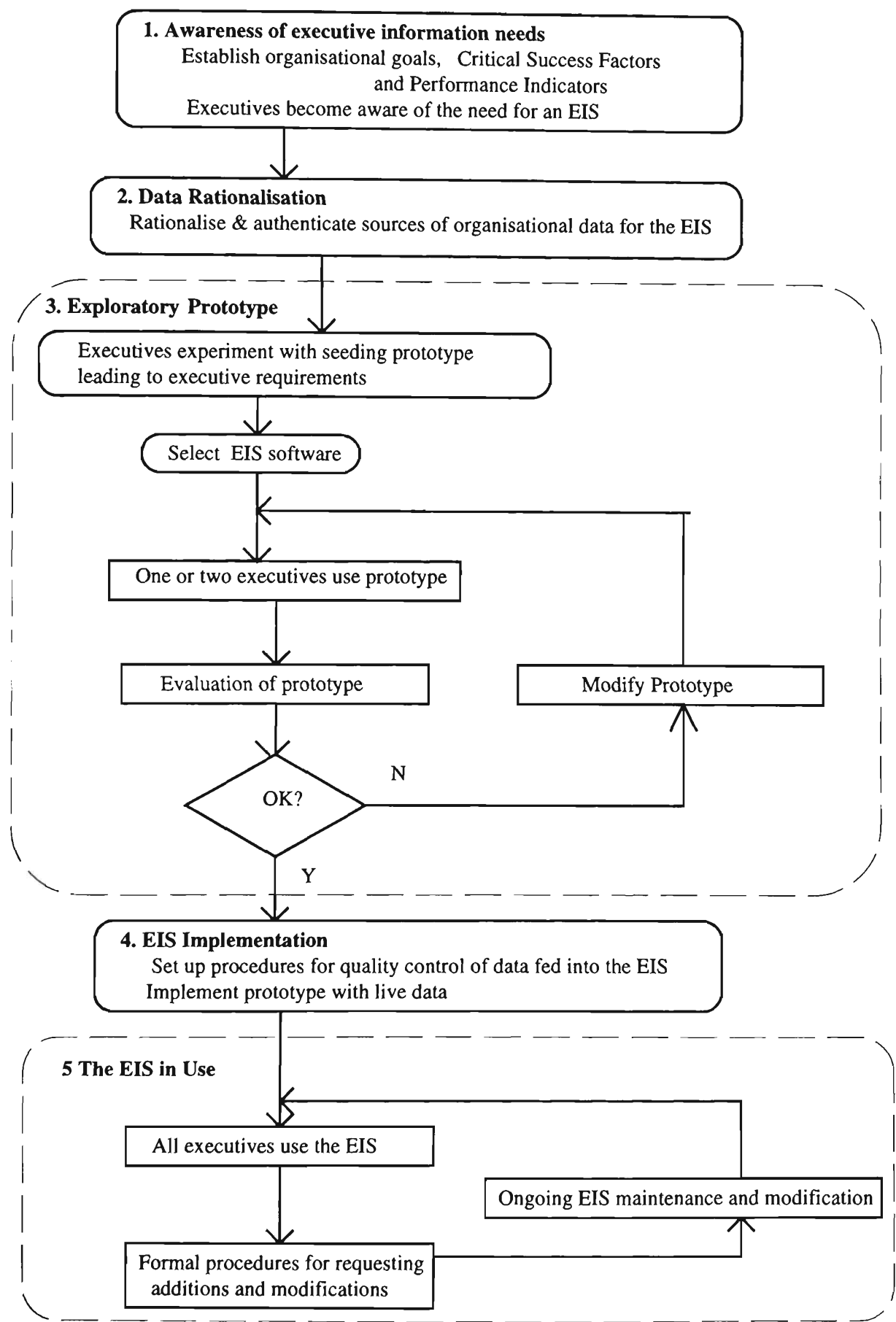
Despite the fact that CHAT stresses the importance of the historical development of activities, there is no real representation of the passage of time in the CHAT model as shown in Figure 6.4. Historical development and active interactions between elements of the model are implied but there are obviously limitations of a two-dimensional figure when representing a dynamic model. Section 3.6 describes how Engeström (Figure 3.7) and Blackler (Figure 3.8) have both produced models incorporating a time dimension into collective activities. My model however is more complex as it depicts three different activities and so a different approach is needed to represent how EIS support for managers changes over time in accord with the CHAT model.

In the research leading up to the work of this thesis, described in Section 1.2, the dynamics of EIS development was studied in detail. Figure 6.7 depicts a framework for the planning and implementation of an EIS, based on a three year, longitudinal case study of EIS in a public organisation (Hasan & Gould 1996). This framework is

grounded in a real-world study and, as the following discussion demonstrated, is consistent with the CHAT-based model of Figure 6.4.

The framework depicts the process of EIS development in an organisation over five stages, which are outlined in Table 6.4. Whereas most EIS literature focuses on Stages 4 and 5 of this framework (EIS implementation and use), the main contribution of the framework is the inclusion of the three preliminary stages. In Stage 1, executives become aware of the need for an EIS, often during the process of establishing organisational mission statements, aims and objectives. Stage 2 is a response to the need to make use of information as a company resource and *mine* the huge amounts of data, stored in the organisation’s databases. Stage 3 is a phase that many EIS projects undergo unintentionally and is a process of growth and learning. In this stage either a prototype EIS or a first attempt at an EIS is introduced into the organisation. This experience enables EIS developers and users to better communicate, resulting in improved specifications and planning for a subsequent EIS implementation.

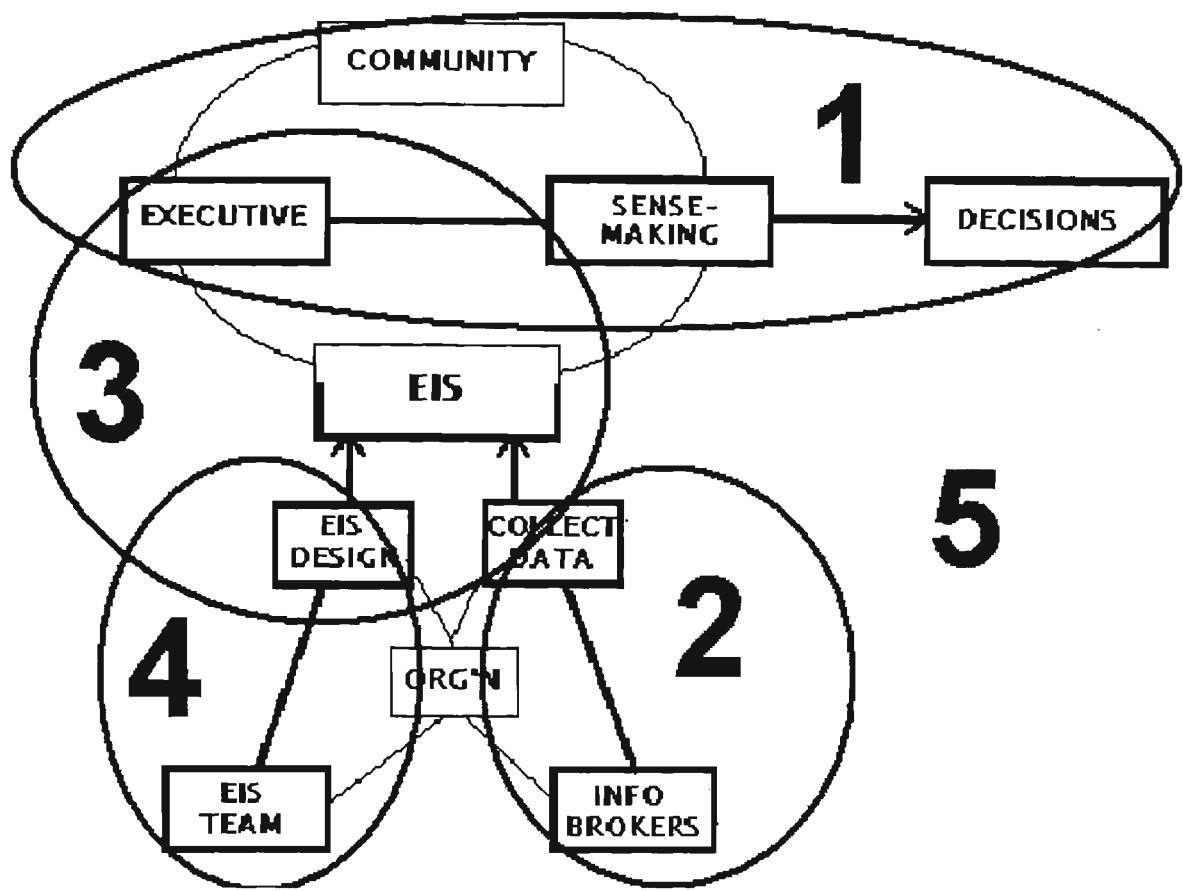
The relation of the framework of Figure 6.7 to the model of Figure 6.4 is summarised in Table 6.4 which contains a description of how the stages of the framework are picked up by the different activities of the model. Stage 1 primarily involved the executive activity of sense-making while Stage 2 involves the data gathering activity. Stage 3 involves subjects from all three activities in the evolution of a prototype system. Stage 4 is conducted by the IT specialists and the final stage again involves the use and management of the on-going system by all three activities. The relationship between the stages of the framework and the activities of the model is also illustrated on a reproduction of the model in Figure 6.8



**Figure 6.7** A Framework for EIS design and implementation consistent with the model

The five stages identified in this framework do not necessarily follow the linear path shown in Figure 6.7, although this is a logical sequence and observed in the case study on which the framework is grounded. Many of the five stages are commonly found in EIS developments such as the five projects in the university study. The QAI project for example went through Stages 1 and 3, identifying university goals and performance indicators (Stage 1) and using a simple prototype to gain a greater understanding of the problem (Stage 3). The DW project went through Stages 2 and 4. The CWIS project could be considered the Stage 3 of the Intranet project. The EIS project has gone through Stages 1 2 and 4 and is probable suffering a lack of communication because it did not carry out anything like a Stage 3.

Table 6.4 The stages of the framework for EIS development		
Stage	Overview	The CHAT Model
1 Establishing Organisational goals and information needs	The first step in providing information for executive decision-makers must be their awareness of the need for some form of executive information system aligned with their organisational goals and decision making responsibilities. The decision to adopt an EIS comes about from the need to define organisational goals and to identify critical success factors, including measures such as performance indicators, which support them.	In the CHAT model this stage involves only the executive's sense making activity.
2 Data Rationalisation	A thorough examination and rationalisation of all organisational data is also an essential part of the EIS development process because of system reliance on aggregated data which filters up from operational systems. In most organisations, transaction processing systems and databases were put in place long before any consideration was given the development of an EIS, and are frequently technically and logically incompatible with EIS data requirements. If this data it to be fed into an EIS it is essential that its source is audited and authenticated.	In the CHAT model this stage involves mainly the information gathering activity with some advice from the technical EIS activity.
3 Exploratory Prototype	Many organisations, particularly if they are not large private companies are hampered in EIS projects but three factors: a lack of experience with this type of system, a low budget and complex data sets. To get the process started an inexpensive prototype can be constructed consisting of a user-friendly interface, such as Visual Basic or Access, utilising some existing corporate data. This will allow a small core of executives to experiment with data manipulation in order to elicit some basic requirements for a more permanent system.	This stage involves all three of the activities in the CHAT model and the outcome may not be an EIS but simply a greater understanding of the problem.
4 EIS Implementation	At some point in time, senior management may decide to go ahead with a formal EIS project. In most cases an EIS team is brought together and is virtually left to do the development.	In the CHAT model this stage would involve mainly the technical development activity with some interaction from the other two as needed.
5 EIS In Use	Once an EIS has been created an implemented it should continue to be viewed as an evolving prototype which is never signed off as complete.	At this stage all three activities of the CHAT model are equally important.



**Figure 6.8** The 5 stages of the EIS development framework superimposed on the model

The significance of the framework is that each of the five stages makes an important contribution to the whole EIS development activity and it would be rare that a successful EIS was developed without going through each of them. However the third stage is perhaps the most interesting. The literature often recommends the use of evolutionary EIS development but rarely describes the value of exploratory prototyping, probably because it is mostly based on private sector organisations where resources for EIS projects are not as scarce as in the public sector and quantitative performance data is relatively straight forward (numbers or money values of products). In these circumstances a logical process following stages 1 and 2, then 4 and 5 may be appropriate. However it is often the case that the first EIS project undertaken in an organisation fails but lessons learnt from that attempt are used to ensure the success of a subsequent project. The first failed EIS project is an expensive example of the Stage 3 concept and it would make more sense to have deliberately gone through this learning process with a much less costly prototype. An example of this was shown in Chapter 5

by the success of the Intranet project of the university based on experience gained from the previous projects which acted as a Stage 3. In particular, the much simpler CWIS project provided the university staff with experience in the use of, and demand for, textual data.

The concept of exploratory prototyping will be evident in the research project undertaken to verify the CHAT model that is presented in Chapter 7.

## CHAPTER 7 VERIFICATION OF THE MODEL

### **The Research Problem**

How computer technologies and associated systems can be used effectively to provide information to support managers in their strategic activities.

### **Research Question 4**

Can the CHAT-based model, developed in Chapter 6, provide guidelines or methodologies that can be of general use to real organisations faced with this problem?

In the previous chapter, a model was developed (Figure 6.4) of information support for the sense-making activity of executives in complex organisations. Table 6.3 summarised the application of CHAT concepts to the model and Figure 6.7, together with Table 6.4, demonstrated how the dynamics of EIS development can be understood using the CHAT-based approach. In this chapter the model, a simplified version of which is shown in Figure 7.1, will be verified by describing a project in which it was applied to the creation of a prototype EIS containing research performance information to support the sense-making activity of university planners and managers.

### **7.1 AIMS AND METHODOLOGY OF THE VERIFICATION PROJECT**

The development of a research performance EIS was chosen for this project, as it was not the focus of any of the other five projects described in Chapter 5 but would take place in the same university context. During the 1990s, the period of the historical study of the other five projects, considerable interest was shown by the Pro Vice-Chancellor of Research and the Research Office in the issues of research performance indicators for an EIS, but it was an extremely complex and sensitive area. Comprehensive data on research performance in the university was collected annually according to government requirements but was stored in a primitive database system as a single list of items that was not available to managers in any useful electronic form.

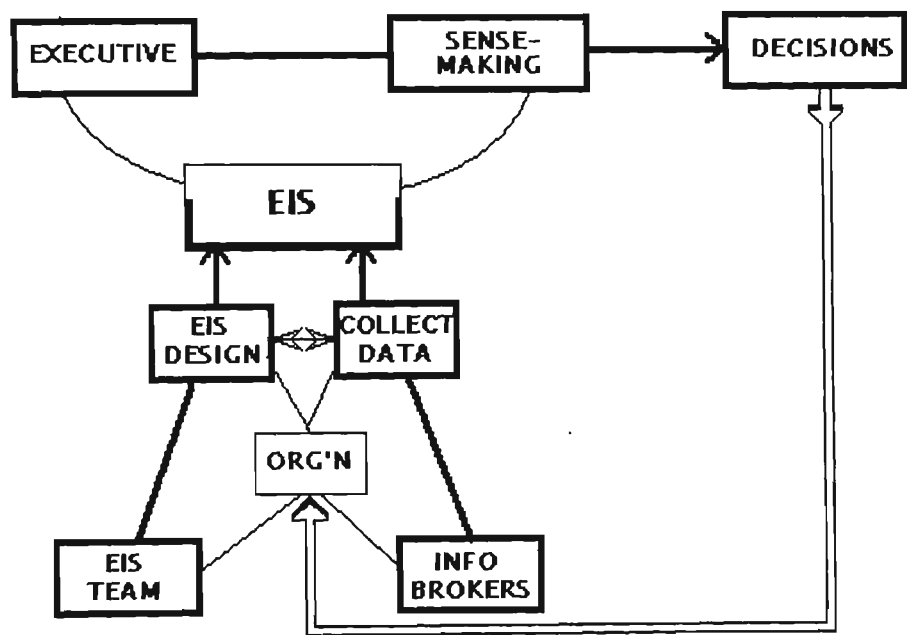
The aim of this research is to evaluate both the effectiveness of using the CHAT model and framework to develop a prototype that succeeds in providing information support

for the decision-making work of research managers. The prototype project closely follows the first three stages of the framework for EIS development, depicted in Figure 6.7. The progress of the three stages is described in Sections 7.2, 7.3 and 7.4.

Initially some background research was undertaken to determine the context of the project. This was based on the three activities of the CHAT model shown in Figure 7.1, as follows:

1. The upper activity, concerned with managerial sense-making, required an investigation of issues concerned with research management, the objectives and strategies. To this end interviews were conducted with typical subjects of this activity, university managers, and members of the university's Centre for Research Policy, to gain an understanding of the work of research managers. The results of this investigation are described in Section 7.3.
2. The lower right activity concerned with data gathering was the responsibility of the university's Research Office. Discussions with the manager of this group revealed that the data they collected was based on government reporting requirements and so information on this activity was obtained through the reports from several government committees on research performance indicators and measures. The results of this investigation are described in Section 7.2. . The university's Research Office supported the prototype project and provided three years of research output data to use in its development.
3. The activity in the lower left of the model was almost non-existent before the project began. Although research performance data was collected, it was purely for government reporting and there was no intent to create a system to process this data into useful information for managers. The building of the prototype therefore was the first attempt at a performance information system for research managers in this university. For the purpose of this thesis the prototype developed by the researcher who was therefore the subject of the EIS development activity. The development

was done in Gentia<sup>1</sup>, a sophisticated EIS development application, which our research group has used extensively for studies of experimental on-line analytic processing (OLAP) applications. Requirements for the prototype were determined from an analysis of the interviews (see point 1) and used the data provided from the Research Office. The prototype EIS implementation is described in Section 7.4.



**Figure 7.1** A simplified version of the model of Figure 6.4, with some of the mediating entities removed so that the three activities of sense-making, EIS design and data collection can be more easily seen.

Once the Gentia prototype was constructed, a group of managers were given access to the prototype and then interviewed on the effectiveness of the system. Those managers who took part, included subjects of the managerial sense-making activity at the executive level, the faculty and research institute level and the small research group level of the university. The prototype was also demonstrated to subjects of the data gathering activity, in the Research Office and potential subjects of EIS design activity in the IT unit. These people were subsequently interviewed to gain their impressions of the project.

The interviewees were questioned about their understanding of how the system was developed and structured, as well as the usefulness of the system for research

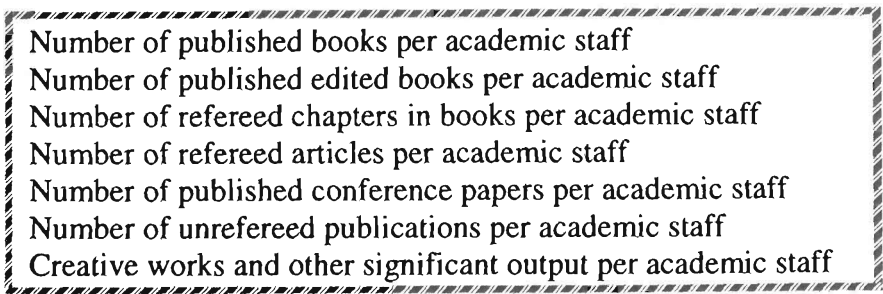
<sup>1</sup> a Business Intelligence development software package from Gentia Pty Ltd.

management and asked to volunteer other views on the provision of information support for managers. The textual data collected was analysed using the phenomenological method described in Chapter 4 and the interpretation of the results is presented in Section 7.5.

## 7.2 THE RESEARCH DATA GATHERING ACTIVITY

Research is a core business of universities and, as universities become more business-like in the current competitive environment, there is pressure to manage research activities more effectively. In Australia, the Federal government has called for improved efficiency and public accountability in higher education leading to an interest in performance indicators in the industry. A government commission was set up in the late 1980s to develop a “broad range of quantitative indicators suitable for evaluating relative performance in higher education” and report on their “practicability, data requirements and appropriate conditions of use” (DEET 1991).

The research performance indicators that they came up with fell into the categories of research grants, publications and other original works, paid consultancies and professional service activities. A performance evaluation group (was commissioned to carry out a study of 40 candidates for research assessment of 1990 data (NBEET 1993). The group’s aim was the identification of the definitions and representational scope of alternative, quantitative measures of research performance. From a list of 40 candidates they chose the seven performance indicators shown in Figure 7.2.



**Figure 7.2.** The seven research PIs chosen by the NBEET committee (1993)

The declared motive of a subsequent report (NBEET 1994) was the concept that quality assurance in higher education needed “more sophisticated quantitative measures in order to arrive at sensible decision about relative research performance”. The focus of the report was on “testing and refining the performance indicators identified in the 1991 report for reliability, verifiability and collectability”. It appears that this report was driven by the need for specifications for the new computer systems being developed by CASMAC, a joint consortium of universities. Consideration of the concrete implementation issues raised awareness of the inherent difficulties in attempting to objectively measure research performance.

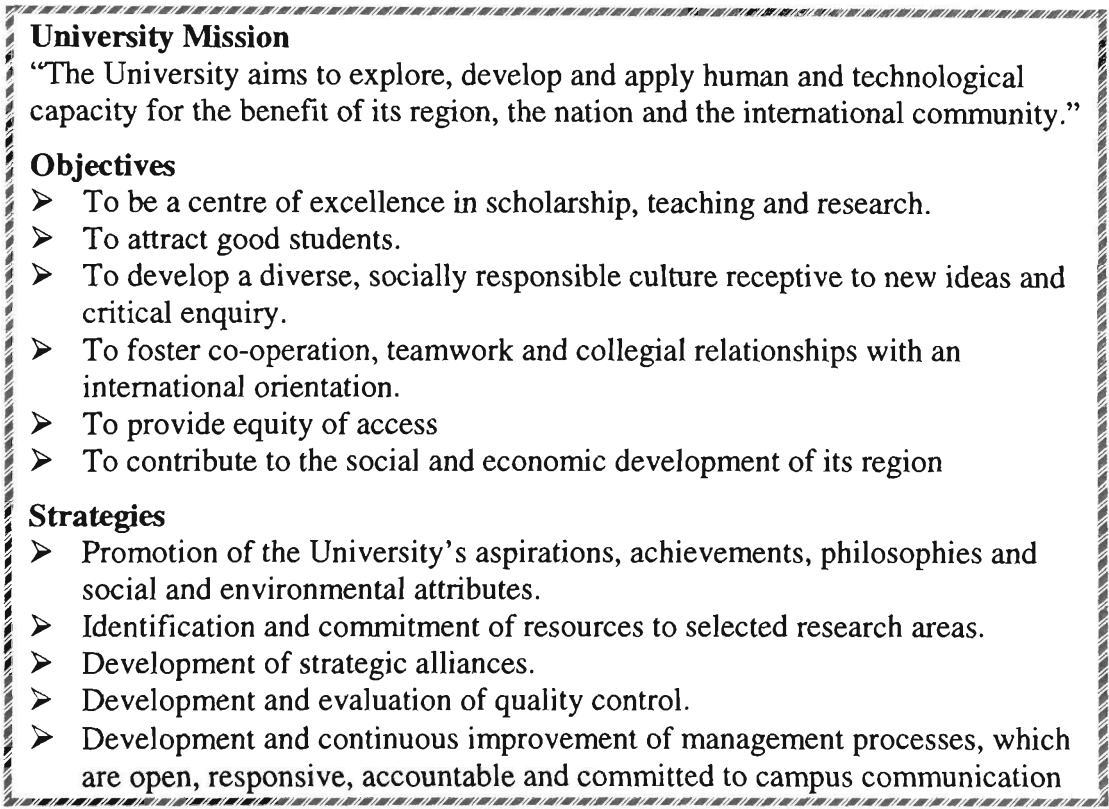
The problem was again addressed in a 1996 report (NBEET 1996) which described research income and expenditure as well as output across institutions and fields of study where there emerged great diversity in terms of research expenditure, income and publications patterns. This report looked at the policy implications of a proposed two-tiered research system both between and within universities where there would be a concentration of research resources within a limited number of universities. The report stressed the need to collect data to assess the implications this, and alternative, policies.

The official government message to universities is that the “basic function of performance indicators is to assist in determining how well a particular institution or department has achieved its respective goals”. (DEET, 1991) However universities are well aware firstly, that performance indicators are tied to government funding and secondly that, in the area of research, performance indicators will affect the university’s standing if the two-tiered research system is introduced. For these two reasons the collection of research performance data within universities has become an important activity over the past four years.

In the university of the study, an annual data collection of research performance data has been undertaken since 1995. Each collection is done mid-way during the following year so that at the time of the project, early 1999, only three years 1995-7 were available with the 1998 data yet to be collected.

### 7.3 THE RESEARCH MANAGEMENT ACTIVITY

While the government committees concentrated on the question of what to measure as research performance indicators, the separate issue of whether this data could be processed into information, that would support more effective research management, received must less attention. The general assumption seems to be that performance measures enable the evaluation of progress towards long-term goals. The difficulty is that there is a huge gap between the lofty research objectives and strategies, set at the organisational level, and research output generated by individuals and small groups.



**Figure 7.3.** A summary of university’s research planning.

Examples of research objectives and strategies, for the university used in the study, are shown in Figure 7.3. These were determined through a straightforward planning process, which began with a mission statement from which came the objectives and then the strategies to achieve them. The challenge is to ascertain how the performance indicators shown in Figure 7.2 relate to these objectives and strategies and therefore how this performance information can be best presented to managers to support the research management processes. The question might even be whether these

performance indicators are a suitable means of evaluating the quality of research and if not the problem would be to devise more appropriate and workable measures.

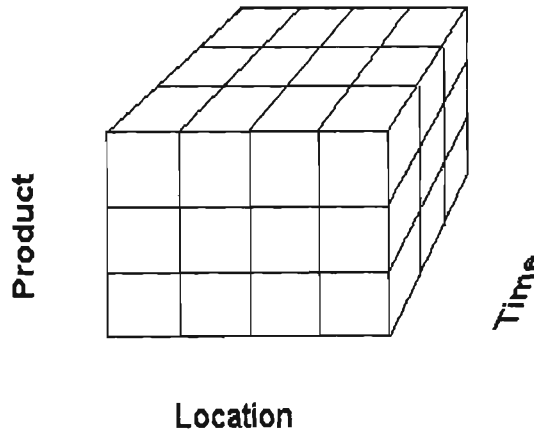
In 1995 the university drew up a Research Management Plan (RMP) which was evaluated in 1996 by a survey conducted by the Centre for Research Policy (Aylward et al 1996) as a part of the ongoing quality improvement processes. This survey of university research staff indicated that there was an “unresolved cultural gap” between those who supported the RMP and those who thought it was irrelevant. The report showed that there was a perception that funding mechanisms, based on output indicators, were biased in favour of some disciplines (mainly the natural and applied sciences). For this reason the report concluded that “while electronic databases would help increase the transparency of the RMP activities, indepth interviews suggest that personal contact is the key to building trust and cooperation”. One requirement of a research EIS should therefore entail the ability to link quantitative data with qualitative assessment records.

## **7.4 THE EIS BUILDING ACTIVITY**

The Gentia prototype was based on a multidimensional database (MDDb) where data is stored in such a way as to be represented to the user as a hypercube or multi-dimensional array, where each core data value or fact occupies a cell indexed by a unique set of dimension values. In its simplest form this is easily visualised using a fact, such as number of products sold, along the three most common dimensions (time, location, product type), as shown in Figure 7.4, but can be extended to include any number of facts and dimensions. There is also a capability to link the MDDb interface to text windows so that qualitative, textual data can be linked to the quantitative data of the database.

The last decade has seen massive advances in technology such that it became feasible for organisations to built massive data-ware-houses, based on multi-dimensional data models. Powerful OLAP systems have been developed to enable end-user access to

organisational performance information stored in MDDB with *friendly* graphical user interfaces (GUI). While the slice and dice, and drill down capability of these systems have enabled managers to view their data in a new light, most interest has been on the issues involved in developing the technology, on its performance in handing gigabytes of data and its ability to integrate with client-server arrangements.



**Figure 7.4** A typical 3D Cube

Most of the literature on MDDB is in the form of *white papers* from OLAP vendors (for example Creeth & Pendse 1995, Gentia 1997). Very little directly addresses the concept of dimensional data modeling in the same way that relational data modeling has been treated in the literature and in textbooks. From the work of Dodds et al (1999) it appears that there are two common approaches to the development of MDDB, one top-down and the other bottom-up.

A top-down approach focuses on the business problem, and is based on the EIS literature including the work of Rockart and De Long (1988), Burkan (1991), Volonino and Watson (1992) and Barrow (1992). They describe EIS development as starting with the identification of an executive champion or sponsor and then determining the Critical Success Factors and Key Performance Indicators, either of individuals or of the corporation, to establish the initial requirements of the EIS. A multi-disciplinary EIS

team is set up and an evolutionary prototyping method is used to continue the development process.

A bottom up approach to MDDB development begins with an analysis of data in the existing organisational database to identify facts and dimensions that relate to a subject of interest (Kimball 1997, Pokorny 1998). When, as is usually the case, the underlying databases are relational, this approach involves the identification of two kinds of tables: the Fact Table which consists of the numerical measurements that exist within the database and Dimension Tables which are more descriptive data items that map to the natural dimensions within the business. The Fact Table is made up of multi-part keys that link back to the Dimension Tables giving a layout referred to as a star or snowflake schema (Weldon 1995). To successfully translate data from a relational database into a meaningful MDDB it is necessary to identify the star schema within the relational model related to subjects of interest to the business analysts. The translation process is essentially one of de-normalisation, and hence simplification. Once the Fact and Dimension tables are identified the translation of data should in principle be capable of automation. However the integration of a MDDB data-warehouse or EIS with underlying operational databases is rarely easy, mainly due to data complexities, anomalies and errors. This is usually referred to as the “dirty data” problem.

The MDDB was designed using a top-down approach focussing on the business problem of research output. The measures or “facts” chosen were:

- Numbers of publications
- Publication Index (Publications weighted on category)
- Number of Staff
- Publication Rate (Publication Index per staff member)

These facts are stored in the first Gentia dimension, traditional called **Meter**. The other dimensions chosen were Time, Publication Category and location within Faculties and Departments (called **Time**, **Category** and **Faculty** in the Gentia model).

The Gentia syntax for the Mddb prototype data model can be seen in Figure 7.5 containing the identified dimensions and measures. This code determines the data structure of the Gentia Mddb (known as a GADB) and an empty database is created when the model code is compiled. The GADB was populated, using a small Gentia program, from a comma-delimited, text file of data exported from the original relational database. A GUI interface was developed using standard Gentia tools and is shown in Figure 7.6. This interface permits slice and dice, as well as drill down, of the Mddb table in the top left of the screen as well as the corresponding graph underneath. Some examples of this are shown in Figures 7.7a,b and c.

For interest to IS developers, the Gentia OO development environment is shown in Figure 7.8.

```

FILE "uowres"

DIMENSION Meter IS
Staff DISPLAY AS "# of Staff",
NoPubl DISPLAY AS "# of Publications",
PublInd DISPLAY AS "Publication Index",
PublRate DISPLAY AS "Publication Rate";

DIMENSION Time IS
Y1995 DISPLAY AS "1995",
Y1996 DISPLAY AS "1996",
Y1997 DISPLAY AS "1997"

DIMENSION PubCategory IS
allcat DISPLAY AS "All Categories" FROM (
bk DISPLAY AS "Books" FROM
(A1, A2, A3, A4 ),
chap DISPLAY AS "Chapters" FROM
(B),
jrn DISPLAY AS "Articles" FROM
(C1, C2, C3, C4),
revs DISPLAY AS "Reviews" FROM
(D),
conf DISPLAY AS "Conferences" FROM
(E1, E2, E3, E4),
G DISPLAY AS "Audio-Visual",
H DISPLAY AS "Software",
I DISPLAY AS "Patents",
crea DISPLAY AS "Creative Works" FROM
(J1, J2, J3, J4 ),
Other FROM (K1, K2, K4, K5, K6));

DIMENSION Faculty IS
allfac DISPLAY AS "All Faculties" FROM (
Arts FROM
(CCS, HP, ML, Phil, Soc, STS, GradScI,
FacCrArts, FacArts),
Comm DISPLAY AS "Commerce" FROM
(Accy DISPLAY AS "Accountancy",
Buss DISPLAY AS "Business Systems",
Ecc DISPLAY AS "Economics",
Man DISPLAY AS "Management",
FacComm),
Edu DISPLAY AS "Education" FROM
(FacEdu),
Eng DISPLAY AS "Engineering" FROM
(MechEng, MatEng, CME, FacEng),
HBS DISPLAY AS "H & B Sciences" FROM
(Psyc, Nurs, BMS, PHN, FacHBS),
Info DISPLAY AS "Informatics" FROM
(ITCS, MAP, ECTE, FacInfo),
Law FROM
(FacLaw),
Sci DISPLAY AS "Science" FROM
(Biol, Chem, Geo, Phys, FacSci) );

```

**Figure 7.5** Gentia code for the dimensional data model



Figure 7.6 The full Gentia GUI Interface to the MDDB showing the Research Data in a table and a 3D chart. Around the table (top left) are buttons to manipulate the MDDB. On the right is a text window containing an explanation of the research performance weightings and at the bottom left is a Teaching Loads chart linked to a MDDB of student numbers and showing student/staff ratios, an item of interest all university managers.

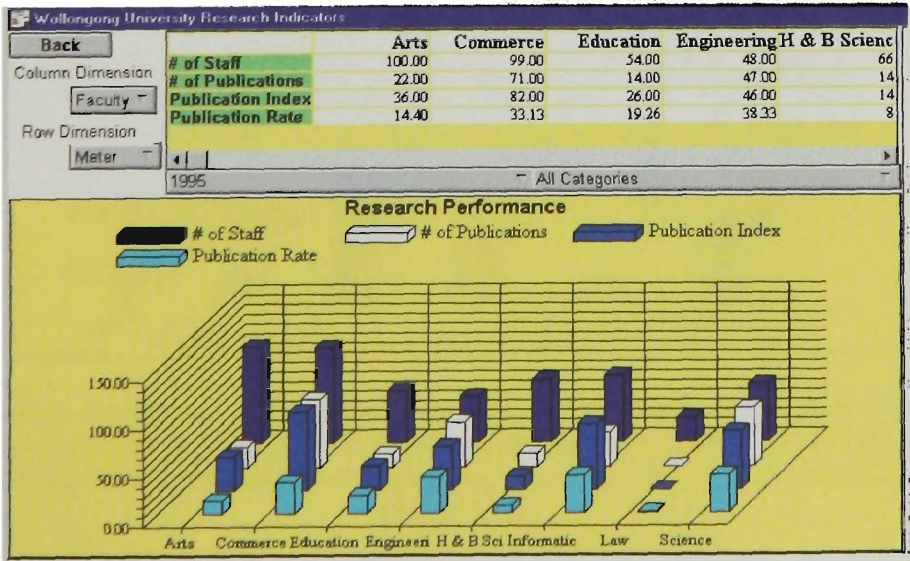
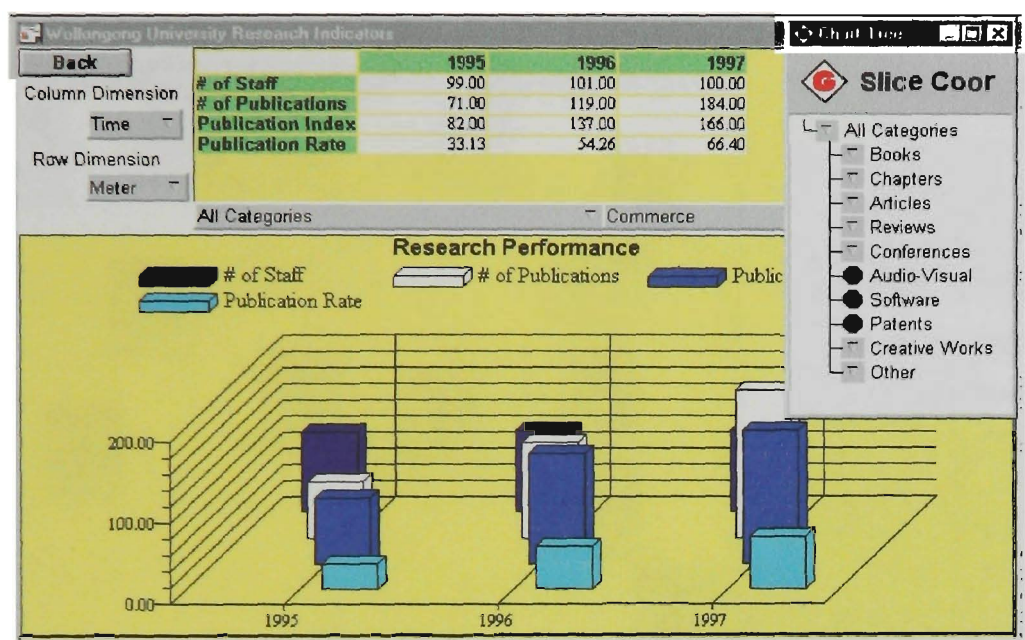
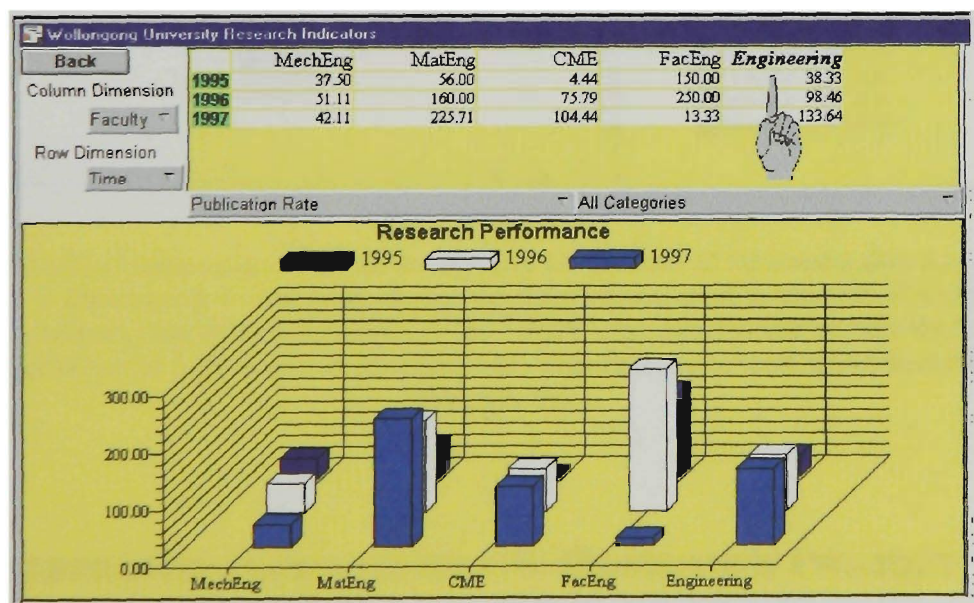


Figure 7.7a The Research MDDB with the Faculty and Meter dimensions as the Column and Rows across the slice dimensions of the Year 1995 and all Categories as shown on the relevant buttons.



**Figure 7.7b** The MDDb is rotated so that the column dimension becomes Time across the slice dimensions of all Categories and the Commerce Faculty. A pop-up window shows the options to drill down on the Category dimension.



**Figure 7.7c** Faculty and Time are the column and row dimensions respectively across the slice of the publication rate Meter and all Categories. Column had drilled down to Departments within the Faculty of Engineering, the hand indicating that it is possible to drill back up.

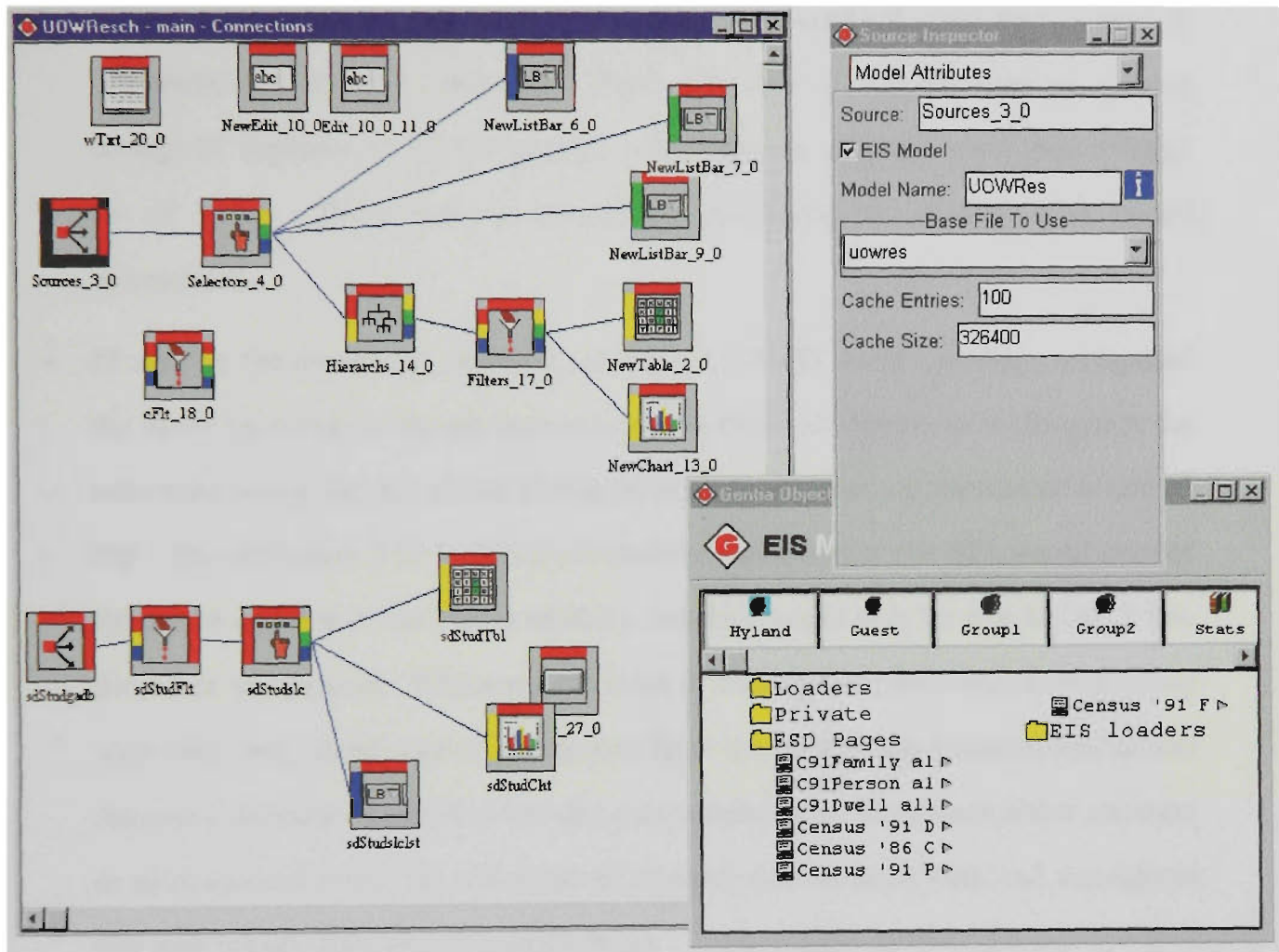


Figure 7.8 The Gentia object-oriented development environment of the screens shown in Figures 7.6 and 7.7. Each icon in the left-hand window represents objects such as the MDDB, the table and charts, buttons, data filters and selectors. The MDDDB data source is selected and the Source Inspector on the right enables the developer to choose the source (here UOWRes) and its characteristics.

7.5 INTERPRETIVE ANALYSIS OF THE PROTOTYPE PROJECT

7.5.1 Analysing the Prototype project in terms of the three Activities of the Model

In analysing the results of the interviews I first sought evidence that the three constituent activities were linked, as depicted in the model, to form a useful, holistic view. I was therefore interested in the attitude of the subjects of each activity towards the other activities in the model. These were as follows:

- The subjects of the *data-collecting activity* (the staff in the Research Office) were unaware of the other two activities. It had not occurred to them that the data they

collected for the annual government research report, could also be used to provide information to research managers. There was also no one in their group with enough IT expertise to see the research output data as anything other than a single list of items. There was no concept of structuring the data to give useful information.

- IT staff in the university, potential subjects of the *EIS design activity*, recognised the desire by managers for performance information. As described in Chapter 5, the university was a member of the UniOn consortium and had a commitment to use its EIS. The university's IT staff did not however believe that this EIS would ever be fully built and that it was highly unlikely that they would ever be able to link it into their data-warehouses. Whenever the issue of management information was raised with them they talked only of information from the student, the financial and human resources databases which fed into the data-warehouses. They were either unaware or unconcerned about the collection of research performance data and considered that was outside their area of responsibility.
- The subjects of the *sense-making activity*, the executives and research managers, were somewhat interested in, and aware of a need for, the other two activities. They all stated that in the area of research performance the university was woefully lacking in available information. Before seeing the prototype, they were skeptical that such information would ever be forthcoming and did not have enough IT expertise to specify exactly what sort of information system would be most useful.

It is my impression that the configuration of the CHAT model was an ideal representation of a comprehensive system to supply research performance information to university managers. It was clear that no such system existed because of the lack of awareness of the need for an integrated approach by the subjects of each of the activities. Cooperation between all three activities would be needed for a successful system to be created. My intervention, using the model, appears to be overcoming this

problem and has created much interest and enthusiasm for the development of a system based on the prototype.

Two other aspects of the configuration of the model were confirmed by the interviews. One, the interdependence of the objects of the two lower activities, the data gathering and the EIS design, was clearly demonstrated as significant. As already stated, the main reason that there was no research performance information system was that the data collectors had no appreciation of IT and the IT staff, if they ever considered research data at all, considered that it was not their responsibility. In my judgement if representatives of these two groups had communicated, their combined skills could have easily produced a workable system, based on a simple relational model, from the first data collection in 1996.

The other aspect of the model that was confirmed was the significance of the model's feedback loop, where the decisions of managers influenced the community of the two other activities. Without any reliable performance information the feedback appeared in this case to be entirely negative. The message to the research workers was that research output was important and being measured to determine the allocation of funds resulting in a great deal of stress and uncertainty about the processes by which diminishing resources were allocated. At the lower levels of the organisation, the process of collecting research output data was an unwelcome chore and there was a great deal of skepticism as to its accuracy and usefulness.

### **7.5.2 Analysing the Prototype as a Sense-making Tool**

Another matter for which I sought evidence in analysing the results of the interviews, was the choice of the sense-making activity of managers as the primary focus of interest. The analysis naturally employed the CHAT approach of studying activities, defined by their objects, driven by motives and mediated by tools and the community. The prototype EIS was presented to the interviewees as a tool for their sense-making

activity. This was in contrast to the only previous use that was made of research performance information, that of government reporting for the purpose of funding.

All managers, except for one of the senior executives who showed only a passing interest, were tremendously excited by the sense-making potential of the prototype for the following reasons:

- They could manipulate the data themselves whereas previously most used intermediaries to query the relational system, a process that expended much time and effort.
- They could easily identify gaps or errors in the underlying data, which could be investigated and corrected. Previously they suspected that the data was flawed but found it hard to identify where.
- They all agreed that, once the underlying data was corrected, this view of data could be used effectively to allow more equitable distribution of resources as all managers would see the same information. Previously different queries would produce different answers depending on how queries were phrased.

All those interviewed agreed that the project of creating the prototype was itself useful in raising awareness of the issues surrounding their needs to make sense of research performance information. Examples of this are shown in following five issues were raised by one or more of the interviewees in the study:

1. There seem to be at least two different motives for measuring research performance in Australian universities and these are the allocation of funding and for quality assurance. It is possible that these two motives are mutually self defeating, as the knowledge that funding is dependent on research output encourages the “research game” where performance indicator scores becomes an end in itself and quality research is not longer the main objective.

2. There is little agreement on what is a suitable set of measures for research performance. The choice of what to include, what are the weightings and how to calculate the rating per staff member are contentious and must differ between institutions and disciplines, so that overall comparisons are rarely meaningful. This seems to defeat the purpose of have the indicators in the first place.
3. There is a problem ensuring quality in the process of collecting, analysing and presenting the information on research performance. There are questions about accuracy and relevance, and whether the end result justifies the effort.
4. There is the question of how to interpret the quantitative measures and whether past performance in an indicator of future prospects. The performance indicators originated from a need to compare the performances between institution and within institution there is a need for some qualitative assessment to be used, in conjunction with the performance indicators, for future planning.
5. There needs to be more alignment of the goals, strategies and assessment of individuals with the goals and strategies of institutions. It often seems that the vision of the executive for the institution is not communicated effectively to units and individuals within the institution and that competition for resources with institutions is at odds with the effective management of the institution.

### 7.5.3 Analysing the Prototype Project in terms of CHAT Concepts

In the previous chapter, a list of the CHAT principles applicable to the model was presented in Table 6.3, and it was suggested that these could provide specific guidelines for EIS design and use. That list is reproduced in Table 7.1 and used to summarise the study of the prototype EIS containing the research performance data.

Table 7.1 A summary of CHAT Concepts Identified in the Project	
CHAT Concept	Relevance of the concept to the Prototype EIS
1 An Activity as a Comprehensive Unit of Analysis	The three activities contained in the model seemed to provide a holistic view of information support for managers. All issues raised in the interviews were part of one of the three activities and cooperation was needed from all three if a successful outcome was to be achieved.
2 The Object-Orientedness of Activity.	An activity, according to CHAT, is identified by its object and driven by motive. Identifying and focussing on the activity of sense-making meant that the purpose of data gathering changed from just a government requirement, tied to funding, to include the provision of information support for managers.
3 The Use of Tools	There are many IT systems that can be used for information delivery but these should be considered as tools to support human activity not as ends in themselves. MDDDB / OLAP systems are examples of information delivery tools that are not as well understood by technical staff as traditional database systems. They are therefore under utilised.
4 The Hierarchical Structure of Activities	Most MDDDB research has concentrated on the operational (machine) level. Little work has been done at the human activity level on how they support management activities.
5 Internalisation / Externalisation and the IPA	It appears that the dimensional view of information afford by MDDDBs are suited to managers' internal models of organisational performance.
6 Community and Context:	There were three distinct communities in the study, managers, IT staff and office workers doing the data collecting. These should be recognised as existing in the wider context of the whole organisation. The model provides an organisational perspective.
7 Collective and Individual Activity	Senior managers work as individuals but are treated as a collective subject in the implementation of an EIS. Designers need to be sensitive to the different needs of individual managers but also to the need to have one authoritative source of information for collective decision making.
8 The Dynamic Nature of Activity	Time is the most difficult dimension to capture in an information system. Changes with time of other dimensions is an inherent difficulty with multidimensional data. Assumptions must be made to make the time component workable.
9 Tool Mediation	My impact was an obvious example of a mediating influence on the current research management activities. The prototype MDDDB has already changed the way subjects of each of the activities view the issue of information support for managers.
10 The Active Nature of Subject	Engaging in the activity of using the MDDDB prototype was a learning experience for the subjects who may now redefine the issue of information support for managers.

7.5.4 Analysing the Prototype Project in terms of the Framework for EIS Design

In Figure 6.7, a framework for EIS design was presented and, it is pertinent to note that the prototype project followed the first three stages of this framework as described in Sections 7.2, 7.3 and 7.4. The only difference between this project and the framework was that there was no obvious sequence from stage one, (establishing organisational goals and information needs) to stage two (data rationalisation), as the latter was already happening for the different purpose of government reporting. However in all other

aspects the framework appeared to be valid. With the preparation of stages one and two it was possible, in stage 3, to create a prototype that contributed greatly to an understanding of the requirements for a complete system. So much so that the prototype, created for research purposes, has since prompted the development of a real research EIS for the university. This would logically be carried out using stage 4, where IT Services would build a system, and stage 5, where an on-going team would manage it.

The MDDB prototype project reinforced the relationship of the model to the framework. The model is a holistic representation of the problem of information support for managers and was used to break down this complex problem into the three manageable activities. The framework gives an indication of how the three activities of the model interact when developing the new EIS and describes the main stages. The ways in which the model and framework can be used more generally is described in the following section.

## **7.6 THE EMERGENCE OF GUIDELINES OR METHODOLOGIES**

There are many situations where performance evaluation is relatively straightforward: for example in many private, manufacturing companies where there is a clear bottom line and well-defined products. IS and management textbooks invariably use these types of companies to demonstrate concepts and theories. EIS vendors set up demonstrations using data from such companies so that their customers can see how well their EIS product grapples with large but relatively straightforward data sets typical of the industry. Most existing guidelines and methodologies for IS development suit the information systems in industries like manufacturing and there is probably no need for new guidelines or methodologies in these cases.

People working in many different industries have read the same management, and IS, textbooks and have seen impressive demonstrations from the same EIS vendors and would like to apply these apparently successful techniques in their organisations. However there always seem to be problem in translating management techniques and

EIS products from private, product-oriented companies to organisations that are concerned with public or professional service. In these cases it is not so much that large amounts of data have to be managed, although often there do, but rather that the data is complex, measures of performance are not so obvious and there is no single objective like that of profit making. In these types of organisations new methods are desperately needed to help make best use of information resources in support of management.

The EIS prototype project, conducted in a public professional bureaucracy, has demonstrated that the CHAT model and EIS design framework are a good basis for such methods. However it is debatable whether these methods should take the form of a formal methodology or whether it would be better to have loose guidelines that could be adapted to the particular situations occurring in different organisations. It is true that most developers of technical systems prefer to follow formal methodologies akin to the bottom-up approach to MDDDB design described above. A less formal and less prescriptive approach, which relies on the initiative of managers and IS staff, is the top-down method of EIS design, described above and this worked well in the prototype project.

The creators of Gentia, the EIS development tool used for the prototype, have long been concerned with this issue. The product itself was based on research carried out into the information requirements of managers (Gentia 1997). It is a sophisticated product using an object-oriented approach to development and enabling the linkage of data in many forms, both relational and dimensional as well as text and graphics. It is interesting to note that they are currently recommending that the product be used in conjunction with the Balanced Scorecard, a management approach that is not unlike TQM, which addresses many of the issues that I have addressed in building the model. It should not be construed that products like Gentia and techniques like TQM and the Balanced Score Card are ideal solutions to the research problem but their growth world-wide indicates that their creators are on the right track. This in turn provides some evidence to support

the relevance of my CHAT model as a solution to the problem. Some pertinent details of the Balance Scorecard and its Gentia's implementation are discussed in Appendix 5.

Both Gentia and the Balanced Scorecard take a holistic view of performance measurement support for organisational strategic management, recognising the important problems, addressing the right issues and having the ability to solve them. However these were not very attractive solutions for the University. Products like Gentia were considered too expensive and required too much investment, in time and effort, to learn. This impression was based on some experience they had already had with a similar product, HOLOS. The Balanced Scorecard had support in some areas of administration but was not popular with most as it was viewed as too formal, with again a huge investment in effort required to get enough people up to speed with the technique to successfully implement it.

The university context needed something similar but less formal, more intuitive and able to implemented using IT in a less sophisticated way. One senior manager interview in the study suggested that there should be someone in the organisation who had sole responsibility for the management of organisational information. This is similar to the position of Chief Knowledge Officer (CKO) describe by Earl and Scott in a recent article (Earl & Scott 1999). A CKO has to understand how different technologies can "contribute to capturing, storing exploring and in particular, sharing knowledge". According to these authors the ideal resume for a CKO seems to include "breadth of career experience and familiarity with the organisation" as well a "infectious enthusiasm". Unlike the more familiar position of Chief Information Officer (CIO) a CKO does not have the responsibility of the entire IT infrastructure of the organisation. In fact Earl and Scott report that most CKOs have small budgets and are required to define their own goals and job descriptions.

The model and framework developed in this thesis would fill this void and support a CKO in just the type of work they are normally brought in to tackle. In CHAT terms the model and framework would be an ideal tool for the activity of a CKO.

## CHAPTER 8 IMPLICATIONS OF THE RESEARCH

### 8.1 AN EVALUATION OF THE RESEARCH

In the introduction to this thesis the following research problem, questions and objectives were enunciated.

#### **The Research Problem:**

How computer technologies and associated systems can be used effectively to provide information, in particular organisational performance information, to support managers in their strategic activities, with particular reference to managers in public, professional bureaucracies such as universities.

**Note:** The focus here is NOT on developing computerised information systems that will be used directly by managers but rather on a broad understanding of information systems that may or may not be completely computerised, that may or may not be used directly by managers, but DO provide information support for managerial activities.

#### **The Research Questions:**

1. What do different disciplines and bodies of knowledge currently say about this problem?
2. Is there a theoretical approach that can provide a holistic contextual and dynamic understanding of this problem?
3. Can this theory be used to develop a holistic, contextual and dynamic model of the problem?
4. Can the model provide guidelines or methodologies that can be of general use to real organisations faced with this problem?

#### **The Research Objective:**

In the context of the Research Problem and Questions enunciated above, to find the holistic contextual and dynamic theory, to develop the understanding and the model, and to investigate the general applicability of the model in real organisations.

To meet this objective, a literature review of the problem area was presented in Chapter 2 and the CHAT theoretical approach was introduced in Chapter 3. From this theory, a model of the problem area was developed, as described in Chapter 6. The model was based on research conducted in a university setting described in Chapters 4 and 5. Finally, Chapter 7 presented a demonstration of how the model could be applied to a new project in the university.

The research was conducted by analysing qualitative data from a single site following an interpretive ontology. This approach to IS research is becoming increasingly more acceptable as described in the Chapter 1. Indeed, there are many who would say that a departure from the dominant positivist paradigm is essential for some areas of IS research. There is a question however on how such research can be assessed on criteria such as rigor, relevance and quality. By its very nature, interpretive research does not lend itself to a predetermined set of evaluation criteria that can be applied in a mechanistic way, but as Klein and Meyers (1999) observe, it does not follow that there are no standards by which interpretive research can be judged. As outlined in Table 1.1, these authors have determined a set of principles that can be used to evaluate this type of research.

In Table 8.1 the seven principles of Klein and Meyers have been use to assess the research of this thesis. For comparison, Tables 8.2 and 8.3 are reproductions of tables in Klein and Meyers' article (ibid), where they apply the principles to the research of Orlikowski (1991) and Walsham and Waema (1994), and Meyers (1994). It is significant that the key finding of their own research is that "most theories of IS implementation are too narrow and mechanistic; IS implementation can only be understood as part of the broader social and organizational context". The research objective is aligned with this sentiment, seeking a broad and contextual solution to the problem of information support for senior managers. The holistic approach that I have taken clearly adheres to the first of the seven principles, which is the one the authors claim is the most important. Indeed, where they "apply and give brief explicit

recognition” to this critical principle, in this research it is probably the most prominent aspect of the approach and the reason why the use of CHAT is so crucial.

Table 8.1.

The Seven Principles for Conducting and Evaluating Interpretive Field Research in IS applied to an Assessment of my Research (compare Table 8.2 where Klein & Meyers, 1999 perform a similar assessment of three studies)

Principle:	Its significance to my Research:
1. The fundamental principle of the hermeneutic circle	This principle is crucial to the holistic nature of the research problem.
2. The Principle of Contextualisation.	The CHAT approach dictates the importance of context which is manifest in the historical data analysis and the background of the university organisational setting (Section 5.3)
3. The Principle of Interaction between the Researchers and the Subjects.	Extremely significant. Explicit recognition was made of the fact that the researcher was a member of the organisation of the study, not a participant in any of the five projects of the historical study (Chapter 5) and the subject of the EIS development activity of the prototype project (Chapter 7)
4. The Principle of Abstraction and Generalisation	Uses the cultural-historical activity theory of Vigotsky and Leontiev and focuses on the work of managers in organisations
5. The Principle of Dialogical Reasoning.	Implied. The use of the historical method enabled the new model to evolve from the old, by reconciling contradictions between the three activities of the model.
6. The Principle of Multiple Interpretations	The different perceptions of the problem, by the subjects of the three distinct activities of the model, exemplify this principle.
7. The Principle of Suspicion	This principle was acknowledged in the literature discussion and adhered to throughout the interpretive analysis of data gathered from subjects of the three different but related activities

Table 8.2. (Klein & Meyers 1999, Table 3) A Comparative Assessment of Three Interpretive Field Studies			
Principle:	Orlikowski (1991)	Wlasham & Waema (1994)	Myers (1994)
1. The fundamental principle of the hermeneutic circle	Implied, but no explicit recognition given to it	Implied, but no explicit recognition given to it	Applied and brief recognition given to it
2. The Principle of Contextualisation.	Discusses the firm's current political structure and overall objectives.	Provides a multi-level analysis of the British financial services sector and an overview of key historical events	Uses the political context to explain some surprising aspects of the case
3. The Principle of Interaction between the Researchers and the Subjects.	Ignores the social interaction between the participants and the researcher	Ignores the social interaction between the participants and the researcher	Ignores the social interaction between the participants and the researcher
4. The Principle of Abstraction and Generalisation	Uses Giddens' structuration theory and focuses on forms of control in organisations	Uses Pettigrew's content, context and process framework and focuses on IS strategy formation and implementation	Uses the critical hermeneutics of Gadamer and Ricoeur and focuses on IS implementation
5. The Principle of Dialogical Reasoning.	The intellectual basis of the research is made clear, but the dialogical aspect is not discussed	The intellectual basis of the research is made clear, but the dialogical aspect is not discussed	The intellectual basis of the research is made clear, but the dialogical aspect is not discussed
6. The Principle of Multiple Interpretations	Alternative viewpoints are presented including the views of those who occasionally undermine the control process	Focuses mostly on senior management, but the views of other interest groups are also presented	Has an extensive discussion of the viewpoints of various stakeholders
7. The Principle of Suspicion	Criticises the short-term focus on profits at SCC and demonstrates the way in which IT has enabled existing forms of control to be intensified	Juxtaposes alternative viewpoints and suggests that one CEO failed to take a longer term view	Examines the views and actions of various stakeholders in terms of their political and economic interests

Table 8.3 (Klein & Myers 1999, Table 2) A Summary of the Three Interpretive Field Studies assessed in Table 8.2			
	1. Orlikowski (1991)	2. Walsham and Waema (1994)	3. Myers (1994)
Research method	Ethnography	Case study	Case study
Research site	A large, multinational software consulting firm	A medium-sized UK building society	A New Zealand government department
Theoretical focus	Implications of IT for forms of control and forms or organizing	IS strategy formation and implementation process	Implementation of information systems
Key findings	Instead of facilitating a more flexible organization, IT enabled existing forms of control to be intensified and fused	The IS strategy formation and implementation process is a dynamic one, involving time-varying relationships, multilevel contexts, and cultural and political aspects.	Most theories of IS implementation are too narrow and mechanistic; IS implementation can only be understood as part of the broader social and organizational context

## 8.2 SOME OBSERVATIONS

The research of this thesis has demonstrated that information support for managers is a difficult and complex problem area, particularly when approached in a holistic manner, encompassing both information systems and management issues. Advances in technology may have been responsible for the information revolution, but do not in themselves provide the answers to all the demands now made by managers for knowledge about how their organisation is performing. The problem is particularly acute in organisations, such as universities, which are not large private companies with a clearly defined bottom line.

That there is a need for advances in this area is not in doubt as there have been several notable endeavours that have made progress in this direction. The TQM movement and the BSC have become popular management techniques for identifying and measuring strategic quality performance in companies. Sophisticated “business intelligence” development packages, such as the Gentia and HOLOS applications mentioned in the thesis, provide the technical capability to store and display huge amounts of company information but these are probably too expensive, both in cost and application development effort, to use in organisations like universities. However these software innovations demonstrate both the need for, and the possibilities of, a successful assault on the real problems of delivering information to management that meets their specific needs. The increased popularity of fields of study such as organisational memory and knowledge management indicates the breadth of qualitative and quantitative information, which technical systems must now handle. However none of these systems are of use unless people have an understanding of their own specific needs and how to go about meeting them.

This thesis proposes a solution to the problem of building better information support systems for managerial work and provides both a better understanding of the problem and a way to proceeding. The understanding comes from the richness of the cultural-historical activity theory which provides a depth of knowledge on the activities of

people in the social context of organisations. This knowledge highlights the importance of the sense-making activity of managers and the role of information, and information systems, as tools, which mediate this activity. This role involves technology, and the activities concerned with the development of technological systems, as well as the human activities of information gathering and processing. The model of Figure 6.4 encapsulates the complexity and dynamics of this situation.

The cultural-historical activity theory has evolved over the greater part of this century. This fact gives the theory credibility and a vast collection of writings has been published on the theory. In presenting these ideas to IS colleagues, there has been skepticism that people in organisations will understand a model that incorporates ideas from such a rich and complex theory. My confidence that this skepticism is unfounded comes from the experience of Engeström and Kuutti, in Finland, and Capper and Hill, in New Zealand, who employ the Developmental Work Research approach based on CHAT to consultancies on work processes conducted in real organisational settings. They have all reported<sup>1</sup> that their ideas are quickly understood and appreciated by their clients and that they are committed to the CHAT approach in practice.

In this thesis, the model, together with the insight afforded by CHAT concepts, provides the understanding that enables subjects of the three component activities to communicate and cooperate. The activity of developing an EIS application for modern computer technology is of particular interest to the author as an IS academic. This activity requires specialised tools and is constrained by the limitations of the technology, so that computer software developers need guidance not just understanding. The framework of Figure 6.7 provides this guidance and, though it falls short of a development methodology, its benefits were demonstrated in the project described in Chapter 7.

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<sup>1</sup> Discussion at the 1997/8 ATIS Workshops held at the University of Wollongong.

### 8.3 FUTURE DIRECTIONS OF THIS RESEARCH

In the introduction to this thesis it was established that EIS research “has not extended beyond the descriptive phase to a theoretical based inquiry into the effect such systems can have when used by senior managers” (Leidner and Elam 1994) and that “technical aspects of EIS building are no longer an issue but it is the link between EIS and an executive's decision process which is most controversial” (Courbon 1994). These two issues, a theoretical basis for EIS research and a focus on the executive's use of the system, have been fundamental to this research and should be the topic of continued study.

As stated in the introduction, the term EIS has been used in a generally sense to denote those information systems that support the work of senior managers. This is similar to the Leidner and Elam (1994) definition of “a computer-based information system designed to provide senior managers access to information relevant to their management activities. Courbon describes the “democratisation” process of EIS, which were once the sole province of executive but are becoming Enterprise (or Everybody's) IS. The current tendency is therefore to study EIS in great breadth than has been the case in the past. However more work needs to be done on EIS organisations where performance information is more complex due to factors such as public accountability and the less tangible nature of their “products”. Service, not-for-profit and professional organisations are different from private manufacturing, retail companies where most management and information systems techniques originate. The proliferation of topics such as “business intelligence”, “managerial decision support”, “information space” and “knowledge management” are indicative of a desire by researchers to go beyond the previous narrow focus of work on EIS. Knowledge Management seems now to be the banner under which exciting qualitative research is being conducted into my problem area.

In Chapter 2, Section 2.2.1 the debate, on the use of the terms *data*, *information* and *knowledge*, was discussed. Many believe that there is confusion between the use of the two words *information* and *knowledge* when people talk about organisational systems. One impression is that the concept of knowledge, rather than information, implies a greater role for people, rather than machines, in the process of support for organisational management. The CHAT message is that activities should be the focus of interest and activities are always undertaken by people, supported by machines or tools.

Another area where more research is needed is who, within an organisation, should be responsible for its information and knowledge. A decade ago there was much discussion in the literature about the role of a Chief Information Officer (CIO), where most CIOs were senior executives entrusted to oversee the IT function of the company. Their principle concerns appeared to be IT budgets, infrastructure and strategy but not the use of information itself as a resource to management. In Chapter 7 the position of Chief Knowledge Officer (CKO) was described as someone with a “breadth of career experience and familiarity with the organisation” (Earl and Scott 1999) with a roving commission to identifying important organisational information and knowledge and to make it available to those who need it. A CKO has a much less tangible job description than a CIO and is not unlike the role that I once suggested for an “Information Broker” (Hasan 1997).

More research is still needed into the most useful ways in which computer applications can be designed to assist managers access and understand their organisation’s performance data. This involves not only the system’s interface but also the form in which information and knowledge is presented, the links between hard quantitative data and soft qualitative information. Managers are becoming increasingly computer and information literate and will increasingly demand systems that can be queried, manipulated and modified by the managerial end-users without subjecting them to extensive technical training.

Most management systems such as TQM and the Balanced Scorecard are structured for large, well-organised private companies. Conceptually, these management principles are applicable to most organisations but may be need to be altered and probably simplified for the more complex organisation mentioned above. Some case studies or action research should be carried out into the management practices of such organisations.

## **8.4 THE VALUE OF APPLYING CHAT TO IS**

If CHAT is to be widely used as a theoretical support for research in the IS discipline there are three important considerations. One is to how make the theory more palatable to IS researchers and practitioners who do not have the time to invest in learning it from its historical roots in other discipline areas. This begs the second consideration of the ethical dilemma associated with transporting the theory, with inevitable modifications and perhaps simplifications. Can it, and should it, still be called the cultural-historical activity theory in its new incarnation? The third consideration is; can CHAT be prescriptive as required by an applied field of study like IS?

In response to this third consideration it has been observed that most previous applications of Activity Theory as a research tool have been highly descriptive in nature. A much more categorical and prescriptive approach has been used in my work (Hasan 1998), which can be generalised as follows.

- Firstly the activities of interest are chosen and identified by defining their objects (in the Activity Theory sense of the word).
- Secondly the structure of an activity is used to filter and organise the research data into categories of subject, outcome, community and tool.
- Activity Theory diagrams can then be then drawn to display this data and provide a working model for analysis. This process should be an evolutionary one where the model is a prototype that can be evaluated by as many suitable subjects as possible.

- Activity Theory concepts, such as the hierarchy of actions and operations, tool mediation and the notion of internalisation/externalisation, can then be used in a focussed way to interpret the situation and coordinate the work related to the problem from different perspectives and disciplines .

Some examples of this last step are the following concepts from CHAT which could be explicitly built into system development methodologies (Hasan 1998):

- ***Understand the real purpose of the system:*** Systems which *informate*, such as executive information systems, must be designed as tools to support the user better understand, or make sense of, the way their organisation is meeting its goals. Designers should look for innovative ways to do this, not just automating existing reporting mechanisms. They also need to be sensitive to the motives driving the system. Managers may have personal and departmental interests as well as organisational ones.
- ***Anticipating the tool mediation effect:*** As soon as a system is new released, its use it will cause changes in the activity it was designed to support and the relationships between people in the organisation. Designers must view the adoption of their creation as an ongoing dynamic process and plan accordingly.
- ***Designing for subjects (managers) in their context:*** Systems developers are not likely to be expert psychologists or sociologists. It would help if they had some guidelines on how to firstly determine different management styles and the organisational characteristics, in their situation, and then secondly to match these to the style of system to build. Most executive information systems now are designed for very rational managers in private manufacturing or financial industries and do not always suit other situations.
- ***Coping with the big picture:*** Everyone would agree that it would be nice to take into account the *big picture* when developing information systems, especially

politically sensitive ones such as executive information systems. However too often entrenched technical methodologies, pressures of deadlines and a lack of business knowledge among system developers constrain information systems projects.

## **8.5 ARE CHAT CONCEPTS TOO COMPLEX FOR IS RESEARCHERS?**

It is my contention that the concepts outlined in the previous section are not any more difficult to understand than the information management problems in modern organisations. The provision of systems to manage business knowledge and provide information to support strategic decision making in organisations is a complex and dynamic problem. CHAT emphasises the wider ramifications of a problem by identifying the object of the activity, the motivations behind it, the tools used to support it and the context in which it occurs. It treats all activity as dynamic and developmental, and looks at the relationship between internal mental activity and the external, social environment.

Information systems research, based on CHAT, has three real strengths:

1. CHAT provides a common vocabulary to facilitate cross discipline discussion about this difficult topic. This is often what initially attracts researchers to the theory and may be due to its heritage in the richer languages of Russia. It is certainly true to say that activity theory is well suited to the field of linguistics and treats language as the basic tool of social and cultural knowledge.
2. CHAT has already proved to be suitable for descriptive and explanatory studies of problems involving the use of information technology. The first and most important step in solving a problem is to recognise and define it. The structure of activity, its hierarchical nature and the concept of tool mediation have provided a framework to explain the successes and failures of computer systems.
3. There are now efforts being directed at a more prescriptive application of the theory. Although the theory itself is well established, its mode of application is not always clear. There is an inherent difficulty in finding a rigorous, structured research

methodology when the problem itself is context dependent, complex and dynamic. At the CHI97 conference in Atlanta Bonnie Nardi and Victor Kaptelinin proposed a checklist for human-computer interface design based on activity theory. This checklist is currently being developed and evaluated. The research of this thesis is also in this category as described in the previous section.

There is still much work to be done in the area of making the theory more prescriptive and hence more palatable to IS researchers and practitioners who do not have the time to acquire and in-depth appreciation of CHAT itself.

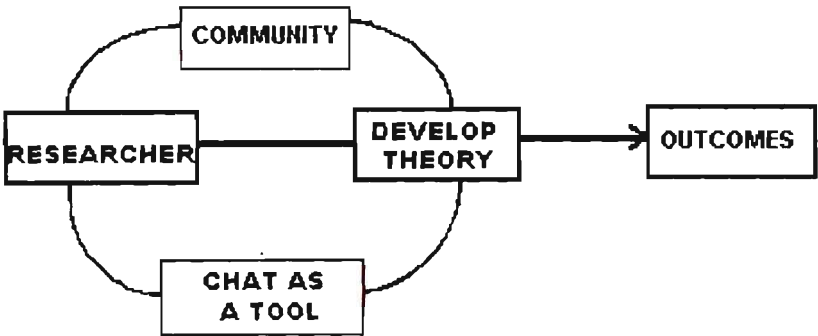
## **8.6 THE QUESTION OF MODIFICATIONS AND ADDITIONS TO CHAT**

As stated in the introduction to the thesis, the identification and adaptation of a well-established theory from a traditional discipline was an explicit goal of my research. CHAT has been identified the suitable theory but it has inevitably needed adaptation to make it suitable for its new context (the Western, IS culture of the 1990s). Any alteration to the theory carries with it a responsibility to maintain the integrity of the theory.

This section of the thesis addresses the dilemma associated with adapting CHAT to suit IS researchers and practitioners in the 1990s, that is, the extent to which CHAT concepts can be modified to be relevant in this context and yet still retain the essence of the original theory.

This issue was debated in a trans-pacific videoconference held in association with a workshop on Activity Theory and Information Systems (Nardi 1998). Several of the participants who have had considerable experience in the practical application of the theory in organisational contexts have little problem with the fact that the theory will inevitably evolve as it is used in different contexts and communities. There was recognition that changes or additions to the theory have already brought criticism from some more traditional CHAT researchers.

Justification for continued changes in the theory comes from the theory itself. The most appropriate way to deal with the problem of allowing the theory to evolve and yet not loose its basic nature is to consider IS research itself as an activity for which CHAT is the mediating tool. Figure 8.1 is an example of this. By CHAT definition an activity is dynamic and contextual, as the activity (research) is mediated by the tool used (CHAT) and the community (IS) in which it occurs. As the research activity learns and grows through the mediation of the tool (the theory) the theory must inevitably be refined to allow the development process to continue. From this perspective, CHAT as the mediating tool of the research activity, there is no alternative but to allow the tool to develop as the research activity matures in new and challenging contexts.



**Figure 8.1** IS Research, considered as an *activity* where CHAT is a *tool*.

# **APPENDIX 1**

## **BROWNE'S SPECIFICATIONS FOR AN INFORMATION SYSTEM TO SUPPORT HIGH-LEVEL DECISION-MAKING**

### **PROCESSES -**

The system needs to:

- Provide information throughout the decision process from the first recognition of the problem to the point of implementation of a solution
- Work simultaneously on providing information on a range of decision tasks such as defining the problem and finding and evaluating options
- Provide information that acknowledges the subtle changes that occur over time in the definition and magnitude of the problem
- Review information already presented to deepen or extend it as necessary when decision makers return, after a time, to a task already commenced
- Assist the incremental process of building a solution by providing answer to the very specific and narrowly focused questions posed by the decision-makers
- Adapt to the shifting priorities of decision-makers in relation to problems to be solved and the patterns of periods of intense information activity alternating with relatively little activity
- Initiate supply of information and not rely on the group requesting all relevant information
- Estimate how long decision makers are willing or can afford to wait for information that they perceive they should have
- Adjust to slippage in the schedules set for solving problems and the timeframes established for provision of information
- Explore the corporate memory contained in people's memories and the files of the organisation for potential solutions
- Monitor the wider environment for information on events and trends impacting the problems of the organisation

- Identify outside interests and stakeholders and facilitate the flow of information between these and the decision-makers
- Stimulate and coordinate the flow of information on possible solutions that come unsolicited to decision-makers
- Provide analyses of all of the options that are identified in the decision arena as well as the option of not taking any action to solve the problem
- Cater to the information needs of a decision group that not only changes in membership over time but varies from meeting to meeting depending on attendance and
- Promote a feeling among decision-makers that they are receiving enough information for their task without inducing information overload

## **OUTPUT -**

The information needs to:

- Explain the genesis and background of the problem to be resolved
- Identify the stakeholders inside and outside the organisation
- Acknowledge different perspectives and interpretations of the nature of the problem
- Explain any earlier attempts made to solve the problem or something like it
- Analyse existing policy and procedure that might give a framework for solving the problem
- Deal with a large number of possible solutions and options
- Identify all potential solutions regardless of the credibility of the sources from which they come
- Clearly distinguish the difference between solutions and the quality of the solutions and the criteria that might be used to evaluate them
- Present information at different levels and include summaries as well as detailed information to allow different users to access the content at an appropriate level.
- Provide abstract information primarily in forms such as general principles, summaries, and numeric data rather than information that is solely based on individual view and experiences

- Cumulate the information provided, over time, to facilitate returning to that information as necessary
- Structure (or restructure) information to allow dissemination to stakeholders of parts of the information available
- Give technical assessments of the options using expertise from inside and outside the organisation
- Speculate on possible outcomes of implementing possible solutions
- Provide background on the political environment and attitudes to different solutions as well as potential blocks to implementation
- Establish authority of the group to choose particular options and
- Summarize the information activities of the group as a basis for developing the awareness of stakeholders outside the group in regard to what information has been considered in the decision process.

## **STAGES OF DEVELOPMENT:**

### **STAGE 1 GROUNDWORK**

- Nominate the person(s) to take responsibility for guiding the process through implementation
- Signaling to the organisation at large that the system is about to be developed
- Establish a time frame and methodology
- Prepare a discussion document
- Setting of priorities

### **STAGE 2 THE INFORMATION AUDIT**

- Identifying the information resources
- Identifying the IT

### **STAGE 3 DEVISING STRATEGY**

- Reviewing priorities
- Strategic planning leading to a plan for implementation.

## APPENDIX 2

### THE INTERVIEWS

(Conducted at the University)

Position	Date	Remarks
<b>General University and IT Management</b>		
Deputy VC	1996	Exec Responsibility for IT
Pro VC (Research)	1999	New Research Manager
Pro VC (Academic)	1999	Responsibility for Academic staff evaluation criteria
Registrar	1999	Working with IT manager on student information for management
Head ITS	1995	Long serving IT leader, in charge of ITS when most of the 5 projects took place
Head ITS / UniOn Rep	1995	Head of Admin IT then seconded to UniOn EIS group
Head AIS	1999	New to Uni - brought in by Exec from private sector to make IT more business-like
Head P & M	1996	Statistician - head of Planning and Marketing- provides stats to exec from DWs etc
<b>Representatives from the Five Projects</b>		
Leader QAI	1998	Head of QAI project
Member QAI	1995	Member of QAI project team
DW	1996,8	in ITS, responsible for DWs
TO DW / CWIS	1999	TO maintaining DW and CWIS
Intranet	1995	in ITS Uni Web manager
Intranet	1997	took over from Tim
PO at UWS	1998	Leader UniOn EIS
<b>Organisational Information Projects Other than Performance</b>		
DEET Stats Officer	1998	Maintains and does queries on DB containing DEET stats.
RAIS	1998	Separate Database containing Core business information (Courses etc) for prospective students
<b>Interviews for Research Prototype Requirements and Evaluation</b>		
Member CRP	1998	Prototype Requirements
Member CRP	1999	Prototype Requirements
Member CRP	1999	Prototype Requirements
Faculty FO	1996,8	Prototype Requirements
Manager RO	1998,9	Prototype Requirements
Faculty Dean	1999	Prototype Evaluation
HOD	1999	Prototype Evaluation
Leader research group	1999	Prototype Evaluation
Head Faculty Research	1999	Prototype Evaluation

<b>Meetings Attended as Observer</b>		
Uni Executive	1996	Meeting to discuss quality restructuring
Uni Executive	1998	Meeting to discuss quality restructuring
Intranet Committee	1997,8	Intranet / Internet development
CWIS Committee	1996	Staff IT communications requirements
Faculty Research	1997,8	Faculty Planning
RAIS Planing	1998	New systems for Uniadvice (for prospective students
UniOn	1999	UniOn EIS demonstration
BSC	1998,9	2 demonstrations

## APPENDIX 3

### PERFORMANCE INDICATOR CATEGORIES<sup>1</sup>

<b>Broad Context</b>		63-65	Academic staff by age (FTE)
<u>Indicators</u>	<u>Title</u>	66-69	Academic staff by qualifications
1	Students	70-81	Student-staff ratio by academic organisational unit
2	Equivalent full-time student units (EFTSU)		
3-5	Type of enrolment		
6-9	Postgraduate students		
10	Overseas students	<b>Finance</b>	
11	Non-overseas, fee-paying students	<u>Indicators</u>	<u>Title</u>
12-17	Basis of admission	82-93	Operating revenues
18-21	Median Age	94-96	Research income
22-34	Equity groups	97-98	Research income by field of study
35	Undergraduate courses by field of study	99-109	Operating expenses
36	Postgraduate courses by field of study	110	Salaries and salary related costs
37	Number of campuses	111-113	Expenses per EFTSU
		114-118	Assets
<b>Staff</b>		<b>Outcomes</b>	
<u>Indicators</u>	<u>Title</u>	<u>Indicators</u>	<u>Title</u>
38-40	Staff	119-121	Retention rates
41-45	Academic and non-academic full-time equivalent (FTE)	122-124	Student progress rate
46-49	Academic staff by current duties term (FTE)	125-128	Graduate full-time employment
50-53	All staff by function (FTE)	129-132	Graduate full-time study
54-57	Academic staff by classification (FTE)	133-136	Graduate starting salaries
58-62	Academic staff by classification and gender(FTE)	137-140	Course Experience Questionnaire (CEQ) overall satisfaction
		141-144	CEQ good teaching
		145-148	CEQ generic skills

<sup>1</sup> Andrews L., Aungles P., Baker S. and Sarris A. Characteristics of Higher Education Institutions ( A preliminary investigation). DEETYA Report

## **APPENDIX 4**

### **THE HOARE REPORT RECOMMENDATIONS ON UNIVERSITY MANAGEMENT**

#### **Recommendations on Governance**

1. The governing body of higher education institutions should have ultimate responsibility for strategic direction and development of the university and external and internal accountability, including monitoring and review of institutional strategic performance. It should also ensure that:

- a. accountability for implementation is appropriately delegated;
- b. there is an appropriate academic body to monitor academic policy and standards and protect academic freedom;
- c. there are adequate and effective separate fora available to determine stakeholders' opinions, particularly for those of staff and students; and
- d. it reports on progress against strategic directions.

2. The role of the Vice-Chancellor should be to exercise stewardship of the institution on behalf of the governing body, and he or she should be formally accountable to the governing body for performance according to an agreed set of objectives, arrangements and criteria.

3. Governing bodies should, on a regular basis, review their own role and performance, and that of the Vice-Chancellor.

4. The Minister for Employment, Education and Training, through appropriate Commonwealth and State/Territory bodies, should recommend that States amend university enabling legislation, where appropriate, so that:

- a. the responsibilities and roles of governing bodies and their members are explicit;

- b. members elected or appointed to the governing body have fiduciary responsibility and must disclose interests in matters under consideration;
- c. the size of the governing body is typically between 10 to 15 members;
- d. the governing body is able to co-opt members;
- e. external independent members outnumber internal members;
- f. the governing body can fill vacancies by appointment on a temporary basis until elections can be held or external appointments are made; and
- g. the governing body can make ordinances, statutes, by-laws and rules without requiring government approval.

5. Changing the focus and structure of the governing body will require greater attention to the nature of appointments and membership:

- a. members of governing bodies should be chosen on the basis of their demonstrated ability and preparedness to contribute and the required mix of skills and attributes for the body, taking into account considerations such as gender equity;
- b. external members should be identified through an independent professional process;
- c. a proportion of members should be replaced regularly and appointments to the body should be made on a three or four year rolling basis with a usual maximum of, say, no more than two or three terms;
- d. the governing body should ensure that its members and potential members can meet all their responsibilities effectively by having:
  - clear guidelines on the roles and responsibilities of members;
  - proper induction; and
  - continuing skilling and development; and

e. in relation to government appointments:

- the institution should provide a short-list of names for discussion with the Minister/Governor, and
- the Minister/Governor should ensure appointments are timely.

### **Recommendations on Strategic Management**

6. A more strategic and systematic approach to management and leadership skills development should be adopted at all levels and across all organisational units of each university.

7. In their strategic plans, universities need to ensure that they are able to meet the accountability requirements of the Commonwealth for the funding they receive from the Commonwealth. The profiles process will need to focus on those outcomes relevant to Commonwealth policies and objectives.

8. To ensure that strategic plans have an appropriate basis against which to measure and account for performance, they should incorporate:

- a. a medium to long term horizon (including three year financial projections);
- b. analysis of the operating environment;
- c. clearly defined objectives and strategies to achieve these objectives, including the availability of resources;
- d. quantitative and qualitative performance indicators and targets;
- e. review against past plans and targets; and
- f. an outline of accountability and reporting processes.

9. Institutional annual reports, as the key retrospective external accountability report, should:

- a. report outcomes and achievements against objectives and performance information established in the strategic plan; and

- b. contain sufficient information to satisfy, as far as possible, Commonwealth, State and other stakeholder reporting requirements.

10. There needs to be a review of all reporting requirements with a view to streamlining and reducing the administrative burden and ensuring that all data collected have some genuine use.

### **Recommendations on Legislative Issues**

1. The governing body of higher education institutions should have ultimate responsibility for strategic direction and development of the university and external and internal accountability, including monitoring and review of institutional strategic performance. It should also ensure that:

- a. accountability for implementation is appropriately delegated;
- b. there is an appropriate academic body to monitor academic policy and standards and protect academic freedom;
- c. there are adequate and effective separate fora available to determine stakeholders' opinions, particularly for those of staff and students; and
- d. it reports on progress against strategic directions.

2. The role of the Vice-Chancellor should be to exercise stewardship of the institution on behalf of the governing body, and he or she should be formally accountable to the governing body for performance according to an agreed set of objectives, arrangements and criteria.

3. Governing bodies should, on a regular basis, review their own role and performance, and that of the Vice-Chancellor.

4. The Minister for Employment, Education and Training, through appropriate Commonwealth and State/Territory bodies, should recommend that States amend university enabling legislation, where appropriate, so that:

- a. the responsibilities and roles of governing bodies and their members are explicit;
- b. members elected or appointed to the governing body have fiduciary responsibility and must disclose interests in matters under consideration;
- c. the size of the governing body is typically between 10 to 15 members;
- d. the governing body is able to co-opt members;
- e. external independent members outnumber internal members;
- f. the governing body can fill vacancies by appointment on a temporary basis until elections can be held or external appointments are made; and
- g. the governing body can make ordinances, statutes, by-laws and rules without requiring government approval.

5. Changing the focus and structure of the governing body will require greater attention to the nature of appointments and membership:

- a. members of governing bodies should be chosen on the basis of their demonstrated ability and preparedness to contribute and the required mix of skills and attributes for the body, taking into account considerations such as gender equity;
- b. potential external members should be identified through an independent professional process;
- c. a proportion of members should be replaced regularly and appointments to the body should be made on a three or four year rolling basis with a usual maximum of, say, no more than two or three terms;
- d. the governing body should ensure that its members and potential members can meet all their responsibilities effectively by having:
  - clear guidelines on the roles and responsibilities of members;

- proper induction; and
- continuing skilling and development; and

e. in relation to government appointments:

- the institution should provide a short-list of names for discussion with the Minister/Governor, and
- the Minister/Governor should ensure appointments are timely.

## **APPENDIX 5**

### **THE BALANCED SCORECARD AND IT'S GENTIA IMPLEMENTATION**

As described in Chapter 6, many organisations are looking for solutions to the problems identified in this thesis and have turned to management techniques, such as scientific management, TQM and, more recently, the Balanced Scorecard that are compatible with my CHAT model. At the same time software houses are creating EIS development products such as Gentia and HOLOS, or EIS additions to the existing organisational systems such as Oracle and SAS to support such management techniques. Even with the support of a sophisticated EIS development system, a popular management technique does not necessarily provide a satisfactory strategy for every organisations. Indeed the techniques mentioned here are often dismissed as simply the latest in a series of management fads. However the literature is full of reports of organisations that have felt that these techniques are worth pursuing and that have experienced some success with them. This could be seen as confirmation of the value of my model and, in support of this claim, this Appendix describes the Balanced Scorecard management technique, with its implementation in Gentia.

According to its creators, Kaplan and Norton (1996), the Balanced Scorecard takes a holistic approach which is “not just a performance measurement system but a management system that can channel energies, abilities and specific knowledge held by people throughout the organisation towards achieving long-term strategic goals”. More specifically, the Balanced Scorecard is a formal management technique that begins at the top of the organisation, setting goals, and then the strategies to achieve them, in four critical areas of Finance, Customer, Internal and Learning as shown in Figure A1. At the same time measures and performance targets are established, aligned with the strategies, and are set up so that they can be regularly monitored. The example shown in Table A1

is the design of a top-level scorecard and, once established, the same process then cascades down the organisation in alignment.

	Strategic Objectives	Strategic Measurements	
		(Lag Indicators)	(Lead Indicators)
Financial	F1 - Improve Returns F2 - Broaden Revenue Mix F3 - Reduce Cost Structure	<input type="checkbox"/> Return on Investment <input type="checkbox"/> Revenue Growth <input type="checkbox"/> Deposit Service Cost Change	<input type="checkbox"/> Revenue Mix
Customer	C1 - Increase Customer Satisfaction With Our Products & People C2 - Increase Satisfaction "After the Sale"	<input type="checkbox"/> Share of Segment <input type="checkbox"/> Customer Retention	<input type="checkbox"/> Depth of Relation <input type="checkbox"/> Satisfaction Survey
Internal	I1 - Understand Our Customers I2 - Create Innovative Products I3 - Cross-Sell Products I4 - Shift Customers to Cost-Effective Channels I5 - Minimise Operational Problems I6 - Responsive Service	<input type="checkbox"/> New Product Revenue <input type="checkbox"/> Cross-Sell Ratio <input type="checkbox"/> Channel Mix Change <input type="checkbox"/> Service Error Rate <input type="checkbox"/> Request Fulfillment Time	<input type="checkbox"/> Product Development Cycle <input type="checkbox"/> Hours with Customers
Learning	L1 - Develop Strategic Skills L2 - Provide Strategic Info L3 - Align Personal Goals	<input type="checkbox"/> Employee Satisfaction <input type="checkbox"/> Revenue per Employee	<input type="checkbox"/> Strategic Job Coverage Ratio <input type="checkbox"/> Strategic Info Availability Ratio <input type="checkbox"/> Personal Goals Alignment (%)

**Figure A1** An example of Lag and Lead Indicators that match the Strategic Objectives in the Four Areas prescribed by the The Balanced Scorecard approach to management (Gentia 1997)

Initially, literature on the Balanced Scorecard came only from its creators (Kaplan & Norton 1992, 3, 6) and focussed on its benefits and practical implementation as summarised in Figure A2. However recent independent commentators have provided a more object description of the Balanced Scorecard as “not only a tool for a clarifying and communicating strategy, but also as a foundation for actively managing it” (Martinson et al 1999). These authors go on to say that a Balance Scorecard-based system could “come to resemble an organisational activity support system”. This

language is very reminiscent of the CHAT concept of tool mediated activity and thus supports the argument that the current popularity of the Balanced Scorecard is evidence of the relevance of a CHAT-based approach to this problem. More examples of statements from Martinson et al (1999) that reinforce a dynamic, contextual, activity-based view of the problem of performance measurement for strategic management are presented in Figure A3.

According to its creators the Balanced Scorecard has the following innovative attributes:

- it “creates a shared understanding of the organisation’s vision.”
- it “creates a holistic model of the strategy that allows all employees to see how they contribute to organisational success.”
- it “communicates the meaning of the business strategy to the organisation.”
- it includes measure of both outcomes (lag indicators) and performance drivers (lead indicators).
- it warns of the dangers of having single measures of success. “If too much pressure is placed on a single measure managers could soon develop dysfunctional methods to achieve excellence on this measure.”
- it “offers an alternative approach for determining when incentive compensation is paid” by not recommending that they are tied directly to scorecard measures using traditional formula-based systems.
- ‘The organisation’s high-level strategic objectives and measures need to be translated into actions that each individual can take to contribute to the organisational goals.’

**Figure A2** Excerpts from Kaplan and Norton’s own description of the Balanced Scorecard

“Evaluation methods that rely on financial measures are not as well-suited for newer generations of IT applications”

“Traditional financial accounting measures (like the ROI and payback period) offer a narrow and incomplete picture of business performance and that a reliance on such data hinders the creation of future business value”

“The Balanced Scorecard is designed to complement financial measures of past performance with measures of the drivers of future performance”.

“The Balanced Scorecard reflects an intent to keep score of a set of items that maintain a balance between short- and long-term objectives, between financial measures, between lagging and leading indicators, and between internal and external performance perspectives”.

“The ability to mobilise and exploit softer and less tangible intellectual assets is becoming more important”.

**Figure A3** Some Observations on the Balanced Scorecard from Martinson et al (1999)

The Balanced Scorecard has an inherent multidimensional structure. There is vertical dimension of the four critical areas and a horizontal alignment of strategies, measures, targets and innovations. There is a depth of alignment through the different levels of the organisation. There are also lagging and leading, as well as quantitative and qualitative, indicators. The purpose of the indicators is another dimension that can also be considered. According to Kaplan and Norton the objective of the scorecard is to manage organisational strategies rather than evaluate employees.

The learning and growth perspective is a particularly interesting one and, according to Kaplan and Norton, includes the three principal categories of “Employee Capabilities”, “Motivation, Empowerment and Alignment” and Information Systems. The latter category demonstrates the integrated, holistic approach of the Balanced Scorecard, as described by the following quotes:

*“If employees are to be effective in today’s competitive environment they need excellent information on customers, on internal processes and of the (financial) consequences of their decisions.” “Front-line employees need accurate and timely information about each customer’s total relationship with the organisation.”*

*“Employees in the operations side of the business need rapid, timely and accurate feedback on the product just produced or the service just delivered.”*

One aspect of the strategic value of information technology is in its potential to manage the Balanced Scorecard itself. Kaplan and Norton designed this holistic tool to support organisational strategic management with performance measurement but fell short of providing the means to automate it. It should be possible to develop a computerised system to assist employees who are in the process of developing a Balanced Scorecard, to capture the resulting Scorecard and to automate its on-going maintenance. A set of requirements for a computer-based system to support the Balanced Scorecard have been determined as follows (Gentia 1997):

1. **The Balanced Scorecard must provide linkage from the corporate vision to strategic objectives to key performance measures – and show ‘cause and effect’.** *More than a list of measures, from vision to strategy to objectives to measures using drill-down and cause and effect diagrams.*
2. **The Balanced Scorecard must allow creation and linkage of organization and personal Scorecards.** *Create and manage scorecards across business units and build individual scorecard portfolios.*
3. **The Balanced Scorecard must support both quantitative and qualitative information.** *The numbers are important, but the commentaries add real meaning.*
4. **The Balanced Scorecard must encourage dynamic communication.** *More than a reporting vehicle it is a strategic feedback system. It must support feedback loops, dialogue, comments, personalized assessments and initiative management.*
5. **The Balanced Scorecard must be easy to set up and maintain.** *Standard implementation features with security and user access definitions and multiple language support.*
6. **The Balanced Scorecard must be enterprise deployable.** *To all levels of the organization, accessed by many users, across mixed platforms & IT infrastructures (including the Web!).*
7. **The Balanced Scorecard must link through to tactical and operational business intelligence applications.** *Integrated environment with linking feeder systems and drill through to analytical applications specific to that organization.*

Gentia, the EIS development product used in the project of Chapter 6, was itself created with a similar holistic philosophy and multidimensional structure to the Balance Scorecard. So it is not surprising that the Gentia company has formed a strategic alliance with Renaissance to promote both the Balanced Scorecard as a management system and an implementation in Gentia which can be used to design, implement and maintain an organisation's Scorecard along the lines of Table A2.

**Attributes for supporting balanced scorecard management model.**

**Balanced scorecard framework**

- ◆ Strategic objective based
- ◆ Vision statements
- ◆ Cascades and connects multiple scorecards
- ◆ Strategic themes
- ◆ Links objectives, measures, and initiatives
- ◆ Comparison of measures to targets

**Management process**

- ◆ Subjective indicator reporting
- ◆ Subjective written assessments
- ◆ Scorecard management discipline (i.e., individualized reminders for necessary input)
- ◆ Initiative management
- ◆ Cascades to individuals' goals/performance
- ◆ Accountability

**Strategic feedback and learning**

- ◆ Performance at a glance
- ◆ Reporting on measures of four perspectives
- ◆ Support for communication/commentary
- ◆ Linkage view with performance indicators

**Table A2** A checklist of balanced scorecard feature requirements.

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