ACCOUNTING INFORMATION SYSTEMS: THE ROLE OF MANAGEMENT DEVELOPED SYSTEMS

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ABSTRACT

A major revolution has taken place in the past 25 years in the technology and systems for processing organisational data. Alongside these developments there has been a dramatic growth in the direct use of IT as personal support tools by those in staff and managerial roles. Groups such as accountants, production planners, and others are now developing their own systems to help enhance the role that they play in the organisation. Despite these developments the focus in accounting research and textbooks remains on accounting information systems — systems developed typically by IS departments. The research reported in this paper is based on interviews with 51 managers (including 26 accountants) in 26 Irish and UK organisations during 1994/95 and sought to examine the role played by Management Developed Systems in organisational planning and control. The results of this research show that in many cases the activities in which managers are engaged are such that it is unlikely that IS staff have the level of knowledge and understanding needed to provide the information/analysis that managers require. Formalised requirements specification by IS staff in many cases acts as a discontinuity in the processing of information during task performance, while Management Developed Systems allow the additional knowledge acquired during task performance to be encompassed in the information processing and decision making.

INTRODUCTION

A major revolution has taken place in the past 25 years in the technology and systems for processing organisational data. Dramatic price performance improvements have meant that organisations now have a formidable resource of sophisticated technology for monitoring and running their activities. Alongside these developments there has been a dramatic growth in the direct use of Information Technology (IT) as personal support tools by those in staff and managerial roles (Brancheau and Wetherbe, 1990; Kumer and Cotterman, 1990; Alavi, 1988; Ein-Dor and Segev, 1988; Stanton, 1988). These end users have in many cases become the key force driving the acquisition and use of computer resources in organisations, with the result that a significantly larger proportion of computing and information systems activities are now taking place outside the traditional Information Systems (IS) department. Groups such as accountants, production planners, and others are now developing their own systems to help enhance the role that they play in the organisation (McLean and Kappelman, 1993; Watson and Carr, 1987; Alavi et al., 1987).

Despite these developments, the focus in accounting research and text-books remains on accounting information systems — systems developed typically by IS departments. For example, in recent years a large number of texts have been published on the broad topic of Accounting Information Systems (AIS) (Cushing and Romney, 1994; Nash, 1992; Leitch and Davis, 1993; Gelinas et al., 1993). These texts address the subject of AIS under a number of headings, including the conceptual foundations of AIS, the technology, design and development of AIS, and the control and audit of AIS. The texts reflect the core of the material taught in the areas of AIS in the curricula of the principal accounting bodies. Over the past ten years there has been a remarkable consistency in both the focus and content of this material. In particular, there has been a marked absence of material addressing the issues of decision support and the development of applications/systems by those in staff and managerial roles, such as management accountants, finance managers, etc. Murphy (1990) has shown that accountants develop 50 per cent of decision support systems in organisations. In addition, Murphy et al. (1995) found that end-user developed decision support systems (dss) based on PC technologies accounted for almost all of the dss applications used by senior managers in organisations. The neglect in the accounting literature of this important

role played by accountants in actively developing decision support systems and other types of information systems applications is something that needs to be remedied.

The research reported in this paper, which is based on interviews with 51 managers/accountants in 26 organisations during 1994/95, sought to determine the extent to which managers in key positions rely on systems that they have developed themselves to meet their key information requirements. In addressing these issues, the focus was on an in-depth examination of the nature of the activities which involve or lead to such systems, and contrasting these with those that rely primarily on the use of information from IS developed systems. The research also tries to determine why in the face of increasing centralised IS capability senior and middle-ranking staff continue to invest significant personal effort in developing their own systems or applications to meet their key information requirements. The remainder of the paper is structured as follows: firstly, the nature of end-user computing and in particular the reasons put forward in the literature to date for managers' developing their own systems is examined; this is followed by a discussion of the nature of managers' decision making and in particular the role of tacit knowledge in managers' problem solving; finally, the research approach and findings are presented, and the implications for further research discussed.
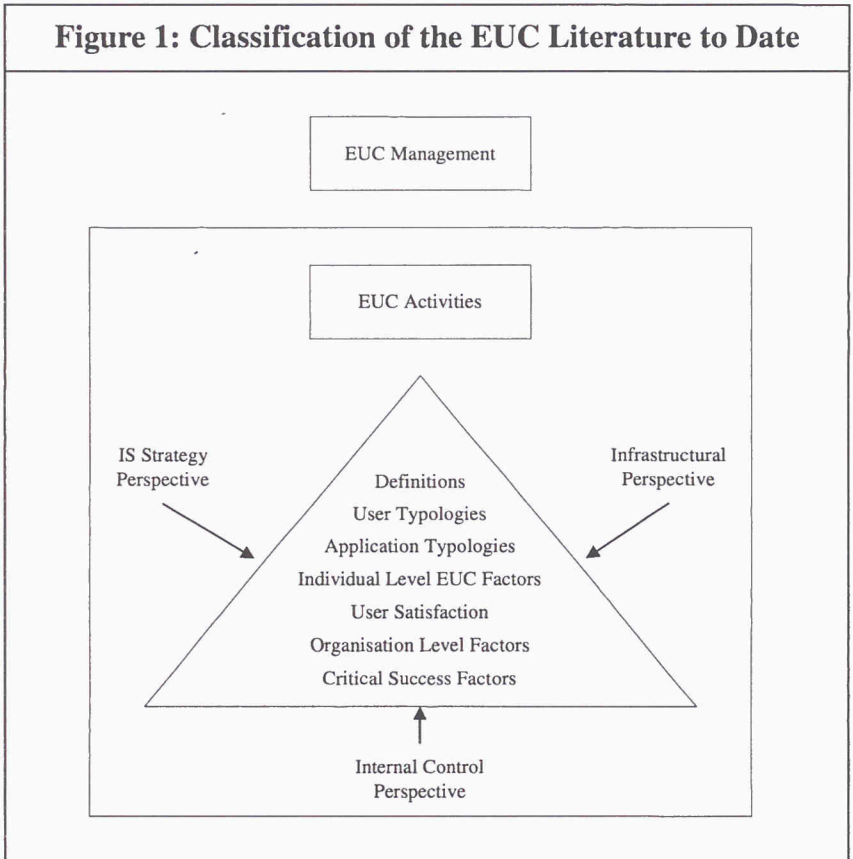
END-USER COMPUTING AND THE ROLE OF MANAGEMENT DEVELOPED SYSTEMS

End-User Computing was the term coined to describe the situation where IS personnel were not the primary developers of systems. While End-User Computing (EUC) has its origins as far back as the late 1960s, corporate interest in EUC did not take off until the advent of micro computing in the early 1980s. Definitions of EUC were slow to emerge. In 1982, Benjamin was one of the first writers to established the practice of describing applications beyond data processing as 'End-User Computing'.

What were the conditions that brought about this move to End-User Computing? Many writers point to the backlog in the traditional systems development as the main impetus for a move towards EUC (Carr, 1988; Gremillion and Pyburn, 1983; Bostrom et al., 1988; Leitheiser and Wetherbe, 1986). Bostrom et al. (1988) point out that many organisations viewed EUC 'as a panacea for the huge backlog of requests to information systems departments for systems development'. Leitheiser and Wetherbe

(1986) found that 'unmet demand has combined with the fall of hardware costs and improvements in software design to increase the amount of computing being done by end users'.

While a large volume of work has been published in the area of EUC, much of it is journalistic in nature, with only a limited amount of serious academic work in print. As **Figure 1** illustrates, this work can be categorised into two main areas. The first and largest category is

Figure 1: Classification of the EUC Literature to Date

EUC Management

EUC Activities

IS Strategy Perspective

Infrastructural Perspective

Definitions
User Typologies
Application Typologies
Individual Level EUC Factors
User Satisfaction
Organisation Level Factors
Critical Success Factors

Internal Control Perspective

research on the management of End-User Computing activities. This work is primarily concerned with identifying strategies, policies, and infrastructure to assist IS managers in managing EUC activities in their organisations. The second is research on the EUC activities of individual managers or groups of managers. This work consists primarily of attempts to develop classifications of EUC activities and to develop explanatory models of the EUC activities of managers.

Research on the management of End-User Computing has been primarily concerned with three broad areas:

- Information Systems Strategies for End-User Computing Activities

- Infrastructural issues for EUC activities

- Internal control considerations associated with EUC.

Robey and Zmud (1992) suggested that many of these studies have been grounded in a theoretical void. They contended that while reference disciplines offer an adequate number of theoretical foundations upon which to base research, IS researchers often ignore them. The authors argued that it is important that applied research in IS reflects the theoretical advances of established scientific disciplines.

The key feature of the research to date in EUC is the overriding focus on the technological aspects and in particular on the direct hands-on use of that technology by individuals or groups of individuals. Individual or departmental efficiency is seen as the key benefit and the main areas addressed are data integrity and application types in technological terms. In addition, the research focuses on the computing and not on the types of decisions being addressed or the impact on the organisation. The end-user typologies put forward are expressed in terms of the users' technological capabilities, not their managerial function. There are very few researchers who have examined the nature of the decisions or the activities that lead to or give rise to managers' EUC activities. In particular, researchers have not addressed such issues as the novelty or frequency of the decisions addressed, the uncertainty of the decisions or the ambiguity surrounding alternatives, choices and preferences.

If we are to obtain a meaningful insight into the nature and role of the systems that managers develop, it is necessary to move away from the narrow technology perspective that has characterised research to date. In

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particular, it can be argued that there has been too much emphasis on a technical perspective, and insufficient attention paid to the nature of the managerial activities, which might better explain why managers need to develop personal systems. Consideration of these issues suggests that it is time to replace the term 'End-User Computing' with one that is more appropriate — Management Developed Systems. The term 'End-User Computing' includes such activities as word processing, E-mail and other types of computing activity which are not specifically concerned with meeting the information needs of managers for decision-making purposes. The term 'Management Developed Systems', on the other hand, refers specifically to those applications or systems that managers have developed directly themselves as part of their decision-making and problem-solving activities. The next section is concerned specifically with the nature of those activities

INFORMATION, KNOWLEDGE AND MANAGERS' DECISION MAKING

Mason and Mitroff (1973) argue that the concept of management information systems (MIS) has suffered because of a failure to analyse in sufficient and reflective detail the components of the definition of MIS. In particular, they suggest that the current philosophy underlying the design of MIS has presupposed a greatly restricted view of knowledge, effectiveness, action and purpose. Harrington (1991) points out that while information is a misunderstood concept, it is at the same time one of the most widely used. He argues that gaining the ability to process more information more quickly does not guarantee success. Harrington classifies the literature on information into what he calls two paradigms: the resource-driven paradigm and the perception-driven paradigm. The central theme of the resource-driven paradigm is that information is treated as a resource to be tapped at any time with the certainty of achieving a predictable value from it. Boland, on the other hand, supports the perception-driven paradigm and argues that

> The essence of information is revealed to us in its name. Information is an inward forming. It is the change in a person from an encounter with data. It is a change in the knowledge, beliefs, values or behaviours of that person (Boland, 1987).

Boland goes on to suggest that this inward forming, which is, in his view, the proper and ultimate interest of information systems research, is not

readily available for observation; only data in the form of reports, graphs or inquiry responses is available. Boland contends that the study of the process by which individual executives make sense of things is critical to the effectiveness of the overall information systems. He argues for a different perspective, where information could no longer be a mere commodity or a resource to be stockpiled since it was generated at the interface between individuals and their environment.

The challenge according to Feldman and March (1981) is for researchers to understand actual human encounters with information. They contend that information engineering characteristically seeks to improve behaviour through instructing human actors in techniques for making better use of information. This approach, which is based on the classical representation of organisational choice, suggests that information about the possible consequences of alternative actions will be sought and used only if the precision, relevance and reliability of the information are compatible with its cost. Empirical studies of information in organisations, however, show that organisations systematically gather more information than they use, continue to ask for more, and that the use of information is embedded in social norms that make it highly symbolic. March contends that

> one can design an information system around a precise, static decision structure and for many elementary decision problems in organisations that is a good idea. But the more difficult and more important task of information engineering involves the design of a system for an imprecise, changing decision structure (March, 1988).

March points to the need to find ways of helping individuals and organisations to experiment with doing things for which they have no apparent reason and to be playful with their conception of themselves. March's view is based on the belief that reason and intelligence have had the unnecessary consequence of inhibiting the development of purpose into more complicated forms of consistency. Freedom to experiment and explore ideas is, according to March, a key feature in successful managerial decision making.

Isenberg (1984) argues that instead of having precise goals and objectives, senior managers have general overriding concerns and think more about how to do things than about what is being accomplished. In addition to

depending on their ability to analyse, they also rely heavily on a mix of intuition and disciplined analysis. In many cases, action on a problem is incorporated into the diagnosis of the problem.

Much of the skill or know-how that organisational actors have is tacit knowledge, knowledge acquired by trial and error, which is often acquired by watching what other people do, and which is not written down anywhere. Polanyi (1967) built an entire philosophical system on the simple observation: 'We know more than we can tell . . . to be able to do something and at the same time to be unable to explain how it is done is more than logically possible it is a common situation'.

Wikstrom and Normann (1994) point out that information on how to do it provides only a starting point, at best, for the acquisition of a skill. The limitations of verbal instruction are even more apparent when the learner is attempting to re-acquire a skill that has become rusty. Much operational knowledge remains tacit because it cannot be articulated fast enough, because it is impossible to articulate all that is necessary to a successful performance, and because language cannot serve to describe relationships and characterise the things related. The question of the costs of articulation are also important. Whether a piece of knowledge is in principle articulable or necessarily tacit is not the relevant question. Rather, the question in many cases is whether the costs associated with the obstacles to articulation are sufficiently high so that the knowledge in fact remains tacit. An experienced businessman is an individual exercising a complex skill. The pursuit of gain is based on tacit knowledge of relevant conditions and, at most, involves subsidiary awareness of many of the details of the procedures being followed. Clear articulation of his methods may be valueless or even counterproductive.

THE RESEARCH APPROACH AND FINDINGS

This research examines the role of Management Development Systems in supporting the activities of managers of organisations. In particular, it addresses the following issues:

- The nature of the activities leading to or involving Management Developed Systems

- The scope and nature of Management Developed Systems

- The nature of the activities involving the use of information from IS Developed Systems.

The approach adopted for this research was a structured interview approach based on a detailed questionnaire. The field research consisted of in-depth interviews with managers in 26 organisations. Up to three managers in each organisation were interviewed. The study included organisations across a wide spectrum of activity. It included multi-national companies and indigenous companies, as well as a number of state bodies. The study was not concerned with making comparisons between individual groups and, accordingly, no stratification was necessary. Twenty-six organisations were chosen to participate in the study. This figure was arrived at as a result of considering the time required to interview people within each organisation and the need to obtain sufficient companies in order for the results to be generalisable.

Given the specific nature of the research, it was essential that the re-searcher have access to professional and managerial staff actively involved in Management Developed Systems. It was decided therefore to identify potential participants through intermediaries. These intermediaries were people known to the researcher and his colleagues, who could identify managers in their organisations who were involved in the development of systems and who were willing to participate in the study. In identifying potential interviewees, the researcher first spoke by telephone with the intermediaries and outlined the scope and purpose of the research. This telephone briefing was followed up with a letter and a copy of the research instrument which the intermediary was asked to pass on to the potential interviewees. A subsequent follow-up phone call was made to the intermediary to confirm the interviewees' willingness to proceed with the interview, and the researcher then contacted the interviewees directly to agree a suitable time for the interview. In recommending who was to be interviewed, intermediaries were asked to consider a number of factors, including:

1. Experience and seniority, ensuring that the people were in a position to give a good overall view of Management Developed Systems in the organisation

2. Length of time in the company — it was important to meet people who were sufficiently aware of most aspects of the company

3. Availability — some of the managers were difficult to meet and might be unavailable.

In most instances the interviews were conducted at the interviewee's place of work and this provided the researcher with an opportunity to gather additional information on the nature of the organisation involved, and its operations. In seeking access to the various organisations it was explained that the researcher wished to name and give an overview of each company in the study. Upon meeting the interviewee, the researcher outlined the objective of the interview. Interviewees were given the background to the study and were informed that their organisation was one of a number of organisations taking part in the study.

The organisations that participated in the study are outlined in the Appendix. A large number of the interviews were taped (with the permission of the respondents) and these transcripts provided a record of the qualitative responses. Where some of the questions were open-ended, this allowed the interviewee to give replies in an unstructured fashion and added to the richness of the responses.

A breakdown of the respondents by Position/Title is shown in **Table 1**. Fifty per cent of those who were interviewed were accounting/finance personnel, with 15.7 per cent coming from the production/operations area, and the remainder being personnel from other departments. Of the 26 accountants interviewed, five held the title of management accountant, while a further three had the title of Financial Controller. In most cases, respondents reported directly to a superior who was at sub-director level or higher. In addition, many of the respondents had 'dotted line' reporting to managers in other functions or locations. This reflected the emerging trend towards matrix structures and reporting in the organisations studied.

Table 1: Position or Title of Respondents

Finance/ Accounting	Production	Marketing/ Sales	Other
Area Finance Manager	Production Manager	District Marketing Manager	Employee Relations Manager
Business Analysis & Planning Manager	Logistics Superintendent	Market Analysis Manager	Group Personnel & Development Manager
Management Accountant (5)	Supplier Engineering Manager	Marketing Operations Manager	Administration Manager
Accountant (3)	Logistics Manager	Sales Co-ordinator	Underwriter
Financial Controller (3)	Quality, Training & Development Manager	Customer Services Manager	Actuary (2)
Financial Accountant (4)	Production Planning/ Customer Services	Commercial Manager	Head of Information Management Unit
Group Accountant	Product Line Director		Pharmacist
SBU Accountant	Industrial Engineer		Electricity Supply Officer
Factory Controller			Performance Analyst
Manager Group Reporting Systems			Business Development Manager
Operations Finance Manager			
Swaps Accountant			
Financial Systems Accountant			
Head of Treasury			
Finance Director			
Total 26	**8**	**6**	**11**

The Nature of the Activities Leading to or Involving Management Developed Systems

This study focused on determining the reasons for the need to have systems developed by management personnel such as accountants. In particular, it sought to establish whether the activities supported by such systems shared the same characteristics as those supported by traditional MIS and AIS systems. Managers in the study were asked to discuss in detail the nature of the activities that lead to or involved them in developing systems. In particular, managers were asked to provide details of specific activities in the recent past which had resulted in a Management Developed System. Details on a total of 94 systems or applications were obtained. As **Table 2** indicates, these activities were of two types; *institutionalised* or repetitive activities which the manager in question undertook on a regular basis and which were supported by systems they themselves had developed and refined over time, and once-off or *ad hoc* activities which had involved or resulted in the development of a system by the manager.

Table 2: Examples of Activities Involving Management Developed Systems

Institutionalised	*Ad Hoc* or Once-Off
Monthly Reporting to Management	Pricing of Complex Financial Products
Margin Analysis	Supplier Performance Analysis
Weekly Contribution Statements	Surrender Values of Investments
Annual and Monthly Budgeting	Product Production Location Decisions
Product Costing and Profitability Analysis	Analysing Impact of Interest Rate Charges
Standard Costing Analysis	Analysis of Risk Exposures by Territory
Stock Valuation Reports	Working Capital Funding Modelling
Production Capacity Planning	Manufacturing Simulation Modelling
Customer Service Monitoring	Capital Investment Appraisal
Logistics Planning	Profits Warning Calculation
Sales Staff Performance Monitoring	Overtime Analysis
Staff Productivity Analysis	Risk Assessment

The traditional approach to the design and development of Management Information Systems (including AIS) requires the user/manager to specify explicitly in advance the data, analysis, and reports required from the system. The results of this research (see **Tables 3a** and **3b**) show that in many cases the activities in which managers are engaged are such that it is unlikely that they would be able to articulate a set of static information requirements that would be suitable for a system developed by IS personnel.

Table 3a: Characteristics of the Managerial Activities Supported by Management Developed Systems

Question	1	2	3	4	5	Mean	Std Dev	Wilcoxon P. Value
These activities require a lot of experience and understanding/knowledge about the organisation and its operations which only a limited number of people have.	0	3	5	23	18	4.1	.84	0*
A lot of this knowledge/understanding comes from having carried out this type of activity in the past, and this makes it difficult for other people to carry it out on my behalf.	1	8	14	22	4	3.4	.93	.01*
The type of analysis involved in these activities is complex, not in terms of the mathematics involved, but because of the level of abstraction and the need for a high level of business understanding.	0	4	2	33	11	4.0	.77	0*
To carry out these activities well, you must have a clear mental model of the business drivers and the critical success factors of the organisation.	3	3	2	22	17	4.0	1.1	0*
With these activities I often don't fully understand the situation that I am faced.with and I like to do some analysis before discussing the matter with others.	3	8	5	21	12	3.6	1.2	0*
With these types of activities I need to spend time doing the analysis myself before I can meaningfully communicate to others what I want.	2	10	8	23	8	3.5	1.1	0*
With many of the activities I carry out I find it difficult to explain to others what I want done or how it is to be done.	2	13	12	12	9	3.3	1.9	.11

1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree;
5 = Strongly Agree.
* Wilcoxon Single Sample Two-Tailed Test Significant at p < .05.

Table 3b: Characteristics of the Managerial Activities Supported by Management Developed Systems

Question	1	2	3	4	5	Mean	Std Dev	Wilcoxon P. Value
With these types of activities I find it difficult to articulate to others what I want or how I'm going to use the information I request.	11	23	7	6	2	2.3	1.1	0*
To carry out these types of activities it is important to have a complete view of the problem/situation and, in most cases, I am the one with the most complete view.	2	5	12	24	7	3.6	1.0	0*
With these activities there may be other decisions/activities taking place that only I know about which can have an important bearing on the analysis.	4	6	9	26	5	3.5	1.1	.02*
With these activities I find it easier to do the analysis myself than to spend large amounts of time explaining what I want to others.	2	13	12	12	9	3.3	1.2	.11
These activities require judgments that I prefer to make and which only come to light in the course of the analysis.	1	11	11	21	4	3.3	1.0	.04*
A lot of the time these activities involve trying to obtain insights into particular situations. It is impossible to know in advance where this insight/inspiration will come from.	2	14	11	13	7	3.2	1.2	.26
These activities involve thinking about problems in their formative stages before they are fully understood or recognised.	0	7	10	22	11	3.8	.96	0*
These activities involve being aware of things, making sense of things and interpreting these things for management.	0	0	1	19	28	4.6	.54	0*

1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; 5 = Strongly Agree.
* Wilcoxon Single Sample Two-Tailed Test Significant at p < .05.

The findings of the research indicate that the activities that result in systems being developed by managers are characterised by high levels of business, organisational and management knowledge. Eighty-four per cent of managers were of the opinion that the activities that led to them developing systems were ones that required experience and knowledge of the organisation which only a limited number of people have and which was acquired through experience. In many cases, this knowledge is the undocumented tacit knowledge held as impressions and judgments in the

minds of managers. Seventy-seven per cent of managers agreed or strongly agreed that the analysis or modelling which was involved in Management Developed Systems was complex, not in mathematical terms, but because of the high level of abstraction involved and the need for a high level of business understanding. Thirty-nine of the managers (83 per cent) in the study agreed or strongly agreed that an awareness and understanding of the business drivers and the critical success factors of the organisation were requirements for activities involving Management Developed Systems. Thirty-three managers were of the opinion that often they did not fully understand the situation they faced when carrying out activities involving Management Developed Systems. Sixty-one per cent of managers agreed or strongly agreed that they needed to carry out analysis of the problem themselves before they could articulate their information requirements to others. This reflected the difficulty that they experienced in developing and making explicit their understanding of the problem. All of these findings were significant at $p < .05$.

Managers were divided in their views as to whether it was easier for them to do the analysis themselves rather than spend a large amount of time explaining to others what they required. While the mean result was not statistically significant, the results showed that for at least 21 managers this was an issue. Managers were clearer in their agreement that the activities involved judgments that they preferred to make. Sixty-two per cent of managers were of this opinion. In 33 cases, managers agreed or strongly agreed that activities leading to Management Developed Systems involved addressing problems in their formative stages before they were fully understood or recognised. The most striking finding was that 98 per cent of managers viewed the activities which gave rise to Management Developed Systems as involving awareness, understanding and interpretation of events and issues for senior managers.

As **Tables 3(a)** and **3(b)** indicate, many of the activities which involve or lead to Management Developed Systems are characterised by high levels of business, organisational and product knowledge. These tasks often require experience and knowledge of the organisation and its operations which only a limited number of people have, and this makes it difficult for IS staff, and indeed many members of the managers' own support staff, to carry out the analysis for them. It is important to understand that the analysis or modelling in which managers engage is complex, not in mathematical terms, but because of the high level of abstraction involved

and the need for a high level of business understanding. In many cases, the activities involving Management Developed Systems reflected managers' thinking about problems in their formative stages before they are fully recognised or understood. In other cases, sudden changes or upheavals in the business required managers very quickly to gain an understanding of what was happening and to take action. These circumstances required an iterative trial and error approach to modelling and analysis, which traditional MIS development and reporting does not facilitate.

The direct development/use of Management Developed Systems offers a practical mechanism for providing information processing capabilities during task performance. Management Developed Systems help managers to engage in direction setting by providing information and analysis that helps them to clarify their thinking. An example is the use of spreadsheet analysis in deciding on how to react to changes in raw material prices by examining the impact of outsourcing or bulk purchasing or product design changes. In this example, the focus of Management Developed Systems is on future directions and the selection of actions from among competing alternatives. The use of systems in this way is in keeping with the need for responsive information systems which allow managers to assess quickly alternative courses of action and to provide short feedback loops for decision making.

Formalised requirements specification by IS staff in many cases acts as a discontinuity in the processing of information during task performance, while Management Developed Systems allow the additional knowledge acquired during task performance to be encompassed in the information processing and decision making. The difference between the two types of systems is that Management Developed Systems are seen as systems to be continually changed, influenced by the managers' evolving thinking on the problem. IS systems are developed on the assumption that the information that they produce will remain valid for a reasonably long period of time.

The Scope and Nature of Management Developed Systems

As **Tables 4(a)** and **4(b)** indicate, the key role of Management Developed Systems appears to be in helping managers to surface or make more explicit their understanding of the situations with which they are faced. Managers appear to rely heavily on Management Developed Systems to help them to specify the problems, variables and issues that are important

in the situation that they face. In contrast to traditional systems development, the end result of many of the systems that managers develop is an improved understanding of the problem/situation, not a completed information reporting system.

Table 4a: The Role of Management Developed Systems in Managers' Information Processing

Question	1	2	3	4	5	Mean	Std Dev	Wilcoxon P. Value
With these activities the important aspects of a decision/situation only become apparent during the analysis.	3	10	8	27	3	3.3	1.1	.05*
With these activities it is not clear what type of analysis is needed before I start.	8	21	3	15	3	2.7	1.2	.09
With these activities the key pieces of understanding are often hidden among large amounts of irrelevant information.	2	13	6	20	7	3.4	1.2	.05*
When I develop a system as part of addressing a problem, I'm not trying to understand just what's happening but why it is happening and to be more explicit in describing and understanding the problem.	1	4	3	32	9	3.9	.88	0*
Using and developing staff and Management Developed Systems involves trying to uncover the important aspects of the situation through a combination of trial and error, filtering and other types of analysis.	4	5	2	31	5	3.6	1.1	0*
With these activities, I like to evaluate ideas myself without wasting other people's time doing analysis, and this can involve testing or experimenting with different ideas in private without others knowing about them.	6	8	9	22	4	3.2	1.2	.33

1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; 5 = Strongly Agree.
* Wilcoxon Single Sample Two-Tailed Test Significant at p < .05.

Table 4b: The Role of Management Developed Systems in Managers' Information Processing

Question	1	2	3	4	5	Mean	Std Dev	Wilcoxon P. Value
The systems that I develop myself allow us to experiment with different ideas and to see whether any of them are worth taking further.	2	8	7	27	7	3.6	1.0	0*
This approach allows me to see the gaps or missing parts of a particular idea and guides me in my search for additional information or further analysis.	1	3	6	34	7	3.8	.81	0*
These types of activities involve dealing with sudden changes or upheavals. In these circumstances, you need very quickly to gain an understanding of what is happening, and take action.	3	4	3	22	19	4.0	1.1	0*
These activities involve analysis or information which needs to be kept confidential for competitive, industrial relations or other reasons.	3	6	2	23	17	3.9	1.2	0*
These activities involve consideration of the different proposals which might come up for discussion, and deciding in advance what my position is on a matter before meeting with other managers or groups.	2	7	7	26	7	3.6	1.0	0*
With these types of activities, I'm very often trying to interpret events or results; in order to do this, I have to be able to break them down into their different parts.	0	1	3	37	9	4.1	.58	0*
With these activities I am often competing against other departments or operating sites and it is important to keep my plans and analysis to myself.	17	18	6	4	2	2.1	1.1	0*
These activities involve ongoing scanning and analysis to protect my position or that of the group.	9	10	3	21	7	3.1	1.4	.61
These activities involve anticipating questions or problems before they arise. I am trying to pre-empt questions and have the answers ready.	0	2	6	32	11	4.0	.70	0*

1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree;
5 = Strongly Agree.
* Wilcoxon Single Sample Two-Tailed Test Significant at p < .05.

The findings of the research indicate that Management Developed Systems provide managers with information processing and analysis capability

during task performance. Fifty-nine per cent of managers were of the view that in many of the activities that involve the use of Management Developed Systems the important aspects of the situation only become apparent during the analysis. Eighteen managers (36 per cent) were of the opinion that prior to addressing problems involving Management Developed Systems it was not clear what type of analysis was needed. Twenty-seven managers (53 per cent) agreed or strongly agreed that the key pieces of understanding were often hidden among large amounts of irrelevant information. The ability to be more explicit in describing or articulating the problems they faced was one of the reasons why managers engaged in systems development. The process of systems development helped managers to verbalise and amplify their understanding of the situation they faced. Forty-one managers (84 per cent) were of the opinion that when they developed systems they were not trying just to understand what was happening, but to be more explicit in describing and understanding the problem. Thirty-six managers agreed or strongly agreed that using Management Developed Systems involved uncovering the important aspects of the situation through a combination of trial and error and other types of analysis. The above findings were all significant at p<.05. An area where the findings were not as statistically significant was the question of using Management Developed Systems to carry out analysis in private. Twenty-six managers were of the opinion that the systems they developed allowed them to test out ideas in private without wasting other staff's time. Sixty-seven per cent of managers reported using the systems they developed to experiment with different ideas to see whether any of them were worth taking further. Forty-one managers (80 per cent) agreed or strongly agreed that the process of developing Management Developed Systems helped them to identify the gaps or missing parts in a particular idea and in their information search. While managers were keen where possible to share their analysis with others, a significant number of managers (66 per cent) preferred to carry out analysis of the situations before discussing the matter with other managers. The activities supported by Management Developed Systems involved attempts by managers to anticipate questions or problems and to have answers ready. The ability to respond to a significant number of queries using existing Management Developed Systems was a feature of many organisations. Managers built up a repertoire of information sources and models which could be adapted to meet requests.

The improved understanding that managers acquire through the process of experimentation and iterative modelling/analysis allowed by systems development is the key benefit, rather than the simple report or spreadsheet which is the product of that process. Using Management Developed Systems managers attempt to 'surface' the assumptions contained in their mental models. In many cases, managers use these to map the relevant data onto the model or filter, and thus explicitly recognise the assumptions or uncertainties associated with the analysis. The focus of the traditional approaches to MIS/AIS development on pre-specification of the problem variables through systems analysis and design assumes a deeper understanding of the problem situation that managers face at the outset than is the case in practice. In many instances, managers appear reluctant to invest substantial effort in the highly public process of systems specification for problems that they struggle to understand.

The Role of Traditional Management Information Systems (including AIS)

For a significant number of managers in this study, information supplied from IS developed systems played little or no role in their activities. In many cases, managers reported receiving large amounts of printouts which they never looked at. In other cases, managers insisted on support staff sanitising the information by summarising the salient details on spreadsheets for them.

There was a high level of consistency in managers' opinions on the activities that involved the use of information from IS developed systems (see **Table 5**). Ninety-two per cent of managers were of the view that information from IS developed systems was used primarily for tracking and control of ongoing activities and involved the use of information based on the detailed recording operations in the organisation. In excess of 90 per cent of managers were also of the opinion that IS supplied information was used in activities that were carried out regularly and that changed very little from month to month. Almost all of the managers in the study agreed that they used information from IS systems to keep them informed of what was happening in other parts of the organisation, and that the IS group was a useful way of providing information consistently to many different groups. Discussion with other managers was a feature of the activities which involved the use of information from IS developed systems, and 90 per cent of managers were of the view that having this

consistent information was important. The two-tailed single sample Wilcoxon test found all of the above results to be significant at p < .05.

Table 5: Characteristics of the Managerial Activities Supported by IS Developed Systems								
Question	1	2	3	4	5	Mean	Std Dev	Wilcoxon P. Value
These activities involve tracking and control of ongoing activities, using information based on detailed recording of activities/operations that are going on in the organisation.	1	0	2	28	7	4.1	.70	0*
These activities are the ones that I carry out regularly and which change very little from month to month.	1	2	4	24	7	3.9	.86	0*
These activities involve finding out what's happening in other parts of the organisation and rely on having access to information about other activities.	0	7	3	24	4	3.6	.91	.01*
These activities involve looking for exceptions to the norm or variance from standards. This involves examining large amounts of information for just a few exceptions.	3	5	2	23	5	3.6	1.1	.01*
Detailed data on these activities/operations in the organisation are rarely important in themselves but we need these data to build up information on what is happening at a higher level.	3	10	3	15	7	3.3	1.3	.04*
There is a lot of information which is used by different groups in the organisation. The IS group is a useful way of providing this information consistently to many different areas.	1	3	1	28	4	3.8	.88	0*
These activities involve discussions and dealings with other managers. In our discussions it is important that we have access to the same information.	1	4	2	24	7	3.9	.92	0*

1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; 5 = Strongly Agree.
* Wilcoxon Single Sample Two-Tailed Test Significant at p < .05.

IS developed systems arise from or are used in activities that are fundamentally different from the activities which involve Management Developed Systems. They provide reports which are historical in orientation and used primarily for tracking and control of ongoing activities at a detailed level. The principal use of IS developed systems is to identify variances from standards or exceptions. IS developed systems are an efficient way of gathering data at the lowest common denominator and making it available across the organisation.

In many cases, the most important role of information from IS developed systems was to act as inputs to Management Developed Systems. In almost all of the systems/applications examined, the bulk of the inputs to the system came from printed IS reports. In only a small percentage of cases did systems make use of on-line connections to IS systems, and in a very small number of cases the systems made no use of IS supplied information. With the conventional management information systems or information reporting systems, the emphasis is on fact-based thinking, using raw data or information provided by the IS group. This information or raw data is usually supplied to the IS group by management or staff lower down the organisation. In the case of these conventional systems, value-added analysis and interpretation are provided after the IS function has provided the raw information. This analysis or interpretation is carried out by the recipient of the data/facts using Management Developed Systems.

CONCLUSION

The view put forward by Barnard (1938) that managers do not make decisions on the basis of orderly rational analysis, but depend on intuition and judgment, is confirmed by the findings of this study. Managers in the study reported that the activities which resulted in them developing systems were characterised by high levels of knowledge, experience and, in particular, tacit knowledge. This supports the suggestion by Nelson and Winter (1982) and Reichs (1991) that much of the knowledge used by managers in running organisations is tacit knowledge and cannot be articulated. Simon's (1989) suggestion that managers have in their memory a large amount of knowledge gained from training and experience, and that they arrive at problem diagnoses and solutions rapidly and intuitively without being able to report how they attained the result is also confirmed by the findings of the study. Managers in the study reported having difficulty explaining how they carried out tasks and said

that they needed to spend time doing analysis before they could meaningfully articulate their approach to others.

The traditional MIS and AIS focuses on data gathering and processing and provides very little support for the more implicit knowledge creation processes which managers require. Management Developed Systems, on the other hand, provide a mechanism to meet the need for flexible information processing and knowledge acquisition during task performance, which characterises many of the more difficult and complex decisions that managers face. Organisations, and in particular those responsible for formulation of IS strategy, must explicitly recognise the important role played by Management Developed Systems in meeting the information needs of managers. The findings from this study suggest that for at least some of the activities that managers perform, they need to interact with their information systems in a much richer way than has been assumed by IS developers. This interaction can shape managers' thinking and give them a greater insight into the problems that they face. It allows a real advantage to accrue to managers, rather than the often negative consequences of engaging in ritualistic usage of outdated and largely irrelevant information systems.

APPENDIX

List of Participating Companies	
Aer Rianta International	The Housing Finance Agency
AIB Bank	Intel Ireland
Analog Devices	Jurys Hotel Group plc
Bank of Ireland	L.M. Ericsson
Baxter International	McNaughton Paper Group
Celtic International Insurance	Marshall Holdings
Department of Health	Midland Global Markets
ESB	Northern Telecom
EMC	Norwich Union
Flender Poser Transmissions	QBE Insurance
Frankonna Insurance	Shell International
Golden Vale	Thermo King Europe
Guinness	Waterford Crystal

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