Contractors and computers, why systems succeed or fail: a grounded theory study of the development of microcomputer-based information systems in ten small companies in the construction industry

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CONTRACTORS AND COMPUTERS, WHY SYSTEMS SUCCEED OR FAIL


by

Brenda Wroe BA (Econ), MSc (Computing)

A Doctoral Thesis

Submitted in partial fulfilment of the requirements for the award of

Doctor of Philosophy of the Loughborough University of Technology

January 1986

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ABSTRACT

A longitudinal study in ten small companies operating in the U.K. construction industry was undertaken using a grounded theory approach over the period 1980-85. The research project involved detailed discussions with management and staff throughout the period of selection, implementation and live operation of a microcomputer-based information system (MIS). The objective was to identify the nature of problems experienced by small companies when introducing microcomputer-based MIS and thereby determine the variables relating to the degree of success achieved.

Whilst four companies successfully reached the stage of live operation and use of the information system, five were judged unsuccessful having abandoned the project during the research period. The remaining company continued to experience organisational difficulties relating to the system development.

The characteristics of the successful and unsuccessful companies are used to build a grounded model of MIS development in small companies. Research findings raised many contextual, processual and methodological issues concerning the selection, implementation and live operation of microcomputer-based management information systems in this type of environment. A strategy for the successful implementation of microcomputer-based MIS, embracing the factors determining success/failure in the small organisation environment, is presented. The thesis concludes by offering some advice to the systems developers and the information systems design community concerning MIS development in small organisations.
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PART ONE INTRODUCTION

1.0 Summary

Part One introduces the thesis with a brief synopsis of the nature of research work and acknowledges those who have provided assistance throughout the project. The thesis structure is outlined and a brief statement of the research mission is then given. The section supplies an overview to the research project documented herewith.

1.1 Research Synopsis

A longitudinal study in ten small companies operating in the U.K. construction industry was undertaken using a grounded theory approach over the period 1980-85. The research project involved detailed discussions with company management and staff throughout the period of selection, implementation and live operation of a microcomputer-based management information system (MIS). The objective was to identify the nature of problems experienced by small companies when introducing microcomputer-based MIS and the variables relating to the degree of success achieved.

Whilst four companies successfully reached the stage of live operation and use of the MIS, five were judged unsuccessful having abandoned the project during the research period. The remaining company continued to experience organisational difficulties relating to the system development.

The research findings raise many contextual, processual and methodological issues in regard to the selection, implementation and live operation of microcomputer-based MIS. A framework embracing the factors determining success or failure in the small organisation environment is derived.
from the empirical evidence obtained. The thesis concludes by suggesting a prescriptive model for the implementation of MIS in the small company environment.

1.2 Acknowledgements

I am indebted to so many individuals and organisations for their assistance, guidance and support during the six year period but the following are most appreciated.

- Dr K. D. Eason, Department of Human Sciences, Loughborough University of Technology, who was my mentor and research supervisor, without whom I would not have survived to the end.

- The management and staff of the ten participant companies, who opened up their working lives for the benefit of others at a time when the organisation was experiencing a difficult metamorphosis. They would however prefer to remain anonymous.

- My friend in researching the small fry in the information system world, Diane Episkopou, who injected confidence and inspiration in the writing up of this research thesis.

- My colleagues in the School of Mathematics, Computing and Statistics, Leicester Polytechnic, who have been my hidden benefactors by taking an inequitable teaching load to enable me to indulge in research for many years.

- My resident sceptic, who ensured I maintained a path of reality, Martyn Wroe.
1.3 Thesis Structure

The thesis is presented in twelve parts, nine supporting appendices and a bibliography.

Part One describes how the subject of the research study developed and how the author planned and established the case studies involved.

Part Two provides a justification for the research approach and subject area of the study. A brief review of the current literature concerning the problems of small companies and the introduction of microcomputer-based MIS is also in this section.

Part Three provides a description of the United Kingdom construction industry and the role played by the small companies. The characteristics of small construction companies are described and an account of the nature of the typical applications to which microcomputers have been utilized is given.

Part Four briefly describes systems analysis and design approaches and methodologies adopted by the MIS community as a background to the suitability of their application to the environment of the small company.

Part Five justifies and provides a detailed description of the research methodology adopted in the work. A discussion of the value of a grounded theory approach in areas of human activity where little previous work has been undertaken provides a methodological justification for the research approach adopted.

Part Six consists of the brief descriptions of the companies involved in the research study. The approach to evaluation
of the qualitative data obtained is given in summary form.

Part Seven presents the author's evaluation of the experiences of the ten small companies relating to the decision to introduce the computer, the determination of their requirements and the subsequent selection of the system involved.

Part Eight presents the author's evaluation of the experiences of those companies who were able to find a suitable system and describes the implementation of the system in each case.

Part Nine presents the author's evaluation of the live operation of those companies who used the implemented MIS.

Part Ten evaluates the degree of overall success in undertaking the activities of MIS development in the ten small companies. The common features of the successful companies are outlined in addition to those of the unsuccessful companies. A discussion of the views of several "expert" readers concerning the performance of the companies is also included.

Part Eleven presents a grounded model which explains the variation in achievement of success in the ten companies which may be useful in identifying the potential problem areas in other small organisations and indicate the likely profile of successful information system development in such companies. Several hypotheses relating to the model in operation are then postulated for the benefit of future researcher.

Part Twelve represents the main lessons which have been learnt from the work and uses them to develop guidelines for
the organisational change involved in the application of microcomputer-based information systems in small companies. The study's strengths and weaknesses are discussed and some opportunities for further research work, which have emerged as a result of this study described, with some tentative proposals are made for the form of such work.

The thesis concludes by providing the reader with a comprehensive list of all published work found valuable to the research work.

Appendices A through H2 contain detailed accounts for each case study company of:

(1) the expectations of those concerned with the MIS implementation,
(2) management plans made to achieve their expectations,
(3) discussions of the achievements in retrospect,
(4) problems and difficulties of undertaking the system development tasks throughout each phase and
(5) any environmental changes of the company affecting the information system development.

These accounts are provided in the format of a summarised research diary for each organisation.

Appendix I contains the initial discussion instruments to collect basic information concerning the activities and structure of the companies and monitor the attitudes of management towards the MIS development.

Appendix J contains further details of the views of the external "expert" readers of the company experiences who were consulted during the research period.
1.4 Origins of the Study

The Department of Civil Engineering at Loughborough University of Technology has an established programme of research into the application of computers in the field of construction management. In 1980, soon after the general availability of microcomputers in the United Kingdom, the author was engaged in an exploratory research project with the objective of defining, developing and field testing appropriate construction management applications for the new generation of computing hardware. As the project developed concern relating to the potential use of such hardware in the significant small firm sector of the construction industry. This concern led to the development of a new research idea which is the subject area of this thesis and was carried out in the Department of Human Sciences of Loughborough University. In this experienced environment the research idea was transformed into a part-time doctoral research project concerned with gaining insight into the human and organisational problems of introducing microcomputers into the typical construction company characteristically very small.

At this time the academic work of the author in the School of Mathematics, Computing and Statistics at Leicester Polytechnic also involved the supervision of many M.Sc. Computing live projects in small organisations of many industries and services. Problems relating to the appropriateness of the tools for analysis of the problems areas and the design of feasible microcomputer-based solutions were a frequent feature of these student projects.

Whilst both institutions had much experience of designing and implementing successful information systems in the
context of larger organisations, little was known of MIS implementation in the small company environment. There appeared to be a strong need for research in this emerging area of information systems.

1.5 The Research Mission

The research project was concerned with the effectiveness of MIS implementation in the environment of small companies in the construction industry. By longitudinal study the author planned to examine the nature of the problems experienced by the management and staff of small companies with a view to explaining the probable causes. The data collected was to be analysed to determine the significant factors involved which would be useful to the management of similar small companies and to the practitioners of MIS development.
PART TWO  MICROCOMPUTER-BASED MANAGEMENT INFORMATION SYSTEMS IN
SMALL COMPANIES

2.0  Summary

This section discusses the justification for the research project by relating some experiences of early implementations of microcomputer-based MIS amongst construction companies in the U.K. For the purposes of this research and thesis the following definition of MIS (Ein-Dor and Segev 1978) is extended to incorporate the use of microcomputer technology.

"A management information system for collecting, sorting, retrieving and processing information which is used, or desired, by one or more managers in the performance of their duties."

(Ein-Dor and Segev 1978  p. 1065)

Several important issues are raised which the research discussion seeks to clarify by providing qualitative data and make proposals concerning them in later sections. Finally the published literature which might shed light on the research problem is reviewed.

2.1  Early Computing Experiences of Companies

The sudden arrival of inexpensive microcomputers in the late 1970's offered the small business comparable computing power to the larger corporation with mainframe computing facilities. Reliable published statistics for the use of microcomputers by small businesses at the outset of the research are difficult to locate. The Department of Marketing at the University of Lancaster (Easton 1980), suggested that considerably less than 10 per cent of companies employing less than 200 employees had a small computer system (defined as costing less than £30,000 in
1980). In 1983 the small business market for microcomputers was firmly reported at the level of 9 per cent of small companies (Gawling 1983), being based on a survey of 2000 small firms which employed fewer than 50 employees in the U.K and had a business telephone.

This assessment of ownership of microcomputers was supported by a research project undertaken by the author, with Professor E.G. Trimble at the Department of Civil Engineering, Loughborough University of Technology, into the applications of microcomputers in construction management. This suggested 21 per cent of all construction industry companies participating in the research project had acquired a microcomputer in 1980 although the proportion of small firms in the construction industry, who had acquired microcomputers at that date, was estimated as less than 1 per cent (Trimble and Wroe 1981).

Many anecdotal accounts of catastrophe, failure and mistakes were related, during the earlier research, concerning the introduction of computer-based systems in both large and small firms. Evidence of a firm of consultants in 1982 suggested that the forced replacement of computers and application software costs firms in the U.K. £50,000 per annum in total. Their survey was based on 200 installations and the findings revealed that within the price bracket of £10,000-£100,000 up to 20 per cent of the 30,000 systems supplied each year were inappropriate and had to be replaced. The main mistakes were listed as:

1. Evaluation which overlooks the essential aspects of the user's business.
2. Sale of single user systems when multiple application is necessary.
3. Equipment and software proves to be a poor fit for the business concerned.
4. Capacity is inadequate, either at the time of installation or for expansion which should have been foreseen.

5. Programs are not written in an appropriate commercial, technical or scientific language."

(Construction Computing July 1983 p. 3)

Furthermore the estimated losses did not take into consideration the inconvenience and upset caused to the user and their customers by the hasty purchase of microcomputers which were intended to be used as a business tool.

2.2 Small Company Microcomputer-based MIS Pioneers in the Construction Industry

The application area selected for investigation was the construction industry where it was considered considerable potential and interest in the implementation of microcomputer-based MIS existed amongst the small company sector. Research undertaken by the author (Wroe 1980) in 1979-80 involved discussions with small firms in the construction industry both in the East Midlands and throughout the U.K. Further work in 1980-81 involved the establishment of a register of construction companies with an interest in the application of small computers and a series of industrial seminars were held with the aim of establishing consensus views on the most advantageous ways of using microcomputers in construction management. Very few firms of less than 25 employees were identified, who had acquired and were using microcomputers in 1980, suggesting that these were pioneering a new field. The applications of the new technology took the form of management information and decision support systems to such areas as financial accounting, contract costing, payroll and estimating functions. The experiences of these small firms were varied and some degree of failure was perhaps more common in the
construction industry than in small businesses generally since its applications are relatively complex. All the pioneering firms however expressed high expectations of the benefits to be derived from effectively applying information technology to construction management functions.

2.3 Computing Problems Experienced by Small Companies in the Construction Industry

The early experiences of small firms in the construction industry were both problematic and varied. The most common ones in 1980 are reported as anecdotal evidence below.

(a) Selection problems

Firms frequently reported finding that the commercial software systems sold to them did not match the complex requirements of the construction industry's administration. A few examples of the complexities, which construction industry software initially failed to satisfy are described in the following sections.

(i) Software facilities did not match requirements of the contractor when processing subcontractor payments (e.g. no provision was made for the deduction of income tax, retention and contractor's discount taken). The result was a very cumbersome process of manual adjustments to reconcile the computer files.

(ii) The practice of incorporating labour-only subcontractors who are employed on a regular basis with the normal, direct employee payroll proved problematic when payment was based on achieved measured work, and tax exemption certificates were not automatically checked by the payroll software.
(iii) The most unsatisfactory feature of the early accounting software on microcomputers was the lack of integration between the various creditor and debtor ledgers and the nominal and contract cost ledgers. The outcome was the necessity to input the same data to several ledgers and errors and inconsistencies were inevitable.

(iv) Facilities for the construction industry practice of taking a retention on contract payments were not available on accounting packages designed for manufacturing industries.

The common practice of purchasing computer systems in the same manner as any other item of construction plant, that is first acquiring the tangible element of hardware and worrying afterwards about how to operate it (in this case software), proved even more dangerous when specialist software was both expensive and difficult to locate.

(b) Implementation of computer systems was slow and problematic

Commercial systems (both hardware and software) frequently lacked any supporting documentation which could be understood by non-specialist clerical staff. Difficulties and deficiencies were sometimes not apparent until the specialist business practices of the construction industry were attempted by untrained, often part-time staff. Hardware teething problems in initial stages of implementation was offputting and resistance-generating to non-specialist staff with limited or no technical support.
(c) **Early outgrowth of the system's capabilities**

Within months of acquisition and implementation in the small firms, limitations of both hardware and software became a critical factor to the successful system operation. The fortunate companies were able to buy more capacity, either memory or storage, but to many this discovery only meant system obsolescence.

(d) **Operational problems of a live system**

Early software systems were developed and supplied as separate financial modules reflecting traditional accounting practices. Lack of integration meant that users had to input the same items of data on more than one occasion when it was used by several program modules. The inevitable result of this repetition was many clerical input errors and inconsistencies in the data held in various parts of the system.

Company management were disappointed by the speed of processing operations and the access and retrieval time when producing management reports from real live volumes of data as opposed to the demonstrations given by suppliers.

The interface between the fringe participants of the information system (ie those personnel remotely involved with either the provision of source data to be input or the use of the information provided) was found to be of vital importance in the effective and efficient use of the system. Such individuals as surveyors, estimators and auditors were likely to be disenchanted by the introduction of the computer and, in some instances minimal cooperation on their part, proved disruptive.
Several companies lost the flexibility associated with manual systems once the data was stored on magnetic media and chaos extended into the manual operations surrounding the actual use of the computer.

(e) Few net benefits were realised by management

In spite of a natural reluctance to admit errors of judgement, management of many small firms described the early systems as slow, inflexible and yielding few rather intangible benefits such as good customer relations and greater management control.

2.4 Apparent Problems and Issues

From the experiences summarised above the following problems and issues were raised which formed the foundation and trigger of this research study.

(1) Was the system evaluation and selection process appropriate to the introduction of information technology in small firms in the construction industry?

(2) How did information system design methodologies meet the needs of the small organisation?

(3) What were the factors affecting the eventual success or failure of the introduction and operation of microcomputer-based information systems in small firms in the construction industry?

(4) How realistic was small firm management's view of the implementation of information technology?

(5) What were the small firm knowledge and skill requirements at various stages of the information system development process?
2.5 A Review of the Literature relating to MIS Implementation in Large and Small Organisations

An extensive search of the literature for relevant published work, relating to the implementation of microcomputer-based MIS in the small business area, revealed little of any consequence available either in the U.K. or elsewhere. This is perhaps not surprising since the small business had only recently been given the opportunity of using a microcomputer-based MIS and the academics and practitioners had yet to find the small business a field of interest for research and publication. The review of the literature which follows has developed over the course of the research project but the problems of MIS implementation in the small business field is still very sparse in the publications.

2.5.1 MIS Success Variables in Large Organisations

The problems of MIS success and failure have been more researched in larger organisations. Early MIS research (Mason and Mitroff 1973) recognised the influence of organisational context and psychological type of the user or manager in the success of MIS implementation. Ein-Dor and Segev (1978) developed this more exhaustively by surveying the scientific, managerial, professional and trade literature over the previous decade which directly concerned the development and use of information systems. These management information systems were computer-based but, since the current information technology was not microprocessor-based, small organisations were unlikely to have been represented at all. In all 120 variables were suggested, of which
<table>
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<tr>
<td><strong>UNCONTROLLABLE</strong></td>
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<tr>
<td>Size</td>
<td>annual sales; work force; assets; market share</td>
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<tr>
<td>Structure</td>
<td>number of product-market units; number of profit-centres; number of divisions; number of groups</td>
</tr>
<tr>
<td>Time frame</td>
<td>planning horizon; average length of strategic decision process; rate of technological change in the industry</td>
</tr>
<tr>
<td>Extra-organisational situation</td>
<td>availability of trained manpower, hardware, software and decision-making techniques</td>
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| **PARTIALLY CONTROLLABLE** | |
| Resources | size of budget; liquidity |
| Maturity   | degree of system formalisation; level of quantification; availability of decision-relevant data |
| Psychological climate | attitudes to information system; perceptions of information system; expectations from information systems |

| **CONTROLLABLE** | |
| Rank of responsible executive | number of levels below chief officer |
| Location of responsible executive | identification with specific functional area |
| Steering committee | exisitance; organisational level |

Table 2.5.1a  **Suggested operational measures for organisational context variables**  
(Ein-Dor and Segev 1978 p. 1067)
a subset of organisational context variables were used to develop hypotheses for future research.

Ein-Dor and Segev suggested the categorisation of organisational variables into uncontrollable, partially controllable and controllable variables from the viewpoint of the organisation itself and the MIS unit. These are listed opposite in Table 2.5.1a. The organisational variables of large and small organisations are classified as primarily uncontrollable or partially controllable. They were embodied in the published work into several hypotheses by Ein-Dor and Segev for future information systems research. The most relevant ones for this research were the following hypotheses. Firstly it was postulated that:

"MIS projects are less likely to succeed in smaller organisations than in larger ones."  
(Ein-Dor and Segev 1978 p. 1069)

The basis for this was cited as a difference in the types of problems faced by small and large organisations, in particular resource availability and the degree of formalisation of systems. Secondly,

"Smaller organisations are prone to MIS failure because of time frame problems."

(Ein-Dor and Segev 1978 p. 1070)

The need to systematize before developing systems and the relative scarcity of resources will generally result in longer lead times for MIS in small organisations than in large ones. Finally,

"Smaller organisations tend to be less mature, thus reducing the likelihood of MIS success."

(Ein-Dor and Segev 1978 p. 1072)
Table 2.5.1b  Information systems in the context of the organisation

(Lucas 1985 p. 67)
The importance of the size of the organisation was thus recognised but not empirically investigated at the time the research project commenced in 1980.

Lucas (1973 and 1981) also argued that information systems exist within the context of the organisation and their success depends on solutions to organisation behaviour problems in systems design, implementation and operation. On the basis of a survey of nearly 2000 people in over fifteen different organisations, Lucas built a descriptive model of information systems in organisations to guide research on crucial organisational behaviour variables in the design and operation of systems in large organisations. He argues that:

"organisational factors can be equally as important as technical details in the design and operation of computer-based information systems".  

(Lucas 1981 p. 62)

The Lucas model, shown in Table 2.5.1b opposite, consists of a series of predicted relationships between important components of information systems activities.

The long term nature of implementation as a process, which begins with the very first idea for a MIS and the resultant changes in the organisation, is stressed by Lucas. He reports that most research on implementation has been an attempt to discover factors associated with success, (i.e. the independant variables related to the successful implementation, as defined by the researchers). MIS success was to be measured by actual usage, intended usage and/or
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<td></td>
<td>Operations policies</td>
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<tr>
<td>Involvement:</td>
<td>User origination of systems</td>
</tr>
<tr>
<td></td>
<td>Involvement and influence</td>
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<tr>
<td></td>
<td>Appreciation</td>
</tr>
<tr>
<td>Situational and Personal Factors:</td>
<td>Personality type</td>
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<td></td>
<td>Business history</td>
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<td></td>
<td>Social history</td>
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<td></td>
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<td>User Attitudes:</td>
<td>Expectations</td>
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<td>Interpersonal relations</td>
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<td>Technical Quality of Systems:</td>
<td>Quality</td>
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<td>Model characteristics</td>
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<td>Cognitive style</td>
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<tr>
<td>Management:</td>
<td>Actions</td>
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<td></td>
<td>Consultant /client relations</td>
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<tr>
<td></td>
<td>Support</td>
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<td></td>
<td>Location of researcher</td>
</tr>
<tr>
<td></td>
<td>Managerial style</td>
</tr>
<tr>
<td>User Performance:</td>
<td></td>
</tr>
</tbody>
</table>

**Dependent Variables**

**Implementation:**
- Frequency of inquiries
- Reported use
- Monitored frequency of use
- User satisfaction

**Table 2.5.1c Variables associated with Implementation Studies**

(Lucas 1981 p. 70)
satisfaction with a system. Lucas lists the dependent and independent variables in implementation studies in Table 2.5.1c, shown opposite.

Lucas (1981) stresses the following implications for systems design based on his model:

1. The formation of a steering committee of users and D.P. department staff as a means to determining the priorities for development of new applications.
2. Training sessions for development staff to adopt the role of catalyst in the developmental process.
3. The placement of a user in charge of the design team for a new system.
4. Management are required to provide sufficient resources to enable the users to spend sufficient time on systems design.
5. Consideration of the decisions and problems is essential in addition to the data flows.
6. Examination of the user interface by ensuring that users have experimented with the input and output to the point of acceptance.
7. Planning for implementation for all users with the resultant preparation for change of those users in different situations.
8. Making sure that adequate resources have been devoted to training and user documentation.
9. Consideration of the possibility of multiple roles of information for the organisation and different decision makers.
2.5.2 MIS Differences between Large and Small Organisations

Very little research evidence is available concerning the small organisation. Indeed Raymond (1985) states that:

"research in the economic and administrative sciences have previously shown a lack of interest in small organisations".

(Raymond 1985 p. 37)

The view that the small firm is a scale model of a large firm is now beginning to change as research in the field of economics, organisation theory, organisation behaviour, business policy and management is starting to focus attention on the small business.

However very little is known of the implementation of information systems in the specific context of small business and information system research so far has been North American and has concentrated primarily on establishing the differences between large and small organisations. Ein-Dor and Segev (1982) found that firm size is inversely related to the centralisation of the MIS function and to the hierarchical level of the MIS director.

Delone (1981) studied the relationship between the size of a manufacturing firm and various organisational characteristics of computer use, such as relative expense of hardware and software, the dependence on external expertise and the previous computer experience of the firm. The major findings of the Delone study were that firm size does make a difference in how businesses manage their computer resources and that small businesses face some
different computer-related opportunities and problems than large businesses. The study found that 74 small manufacturers in Los Angeles have been using their computers for less time than larger manufacturers. Inexperience is a significant problem for any organisation regardless of size. It was also found that, regardless of experience, the small firm was highly dependent on external software support, spent relatively less on its data processing department and invested proportionately more on hardware. Delone states that many small businessmen are ill-equipped to make the decision of choice of software vendor which is likely to be critical to the success of the overall computerisation effort. He suggests that the low level of computing expenditure may be the result of poor planning, and may imply that the small firm is taking ill-advised risks, such as underemphasis on acquisition of software and necessary personnel.

Turner (1982) investigated the notion, put forth by Delone, that firms of different size exhibit distinct patterns of obtaining data processing resources and found that smaller banks tended to obtain their computer resources externally rather than investing in the creation of internal resources. Contrary to Ein-Dor and Segev's findings that smaller firms have greater MIS centralisation than do larger firms, there was no indication in the Turner study that larger banks have decentralised their data processing activities. However the study did support the general notion that smaller firms confront different opportunities, adopt different tactics, and
consequently encounter different problems than do larger firms in making use of computer systems (Turner 1982).

Raymond and Magnenat-Thalmann (1982) directly examined the question of MIS success in the small business in the Canada. Raymond (1985) suggests two reasons for the relative absence of information system research from small businesses. Firstly, the microelectronics revolution which led to the development of mini and microcomputers now allows very small firms to implement a computer-based information system. A penetration into the small business environment is required before any prescriptive or descriptive theory can be based on empirical research. Evidence of this is beginning to appear and is contributed to by this research project. Secondly, in the MIS research framework proposals, Raymond states that:

"the presumed importance of the organisational context thus implies that research findings in a big business environment cannot necessarily be generalised to small business as the characterization of the organisational context of a small firm has been shown to be fundamentally different to that of a large firm."

(Raymond 1985 p. 38)

2.5.3 MIS Research in Small Organisations

Raymond (1985) poses the question

"What are the organisational characteristics of computer usage which are associated with the success of MIS in the small business?"

(Ibid 1985 p. 37)

He reports empirical evidence from a sample of 464 computerised small firms, with 20-250 employees in the
The results indicated that the level of MIS success in a small firm can be increased by a greater degree of sophistication in terms of the number and type of applications available, and by allowing the organisation and the users more autonomy in the development, operation and utilisation of these applications.

A strong case for the separate consideration of the small company was put by Kole (1983b). He argued that the:

"Managers of small businesses have limited experience with information systems and little time to become educated. These firms do not have systems specialists and they can not or will not want to add them."

(Kole 1983b p. 262)

He investigated the implementation of MIS in three small companies in the USA and suggested that a non-developmental strategy was likely to lead to a more successful implementation in this environment. The argument of this rare empirical study was that:

"Large organisations have installed and are upgrading their MIS as a means of improving performance. Small firms are rapidly moving in the same direction. Yet there is no single strategy or consensus on how these firms should proceed to achieve successful MIS implementation."

(Kole 1983a p. 31)
2.6 Conclusion

The published evidence therefore supports the case for a separate research study into the implementation and use of MIS in the small business environment. Indeed the lack of empirical evidence in this environment has been noted by many writers (Raymond 1985, Lustman 1983). Therefore it is apparent that the special features of small businesses in the construction industry and the nature of their MIS needs to be explained at this point.

The research problem of this study is therefore stated as the evident problems associated with the selection and implementation of microcomputer-based MIS in all small companies in early 1980.
PART THREE  THE NATURE OF THE CONSTRUCTION INDUSTRY SMALL COMPANY

3.0 Summary

The aim of this section is to provide a background description of the United Kingdom construction industry and portray the significant role played by small companies in that industry. The characteristics of typical small construction companies are then described and an account of the nature of the MIS applications to which microcomputers have been utilised follows.

3.1 The Role of Small Companies in the Construction Industry

Little statistical information or empirical research work has been undertaken into the operations, economic position and management attitudes of small firms in any sector of the U.K. economy in spite of the British tradition of being a nation of small businessmen with considerable entrepreneurial talent, willing and able to take risks, to innovate and to be agents of change (Beesley and Hamilton 1984). Government interest in this sector of the economy has gradually developed since the late 1960's. The principal work on the small firm sector of the economy was that undertaken by the committee of inquiry, headed by J.E. Bolton (1971), which was set up in 1969:

"To consider the role of small firms in the national economy, the facilities available to them and problems confronting them; and to make recommendations."

(Bolton 1971 p. V)

and made recommendations for changes in the taxation of small firms, reductions in the burden of form-filling, new legislation on monopolies and restrictive trade practices
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>40,580</td>
<td>55,498</td>
<td>64,585</td>
<td>71,386</td>
</tr>
<tr>
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<td>34,541</td>
<td>44,872</td>
<td>51,370</td>
<td>54,533</td>
</tr>
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<td>27,081</td>
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<tr>
<td>8-13</td>
<td>10,052</td>
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<td>8,630</td>
<td>7,129</td>
<td>7,241</td>
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<tr>
<td>14-24</td>
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<td>139,243</td>
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<td>165,163</td>
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<td></td>
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<td>35-59</td>
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<td>1,721</td>
<td>1,682</td>
<td>1,603</td>
<td>1,529</td>
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<td>484</td>
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<td>484</td>
<td>416</td>
<td>411</td>
<td>418</td>
<td>406</td>
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<tr>
<td>115-299</td>
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<td>598</td>
<td>562</td>
<td>563</td>
<td>555</td>
</tr>
<tr>
<td>300-599</td>
<td>208</td>
<td>162</td>
<td>152</td>
<td>154</td>
<td>144</td>
</tr>
<tr>
<td>600-1199</td>
<td>92</td>
<td>82</td>
<td>76</td>
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<td>74</td>
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<tr>
<td>1200 &amp; over</td>
<td>48</td>
<td>39</td>
<td>38</td>
<td>39</td>
<td>40</td>
</tr>
<tr>
<td>Total Large Firms</td>
<td>6074</td>
<td>5337</td>
<td>5152</td>
<td>5074</td>
<td>4836</td>
</tr>
<tr>
<td>Total All Firms</td>
<td>13,632</td>
<td>115,186</td>
<td>144,395</td>
<td>160,596</td>
<td>169,999</td>
</tr>
</tbody>
</table>

| % of Total attributed to Small firms | 94.65 | 95.37 | 96.43 | 96.86 | 97.16 |
| % of Total attributed to Large firms | 5.35  | 4.63  | 3.57  | 3.14  | 2.84  |

Table 3.1a Number of Private Building Contractors by Size of Firm 1980–1984

Source: Department of the Environment Housing and Construction Statistics 1974–84, HMSO 1985
[Table 3.1 p. 19]
The Bolton Committee published its report in November 1971 and changes in company law with relaxations in development and planning controls. The report saw small firms as providing a productive outlet for enterprising and independent-minded people; offering the most efficient form of business organisation in industries where the optimum size of production unit or sales unit is small; contributing to the variety of consumer choice in many markets; often producing specialist supplies to large companies more cheaper than the latter; and providing an important source of innovation in products, techniques and services.

The Bolton Report concluded that three main characteristics should be taken into consideration when defining small firms, that is small market share, owner management and independence. The statistical definition used as an operational measures for identifying small firms varied with industrial sector and that used in the construction industry small firm was those organisations employing 25 employees or less. This small value reflects the relative predominance of small sized firms in the construction industry as opposed to manufacturing industries where the upper limit was taken as being 200 employees. The importance of the small firm in the construction industry has been increasing over the period 1980-84, as shown in Table 3.1a opposite, rising from a significant 94.65 per cent in 1980 to 97.16 per cent in 1984.

Of the 169,999 firms, recorded in the 1984 Housing and Construction Statistics, 165,163 equivalent to 97.16 per cent had less than 25 employees. However they accounted for approximately £9607.6 million worth of work done or 41.04 per cent of total construction output in 1984 as shown in
<table>
<thead>
<tr>
<th>Size of Firm by number employed</th>
<th>New Work Value £ million</th>
<th>Maintenance &amp; Repair Value £ million</th>
<th>All Work Value £ million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Firms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>109.7</td>
<td>236.9</td>
<td>346.6</td>
</tr>
<tr>
<td>2-3</td>
<td>166.2</td>
<td>332.0</td>
<td>498.2</td>
</tr>
<tr>
<td>4-7</td>
<td>241.6</td>
<td>359.6</td>
<td>601.2</td>
</tr>
<tr>
<td>8-13</td>
<td>182.1</td>
<td>229.3</td>
<td>411.4</td>
</tr>
<tr>
<td>14-24</td>
<td>286.0</td>
<td>258.5</td>
<td>544.5</td>
</tr>
<tr>
<td>Total Small Firms</td>
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<td>1416.3</td>
<td>2401.9</td>
</tr>
<tr>
<td>Large Firms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-34</td>
<td>162.3</td>
<td>123.9</td>
<td>286.1</td>
</tr>
<tr>
<td>35-59</td>
<td>284.9</td>
<td>161.6</td>
<td>446.4</td>
</tr>
<tr>
<td>60-79</td>
<td>150.2</td>
<td>74.4</td>
<td>224.7</td>
</tr>
<tr>
<td>80-114</td>
<td>181.2</td>
<td>75.4</td>
<td>256.6</td>
</tr>
<tr>
<td>115-299</td>
<td>482.0</td>
<td>159.3</td>
<td>641.3</td>
</tr>
<tr>
<td>300-599</td>
<td>328.4</td>
<td>88.4</td>
<td>416.9</td>
</tr>
<tr>
<td>600-1199</td>
<td>342.1</td>
<td>65.4</td>
<td>407.4</td>
</tr>
<tr>
<td>1200 &amp; over</td>
<td>651.5</td>
<td>119.8</td>
<td>771.3</td>
</tr>
<tr>
<td>Total Large Firms</td>
<td>2582.6</td>
<td>868.2</td>
<td>3450.7</td>
</tr>
<tr>
<td>Total All Firms</td>
<td>3568.2</td>
<td>2284.5</td>
<td>5852.6</td>
</tr>
<tr>
<td>% of Total attributed to Small firms</td>
<td>27.62</td>
<td>62.01</td>
<td>41.04</td>
</tr>
<tr>
<td>% of Total attributed to Large firms</td>
<td>72.38</td>
<td>37.99</td>
<td>58.96</td>
</tr>
</tbody>
</table>

Table 3.1b Value of Work Done by Size of Firm and Type of Work 1984

Source: Department of the Environment Housing and Construction Statistics 1974-84, HMSO 1985 [Table 3.14 p 35]
Table 3.1b, opposite. The annual turnover figures, shown in Table 3.1c following, however may be artificially inflated by considerable amounts of subcontracted work which is undertaken particularly as the size of the company increases.

<table>
<thead>
<tr>
<th>Size of Firm by number employed</th>
<th>All Work Value £ million 3rd Qtr 1984</th>
<th>All Work Value £ million 1984</th>
<th>Number of Firms 1984</th>
<th>Average Annual Turnover 1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>346.6</td>
<td>1386.4</td>
<td>71,386</td>
<td>19,421</td>
</tr>
<tr>
<td>2-3</td>
<td>498.2</td>
<td>1992.8</td>
<td>54,533</td>
<td>36,543</td>
</tr>
<tr>
<td>4-7</td>
<td>601.2</td>
<td>2404.8</td>
<td>27,081</td>
<td>88,800</td>
</tr>
<tr>
<td>8-13</td>
<td>411.4</td>
<td>1645.6</td>
<td>7,241</td>
<td>227,261</td>
</tr>
<tr>
<td>14-24</td>
<td>544.5</td>
<td>2178.0</td>
<td>4,922</td>
<td>442,403</td>
</tr>
<tr>
<td>Total Small Firms</td>
<td>2401.9</td>
<td>9607.6</td>
<td>165,163</td>
<td>58,170</td>
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<td>Large Firms</td>
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<td></td>
</tr>
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<td>25-34</td>
<td>286.1</td>
<td>1144.4</td>
<td>1,604</td>
<td>713,466</td>
</tr>
<tr>
<td>35-59</td>
<td>446.4</td>
<td>1785.6</td>
<td>1,529</td>
<td>1,167,822</td>
</tr>
<tr>
<td>60-79</td>
<td>224.7</td>
<td>898.8</td>
<td>484</td>
<td>1,857,025</td>
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<td>80-114</td>
<td>256.6</td>
<td>1026.4</td>
<td>406</td>
<td>2,528,079</td>
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<td>115-299</td>
<td>641.3</td>
<td>2565.2</td>
<td>555</td>
<td>4,621,982</td>
</tr>
<tr>
<td>300-599</td>
<td>416.9</td>
<td>1667.4</td>
<td>144</td>
<td>11,579,166</td>
</tr>
<tr>
<td>600-1199</td>
<td>407.4</td>
<td>1629.6</td>
<td>74</td>
<td>22,021,621</td>
</tr>
<tr>
<td>1200 &amp; over</td>
<td>771.3</td>
<td>3085.2</td>
<td>40</td>
<td>77,130,000</td>
</tr>
<tr>
<td>Total Large Firms</td>
<td>3450.7</td>
<td>13802.8</td>
<td>4836</td>
<td>2,854,177</td>
</tr>
<tr>
<td>Total All Firms</td>
<td>5852.6</td>
<td>23410.4</td>
<td>169,999</td>
<td>137,709</td>
</tr>
</tbody>
</table>

Table 3.1c  Annual Turnover by Size of Firm 1984

The construction industry in the U.K. covers several main activities - civil engineering, building, contracting, house building and general contracting. The smaller builder tends to concentrate on the latter of these two activities. Supporting all the main contractors are specialist subcontractors such as mechanical and heating engineers, or those concerned with finishing trades - plasterers, decorators and the like. Table 3.1d below shows the distribution of construction industry companies by trade.

<table>
<thead>
<tr>
<th>Trade</th>
<th>1984 (October)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General builders</td>
<td>68,250</td>
</tr>
<tr>
<td>Building &amp; civil engineering contractors</td>
<td>3,722</td>
</tr>
<tr>
<td>Civil engineers</td>
<td>15,292</td>
</tr>
<tr>
<td>Plumbers</td>
<td>11,004</td>
</tr>
<tr>
<td>Carpenters and joiners</td>
<td>15,232</td>
</tr>
<tr>
<td>Painters</td>
<td>5,678</td>
</tr>
<tr>
<td>Roofers</td>
<td>4,016</td>
</tr>
<tr>
<td>Plasterers</td>
<td>4,342</td>
</tr>
<tr>
<td>Glaziers</td>
<td>564</td>
</tr>
<tr>
<td>Demolition contractors</td>
<td>920</td>
</tr>
<tr>
<td>Scaffolding specialists</td>
<td>496</td>
</tr>
<tr>
<td>Reinforced concrete specialists</td>
<td>8,802</td>
</tr>
<tr>
<td>Heating &amp; ventilating engineers</td>
<td>15,567</td>
</tr>
<tr>
<td>Electrical contractors</td>
<td>850</td>
</tr>
<tr>
<td>Asphalt and tar sprayers</td>
<td>3,740</td>
</tr>
<tr>
<td>Plant hirers</td>
<td>1,431</td>
</tr>
<tr>
<td>Flooring contractors</td>
<td>1,516</td>
</tr>
<tr>
<td>Constructional engineers</td>
<td>1,401</td>
</tr>
<tr>
<td>Suspended ceiling specialists</td>
<td>832</td>
</tr>
<tr>
<td>Floor and wall tiling specialists</td>
<td>1,158</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>2,535</td>
</tr>
<tr>
<td>All Trades</td>
<td>169,999</td>
</tr>
</tbody>
</table>

Table 3.1d Number of Private Building Contractors by Trade of Firm 1984

Source: Department of the Environment Housing and Construction Statistics 1974-84, HMSO 1985 [Table 3.1 p. 19]

For the purposes of the research it was felt that the companies employing less than 35 employees would reflect similar characteristics and so the Bolton definition of the small firm was widened to take this into account.
3.2 The Goals of Small Construction Companies

Very few small companies in the construction industry plan or experience substantial economic growth. Table 3.1b shows that only 2.84 per cent of companies employ more than 25 employees. However, the small firm sector has a history of rapid expansion from small beginnings, bankruptcy and re-establishment of trading soon after on a smaller scale. The profit-maximisation goals attributed by economists to small firms in a perfectly competitive market are atypical of the small construction industry company (Hillebrandt 1971). One such managing director of a small general contracting firm expressed their particular company goals as follows:

"... to continue as an on-going enterprise
... to provide a reasonable return on capital employed for the directors, shareholders or partners of the firm
... to produce reasonable quality work which ensures the minimal requirement for further maintenance
... to maintain a sufficient workload to keep the workforce profitably employed and finally to minimise risks." [1]

3.3 Variables associated with the operations of small construction industry firms

The success or failure of the small firm to achieve its goals is influenced by many variables which are outlined in the following sections:

(1) Economic environment

The operations involved in construction are labour-intensive and materials are heavy and expensive to

Footnote:

1. The view was expressed in 1980 by the managing director of Company A who later became a participant case study. It is felt that the views expressed are likely to be typical of many small construction companies.
transport with the consequence that firms operate within a small radius of head office. Norris (1982) states that the size and geographical spread of work calls for a different type of relationship between contractor and client, with speed and reliability being of prime importance. Department of Environment, Housing and Construction Statistics (1984) state that 37.95 per cent of work carried out by small firms are in fact housing repairs and maintenance with a further 41.03 per cent on new housing. Repair and maintenance is characteristically let in small diverse parcels of work and is consequently more suited to the small flexible organisation than the large firms who will generally subcontract such work if they do not have a small works unit within their organisation. Both repair and maintenance and new housing work require very little advanced technical knowledge or capital assets and consequently entry into the construction industry is extremely easy. Within this competitive market there is little repetition of similar work and profit levels are very variable, often only breakeven.

Difficulties arise when the firm is not able to manage the cash flow of such varied work agreements. Individual firms may be dependent on a small number of larger organisations who subcontract work to them. Cash flow for such firms may be controlled by firms of architects, the management of larger corporations and private clients.

(2) System inputs

The varied work is often performed by a transitory workforce with a low skill level and little loyalty to
any one company. For larger contracts and fluctuations in the workload level the company will normally engage subcontract labour-only workmen, a phenomena more prevalent in the south of the U.K. The remaining stable core of any small firm workforce is likely to be skilled tradesmen who have supervisory responsibilities ranging beyond their own trade. The remoteness of the place of work continually presents a problem of control for large and small firms alike.

3) Organisational environment

The management of small firms in the construction industry are principally craftsmen by background with very little formal training in management (Norris 1982). Responsibility boundaries amongst members of staff are both flexible and permeable since the organisation structure is likely to have evolved over many years in established firms. More recently established firms may be more structured in their initial approach to management but the need for non-specialist individuals with general skills in both office and contract management is still predominant feature of specifying job functions. Support functions are often provided by part-time clerical or secretarial staff and the control of activities is characterised by the poor and incomplete management information.

4) Social factors

Many small firms are established as family concerns which draw on the members of the family to undertake supporting functions particularly at times of difficulty. Partnerships may be a combination of craft
skills and management but the coordination of functions must inevitably be flexible.

Direct supervision of operatives is a major part of small firm management. Work which is dispersed over a local area requires good labour relations and the small contractor will employ men who work at more than one trade with the result that demarcation problems are rare.

(5) Political factors

The construction industry had been used by many U.K. governments as a regulator for the national economy and the booms and slumps of the trade cycle are felt to an exaggerated extent by small construction companies. Legislation concerning the employment of subcontract labour is very complex and frequently changes as the authorities attempt to control the personal taxation liabilities of a basically itinerant workforce. The government is itself a client either directly or indirectly to many small firms and the cash flow of such firms is thus within their realm of power.

3.4 Microcomputer Applications in Small Construction Firms

The commercial availability of microcomputer technology around 1980 has presented all small companies in the construction industry with the possibility of powerful computing facilities. Inexpensive and compact computers running interactive, user-friendly software has meant that the small building firms need neither specialist staff nor a special environment in which to operate it. Those small firms which have pioneered the application of microcomputers within the construction industry have done so with three
principle objectives, more control of contracts, increased feedback on costs and more efficient administration, principally through the control of debtors, creditors and subcontractors.

A small number of specialised software houses have evolved in order to meet the need for unorthodox accounting practices, involved in subcontractors and contract work generally, and have also diversified to provide systems to aid management in other areas of construction management, such as estimating and planning. These software houses have staff with both professional backgrounds of construction and computing but software is consequently expensive and specialised.

Applications beneficial to the small contractor have been described by the author (Wroe 1981), as follows:

(1) **Payroll and Labour Costing**

The payroll of a firm as small as 20 employees may be processed on a microcomputer with time and cost savings but the real benefit is derived from the provision of prompt labour cost information for individual contracts. Construction industry payrolls incorporate nationally agreed working rules, which are both complex and tedious, and firms frequently operate complicated payment systems for both direct employees and labour-only subcontractors which is based on time, measured work and a variety of bonuses.

(2) **Purchase Ledger**

The construction industry differs from conventional manufacturing in that the most significant accounting function is the maintenance of the purchase ledger and
the associated nominal and contract cost ledgers rather than the sales order invoicing process. Small firms are able to justify the use of a microcomputer to control the payments to a large number of materials suppliers typically involved in any contract. Such systems have the potential of improving the vital cash flow of the small firm by providing the facility to partially pay invoices or claim discounts by paying selective invoices by a specified date.

(3) Subcontractor Ledger
This distinguishing accounting function may be managed by specialist packages which provide such facilities as the generation of payment certificates for work completed within a specified period and the retention of payments due for a time interval after the completion of any work. This practice of retaining a percentage of earnings to be released at a later date complicates the cash flow management of any construction firm but particularly the small one which undertakes many contracts during a trading year. Government legislation mentioned earlier is particularly complex in respect of subcontractors and the firm may be burdened with the responsibility for deduction of tax at source and the appropriate statistical returns to the revenue authorities.

(4) Contract Costing
The variety of work presents problems of maintaining accurate and up-to-date cost information particularly on small works which may be completed before supplier invoices are received. The author (Wroe 1980) stressed the prime benefits to be derived from using a
microcomputer systems lay in the provision of cost information at a detailed level as a by product of the ordinary accounting functions of purchase ledger, payroll and subcontractor ledgers.

(5) Client/Sales Ledger
The practice of retaining a proportion of the contract value by the client until several months after the completion of work results in a slow movement of outstanding balances on these debtor accounts. The recovery of these outstanding debts presents difficulties for the small firm which can be overcome by maintaining a computer-based sales ledger on an open item basis with provision for retentions by clients.

(6) Estimating, Planning and Budgetting
The estimating function is the first task to be encountered for any potential project and it involves assembling a large amount of detailed information and organising it in an predetermined manner. The raw data for estimating is cost and performance information in the form of labour rates, plant and material costs which can be stored and kept up to date on a magnetic disk. Software is being marketed which provides the small firm with a basic "price book" together with the calculation tools for a task which many estimators feel has a strong intuitive element.

Planning tools for the small construction company are principally variations of barcharts and the majority of project planning software uses network analysis techniques which are generally too complex. However general purpose spreadsheet software now presents the
management of small construction companies with simple tools for planning building operations and financial budgetting.

(7) **Office Administration**

Word processing and information retrieval systems have been found advantageous to small firms in such situations as submitting standard tender letters and requesting material and subcontractor quotations.

### 3.5 The State of the Construction Industry Computing Market

The interest of both small and large construction industry companies in the use of microcomputers has accelerated since the first specialist packages were introduced around 1979. A specialist journal, *Construction Computing*, is published by the Chartered Institute of Building and is aimed at providing an informed guide to the ever changing microcomputer market.

No reliable published statistics are available for the number of small construction industry companies who have introduced some form of microcomputer-based MIS. A recent survey (Small Business Research Trust 1985) suggested that 34.9 per cent of the construction industry small companies had acquired a microcomputer by 1985. The author considers [2] an unpublished estimate given by the most successful construction industry software houses as less than 1 per

Footnote:

2. The statistical definition of the small business used in the Small Business Research Unit survey (1985) (as high as 100 or more employees) was far wider than that generally adopted within the construction industry, i.e. less than 25 employees. The estimate of the software houses at InterBuild Exhibition 1985 was of a total of 1500–2000 small firms had a microcomputer.
cent had purchased specialised construction industry software, to be a more realistic figure.

3.6 Conclusion

Small construction industry companies are therefore seen to be a special vertical market in respect to their computing needs. A very small proportion of the companies have already attempted the development of a microcomputer-based MIS but many difficulties have been experienced. There are considerable opportunities within the management and administrative operations of the small companies and it is therefore likely that development of MIS will be an active area of organisational change. Research into this area of MIS implementation is therefore likely to have a high practical benefit to small companies in the future.
PART FOUR INFORMATION SYSTEMS DESIGN

4.0 Summary

Small businesses are clearly potential and actual users of microcomputer-based MIS. What are the MIS development approaches to be advocated in the case of small companies? This section describes the wide range of development activities involved in the design of most computer-based information systems. A review of the information systems design methodologies which have emerged with the growth and increased complexity of computer-based MIS follows. This is neither a detailed nor a comprehensive account of all the possible alternative methodologies available and is only included to present the design environment of large companies before considering the small business environment once again.

4.1 Information System Development in Organisations

Information system development is taken here to refer to the combination of humans, computers, programs and procedures designed, developed and implemented to meet the information needs of management in some aspect of decision making. This process of organisational change arises out of the recognition of a need for better informed decision making by all levels of management. It necessitates the initial recognition, by those involved, that a problem situation exists for which the operation of new procedures, tools and staffing will result in an overall achievement of improved performance in a key area within the organisation. A detailed investigation and analysis of the information flows within the problem area forms the basis for the design and subsequent implementation of a new information system to
meet this need.

The task of information system development is a hazardous process and its dangers are well covered by the literature (for example Lucas 1975 and 1978, Bostrom and Heinen 1977, McCosh 1984) and for these reasons information system methodologies have been developed in an attempt to increase the probability of success.

A variety of systems analysis approaches have been summarised by Wood-Harper and Fitzgerald (1982) and Maddison (1983) has described the features of several specific information system methodologies. This latter work followed on from an IFIP Working Group 8.1 conference in 1982 which reviewed comparatively several information system methodologies (Olle, Sol and Verrijn-Stuart 1982).

Maddison defines an information system methodology as:

"A recommended collection of philosophies, phases, procedures, rules, techniques, tools, documentation, management and training for developers of information systems."

(Maddison 1983 p. 4)

An information systems methodology therefore encompasses more than systems analysis and design tools and techniques but becomes the whole approach. An IS practitioner will select a methodology on the basis of the particular organisational environment, the problems to be addressed and the standards and practices of the institution or company he belongs to.
4.2 Changing Approaches to the Development of Information Systems

Maddison suggested that several tens of methodologies existed in 1983, each having at least a published paper based on it. Many methodologies are little more than the combined expertise of a handful of experienced information system developers who have worked closely together and developed perhaps 10 to 20 systems (Maddison 1983 p. 4). A suitable framework for considering the features and development of the main groups of methodologies for background to this research is that of Wood-Harper and Fitzgerald (1982).

4.2.1 Traditional Life Cycle Approach

In accordance with the well established management principle of breaking down any problem into manageable portions, it is generally accepted that the development of information systems can be conducted as a series of clearly defined, discrete and often sequential phases. Land (1982) describes the information systems life cycle as:

"A project is conceived, requirements are analysed, feasibility is established, a series of designs are conceived and embodied in specifications, hardware is selected, the system is constructed and tested and finally implemented. The new system operates until it no longer effectively meets the needs of the organisation, either because new technological opportunities have made the existing technology obsolete, or changing user requirements cannot be satisfied by the existing design. At that point a new system is required, a new system is conceived, and a new system life cycle gets underway."

(Land 1982 p. 60)

The actual phases applied to projects, the "development life cycle", will vary between
<table>
<thead>
<tr>
<th>PHASE</th>
<th>TASKS</th>
<th>DELIVERABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy</td>
<td>Understanding the overall business objectives.</td>
<td>Terms of Reference</td>
</tr>
<tr>
<td></td>
<td>Deciding organisation-wide guidelines and coordination applying to all information systems.</td>
<td></td>
</tr>
<tr>
<td>Feasibility</td>
<td>Evaluation of feasibility leading to a report assessing costs and benefits of alternatives and appropriate management decisions.</td>
<td>Feasibility report</td>
</tr>
<tr>
<td>Analysis</td>
<td>Understanding and documenting the system operation and problems, describing as models the essentials of the activity and information types, the message types, the business procedures main information flows, the user types, interrelationships including people external to the organisation. Specifying the external interfaces and design aspects of the IS, including the functions as seen by users, input, output, reports, screens, privacy, security, integrity and reliability.</td>
<td>Requirements report defining inputs, outputs and business procedures decisions.</td>
</tr>
<tr>
<td>Design</td>
<td>Specifying the internal architecture, logical and physical structures of hardware, software, the locations and distribution of these, internal data flows, networking, schemas, consistency, recovery and internal mechanisms generally.</td>
<td>Systems specification defining files, programs, dialogues and internal mechanisms generally.</td>
</tr>
<tr>
<td>Construction</td>
<td>Creating a working system, maybe by prototyping.</td>
<td>Documented, working system</td>
</tr>
<tr>
<td>Implementation</td>
<td>Enabling transition by users using a previous system to a new one.</td>
<td>Verified test data</td>
</tr>
<tr>
<td>Support</td>
<td>Maintenance, repair, tuning and minor enhancements throughout the operational life of the system.</td>
<td></td>
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</tbody>
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Table 4.2a Information System Development Phases, Tasks and End of phase Deliverables

(Parkin 1980, p. 83)
organisation. These phases, comprising many tasks, are divided by decision points at which explicit decisions to proceed or not are made by organisation management. The end of each phase is identified when all tasks on a checklist have been completed and agreed documentation delivered.

Typical development phases and associated tasks involved are described in Table 4.2a shown opposite. Organisations are portrayed as generating requests for a continual path of new information systems from user departments, which are periodically reviewed and allocated funds from an overall data processing budget by a overseeing Steering Committee within the organisation (Parkin 1980). Within an organisation, information system development projects are managed by a systems planning team, whose function is to view the organisation as a whole and, to examine in detail the information requirements within and across departments or managerial functions.

The actual system development is undertaken by systems analysts and programming staff. It is the responsibility of a project manager to ensure the achievement of established checkpoints (see Table 4.2a) at which time specified end-of-phase documentation information is available and the user management review the anticipated costs and benefits to be accrued. Emphasis has been put on the importance of tight project control, clear cut-off points to the phases and a large, experienced and highly educated project team in the ultimate success of information systems (Parkin 1980).
This life cycle structure has provided several advantages for information system development. Clearly less risk of commitment to an unviable project is secured by frequent review. Planning, estimating and control becomes more manageable when concerned with separate phases and by concentrating technical functions into particular phases the most effective use of specialist skills are achieved.

The organisational environment for which this traditional approach to systems development was most suited existed throughout the 1960's and early 1970's. Centralised data processing departments designed and implemented batch systems to meet the well known requirements of transactional data processing, particularly in the financial management field. There was little need for involvement by the user concerned other than to establish a formal agreement on the functional aspects of the proposed system.

Such an approach emphasises the investigation of existing application areas, where systems already exist, and reflects a functional view of management decision making. Systems analysis is undertaken first in terms of the processes and associated problems and subsequently, in terms of the data involved using standard documentation techniques. Stowell (1984) views most system design throughout the 1960's and early 1970's has thus concentrated on replacing existing manual data processing systems with new more efficient computer based systems.
"Many of the information systems installed are based on the new-lamps-for-old approach of past managerial philosophies. We continue to replace one thing with another retaining a vision of all these 'bits' becoming some integrated information network."

(Stowell 1984 p. 1)

This approach is suited to transaction processing applications and in particular to the situation where the information system development strategy is based on the current organisational boundary and structure. The phases themselves assume the development of bespoke information systems in organisations although the application of packaged software may be evaluated as a solution.

The main drawback of the life cycle is thus the lost opportunity of improving the organisation and outdated systems or techniques. Designers using this approach built the existing state of technology into the systems by making early decisions on the physical characteristics of the implementation. The effect of this was that systems proved to be inflexible when users' needs changed or when superior technology was developed and there was a high risk of maintenance burdens, system failure and obsolescence. Where the user community is unable to express the desired objectives of the information system, traditional methods can only provide improvements in the form of quantity not quality of management information.

The approach is extremely costly and disruptive with the result that both users and systems designers have sought ways in which information systems could be more flexible and changeable, implemented in a
evolutionary manner, less technology dependent, more accurately representative of the real world problem solving, and furthermore discardable in the long term (Land 1982).

4.2.2. Systems Approach

General systems thinking associated with Bertalanffy (1968) provided the basis for an approach to solving problem situations in organisations, known as "system engineering" or "hard systems thinking". The systems engineering approach involved:

"a set of activities which together lead to the creation of a complex man-made entity and/or the procedures and information flows associated with its operation"


A specific information system requirement was thus viewed hierarchically, in the context of a larger system and attempted not to limit the range of possible solutions. Systems engineering generated a demand for a methodology to design systems, in the post war period in highly competitive market situations, when technology was advancing fast. Systems analysis was conceived as a systematic appraisal of the costs and other implications of meeting a defined requirement in various ways. The approach put considerable emphasis on the definition of the problem and on the need for consensus over the objectives. However little guidance was given to how each stage was to be undertaken and great reliance was placed on the intuition and creativity of those concerned, principally the systems analyst. In situations where the new system has never been
created before, as in research and development technologies, this approach has much to offer when the environment can be closely controlled.

Research work, undertaken since 1970 at the University of Lancaster, set out to establish a systems modelling language as technique for use in ill-defined problems situations in organisations. By analysis of both the system within which the problem lies and its wider systems and their respective objectives, the approach emphasised the importance of consistency within the hierarchy of systems within an organisation.

As the problems encountered in the programme of action research became more ill defined and unstructured in nature, the soft systems methodology of Peter Checkland was developed (Checkland 1981). The aim is to look at the business problem in its environment, considering the organisation and attitudes of those involved as well as procedures. Checkland emphasises throughout the subjectivity of systems analysis and the importance of an iterative approach to the activity of analysis. The purpose of the approach is to create a situation in which the problem can be solved and desired changes introduced. The views of all the "stakeholders" in the new system are the subject for debating the nature of the new system with the objective of defining an all round solution.

Using Checkland's soft systems methodology the systems analyst emerses himself in assembling the richest possible picture of the problem situation in
the real world, before stepping back into a systems thinking mode in the conceptual world, in order to build a logical model based on agreed root definitions on the systems or subsystems concerned. The analyst compares the models with each other and with an analysis of what actually exists before confronting the different interest groups with their different models and the implications of the differences. The real world debate then centres around identifying desirable and feasible solutions, which meet the views of all concerned i.e. the questions of "WHAT" needs to be done rather than "HOW" it is to be achieved (Wilson 1984).

The main advantage of this approach is seen to be the seeking out of the problem by the systems analyst rather than the taking of the problem on face value. The problem is often defined by someone in the organisation who is in fact influenced by the effect of the problem rather than its root causes which may in fact be hidden. By modelling the necessary activities conceptually the analyst generates more than one solution to the problem and consequently can act as an advisor in the problem area rather than the provider of a specification of technology. The approach naturally involves the users in the eventual implementation of the agreed solution, since the close relationship between analyst and client has been established early in the debate concerning feasible solutions.

Such a radical approach to problem solving may be undesirable in many circumstances where organisations
prefer a more evolutionary approach. Checkland assumes an inherent democratic philosophy of management and employees when introducing new systems and not least the skills, time, resources and motivation on behalf of both users and project development staff to undertake the iteration of the conceptual modelling and system debate. Little firm guidance or design tools is given to the system designer as the limitation of what is "known to be achievable" is paramount. Early outdating of the changes made may result in the frequent need for maintenance amendments, due to overcentration of the current attitudes of the parties involved.

Wilson (1984) has extended Checkland's methodology in a specific information systems methodology which incorporates some of the tools of structured systems analysis to rectify some deficiencies of the system designer. Structured systems analysis and design techniques, as designed by Gane and Sarson (1979) and Jackson (1983) which are discussed later in this section, are thus complementary to the soft systems methodology.

4.2.3 Socio-Technical and Participation Approach

The problem of achieving a close match to the needs of those management and operators involved, led to the development of the socio-technical approach which explicitly recognises the importance of different interest groups concerned with a system by seeking to discover the social, technical, economic and organisational objectives as perceived by the
different groups. User participative methods, associated with Mumford and others, have also placed emphasis on the human aspect of information system design, particularly in understanding their information requirements and designing systems to meet their needs (for example Mumford and Henshall 1979, Eason 1984, Land and Hirscheim 1983, Ives and Olson 1984). The motivation here is partly to ensure user involvement and acceptance of a design, without which the "best" technical solution will be a failure.

The underlying assumptions of such approaches are that the designated users have the knowledge of system requirements and system capabilities. It is also assumed that the organisation can, and will, release the users from their normal tasks to become participants throughout the change process and, not least, the management is amenable to such a philosophy. As a methodology, participation rarely attempts to tackle the whole problem range but concentrates on the needs of current users.

Considerable user training in the techniques of system modelling and the technical feasibility aspects of design are necessary to enable users to take any responsibility for system design which proponents of full participation would recommend.

### 4.2.4 Data Analysis Approach

Data analysis originated from the design of data base systems which encouraged a higher level of analysis than procedure-oriented traditional approaches by building a detailed logical data model. The entity
modelling view (as first described by Chen 1976) is that it is the data relationships, usages and properties which are important to the organisation when designing information systems to suit current and future needs. Burchett recently described the popular LSDM design methodology as data driven.

"Using LSDM, the developer is encouraged to build 'data' oriented systems. Justification for this approach is based on a number of factors:

* All application systems have an underlying, generic data structure.

* In general terms this generic structure tends to change very little over time. Although there may be extensions and minor changes, given the application remains in the same business area the data structure remains broadly the same."

(Burchett 1985 p. 45)

This approach incorporates implementation-independent analysis at a conceptual level and it is argued that management must face policy decisions well before physical design of files and procedures. The approach inevitably produces a data base structured system which has its associated problems of security and privacy issues.

Commercial information system methodologies, such as Jackson's structured design (Jackson 1975) and LSDM (Burchett 1985), assumed that the structure of the user's application is reflected in the structure of the data itself, which if properly represented, can lead to a simple error-free program structure. A graphical language provides the analyst with tools to implement a structured solution which concentrates on the data. The process is automatable and software tools have been developed. In practice the Jackson
structured design methodology requires considerable training by practitioners and also users who need to understand the concepts and notations in order to participate in the design of a new system.

Other data-centred developments in approaches to information system design has been the increasing use of data dictionaries, which do not contribute to the analysis of business needs, but aim to ensure unambiguity and integrity of data in any design. These tools for recording and processing information about the structure and usage of data are usually automated and the greatest use has been in the development of large central data base systems.

4.2.5 Structured Systems Analysis and Design

The traditional structure of the development life cycle provided a specification of what was to be achieved at the end of each phase, usually in the form of a standard documentation (National Computing Centre 1982). Little guidance was given on how to achieve this position. Definition of the tasks and specification of analysis, design and documentation tools and techniques for providing structure to the activities of the development staff are the features of the structured approach to information systems development. Structured systems analysis and design is a system modelling methodology which provides the systems analyst with analytical tools to enable him to isolate the logical nature of systems from the existing physical methods. The original ideas put forward by Yourdon and associates (Yourdon 1978) did
not however make any recommendations concerning the information system strategy for the implementation phases of the life cycle.

This approach is thus a documentation technique which is aimed at giving designers the freedom to make the decisions on "what" information needs are prior to considering "how" information requirements are to be met. It is a function, process-oriented approach with guidelines on how to apply the tools in a problem situation. Considerable support has been found in the information system design community since it enables the coordination of large teams of analysts in their efforts of design systems to meet the complex problems of large organisations. Many different authors have in fact contributed to the development of tools, the most well known being the data flow diagram (De Marco 1978, Gane and Sarson 1979). A hierarchical decomposition of the functions of the system to a more detailed level is supported by the establishment of a data dictionary containing the details of all elements of the data flows and data stores.

4.3 Application of Information System Design Methodologies

There is clearly no prescriptive definition of the "best" information systems design methodology and fashions have changed many times over the last twenty years. Approaches such as those outlined above however do have some degree of success in the environment of large organisations, where it can be assumed that the following features exist.
1. The organisation possesses a knowledge of information systems and are able to define information system goals which will be beneficial to the organisation.

2. An information system development vehicle, (time, money and management by which the MIS project can be achieved), is available within the organisation.

3. An atmosphere of openness and free thinking across the management and workers in an organisation.

4. A stable economic and political environment exists within which change may take place.

Large and medium sized organisations have been the main consumers of computer-based management information systems for decades but the advent of microcomputers has widened the market to include all but possibly the smallest enterprise. However the conditions listed before are unlikely to be found in the small business environment described in Part Three. Raymond argues that the small firm system development environment is very specific.

"The characteristics of small business which affect information systems are the centralisation of the structure, the insufficiency of resources for MIS, and the uncontrollability of the extra-organisational situation."

(Raymond 1984 p. 38)

4.4 Conclusion

The specific features of the small company environment make it likely that the current approaches to the development of information systems are a very poor tool for MIS development when the context is that of a small firm. It is therefore important for IS researchers to study this environment with a view to discovering the needs of MIS developers and the small companies themselves.
5.0 Summary

This section evaluates the available research methodologies which could be utilised for the intended research project. The arguments in favour of a non-scientific approach are presented and the several candidate methodologies are discussed. Each one is evaluated in terms of its strengths and weaknesses in view of the specific objectives of the information systems research and the choice of longitudinal cases studies to generate grounded theory is justified. Details of the data collection techniques adopted are then presented with final mention being given to the problems associated with the selected approach.

5.1 Social Research Background

Many of the problems of investigating the selection and implementation of microcomputer systems in small firms within the construction industry are common to those facing the investigator of this process in any small organisation. At the time of the investigation commencement in 1980, an extensive literature search of published material on the introduction of new technologies in small firms and work conducted in the U.K. construction industry revealed very little previous research work had been conducted in the field of MIS in smaller companies.

5.2 The Failure of the Scientific Approach in Information System (IS) Research

Information systems research methodologies have been previously reviewed (Keen 1984, Galliers 1985) arising from
the view that traditional empirical scientific research approaches are inappropriate in the context of information systems. The scientific method of research has been criticised because of its inherent characteristics of repeatability, reductionism and refutability (Checkland 1981 page 13). Although the scientific approach has long been adopted on the grounds of objectivity, rigour and respect for the facts, such features may be considered to be weaknesses and thereby problematic in the field of information system research (Galliers 1985). He points out that:

"The very act of installing an information system changes the situation into which it is installed. Therefore no particular "experiment" can be repeated."

(Galliers 1985 p. 2)

The assumption that the division of a whole into parts does not distort the phenomenon being studied is also problematic and unfounded on the evidence of IS research. The third characteristic of the scientific approach of refutability is equally inappropriate since predictions on the outcome of observed behaviour and events in social systems may change the outcome. Checkland clearly points out that:

"Physical systems cannot react to predictions made about them; social systems can."

(Checkland 1981 p. 70)

Galliers goes on to state that the supposed strengths of objectivity and respect for the facts, turn out to be unachievable practically when undertaking IS research. He suggests that the perceptions of actions or re-actions associated with the use of information systems will be coloured by what Simon termed "bounded rationality" (Simon 1957) and Land called "cognitive filter" (Land 1984). Thus
researchers are blinkered when viewing a social phenomenon and are always likely to place a scientific interpretation on events according to their own experience and outlook (Checkland 1981). The respect for the facts is equally contentious since many views are possible, indeed valid, of the same facts.

The choice of research methodology for this study would significantly affect the type and amount of information derived from an investigation. It was therefore a particularly important choice in a new area when research objectives were to generate knowledge of the experiences of small firms and hence suggest theories concerning their behaviour.

5.3 Current Methodological Approaches to Information System Research

Returning to the planned investigation into the problems and aspirations of small construction firms when implementing MIS several alternative strategies were considered. Ein-Dor and Segev suggested four principal modes of conducting IS research, namely:

(a) laboratory experiments
(b) field experiments
(c) surveys and
(d) case studies (Ein-Dor and Segev 1981)

The following alternative research methodologies were considered by the researcher at the commencement of the project.

5.3.1 Broad Questionnaire Survey

The collection of large amounts of data suitable for
statistical analysis can be done by using
questionnaires, interviews or a combination of both.
Such a broad survey of a large number of small firms
with recent experience of introducing microcomputers
requires a large population of potential organisations
from which a stratified, representative sample can be
drawn.
The advantages of adopting a broad questionnaire
survey technique in an organisational investigation
are clearly:
(a) It enables the restatement of the investigation's
findings in quantitative terms, so that they can be
aggregated and subsequently analysed, using
computerised statistical techniques. Hence
comparisons can be made between the various groups in
a stratified sample.
(b) Reliable conclusions can be drawn concerning
issues already known to the investigator and
incorporated in the data collection questionnaire.
(c) The investigator is able to exercise considerable
control over the selection of the subjects. The
consistency in the quality of the data can be assumed
since all the subjects are asked for the same
information in the same manner.

However the drawbacks of the questionnaire technique
are:
(a) It is hard to know what constitutes a
representative sample of organisations. The
researcher can never be sure that a sample is
representative of all existant organisations.
(b) All the significant variables involved need to be
known at the outset in order that they can be systematically incorporated into the detailed design of the questionnaire. This situation is rarely the case when little research has been undertaken in a particular area of organisational behaviour. 
(c) The strategy of questionnaires could in fact result in the most important variables in the process being undiscovered by the investigation. 
(d) When completing questionnaires, recollections of problems and events involved in any process taking place over an extended period of time are known to become incomplete or distorted depending on the most recent experiences of those being questioned. The desire to answer questions in a manner perceived to be approved by the interviewer is a strong motivation of any interviewee.
(e) There is always a possibility of different interpretations of questions in even a pretested questionnaire. A significant interviewer role may be necessary where the respondents are unfamiliar with the terminology and language of the subject matter in order to ensure full understanding of the questions being answered.

5.3.2 Prototype Implementation

This research strategy would involve the design and development of a prototype MIS for field testing in a selected small firm and subsequent modifications in the light of any findings.

Advantages of a prototype approach are considered be:
(a) The organisation concerned actually influences the direction and hence of the investigation operation
since continual feedback is given to the investigator on the effectiveness of the current system.

(b) A detailed knowledge of the needs and behaviour of at most one or two organisations is obtained. The application can be viewed as a prototype for other similar firms which may be subsequently tested.

Drawbacks to the prototype approach should however be noted as:

(a) Some important issues could be overlooked by a prototype strategy, as the organisation could not be subjected to all eventualities, were they in fact known to the investigator at the outset.

(b) Generalisations or comparisons may not be made from a single detailed study. A research project at Loughborough University of Technology (Trimble and Wroe 1981) adopted this approach with a microcomputer project planning system in larger construction firms but found that the individual nature of data processing and administrative systems operated by firms, in which the prototype system was implemented, was a limiting factor. It was difficult therefore to consider the generality and success of the systems.

5.3.3 Longitudinal Case Studies

In depth case studies of a limited number of small firms may be conducted over an extended period of time. The research strategy, of entering an organisation openly in the role of investigator for the express purpose of learning more about its activities, is a strong candidate for any IS research project concerning organisations. Data is collected
by many means, such as field notes describing events relating to the area of investigation and periodic interviews with the staff of the organisation.

Pettigrew called for the use of more longitudinal research since:

"Time itself sets a frame of reference for what changes are seen and how those changes are explained. The more we look at present day events the easier it is to identify change, the longer we stay with an emergent process and the further back we go to disentangle its origins, the more likely we are to identify continuities...Without longitudinal data it is impossible to identify the processual dynamics of changing, the relationship between forces of continuity and change, and therefore the inextricable link between structure and process."

(Pettigrew 1983 p. 12)

Advantages of the longitudinal case study approach are as follows:

(a) The case study strategy is particularly valuable for exploratory analyses of organisations or groups that are not yet well enough known for an investigator to be precise and systematic about the variables he or she wishes to investigate.

(b) In areas where the important issues are as yet unknown, hypotheses concerning organisational behaviour are often best generated by a qualitative approach to research. Such an approach involves examining data itself which has been collected from many sources in an unstructured fashion to formulate ideas or models which can then become the subject of verifiable hypotheses. Loosely structured case study investigations are considered the most suitable way of gathering the data to form the basis of these grounded theories (Glasier and Straus 1977).

(c) By becoming closely involved with the management
and staff of the organisation over a period of several years, the investigator is able to penetrate, understand and record aspects of the firm's behaviour, which might not have been apparent at the outset of the investigation or to the investigator undertaking a single survey application. The real impact of any system tends to develop and widen as people gather experience of using it and find new uses and needs. It may take some time before the economic, social and organisational consequences of a new MIS may become apparent and investigations lasting a minimum of two years are likely to be more fruitful.

(d) The strategy allows a high degree of flexibility enabling the investigator to modify the data collection techniques when new insights emerge as the study progresses.

(e) In an unpredictable dynamic process, the longitudinal case study strategy enables the researcher to monitor and interpret events and attitudes without affecting the process itself or the organisation. The identification of several cooperative small firms at an early stage would provide an useful and accurate record of events for a "before-and-after" analysis of the data.

There are felt to be no significant drawbacks of the longitudinal case study approach for IS research other than the smallness of the sample involved.

5.3.4 Phenomenological Studies

The scientific approach is concerned with how things work while phenomenology is concerned with finding out what things are. The advantage of such an approach in
MIS research would be that:

(a) it sets out to describe the situation, with a view to producing objective knowledge.

(b) it involves a process of recognition of prejudice since the phenomenologist always includes himself or herself and the method being used as part of the phenomenon being studied (Boland 1985). It is thus self reflective in nature, emphasising the point that researchers are subjective people who will undertake their research from a particular standpoint or bias and, in order to carry out reasonably valid research, this standpoint must be made overt.

5.3.5 Action Research

Action research has been used as a technique for organisation development and has been defined by (French and Bell 1984) as

"the process of systematically collecting research data about an ongoing system relative to some objective, goal or need of that system; feeding these data back into the system; taking action by altering selected variables within the system based both on the data and on hypotheses; and evaluating the results of actions by collecting more data."

(French and Bell 1984 p. 107)

This iterative process of data collection, analysis and feedback, and taking action based on the data is the means by which much research work has been undertaken on information systems (for example Checkland 1981, Miles 1985).

Advantages of such an approach in the area of information systems research are identified as follows:
(a) a clear model for the planning of the research is established at an early stage.
(b) the researcher has a real influence on the situation as the problem situation is viewed collaboratively with management, objectives are set, actions agreed upon and taken before the problem situation evaluation is reiterated. Thus the process of action following research is based on diagnosis of the problem situation.
(c) it is a scientific approach since it involves the empirical validation of stated hypotheses concerning the behaviour or events of a problems situation.

The principle drawbacks of the action research approach are:
(a) the technique of manipulating identified variables in a problems situation is difficult where little is known of the environment and those variables are not yet known.
(b) difficulty lies in separating the results of the the action research and those external environmentally caused.
(c) the long term requirements for investigation is a considerable burden for the small organisation on whom the burden of supporting or accommodating the research in intensive activity is significant.
(d) there are also problems of generalising the result to any other case since the findings are context specific.

5.4 Information System Research Methodology Adopted

The need was for a methodology which examined the organisations at case study depth but made attempts to
preserve comparability of the data collected as the important issues in the successful MIS development became apparent to the investigator. The methodology selected for the investigation was principally that of several longitudinal case studies.

5.4.1 Problems associated with other methodologies

The following problems were found to be associated with broad questionnaire surveys, prototype implementations and phenomenological studies:

(a) At the commencement of the investigation the population of small firms with any relevant experience in the implementation of microcomputer-based MIS was only a limited proportion of the total number of small firms in the construction industry. The location of a sufficiently large questionnaire sample to produce reliable results from any statistical analysis was considered prohibitive. Norris (1982) noted difficulties in obtaining reliable research data by means of questionnaires sent to small building firms in the Nottingham area which he attributed to the craft background of the typical small construction firm management.

(b) The need of the investigation was to generate a large amount of information concerning the varied experiences of small firms rather than a limited range of statistically reliable data. These management experiences would only become evident if the firms were repeatedly subjected to lengthy questionnaires throughout the selection, implementation and live operation of the new system.

(c) In this pioneering situation, management would
naturally present a picture of a successful implementation rather than failure or difficulty in any aspect. The likelihood of misrepresentation of the events is more applicable when the respondent remains anonymous to the researcher and data is collected on a single occasion.

(d) The management of small building firms are basically craft oriented and difficulties in the interpretation of questions would be significant, particularly where unfamiliar computer industry terminology is used. On a large scale, this degree of essential interviewer participation is a very labour intensive and hence expensive approach to the investigation work.

(e) The prototype implementation strategy was considered unsuitable for discovering the socio-technical variables and organisational issues affecting small firms generally since it would concentrate on the experiences of one case study.

(f) Phenomenological studies and action research were also discounted since the degree of observation involved would be likely to prove an obstacle to the progress of the MIS development. The introspection required of the participant companies would be likely to involve much time and interpretive skills which were unlikely to be available.

5.4.2 Data Collection Techniques

Field data was collected by periodic interviews of 2-3 hours in duration with the organisation staff and management who were currently involved with the development of the microcomputer-based MIS. These
interviews were conducted by the investigator personally, at intervals of 2-4 weeks in the initial stages of selection and early implementation and at maximum every 12 weeks in the latter stages when the operation of the computer was less eventful from the investigation viewpoint. Thus, on average, detailed discussions occurred with the management and operating staff of each small construction firm on 8-12 occasions during the investigation, a total of some 300 interview hours for the entire project over a period of five years.

Some firms implemented second microcomputer systems either in replacement of earlier systems or in another area of the company's data processing operations and in such instances these were investigated individually.

By the phased enrolment of the participant companies over the study period, knowledge obtained from the earlier case studies was able to direct the research focus of the latter cases. Detailed field notes were taken during the interviews and although a general framework of topics was used for the discussions it was not considered possible or beneficial to keep strictly to the listed areas. The field notes were summarised to produce MIS diaries for each company. These are included as Appendix A through A2.

Few quantitative measures of comparison were readily available and even data collected on obvious variables such as company turnover and number of employees on the payroll varied frequently for an individual firm within the period of investigation. Appendix I was
therefore only used as a guideline to the further understanding of the organisations themselves rather than serving any purpose for reliable statistical comparisons.

The principal intention of such a loosely structured data collection technique was to reveal the most significant variables concerning events, expectations and approach adopted. As these variables were unknown at the commencement of the research project, it was not possible to design a strictly replicable interview strategy.

Since the companies acting as subjects for investigation revealed many confidential aspects of the process of computer implementation and also of the companies' business affairs themselves, a policy of using pseudonyms when referring to particular organisations has been adopted throughout this thesis.

5.5 Methodological Problems Experienced

Some problems were however encountered with the selected methodology and these are discussed below. The decision to conduct an in depth examination of several small firms undergoing the implementation of microcomputer-based MIS by means of longitudinal case studies did present some limitations.

(a) Identification of organisations

Initial location of potential firms was difficult when the microcomputer technology was relatively new and the construction industry was a reluctant user at the outset. The early participants were located by several
means, such as letters to industry journals, conferences and exhibitions. However during the course of the investigation it became easier to locate companies at this early stage as the project generated much support from interested firms.

If justice is to be done by adopting case studies, similar organisation are required in order to establish a representative sample. After the early stages of the investigation very careful selection of further participative organisations was made in the light of the characteristics of those already in the sample. The end result was a wide ranging sample of small firms including both civil engineering and building, main contractors and subcontractors from the very small to a turnover of around £3 million per annum.

(b) Role of the investigator as an advisor

The microcomputer only became available in the early 1980's and therefore the stock of expertise in selection and implementation of such systems was limited. It is unsurprising therefore that any firm, and particularly the management of small firms, may seek sources of advice or consultancy from the investigator of the process. The need for this advice is one of the important issues of the research and the investigator took great effort to record the times, areas and ways in which such support was required in order that the research should continue.

Margerison (1978) stressed the importance of advisors in organisational change in working with management and other employees to identify the key issues that need to be worked on to improve the effectiveness of any change.
He noted the difficulties with which people within organisations undertake change without external help. The investigator was continually aware of the possibility of losing objectivity by being drawn into an active role in the process being investigated. The investigator therefore made actual development deliberate attempts to be supportive rather than active when called upon by the participant companies to give advice or even act on their behalf in some situations.

(c) Hawthorne effect

Participation in the investigation could itself provide expectations of success to be reported in various forms at each interview and the danger that participant firms would manipulate the course of events so as to produce "success" was a recognised possibility and was carefully monitored (Roethisberger and Dickson 1939). The time period involved in the longitudinal case studies did provide a counteracting influence as the truth could not be hidden indefinitely. In fact the closeness of the relationship between researcher and organisation staff became a factor encouraging honesty when reporting the progress or lack of progress as often occurred.

Since a limited number of organisations were involved throughout the investigation period the sample was inevitably small. It proved quite difficult to select firms who not only had the necessary qualities of long term participation but also had similar economic and organisational profiles to those already involved.
(d) Perception of Interviewee

There are several possible sources of error derived from the use of the interviewing technique. The interviewee perception of the events and present situation may be biased or there may be a reluctance on his part to report the true impression of what occurred. Nevertheless it is hoped that the generalised hypotheses derived on the basis of a limited number of cases can be justified on the grounds that the same investigator using a consistent approach made it possible to duplicate the research.

5.6 Conclusion

The research methodology chosen was the selection of ten longitudinal case studies of small construction companies undertaking MIS development. Despite the difficulties mentioned such as researcher involvement, this was considered to be the most effective long term methodology to achieve the objective of collecting research data in this field. The difficulties can be handled by careful monitoring of the researcher role throughout. Therefore the sample of participant small companies used in the research is considered in the next section.
6.0 Summary

This section presents the organisational environment in which the research study took place. It describes how the ten participant companies were located and gives a brief outline of the structure of each company to enable some comparisons to be made. The scope of the subsequent evaluation is defined by establishing the essential MIS development activities being used as criteria for success or failure.

6.1 The Participant Companies

The grounded theory approach requirement (Glaser and Strauss 1967) was for:

a. a representative sample of small companies in the construction industry who
b. intended to establish a microcomputer-based MIS commencing earlier in the research period and
c. were willing to open their doors to a researcher by allowing open access to all necessary company decision making by frequent informal discussions.

The low level of use of microcomputers in small construction companies in 1980-81 led the researcher to seek contacts by many means. The researcher was acquainted with the initial two companies in a research/consultancy role in the early stages of the research project and subsequently made efforts to obtain the long term support effort of other similar companies through contacts in the construction industry and the professional associations. Organisations such as The Construction Industry Computing Association, The
### Table 6.1 A Profile of the Cases Study Companies

<table>
<thead>
<tr>
<th>Companies</th>
<th>A</th>
<th>B1</th>
<th>B2</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H1</th>
<th>H2</th>
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<td>0.25</td>
<td>0.75</td>
<td>1.25</td>
<td>2.25</td>
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<td>2</td>
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<td>18</td>
<td>0</td>
<td>30</td>
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<td>60</td>
<td>14</td>
<td>10</td>
<td>50</td>
<td>10</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nature of Work</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>C</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Accountancy trained staff</td>
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<td>3</td>
<td>0</td>
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<td>1</td>
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<td>y</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
<td>n</td>
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<tr>
<td>Geographical area</td>
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<td>O</td>
<td>O</td>
<td>Y</td>
<td>N</td>
<td>W</td>
<td>L</td>
<td>Y</td>
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<td>Computer Application</td>
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<td>E</td>
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<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
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</tbody>
</table>

**Key:**
- B = Building
- C = Civil Engineering
- S = Structural Fabrications
- Y = Yorkshire
- O = Oxfordshire
- N = Nottinghamshire
- W = Warwickshire
- L = Leicestershire

n = no  
y = yes

A = Accounts/payroll  
E = Estimating  
* indicates the same company
Construction Industry Training Board and The Chartered Institute of Building all assisted by publicising the project throughout the industry.

However the other eight participant companies were enrolled over the 1982-84 period with the result that the minimum participation period in the research project was two years whilst the maximum stretched to five and six years. Table 6.1a below shows the time scale involved with each organisation. A profile of the companies who participated actively in the research is shown in Table 6.2a which follows. No company had any professional computing staff.

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</tbody>
</table>

Key: SSSS = Selection Phase  
IIII = Implementation Phase  
LLLL = Live Operation Phase

Table 6.1a The Research Study Period
6.2 Background Descriptions of the Participant Companies

6.2.1 Company A

Company A was a small general building contractor, in existence since 1951 with a turnover of approximately £150,000 per annum in 1980. The company, situated in Sheffield, had gradually grown to this size and had a workforce of 10 employees. When the need for more specialist work arose the company employed subcontract labour mainly in the plumbing and electrical trades. The principal work is repair and maintenance operations for the public corporations such as the National Coal Board and Area Health Authorities. Domestic and industrial alterations and extensions and speculative high quality building development also accounted for a substantial portion of the workload. The company was a second generation business, being managed jointly by three members of one family.

The decision to introduce a computer was made with the objective of achieving adequate, consistent management information, improving the cash flow and acquiring a new image in line with the new generation of management.

6.2.2 Companies B1 and B2

Two separate occurrences of information system development in the same company on different occasions are included in the research and are referred to as Company B1 and Company B2 as they were in fact undertaken by different departmental management.

The company had been established over 100 years and in recent years had acquired other relatively small,
related companies to form a group with joint turnover of £5 million per annum. The company, which was situated in Oxford, was the largest member of the group with an individual turnover of £2 million in 1981. The company undertook work of a high quality nature, particularly the refurbishment of university colleges and general building work for both public and private clients. The majority of the work force was subcontracted labour although a basic core of around 30 employees was kept.

The company had contracted over the last 20 years to a lower operational level, which they found more stable and profitable. The administrative and contract staff, such as estimators and surveyors, represented a fairly large proportion of the employed persons for a small company, a consequence of its history and the directors' information requirements. The company had a limited memory visual record computer since the early 1970's on which payroll and financial accounts were undertaken.

The principal motivation of Company Bl in 1981 was to replace the obsolete visual record computer, which was expensive and difficult to maintain, and also to provide better management information on contract costs. Company B2 had recently replaced a visual record computer with three standalone microcomputers for the payroll and financial accounts for the group's companies when it decided to extend the use of computers in the estimating department.
6.2.3 Company C

Company C was a recently established company, having been set up in Leeds in March 1982, following the liquidation of a previous limited company. By January 1983 the company had a turnover approaching £0.25 million with 16 subcontracted employees including a small administrative staff. The company attitude was one of employee participation in the financial decisions made by the two directors, and information was generally shared with the core workforce of five employees in order to assess the profitability of each contract and the company as a whole.

The company had experienced relatively rapid growth and the local council small works department was its major client providing the vast majority of work undertaken. The work is generally small repairs and maintenance contracts.

The managing director had a commercial insurance background, prior to his involvement in the construction industry. From a beginning of spare time renovation and modernisation of property, the small company had engaged in contracting work on a similar basis but, after rapid expansion had been forced into voluntary liquidation. The management attributed their failure in this venture to a lack of business knowledge and skills rather than lack of work or poor craftsmanship. When a new limited liability company, Company C, was established to undertake the readily available work, the management felt that the enterprise should be closely managed financially whilst still operating as a small company.
The management therefore took early steps to acquire financial management skills, by taking a more positive role in the functions previously undertaken by the company accountant. This involved learning the principles of bookkeeping and derivation of management information with which the daily operation of the company could be monitored against. The management felt that the tedious tasks involved in maintaining accurate records of the jobs and client accounts provided scope for the use of a small computer but the company's accountant was not in agreement on the grounds of the company's size. The project was thus postponed but the management took steps to gain an appreciation of the use of computers in business by attending an evening Basic programming course at a local technical college.

The principal motivation in the introduction of a microcomputer was to alleviate the problem of increased paperwork involved in the administration of the small works and indirectly enable the company to grow in turnover. The management also felt that they did not wish to bring in further administrative or accounting staff in an attempt to keep overheads at a minimum.

6.2.4 Company D

The company had been established for three years in 1983 and had experienced considerable growth to reach a turnover of £0.75 million. The managing director had many years of experience as quantity surveyor whilst employed with larger companies. The major work was civil engineering contracts in the Nottinghamshire
area, for public authority bodies, such as the Area Health Authority and the Education Authority, and also for many large corporations such as breweries. Some small works, mainly repairs and maintenance were also undertaken.

The principal motive for computing was the rapid growth experienced since the company's formation which had caused the accounting functions to be problematic. Three office staff were employed in addition to those contract-based employees, who numbered 18 in 1983.

6.2.5 Company E

The company's contracts involved both small civil engineering and building works to a value of £1.25 million in 1984. Company E was established in 1980 and experienced rapid growth, being part of a larger group of building companies. The company employed a small administrative and contracts management staff but no workforce, satisfying all labour requirements by subcontract labour.

The decision to introduce a computer was based on the need for more up-to-date information and a desire to be less dependent on the accountancy services of their parent company. Rapid growth in the field of civil engineering during a general period of recession meant that the costs incurred on the contracts was vitally important to the continued profitability of the company. The company had no staff who had any experience in the management or financial accounting functions and the invoices and other source documents were sent to the parent company, who acted as a bureau.
providing both accounting and computer facilities. The management information was returned to the company after a period of three to four weeks during which time the company had no source of information for management.

6.2.6 Company F

The company was a small civil engineering and road surfacing contractor with a turnover of £2.25 million per annum. It normally acted as a subcontractor to other contractors and the work undertaken is highly plant intensive, the normal job lasting for only a few days. Material costs accounted for a very high proportion of the total costs and hence the company felt in 1980 that the control of supplier and customer accounts was a high priority and subsequently installed a microcomputer.

The purchase of the first system was made almost as an impulse buy. The computer hardware was initially purchased from the nearest local supplier of computers on the recommendation of the director's local garage and then the company subsequently looked for programs to run. They looked to the hardware supplier to meet this need but discussions concerning the facilities of the general software revealed that the company's requirements were rather different. The supplier was a very small local software house, who agreed to tailor a system for the subcontractor. With a considerable amount of perseverance on behalf of both parties a solution was achieved which appeared to meet the needs of the company.
Four years of operation of the system led to the many difficulties. The lack of operator time available on the present microcomputer and a mistrust of the integrity of information being provided by the system (due to input errors not being trapped by software) were the main difficulties. The lack of management information also suggested the system was suffering from inadequate capacity, traceable to the software system structure and also hardware limitations.

The decision to consider the introduction of a new system to replace the original microcomputer was made when the company was visited by a local company who were themselves considering becoming a first time user.

6.2.7 Company G

The company was a very small organisation with a sole managing director having been formed in 1982. General building contracting was undertaken with no particular specialities other than serving a particular local industrial area of a radius of approximately 10 miles. The turnover was £100,000 per annum in 1983. Two large clients provided a substantial amount of the company's work load.

The company employed no direct employees and subcontracts all its labour requirements on a labour only basis. The computer was acquired in the belief that it would alleviate some of the administrative problems of an expanding company and enable the owner to concentrate on the management of contracts.
6.2.8 Companies H1 and H2

Two separate occurrences of information system development in the same company on different occasions are included in the research and are referred to as Company H1 and Company H2. In Company H2 the MIS implementation was attempted to be established in two subsidiary companies (H2a and H2b) simultaneously. The two latter instances of implementation will be treated together in the research evaluation.

Company H1 was involved in the construction of steel fabrications for the civil engineering and building contractors and had a turnover of £2 million in 1984 with a workforce of 30 employees. The company had previous computing experience using a bureau service for the design of steel structures and also had two microcomputers for administrative file handling functions. An expensive and sophisticated small mini computer had been acquired in 1982 to run a design and draughting package.

The principal motivation for both MIS implementations undertaken during the period of research was the replacement of an unsuitable system for accounting functions and the provision of management information regarding costing of the contracts undertaken.

6.3 Evaluation and Analysis of Case Study Experience

The data collected was characteristically qualitative and related primarily to the context and developmental process by which each company introduced the information system are summarised in the Appendix A through H2. Each company
management was asked to discuss their plans, objectives, achievements, non-achievements and problems experienced over the previous period and management and staff views were summarised in a diary format for later evaluation by the researcher.

Data was gathered on all aspects of the introduction of the management information system in each small organisation, without any artificial boundaries being imposed on the content. The purpose was to construct the richest picture of the process of introducing information technology in small companies. From the mass of qualitative data collected the research raises several significant issues surrounding the organisational context and the system development process and puts forward suggestions in Part Twelve as to how changes in the process would secure a more successful outcome for the small organisation.

Discussion was initiated around the contextual environmental conditions of the business, under which the process of technological change was occurring. The progress to date was recorded and management explained the nature and extent of the problems experienced. The management also expressed their detailed plans and aspirations with regard to undertaking each functional stage.

6.4 Criteria for Evaluation

The process of information system development lasted from between one and five years and was divided into three phases for subsequent analysis. These phases of activity were as follows:

1. Selection phase
2. Implementation phase
3. Live operation phase
Companies

A B1 B2 C D E F G H I

SELECTION
a: Determination of requirements:
   - identification of problem area and system objectives
   - assessment of mandatory and desirable information needs
   - sizing of data storage
b: Selection of system:
   - location of potential systems
   - evaluation of alternatives
   - negotiation with supplier
   - selection time
   (in relation to plan)

SELECTION JUDGEMENT

IMPLEMENTATION
a: Installation of system
b: Implementation time
   (in relation to plan)
c: Training:
   - general system appreciation
   - routine operating skills
   - non-routine operating skills
d: System conversion:
   - data capture/encoding
   - master/library file creation
   - establishment of working system
e: System testing:
   - trial processing
   - reconciliation with requirements

IMPLEMENTATION JUDGEMENT

LIVE OPERATION
a: Abandonment of former system
b: Evaluation/tuning of system operation
c: Management use of information
d: Enhancement of system facilities

LIVE OPERATION JUDGEMENT

OVERALL PROJECT JUDGEMENT

Key
S = successfully achieved / undertaken well
R = relatively successful
U = unsuccessful / badly undertaken

Table 6.4a A Template for Evaluation of Functional Stages in the MIS Implementation
6.5 Conclusion

The research environment is thus ten small construction companies and qualitative data was collected in a longitudinal manner from the time of the initial management decision to investigate the possibility of developing a microcomputer-based MIS through to its live operation or abandonment. The data collected was used to assess the degree of success or failure on the basis of several criteria within each development phase. The next three parts provide the detailed evaluation of the company experiences in turn.
7.0 Summary

This section covers the research evaluation of the initial activities of MIS development which are defined as the Selection Phase. The criteria for the evaluation of success or failure of the companies are first established. Each selection phase activity of the ten small companies are then evaluated in turn by the researcher, together with the underlying reasons for the judgement.

7.1 Analysis and Evaluation of the Selection Phase

Carter and Silverman (1980) state that:

"The need to make a decision triggers a demand for information. If the information can be obtained from an existing data bank, the information requirements determine how the data must be transformed in order to satisfy the demand. If not, new data requirements are determined and data are collected from the appropriate data sources".

(Carter and Silverman 1980 p. 17).

They further suggest that a systematic approach on behalf of organisation management would be to first establish the managers' goals and objectives.

"Since we know how important accurate and timely information is for effective decision making, the establishment of the organisation needs for information enables us to design a system which will efficiently meet these requirements".

(Ibid p. 17).

Ten companies commenced the MIS development process by management decision activity to investigate the feasibility of introducing a microcomputer-based MIS to meet a perceived need. The activities undertaken leading up to the actual installation of the system were seen to comprise the
Selection Phase of the process. The performance, experiences and achievements in these activities were then evaluated with regard to success as follows:

a: Determination of requirements — The evaluation criteria were as follows. Initially the extent and ease with which the information problem area was identified by management and consequent objectives set for the new system to meet. Secondly the assessment of mandatory and desirable information and system needs as a template for the evaluation of alternative systems was considered. Finally the extent and ease by which the company assessed its computing requirements by undertaking a sizing exercise.

b: Selection of a system — Evaluation criteria were as follows. The extent and ease of the search for potentially suitable commercial systems and the resultant evaluation between alternative systems located: The negotiations with suppliers of systems also contributed to the overall degree of success in the selection phase. The closeness of fit between the selection activities planned and those actually achieved were finally made an evaluation criteria for success.

7.2 Company A

A summarised diary of Company A's experiences in the selection phase provides details of the experiences and may be found in Appendix A.

7.2.1 Selection Phase

Company A expressed its objectives for introducing a microcomputer-based MIS very precisely, showing much
thought concerning the nature of management information required. Management were able to clearly identify the business requirements and hence the nature of the supporting information system. However the procedure by which Company A was then able to locate alternative microcomputer software package systems and select a suitable solution to meet their needs was less well achieved.

A lengthy period of almost a year was taken to establish the feasibility of introducing a microcomputer, formalising needs and selecting a means by which these could be fulfilled. A further year elapsed whilst the software development was undertaken by a collaborative supplier.

The overall selection phase for company was thus considered to be REASONABLY SUCCESSFUL.

7.2.2 Reasons for Judgement

(a) Determination of Requirements: Successful

The company was principally managed by one management-oriented, highly motivated director, although supported positively by his craft-based co-directors. He possessed a clear vision of the company's future, although possessed no personal computing skills. As managing director and principal estimator for the organisation, this person was engaged in considerable boundary spanning activities (Dollinger 1984), concerning strategic planning and the daily operations and control of the company.

The introduction of a microcomputer MIS to support this future was identified as critical, if the company was to meet the envisaged needs of the local construction market.
A detailed specification of functional requirements was established early in the feasibility considerations, even before viewing the accounting packages. This information was however not formally recorded and hence unavailable for further management reference at a later date.

The necessary skills and knowledge to undertake the detailed evaluation of needs was an area of severe weakness in the company. Involvement with an outside provider of expertise from an early stage had a considerable influential effect on the way in which the company achieved the desired information system. This outside advisor conducted a limited search for commercial packaged software within the vertical market of the construction industry but provided valuable technical knowledge of the unsuitability of a potential package solution due to future compatibility problems. The company did seek information from within their own area of industrial expertise but were faced with opinions of inapplicability and inexperience of computing in small construction companies from the professional bodies concerned.

The influence of the outside advisor was also significant in the choice of the means of achieving the MIS requirements. A bespoke system development option is hazardous for most organisations who have at their disposal a wide range of technical, operational and management skills but the resources of Company A was inadequate in quality and quantity. The high risk of pitfalls, particularly in view of the lack of computing experience of the management, were not acknowledged at the outset. The management's operational experience of
designing and constructing building projects was evidently carried through into the information system field without any deep consideration of potential problems.

(b) **Selection of System**: Reasonably Successful

The time and cost of diverting management attention to facing detailed system specification problems has the possible advantage of prompting an early and high level of management and user involvement and therefore company identification with the system. In this way a clear understanding of the nature of the system's operation and scope is derived. However, problems of computer hardware selection in 1980-81, when clear technical standards had not been established by the market leaders, the time scale of the project and the extra burden of supporting the old system were also unappreciated at the outset by Company A. The application of microcomputer systems by small building firms was very much in its infancy in 1980-81 and Company A suffered many of the problems of a pathfinder using an emerging technology.

The bespoke system mode of MIS development relies heavily on the management skills of planning and controlling the project, analytical skills of determining a viable solution to the company's needs, technical skills on being able to achieve the solution and operational skills of being able implement the planned system. The choice of collaboration system development also presented Company A with the possibility of conflicting objectives at some stage, as happens when what is profitable to the software house is not operationally desirable for the company. A new area of boundary activity was thus established which had to compete with all the other necessary activities of
the company and the owner/manager concerned.

3 Company Bl

A summarised diary of Company Bl's experiences in the selection phase provide details of the experiences and may be found in Appendix Bl.

7.3.1 Selection Phase

Company Bl was able to define its objectives for introducing the microcomputer-based information system with some confidence although the management did not formally document such decisions. The determination of requirements was based on a previous MIS with only small extension of facilities and was achieved reasonably well by management within the company and without any outside assistance. The search for a suitable MIS from those alternatives identified was on the whole successfully achieved, if limited in scope, although some problems were overcome to achieve the selection phase according to plan.

The overall selection phase of Company Bl was considered SUCCESSFUL.

7.3.2 Reasons for Judgement

(a) Determination of Requirements: Reasonably Successful

The maturity and previous experience of Company Bl was a considerable influence in providing the current management with the necessary skills and knowledge to identify the company information needs and select a suitable solution to meet those needs. Having been a much larger organisation prior to the onset of the recent economic recession, Company Bl still had some considerable degree of administrative slack to enable valuable time to be
provided by a senior management person and a bookkeeper. These individuals had both professional qualifications and lengthy experience in the accountancy field in which they sought a MIS. Previous computer system experience, albeit on an early generation of visual record equipment, and detailed operational skills of handling data and providing information for management were significant factors with regards to a successful MIS project in this phase.

There was a clear economic motivation for system development in 1981 at this point, as Company Bl was unable to operationally maintain its present hardware any longer. Management were able to explain the company objectives for the new information system to suppliers, on the basis of experience over a number of years as a larger company with an established and structured administrative system.

The possibility of meeting the need by a minicomputer with several terminals was considered but discounted on both economic and operational grounds since the company had several small companies within the group to cater for. The selection of the microcomputer system as a feasible solution was not unproblematic but the company's clear philosophy of support, software, system, in that order of priority, had been derived from earlier experience.

(b) Selection of System: Successful

In spite of this environment Company Bl's management still felt a serious lack of control over events when their contact with the computing suppliers was assessed. They were concerned about the lack of ability to thoroughly test the performance of a package in the demonstration conditions. The degree of mistrust of the claims of
software suppliers was considerable, as they felt in a weak bargaining position, having only a little computing-related experience, minimal knowledge of the extent of application of microcomputer technology to construction industry applications, and knowledge of some of the possible pitfalls of an inappropriate choice from the experience of neighbouring larger firms.

The selection procedure was deliberately slow and as thorough as possible. They were prepared to release senior management (but not at director level) to undertake the task of evaluation of any packages which they were able to locate and took several months of deep consideration over the problem. During this period Company Bl felt the need to contact an outside advisor, whom they felt to be independent of the system suppliers. This was additional evidence that the future relationship of trust between the company and the supplier was seen to be critical. The outside advisor provided information on which suppliers to locate. However the company did not completely rely on the skills of the outside advisor but, worked in liaison, making their own decisions in the light of the advice of this advisor.

The financial accounting/costing package itself was evaluated against some established mandatory requirements of the company, which they had been able to formulate from the experience of a very simple and restricted processing capability of early generation of software. The exact function of the previous software had been difficult to define some years before, when it had been purpose written for the company, then much larger in size. The limitations of this previous system (e.g. lack of costing
information, non-integration and repetition of input) were consequently seen as the mandatory requirements of the new system. However the company had moulded it's data processing requirements to those minimum necessary functions to support operations with the outside world and thus had a fairly simple overall requirement for the new system to meet. Their concern was to minimise complexity and therefore enable less skilled staff to operate the system. This philosophy of a simple system using simple technology gave more support to the emphasis of supplier support as a criterion for judgement.

During the selection phase Company B1 entered into negotiations with a supplier of a potentially suitable system but mistrust of the claims of the sales staff caused them to withdraw, later to find the company had gone into liquidation soon after. The selected supplier was based in London but it was felt that there was sufficient internal expertise of the normal data processing cycle not to need extensive training on the operation of the system. Telephone support provided by well qualified and knowledgeable staff in the software house, itself relatively small and growing, was judged essential.

In summary, although the company embarked on the project at a time when the market for application packages for the construction industry was in it’s infancy, the environment and system requirements were such that this stage was successful in identifying and meeting the need without significant problems.
A summarised diary of Company B2's experiences in the selection phase provides details of the experiences and may be found in Appendix B2.

7.4.1 Selection Phase

Company B2 was able to approach the selection phase well experienced in the functions required to achieve a satisfactory result for management concerned. Objectives for the introduction of the system were clearly established and the company engaged the assistance of an outside advisor in determining the feasibility and functionally specifying the desired system. The selection of the actual MIS was however slightly less straightforward and took longer than was anticipated thoroughly undertake the evaluation and select a system.

Overall the company was able to progress through this stage with some degree of confidence and was thus considered to be SUCCESSFUL.

7.4.3 Reasons for Judgement

(a) Determination of Requirements: Successful

The same senior management (as in Company B1) decided to extend the use of computing within the company, two years after the financial applications had become operational. The problem area where the new MIS was to be established was however not traditionally associated with computing. Even in large contracting companies computer-aided estimating had for some time been seen to be uneconomic, as the basic information is continually changing with price fluctuations and competitive situation and also the relatively low usage rate of the stored information, since
very few tenders priced were awarded to the company. This belief, by the estimating profession, has long prevented the extensive use of computing until the advent of the microcomputer in the early 1980's.

In Company B1 however, the top management had reaped the benefits of microcomputer technology in the form of lower administration costs and much improved management information and looked to the new area with similar objectives in mind. There was very little involvement with the estimating management when considering the feasibility of such a system. The estimator was actually consulted once the decision had been made to investigate the available commercial systems but there was little personal involvement in the venture.

Company B1 looked to an outside advisor to provide both skills and knowledge in identifying requirements of a proposed system, since no suitable experience was on hand from within the company, and also in selecting the most appropriate mode of achieving this information system. Although the feasibility aspects were seriously considered by the outside advisor, the management had made a decision in principal in favour of the application, needing only confirmation of this belief. When engaged in establishing the requirements of the system, the outside advisor found it very difficult to persuade the chief estimator to spend sufficient time to participate fully in the future system design. Great reliance was made on the specialist knowledge of the outside advisor to make detailed requirements specification.

(b) Selection of System: Successful

When deciding on whether to buy a packaged solution or
write a bespoke system as a means of satisfying this
information need the management delegated entirely the
responsibility to the outside advisor. Company B2 was in
a pathfinder position and found few developed software
packages although many were in a partial state of
development. Nevertheless these packages were being
positively marketed by the suppliers. Awareness of a
rapidly changing market in turn led the management of
Company B2 to rely upon the outside advisor to guide them.
Similar dangers lay ahead to those of Company A, as
previously described, who also chose the mode of
collaborative development with a software house when faced
with a sparse market for established software packages.

There was very little participation in the design of the
system by the estimating department management and
consequently, an early partnership and opportunity for
identification with the new system was lost. Throughout
this period the estimating department was extremely busy
and found the demands of the supplier design staff for
time and effort were difficult to meet. Eventually the
supplier conducted their negotiations with top management
rather than the departmental staff.

The overall evaluation was that the company was reasonably
successful despite a delay in the selection of a system to
meet their needs.
Company C

A summarised diary of Company C's experiences in the selection phase provides details of the experiences and may be found in Appendix C.

7.4.1 Selection Phase

Company C was also able to select a MIS with the assistance of an outside advisor in the time period anticipated and planned for by management. The weakness in this phase was in the inadequate identification of system objectives established by the company and a superficial determination of information requirements. Company C did however anticipate some degree of expansion of needs, in their decision on the hard disk microcomputer at the early stage of computerisation.

On balance the company was thus considered to be REASONABLY SUCCESSFUL overall in the selection phase in view of the lack of clarity in the determination of requirements.

7.4.2 Reasons for Judgement

(a) Determination of Requirements: Unsuccessful

Company C had some difficulty in determining the requirements of the MIS, although management views were of a smooth operation achieved on time and to their satisfaction. The management experience of a previous company liquidation problems had prompted the adoption of a philosophy of employee participation in decision-making and full communication of management strategy. Committed to expansion in a positive and planned manner, the company recognised the existence of major administrative problems associated with the primary market which they sought to
meet in the area, that is the local government contracts for small works and maintenance. The problem of voluminous paperwork in relation to the turnover of the work would only be administered profitably if extra skilled accounting staff or a computer based-system was installed. However the management strategy was to remain a small organisation in administrative terms whilst achieving the desired overall growth.

The company management recognised the opportunity to efficiently respond to a volatile market situation by being able to keep tight control over the cash flow. This was to be achieved by means of debtor control and accurate and up to date costing of the construction work, however small the job. The general business background of the owner/manager was significant, in recognising a need for advice and guidance regarding the overall company strategy and, in particular in regard to the consideration of feasibility and installation of a selected microcomputer system. Company C sought assistance from an outside advisor in the form of a consultant in the unknown field of construction industry computing. An informal team of management consultant, computing consultant and owner/manager were then able to address the problem of feasibility and selection of a suitable computer system.

The question of problem area recognition was discussed by the owner/manager with the computing consultant, but attention was misdirected to the problem area of job costing, only a symptom of the real problem which lay with the management of the applications for payment to the local authority on the basis of work done to an agreed contract. The consultant advised on the possibility of
solving the costing problem with a construction industry accounting and costing package which were appearing on the market at the time.

(b) Selection of System: Reasonably Successful

The consultant's solution-oriented approach to his assignment was further encouraged by the owner/manager, who totally delegated the search and selection of the package on the belief that technology involved was both unfamiliar and complex. Little time was taken to evaluate alternative software packages, only a single demonstration of operation was used to match with weakly defined requirements. The consultant reduced the risk of his client however, by recommending established and well tested technology of a major US manufacturer in a market, which was cluttered with obscure names in micro-technology.

Pressure to make progress with the cash flow control was a constant incentive to implement change in the small company throughout the summer period of 1983, when local authority departments were themselves operating under reduced finances. Company C were eager to delegate the extra tasks of selecting a system and responded quickly to the supplier proposals to make a firm contract. The only person, who had interest but was not involved in the project, was the company accountant. He belonged to a conservative organisation, who had previously voiced their concern on the wisdom of the project in the case of such a small organisation.

In meeting the objective of identifying the problem within the organisation, Company C appears to have been only
partially successful due to the solution-oriented approach of the outside advisor and hence they could only be evaluated as REASONABLY SUCCESSFUL in the selection phase.

7.6 Company D

A summarised diary of Company D's experiences in the selection phase provide details of the experiences and may be found in Appendix D.

7.5.1 Selection Phase

Company D failed to identify its specific problems areas and made very little attempt to make decisions on the objectives of the new information system. Some attention was given however to the sizing of the requirements for data storage in view of the plans for growth of the company. The selection process was also hindered at several stages in progress when the company had difficulties in locating systems and evaluating those found. However, the management of Company D found that the period concerned was lengthy this was expected in view of the lack of previous experience.

In view of these difficulties in selecting a system the verdict was that the Company D was REASONABLY SUCCESSFUL in this phase.

7.5.2 Reasons for Judgement

(a) Determination of Requirements: Unsuccessful

The management expertise in Company D, based on large organisation experience, influenced the manner in which the company identified their need for a computer system and then sought a means to satisfy that need. The premise that growth requires a computer-based solution to their
current accounting problems stems from the previous limited knowledge of the directors in computer-based systems within larger organisations, where they were users of management information provided.

The directors recognised their organisational inability to identify the detailed requirements and find a suitable MIS without devoting a great deal of time and resources which they could not afford to do. The company thus chose to employ the skills and knowledge of an outsider advisor. This venture was only partially successful, as the outside advisor proved to have only general business systems knowledge, which was insufficient when the special needs of the construction industry accounting practices became formally recognised. Company D management did however build up some of their own skills and knowledge with regard to clearly defining their requirements, by participating in the joint search for a suitable system. Much time was misused by not recognising the applicability of the vertical market although the company directors were able to firm up their true requirements.

(b) Selection of System: Reasonably Successful

Once left to their own resources, the company were only able to make a limited market search for specialist software, as time and planned implementation deadlines were approaching rapidly. They sought assistance from the construction industry employer's federation to which they belonged, but found that there was still much effort required in evaluating the leads given. The initial contact with, and subsequent meeting with the suppliers, proved to be the critical factor in making a decision in favour of one particular system. The adoption of large
company practices, even within the small organisation environment led the management to define their requirements to a high degree of specialism, insisting on several areas of sophisticated performance, rather than make adjustments within their own system requirements in order to secure a system at an acceptable price. This policy severely reduced the options open to the company.

When evaluating potential systems, the contact with the supplier for the purpose of demonstrations proved critical. Thus the supplier who was able to provide most assistance in providing the knowledge necessary, was accepted more readily than a company who employed professional salesmen with little system details knowledge. Company D strove to be able to establish a model of the offered system to be able to match with their established requirements. The system publicity literature was important in Company D, since there were difficulties in knowing the appropriate questions to ask.

The company was reasonably successful in identifying what they considered their needs were although these were set at such a sophisticated level that many implementation problems later followed.

7.7 **Company E**

A summarised diary of Company E's experiences in the selection phase provides details of the experiences and may be found in Appendix E.

7.7.1 **Selection Phase**

Company E's only real problems in the selection of a suitable microcomputer-based MIS was in the ability to
evaluate the alternative systems identified by the outside advisor. All other tasks were undertaken by the outside advisors of the company and, in that sense successful since progress was made within the planned time available.

The overall assessment of Company E's performance in the selection phase was SUCCESSFUL.

7.7.2 Reasons for Judgement

(a) Determination of Requirements: Successful

Company E was considered successful in defining their MIS requirements and also in selecting a suitable computer system, in spite of some potentially detrimental factors being involved. The company was a new and progressive organisation, which operated within a structure of a group of established similar companies. The very rapid growth of the company produced a real need for timely and accurate management information on the costs of work undertaken, and also on the company's relative position with its creditors and debtors in order to control the critical cash flow.

The company had no long standing reputation to build on, but was concerned with the establishment of such a reputation, principally through management skills and quality of work. The size of the civil engineering contracts being undertaken was relatively large, compared to the company's turnover, but the directors concerned in the organisational change were engaged in many activities of a supervisory nature which spanned and interfaced with a wide range of individuals.

The role of the outside advisor in any organisational
change was firmly established prior to the computer system project. Support was readily on hand from the group accountant, who had detailed experience of providing financial reports for the company.

Internally there was very little administrative slack in the administrative operations of Company E, which could be used to meet the demands of contract management for timely accurate information. The option of bringing the information system into the direct control of the organisation was the only option available, if the company was to meet planned growth targets and project a dynamic company image.

The definition of system requirements proved to be problematic in some ways, since there were no computing skills or systems experience whatever within the firm. However these qualities were available in some aspects from the group accountant, but no source was available in the area of contract management information in the civil engineering field. The two directors, who would have been able to establish such requirements, had little time to spare and had no experience of the benefits any MIS could offer.

The system required was construction industry specific, since the company practice of engaging subcontract labour in preference to maintaining a direct labour force led to complex financial procedures, a fact recognised at an early stage by the company.

(b) Selection of System: Successful
Company E had initial problems of locating a suitable system but was assisted by management's attendance at a
construction industry conference organised by a trade organisation. This was extremely fortuitous as the directors appeared not to have undertaken any systematic search prior to this event. The inappropriateness of the content of such a seminar was the principal concern of Company E management but they were fortunate in the presentation of a small firm viewpoint by one of the speakers. The large firm orientation of the seminar, with relatively little understanding of the problems of the small firm, formed in the minds of the directors a commitment to engage the skills of someone experienced in both small construction firms and computers systems.

Company E was fortunate in this phase since all responsibility for the direction and nature of this change was delegated in good faith to the consultant and the group accountant. The lack of real participation, by either management or operational staff, had potential repercussions, in that no internal expertise was built up and the company risked its long term operations on the skills and integrity of the outside advisor. The pressured environment of the small firm management was the principal reason for the adoption of such a high risk strategy. A larger company could no doubt have secured the resources to free management and staff to participate.

7.8 Company F

A summarised diary of Company F's experiences in the selection phase provide details of the experiences and may be found in Appendix F.

7.8.1 Selection Phase

Company F was able to define the problem area and
consequent objectives of the new MIS because their existing microcomputer system acts as a baseline for establishing requirements. Recognition of the need for expert knowledge in an emerging technological field led them to liaise with an outside advisor to achieve a clearly defined statement of requirements.

External factors were the principal reason for an unsuccessful search for a suitable solution to meet those information needs. In view of the suspension of the project after nine months of effort the selection phase was considered to be UNSUCCESSFUL.

7.8.2 Reasons for Judgement

(a) Determination of Requirements: Reasonably Successful

Company F was a second-time computer user seeking a replacement system, with therefore considerable experience from which to benefit in the selection phase. There were notably the established business procedures within the organisation which had been built up over a period of over three years whilst using the first computer. Routines for capturing the necessary data for the software, methods of validating data and systems for maintaining control had been recognised as high priority in assessing the suitability of any proposed system.

Company F had created considerable computing and business experience within the operations staff who were able to be active participants in the selection of the replacement system. The management emphasised the importance of information to the ultimate success of the company and had clear ideas of the content and frequency of management reporting which they desired. This information-oriented
management style was fundamentally derived from the earlier experience of the process of computer-induced organisational change and also the contracted-in skills of the outside accountant, rather than the background of the managing director, himself who was craft-oriented. The accountant acted throughout at a similar authority level to the director but without the associated entrepreneurial commitment or risk. The company was thus in a strong position to be able to define their needs clearly and accurately to any system supplier.

(b) **Selection of System: Unsuccessful**

The environmental and organisational context, in which the selection process in Company F took place, was unfavourable since the company suffered serious cash flow problems associated with rapid growth at a time when the rest of the construction industry was experiencing severe economic depression. The progress of material operations of the company workforce was entirely controlled by the weather, and a period of severe cold and snow prevented work being undertaken, even though the order book was healthy. There was little scope for extra work in the administration section as the staff were constantly under pressure from the inadequacies of the old system to cope with the increasing demands for timely information by the management.

In this situation of pressure for a new management information system, a clear understanding of what was required but little time to seek out a solution to the problem, the company sought outside advice from a specialist consultant. This deliberate attempt to maximise on their own experience of system requirements
and also the market knowledge of the consultant appeared to be the only way of implementing a new system without making the same mistakes at on the first occasion. The management recognised the dangers of engaging someone unsuitable and took this into account when engaging someone known to have undertaken a very similar project for a neighbouring company very recently.

The slow progress of selection was influenced by the severe shortage of time by management and complete trust was placed in the integrity of the outside advisor. This was evident when the management decided that they would only spare the time to see demonstrated a system already recommended as suitable by the advisor. The director himself chose to delegate the system choice to the advisor, provided the accountant (also an outsider) and his operational staff were satisfied of the operational feasibility. At no time did the director himself attempt to acquire any skills and knowledge of the systems being proposed, since he was extremely busy with boundary spanning activities of the small firm entrepreneur, such as client discussions, supplier handling, dealing with public bodies.

7.9 Company G

A summarised diary of Company G's experiences in the selection phase provides details of the experiences and may be found in Appendix G.

7.9.1 Selection Phase

Company G had several problems in the selection phase which stemmed from the initial failure to establish the
objectives of the system. Without any spare resources or
time, the selection from identified alternatives was
superficially undertaken and the decision was made in a
quick response to the supplier rather than the
appropriateness of the system.

The selection phase was thus relatively UNSUCCESSFUL for
the company.

7.8.2 Reasons for Judgement

(a) Determination of Requirements: Unsuccessful

The very small size of Company G was the overall
environmental factor influencing the process of selection.
The company had only the manpower resources of the
owner/manager, with which to search for a suitable system
and install it, although the original intention was to
engage the assistance of the director's wife to operate
the system once established.

The decision to install a computer appears to have been
made, not on genuine or perceived needs (as would be
indicated by administrative problems), but more a general
feeling on the part of the proprietor, that companies such
as his were being left behind in the much publicised
"information technology revolution". The absence of any
initial measures of effectiveness by which the success or
failure of the system could be later judged, left the
owner/manager without any target with which to measure
achievement when project progress needed to be assessed.

The recent professional education of the proprietor, and
the youth of the company itself, were contributory factors
in the manner in which the system was searched for.
Recognising the specialist requirements of the
construction industry and believing many other small companies had already incorporated computing into efficient administration, the proprietor sought specialist systems within the construction industry itself.

(b) **Selection of System: Unsuccessful**

A limited search, at a national building exhibition featuring computing companies, provided some leads but it is evident that the lack of time and knowledge prevented the entrepreneur from making a detailed evaluation of the system on the basis of demonstrations. Instead the decision was made after a brief evaluation of hardware and software supplied by a local dealer. Great importance was attached to the supplier's small size, proximity, credibility and professional integrity and experience of the individual with whom contact was made. Much reliance was placed on the system literature, provided since the selection of the system to be viewed working was made on the written literature of one supplier, and the published experiences of a small firm in a professional journal, subscribed to by the entrepreneur.

The company appears to have been very exposed to the media surrounding the market for small business computer systems.

7.10 **Company H1**

A summarised diary of Company H1's experiences in the selection phase provides details of the experiences and may be found in Appendix H1.

7.10.1 **Selection Phase**

Company H1 was reasonably successful in identifying the
problem area although management did not feel the need to formally specify either the objectives of the desired system nor consider the features required in the new information system. The overall assessment of the company endeavours in the selection phase was thus UNSUCCESSFUL from the researcher's viewpoint.

7.10.2 Reasons for Judgement

(a) Determination of Requirements: Reasonably Successful

As Company H1 was an established business, similar in size to Company B1, with associated administrative support, the introduction of a computerised MIS was considered as a natural progression in line with the overall growth of the company. Mainly large structural steel contracts were undertaken, which required continual flow of drawings from the draughtsmen who were gradually accepting the computer-produced output. There is some evidence of early staff resistance but the director, who had been responsible for its introduction, personally trained and promoted the use of the system. This experience of initial resistance being overcome by personal involvement, was adopted as a recipe for eventual success and acceptance of any new computer system by the staff.

The same director was not by background management-oriented in any professional sense since his entrepreneurial experience was in the dairy farming industry. However the move into the structural steel fabrications business generated an area of considerable management skill and expertise particularly in the director.

The office environment, into which the new system was to
be installed, was most favourable since there had been some early use of microcomputers for payroll and materials listings. Hardware was therefore readily available for the company to simply add another application to the same type of machine. Having established business relations with a local computer dealer, the company did not feel it necessary to formalise the next phase of the overall organisational change and, in line with previous negotiations with the dealer, a discussion of a "problem of keeping up to date with accounts" naturally led to the promotion of software supplied by that company.

(b) Selection of System: Unsuccessful

The approach to selection of the new accounting system was to "try it and see if it works" by installing the proposed system on a pilot basis. Whilst this selection approach may be appropriate for capital equipment acquisitions where the suitability can be independently assessed fairly rapidly, the technique does not take into account the high investment costs of MIS implementation. The benefits are not likely to accrue until the company has operated the system for some period, by which time it may be too late to abandon in view of the human investment involved in this evaluation procedure.

The only staff involved in the initial MIS selection was the director himself, who formed the judgement of suitability of the system, on the basis of a single sales demonstration on site. There was no involvement of the other working directors, a likely detrimental factor in the long term success of the system, since their commitment could not be counted upon to support the installation and use of the management information system.
generated. The case of company H1 was clearly one of a computer enthusiast in a position to instigate a considerable degree of technical and organisational change without the support of other senior management.

There appears to have been no clear definition of information requirements prior to the demonstration by the local supplier, in spite of the known complexities of the industry's relationship with clients and subcontractors. The speed of processing operations was the priority criterion by which the system was judged, a problematic situation which itself was open to misinterpretation, since the demonstration of systems are normally based on the restricted size data files with associated high response rates to user enquiry. Company H1's previous experience within the minicomputer field generated expectations of comparable support levels and training programmes to be provided.

11 Company H2

A summarised diary of Company H2's experiences in the selection phase provide details of the experiences and may be found in Appendix H2.

7.11.1 Selection Phase

Company H2 (Company H1 at a later date) was more precise in the determination of requirements in this case. In particular they were able to draw on recent experience to identify information needs with some degree of precision. Careful attention was also paid to the sizing of the needs for data storage. The company was well equipped to search for potential systems and in spite of the isolation of the
decision to one area of management the researcher assessment was of a REASONABLY SUCCESSFUL phase.

7.11.2 Reasons for Judgement

(a) Determination of Requirements: Successful

The importance of carefully defining the system requirements was established on the basis of Company H2's previously unsuccessful MIS experience. On the second occasion in a year, the management decided to formalise the procedure in many ways on the basis of this experience, and considerable attention was given to checking out suppliers on details such as the length of time the dealers have been in business. Support was assigned a very high priority both in the written documentation, the proximity of the supplier and the extent of user training and advice being provided with the system. Certain technical criteria for selection of both hardware and software were now able to be established as Company H2 already had a base system with which to compare the speed and nature of the operations.

(b) Selection of System: Reasonably Successful

The environment had some administrative slack since the company had maintained the staffing levels of the original manual system. In addition to this a student with a high skill level in general computing had been employed to assist the director in the search for a new system. They tried to adopt a prototype technique once a potential system had been identified and purchased the system on a trial basis. However the necessary commitment level for this strategy was not company wide and if this is to be success firm support needed from within.
Companies
A B1 B2 C D E F G H1 H2

SELECTION

a: Determination
of requirements:

- identification of problem area and system objectives
- assessment of mandatory and desirable information needs
- sizing of data storage

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b: Selection of system:

- location of potential systems
- evaluation of alternatives
- negotiation with supplier
- selection time (in relation to plan)

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Key
S = successfully achieved / undertaken well
R = relatively successful
U = unsuccessful / badly undertaken

Table 7.12a Functional Activities of the Selection Phase

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7.12 Conclusion

The results of the selection phase activities of the ten small companies are collected together in Table 7.12a, shown opposite. Since only three companies were considered overall successful it is clear that the selection of a suitable MIS to meet the needs of a particular small company's problems was not a troublefree operation. Most difficulty appears to have been experienced in the tasks identification of the problem area for which a MIS was desired, establishing the systems' objectives and evaluating alternative modes of MIS development and alternative MIS solutions. Only one company (Company F) failed to proceed any further, having not been able to achieve any success in the selection phase. Two other companies were unsuccessful in their selection activities but nevertheless proceeded to the implementation phase. A similar structure is used for the evaluation of the implementation activities of the nine remaining small companies follows in Part Eight.
PART EIGHT THE IMPLEMENTATION PHASE

8.0 Summary

This section covers the evaluation of the implementation phase activities contributing to the development of the MIS in the small construction companies. Initially the criteria for evaluation are established. Each implementation phase activity, undertaken by the nine small companies reaching this stage, are then evaluated in turn by the researcher, together with the underlying reasons for the judgements made.

8.1 Analysis and Evaluation of the Company Experiences in the Implementation Phase

Nine out of the ten original participant companies progressed to the implementation phase of the new management information system. Appendices A through H2 contain the summarised diaries for each company for the implementation phase. In most cases this was the most difficult phase, since the expectations of both management and staff were frequently not achieved. The areas of development activity analysed and criteria for evaluation of the qualitative data collected were as outlined below.

a: Installation of the system - the criterion used for judgement of the installation of the system were the ease with which both the microcomputer hardware and management information system software was delivered and installed in the premises of the small company. This involved the coordination of the work of hardware suppliers, the software developers or dealers and, in some cases, preparatory work on the office environment. Initial
teething problems with new technology was frequently experienced and delays were not unknown after the early pressure from suppliers to make contractual agreements to buy.

b: **Implementation time** — the criteria for assessing the MIS development progress was the nature and accuracy of any plans made by management. The management expectations of time to implement the MIS were considered, the actual time and resources required to reach a live operation state for the system, were used as measures of success or failure.

c: **Training** — the criteria for assessing the success of training was the range of skills required to operate and use the new hardware and the information system and acquired by the company's staff. They consisted of general system appreciation skills, routine operating skills and the less frequently, required non-routine operating skills. These must be acquired from either within or outside the organisation for the full effective use of the MIS.

d: **System conversion** — The success of the conversion to the new information system was evaluated by assessment of the conversion activities. All company data needs to be converted into a computer readable format, all business procedures require restructuring and the current position of the company financially needs to be firmly established on the new system.

e: **System testing** — The management requires to be satisfied that the new system is functioning as expected, and that the anticipated benefits are therefore achievable. Early
testing out of the routines, as a check of the facilities provided, together with a full reconciliation of the processing accuracy, and suitability to the task concerned, are required prior to abandonment of the former system. The extent of such testing and the problems encountered were the criteria for judging the success or failure of this development activity.

8.2 Company A

8.2.1 Implementation Phase

The implementation phase for Company A, lasting for almost two years, was a lengthy and tedious time for the management, as the system development collaboration with the supplier required a considerable input from Company A's clerical staff and management. As a result of the slow progress the staff found that considerable knowledge of how the software system's internal model worked was acquired. This was of long term benefit in operator training. Backdating of the company's financial transactions to create a working system was reasonably successfully achieved after some months. The establishment of the system master files had been already relatively smoothly undertaken.

The thoroughness, with which the management information generated by the working system was checked, gave much confidence to management and staff for later tasks. Staff training was essentially concerned with the operations of the software, leaving them to work out the business procedures and, although
training was informally provided, the effect was very beneficial in the degree of understanding resulting. Initial appreciation of the operations of the hardware was only superficially provided when management were selecting the system.

The implementation phase was thus considered to be SUCCESSFUL overall, with some reservations being expressed with regard to the considerable overrun on the time taken, although this did have beneficial long term effects in terms of user understanding.

8.2.2 Reasons for Judgement

(a) Installation: Reasonably successful
The use of an early generation of microcomputer hardware in the relatively hostile environment of a building contractor's office, located adjacent to the builder's yard and workshops, led to several early installation problems. Supplier promises concerning the technical facilities of hardware proved in many ways to be both optimistic and ambitious, some features being supplied only as upgrades to the early model, after a delay of a maximum of twelve months. Power supply problems and restricted disk capacity were the most serious since they resulted in the staff having to recover the converted system data files on several occasions.

(b) Implementation period: Poorly achieved
The implementation phase was an extremely lengthy episode for Company A, which brought both benefits of gradual training and problems of lack of motivational feedback to the staff and management concerned. The eventual successful MIS implementation was achieved
having overcome several difficult problems for the small firm, principally due to the lack of internal expertise and spare resource capacity. The time period involved generated a feeling of an unachievable moving target's for at least one member of the clerical staff.

(c) Training: Reasonably successfully achieved

One clerk perceived the computer project as a intrusion which disrupted the normally calm routine of the contractor's office. The benefits of working in a small firm for this clerk, were clearly the friendly, flexible manner characterising the client and employee relationships with the office staff and the perceived informality of the office procedures. An early resistance to the computer was likely to have arisen from these beliefs and also from the fact that, prior to the MIS project, the earlier manual system had generated sufficient workload for only one full-time clerk. The reticent user thus viewed the computer as a possible replacement of her own services in the long term as the company had recently employed another secretary with a little previous computing experience. Some barriers to acceptance and learning were consequently established early in the MIS implementation.

Whilst the programs were being developed, the staff concerned were given the opportunity to become accustomed to the prospect of a microcomputer-based system. Staff training was both evolutionary and detailed in approach, as each section of the new system was completed and handed over for user testing.
and establishment of the detailed business procedures involved. Very close relationships were built up in this manner, as the software developers showed an unexpected willingness to respond to the needs of the staff within the small organisation. This is unlikely to have been the situation had the company purchased an off-the-shelf package to implement.

(d) System conversion: Successfully achieved

During early training the strategy of using historical data drawn from the organisation, did have beneficial effects in the long run since the business procedures and training needs were worked out on the basis of known practices with real clients. Although a lengthy procedure for Company A, requiring the continued application of extra resources since the manual system had also to be maintained, this had the effect of a slow progression up the learning curve for the staff concerned, and hence a greater likelihood of acceptance and success long term.

The company experienced several problems in converting the system which could be traced back to the mismatch between existing manual practices and the designed procedures of the computer system. The users had no experience of coding of customer or contract records although a basic double-entry accounting system did provide some degree of structure. The actual conversion of the old to the new system was undertaken by staff in a systematic fashion, although the amount of extra work involved was burdensome on the organisation, who only overcame this by the use of other members of the family.
One notable problem of conversion to the new system was felt in the relationships with the outside world. Business in the highly localised construction industry involved other small companies on an informal, personal basis of mutual support within the locality. When the company needed to formalise its relationships with the market environment, as was necessary with a computer, this lead to repercussions in the long-term. The computer altered the relationships with subcontractors for Company A and required the adoption of new formality (e.g. when dealing with subcontractors regarding tax certification and retained earnings) which indirectly affected further dealings with those business.

(e) System testing: Successful
The method of MIS implementation itself generated many problems, which could be traced back to the lack of a formal, documented specification of the business needs. The company was in a weak bargaining position once development had begun, as Company A had already purchased the hardware and would be unlikely to have found a suitable alternative specialist software package had the relationship broken down. Many of the exact details of the nature of the specialised features of the construction industry business procedures were only discovered in the light of testing out early functions. The results of lacking such knowledge were built into the design assumptions which could be costly to rectify when discovered later. The supplier also had some considerable difficulties in meeting the needs of Company A without
commitment of extra resources and time, a difficult task for a small organisation.

Reconciliation of the developed system against Company A's requirements was only possible after several versions of modules had been supplied. By this time the staff had played a very active role in the thorough verification of the accuracy and appropriateness of the output.

(f) Additional Criteria (e.g. staffing)
Company A was also faced with the need for careful staff matching with the tasks concerned. Family members were called in to provide a degree of administrative slack when extra resources were required. When a computer becomes the central storage depot of all the company's information this practice is often hindered because of lack of training and skills on the part of the peripheral family members, who may withdraw entirely from the pool of resources once the computer is implemented.

8.3 Company Bl

8.3.1 Implementation Phase
After a few initial installation problems, principally caused by the requirement for duplicate sets of hardware for the sister companies, the implementation of the MIS for Company Bl was undertaken according to management plans and on schedule. Training of the staff was staged, with the initial learning of the system being undertaken by the senior staff, who had been responsible for the selection, and had some knowledge of the software. The system conversion was
particularly smoothly achieved as the company financial data was simply transferred from an obsolete system to a maintainable functionally similar system, within a period of three elapsed months. The testing out and reconciliation of the management information generated by the system was systematically approached with confidence by Company Bl.

Hence the implementation phase for Company Bl was very SUCCESSFUL providing the management with early benefits in the form of current, up-to-date information within a short period.

8.3.2 Reasons for Judgement

(a) Installation: Reasonably successful

Company Bl had contracted to purchase the hardware from a local supplier and was provided with a commendable service in the provision of the basic hardware. Some initial printer problems were soon remedied but the selected hardware had been established on the market for some time and had many other users in the area.

(b) Implementation period: Successful

The company was very successful in implementing the new system within the planned period of time, having sufficient administrative slack to enable the complete release of the senior staff involved. Two competent individuals had been involved in the preparation of the company financial data, which needed little modification and was complete for the purpose.
(c) **Training:** Successful

Whilst the level of real supplier support for the initial stages of system implementation in Company B1 was minimal, the supplier only providing a half-day on site training and thereafter a hot-line support service, this did not affect the staff training which was internally planned and undertaken. There was however considerable need for use of the software operation manual, which was written in such a format as was understandable by the accountancy trained, senior staff but with which junior staff had difficulty in using. The intention of Company B1 was to create a local company expert who could be held responsible for the hardware and software aspects of the system and who would in turn train the other staff to operate it.

(d) **System conversion:** Successfully achieved

The system being implemented only slightly extended in scope the previous visual record system, and thus the system data was available in a suitably structured and coded form to be simply entered into the new system. Contract costing (the only extension in system functions) was phased in gradually as the new data became available since Company B1 considered it to be unwise to undertake too many tasks simultaneously and this was assigned a low priority.

(e) **System testing:** Reasonably successful

The reconciliation of the output was systematically undertaken, by one ledger module at a time, and compared with the known status of the existing system records, which continued to be run in parallel. This
provided the management with an assurance of the integrity with which the data was kept. Some problems arose with a loss of detail on the employee payslips but the company was able to commission a modification to the program to overcome this detail. The support of the supplier was vital in the successful modification of the payslip, without which one of the sister company's would have had operational problems in reporting to the workforce in the detail required.

(f) Additional Criteria (e.g. staffing)

The level of internal expertise was very high for a small company, an inheritance of the former size of company operations. More importantly, however, the two senior staff responsible for the implementation were not involved in the production side of the business, having no boundary spanning activities whatsoever. They were thus in a position to devote their full time and knowledge to the implementation of the new system which was successfully achieved within the short target period of three months.

Previous experience was drawn on to plan the work involved, the staff being fully aware of the extent of the tasks involved. The company itself had a relatively large administrative section, with an established management structure, which could be used to schedule, coordinate and delegate the necessary tasks with the appropriate authority.

8.4 Company B2

8.4.1 Implementation Phase

Company B2 (Company B1 with a later application) was
subsequently unsuccessful in the implementation of the MIS within the estimating department. The selected system was installed successfully but the company had problems undertaking the training programme provided by the supplier. Establishing the system for operational use became too difficult a task for the users to achieve and consequently no testing was undertaken. The MIS project was finally abandoned when the management released the hardware purchased to another department for consideration of use with a different application.

The researcher verdict was therefore that the implementation phase of the MIS in Company B2 was UNSUCCESSFUL.

8.4.2 Reasons for Judgement

(a) Installation: Successful

There were no significant problems of installation of the hard disk microcomputer and printer. Collaboration with the supplier for the purposes of developing the estimating software did not involve the company in any serious program testing since the software provided had already been extensively tested elsewhere.

(b) Implementation period: Unsuccessful

The estimating department finally abandoned the MIS project after a series of unsuccessful attempts at implementation over a period of many months.

The worsening economic recession in 1984-85 had a serious effect on the workload of the contractor's estimating department, as companies competed to tender
for the limited amount of work available with a corresponding lower success rate on acquiring the tender contracts. The number of tenders to be priced increases significantly and the type of work may vary erratically in the nature and location, thus making the task of actual pricing very difficult. The estimating department was cut back and had no slack resources within it and thus there was no time to spare to become trained sufficiently in the system.

(c) **Training:** Unsuccessful
The supplier provided sample data on which the staff could experiment at leisure. When time was found, the intermittent nature of the training sessions meant that the operator was frequently starting again with little real progress being achieved in the training sessions with the supplier.

(d) **System conversion:** Unsuccessful
The nature of the MIS itself was a large database of prices for various materials and work items, which must be established by the estimator himself, if the system is to yield long term beneficial information. Whilst the supplier provided a skeleton library of rates, these required careful revision and extension by the estimating department to match the specific local conditions and type of work which the company was competitively tendering for. This was a burden for the department as the staff were stretched to the full and the data for the establishment of such a library is traditionally stored in the memory of the estimators themselves. The library creation could have been a clerical task to input into the computer
but the data itself was not sufficiently formalised or recorded to enable such delegation of tasks to an office junior.

(f) **Additional Criteria** *(e.g. staffing)*

The most significant factors contributing to this failure were the lack of personal involvement and commitment of the management concerned, and the high level of workload of the department throughout the project period. The estimator was in his early forties and had neither been exposed to the use of computers at any stage of his basic general or vocational education, nor had he been involved with any of the company's existing computer applications. His estimating skills and knowledge had been acquired over twenty years of working with the company, during which time he had risen to become the department manager without any formal management training.

The decision to implement a computer-based MIS in the estimating department was made at board level, with only nominal discussion with the estimating manager himself. The commitment to introduce computers throughout the organisation appears to have been a quest of the company. The feasibility considerations were strongly biased in their interpretations by the top management. The detailed discussions, in liaison with the software suppliers, involved the older member of the department, an open-minded, progressive individual interested in the prospect of the new MIS project, in addition to the manager who showed only a little enthusiasm.
The management decision to cut back the scale of operations of the entire company, involving the loss of a member of the estimating department, unfortunately meant that the source of enthusiasm for the system was lost. This key individual who had shown significant interest and aptitude in the early training sessions left, created even less chance of success of the MIS project. The work was then the total responsibility of the manager who had no time available for implementation and consequently revealed his lack of enthusiasm and ability for the project.

The top management of Company B2 recognised the dangers of this early rejection of the system in their consideration of subcontracting the time-consuming task of establishing the database to the supplier on a consultancy basis. The estimator's resistant to this move was further evidence of his non-acceptance of the system.

8.5 Company C

8.5.1 Implementation Phase

Company C was successful in the majority of tasks associated with the implementation phase. After the prompt installation of the hardware the company was able to convert the old system by using outside assistance to compensate for the lack of skills and administrative slack within the small organisation. With a minimum of system testing the company was able to reconcile the information provided from the new system with that required. Some problems did arise when it was discovered that the major problem area was
not alleviated by the system installed.

Overall however the company was able to SUCCESSFULLY implement the new MIS within the time schedule.

8.5.2 Reasons for Judgement

(a) Installation: Successful

Equipment was supplied locally during the summer period of 1983 and the software package was installed by the supplier during a single visit to site. The company management, being completely unaware of the alternatives available, was unable to make any of the significant decisions with regard to the structure of the implemented system, which was thus decided to be identical to that of the demonstration model supplied with the software. These early decisions required information concerning the final management reports to be generated, which the company management lacked the long term knowledge required. The company accountants, who would have been able to supply this information, however were not involved in the process. Thus, although the installation appeared to go smoothly, the company found some two years later that the decisions made had in fact been inappropriate.

(b) Implementation period: Reasonably successful

The company was able to successfully achieve implementation, to a point where they reaped the desired benefits from the system, in a period of six months with the assistance of the extra staff and at the expense of an overrun of budget by £2000. This incurrence of extra costs could only be absorbed from reserves in the case of a stable company or from future profits in the case of growing small
There was a strong incentive to achieve success from the outset of the MIS project in Company C, provided by the buoyant but volatile economic environment within which the company operated. As a new business with young management, the company had a positive management attitude and hence commitment to the establishment of the system within a short period of time.

Faced with the problem of immediately underachieving the planned project progress, the small firm had the choice of either drawing on administrative slack or supplementing its resources from outside with suitable quality of personnel. After initial attempts to supplement the time available, to take advantage of the training programme provided by the supplier, by working weekends and evenings, the management were advised at a critical stage to subcontract some of the extra workload of the implementation to specialist manpower. They took this advice whilst recognising the burden of extra costs to the company.

(c) Training: Reasonably successful

Company C found difficulty in absorbing all the training for operation, provided by the supplier, since it was concentrated into two short days on the company premises. The eventual operator was not employed at this time and so what operational and system knowledge was absorbed was further diluted when it was passed on again. Training concerned only aspects of routine system use and general hardware appreciation, the
company was left to work out the non-routine elements of the system.

(d) **System conversion: Successful**

Significant problems were revealed in the Company C's perception of the tasks necessary to be undertaken to get the system implemented and thereafter operate it to the benefit of the company. The company seriously underestimated the amount of management and clerical time, the level of understanding and the volume of company data required to establish the MIS to a state of being able to rely on the information generated.

The volatility of the demand for the construction services of Company C generated a high extra workload for the small firm. Faced with this situation the small company frequently finds that the search for alternative sources of work becomes more important than the implementation of any MIS project unless, as in Company C's case, the management are sufficiently committed to the project that extra resources are drawn in to create a buffer for such dilemmas. With this buffer staff the management of Company C were able to devote their attention to coping with the variety and volatility of relationships on the boundary with clients and other organisations.

(e) **System testing: Unsuccessful**

System testing was thoroughly undertaken by the outside staffing, but only in regard to the integrity and completeness of the data concerned, not with regard to whether useful management information would be generated, since this could not be established with the extremely busy management. Considerable trust was
placed in the skills and knowledge of the outside staffing, believing that their previous experience and knowledge was directly transferable between companies of all types.

A mismatch of the implemented MIS and the problems actually experienced by Company C only became apparent when the implementation was almost completed but the symptoms of the local authority contract difficulties had not been resolved. This appears to have resulted from the earlier solution-oriented approach of the consultant employed. However as a result of this earlier MIS implementation Company C acquired a level of understanding of the computer system capabilities and the way in which this could be used to solve the problem of the local authority data administration.

8.6 Company D

8.6.1 Implementation Phase

Company D took the longest time to implement the selected MIS of all the case studies despite its relative size within the group. The overall implementation was hindered by extremely slow progress throughout, erratic training, staggered and uncoordinated installation of software modules. Further difficulties arose with the conversion to a relatively sophisticated system when staffing and skills problems emerged in the organisation.

The overall assessment of the implementation phase of Company D was therefore UNSUCCESSFUL.
8.6.2 Reasons for Judgement

(a) Installation: Reasonably successful

The complexity of the selected system had a severe impact on the ease with which the system was installed. Each subsystem was installed by the company independently and, as the decision had been made to retrospectively enter all the transactions of the previous six months, this involved extremely large amounts of data input. The extensive MIS facilities required many items of data which were difficult to find in retrospect (e.g. the certificate numbers of past employees) and there appeared no short cut to the easy implementation. They planned to become dependent upon the new system within a period of six months.

The source of such optimism was the professional manner with which they were sold the system. The suppliers were very keen to get the company through the preliminary stages of establishment of data files and training for the operations of the system. However the software package, supplied on a new manufacturer's hardware, was directed at the small contractor market but assumed that the companies had at their disposal sufficient staff and time to make similar progress to the larger systems, which the supplier had many experiences of installing and training for use.

(b) Implementation Period: Unsuccessful

Company D had very little administrative slack, although the clerical resources available were largely part-time, untrained and engaged on the overloaded manual data processing system. The company management
set target dates for the completion of various tasks of the implementation but were unable to make available the staff time to achieve much progress. Indeed the company management were unaccustomed to administrative planning as a necessary management activity, and made several mistakes, which in hindsight could be attributed to their inexperience with the demands of computer systems generally. For instance, the start date was set too far back to be achievable without extra staff resources, too many integrated modules were decided upon to be implemented simultaneously, complicated processing rules were established in line with their desire to maintain the flexibility of a small company administration.

The economic environment of the company was continually changing throughout the two year period, whilst the management attempted to implement the MIS and keep in business. Whilst not being directly affected by the national miner's strike in 1984-85, Nottingham being a working area throughout the thirteen month long strike, the level of economic activity throughout all areas of industry was at a restricted level. Company D found that the large contracts for civil engineering works became rarer and the company had to search further afield and accept smaller works, even the extensions and renovation work in the private housing sector. All this meant that the management staff, who had anticipated being able to devote much time to being actively involved and supervising the implementation of the computer, were being continually called upon to seek for new work, negotiate with clients and suppliers and handle the
resulting detrimental cash flow situation, arising from the less assured payment terms of the different type of work.

(c) Training: Reasonably Successful

One director was more interested in the MIS project and had made an early decision to be trained by the supplier in all aspects of the computer system's operation in order that, when it was handed over to junior clerical staff, he would be confident of his ability to resolve any difficulties arising. In this way the company itself would not be in the undesirable position of being totally reliant on a junior member of staff. However this well-motivated decision reduced the rate of any progress made to that possible from the time available by the director. He did not have all the necessary skills and knowledge of how the system operated and, without the continued support from the supplier organisation, found severe difficulty in maintaining satisfactory progress.

The system features were hidden within a complex jargon of computer system terminology and it was some time before the director understood the software manual and support provided over the telephone. Nevertheless several mistakes were made where the clarity of the system operation was obscured (e.g. as when the director chose not to print the subcontractor payment advice notes and did not realise that the internal transactions would therefore not be reconciled by the system, with the result that the disk filled up, reports were very slow to generate and the true financial picture of the company was not
available for enquiry).

In situations where the system is complex and there is no internal source of computing expertise, the relationship established and maintained with the supplier is crucial. Company D was guided by the supplier in the early stages of establishment of data files but received only the minimum training period. The manager failed to recognise the importance of the support level and actually chose not to take advantage of all that the company was entitled to. Small firms frequently establish informal, unstructured relationships with external parties, on the grounds of flexibility but, when dealing with large organisations, as Company D's supplier was, the balance was to the detriment of the smaller party. Indeed the director confessed to a feeling of guilt concerning the progress and reported on one occasion an incorrect state of implementation to the supplier. The company thus received less assistance from the supplier as might have been the case.

(d) System Conversion: Unsuccessful

Left without any positive support from the company accountants, only minimal trouble-shooting telephone assistance from the supplier, after the intensive training days and no support from within the organisation, the company director found that progress with backdated transactions did not match the rate at which the company continued to trade. The issue once more was the recognition of the need for skills and knowledge and the possible sources available for this expertise. In this situation of slow and difficult
progress any unexpected and unplanned for occurrences, e.g. hardware faults prove to be further reasons for destroying any confidence that might have been built up.

The characteristic of the Company D management however was continued optimism concerning implementation and the director treated the whole episode as a learning exercise for the company, disregarding the fact that two years after the original purchase, the system was still not live and no identifiable benefits from any aspect of its operation had been realised.

8.7 Company E

8.7.1 Implementation Phase

The staff of Company E were well supported from the Company accountant and the implementation was consequently a smooth operation in accordance with management plans. The supplier installed the hard disk microcomputer with software shortly after the end of the financial year and very few hardware problems were experienced. Staff training was gradually undertaken with some significant learning difficulties being experienced by the staff. The system conversion was rigidly controlled by an outside advisor (an external accountant also involved in the selection phase), who was responsible for both the provision of the system data, and was the management's agent in the final acceptance of the system from the supplier.

Overall the implementation phase was SUCCESSFUL in Company E.
8.7.2 Reasons for Judgement

(a) **Installation**: Successful

With only a few printer problems which the company were able to rectify, by personal delivery to the local supplier for overnight attention, the installation was achieved without any disruption to the normal working routine of the company. The supplier provided two versions of software, a demonstration system on which to explore the facilities during training sessions and a skeleton system to use as a basis for building the operational system. The staff had very few decisions to make regarding the structure of the system installed since the skeleton system had been verified as suitable for the company's needs by the outside advisor.

(b) **Implementation period**: Successful

The company was expanding throughout the period but, since the management engaged in boundary spanning activities differed from the staff involved in the implementation activities, this did not prevent progress. The only serious disturbing event of the implementation was the company office removal to new premises, which was used as an opportunity to organise the location of the computer in an effective manner. Management plans were realistic from the outset based on the expectations expressed by the outside advisor. Targets set for gradual implementation over a period of a year were achievable, considering both the level staff resources involved and the limited previous experience of such change for the management and staff. It was decided not to try to implement the difficult
area of subcontract management in the first instance until the company had some more expertise. These procedures could be simply catered for by the system in an alternative manner.

(c) Training: Reasonably well achieved

The training methods adopted by the supplier of Company E's selected system was in the interest of small companies with no computing experience to draw on. Training was spread over several short sessions with more than one individual being involved wherever possible. In addition, the demonstration system initially provided for the company staff to experiment with, was aimed at generating operator confidence and early understanding of how the system worked.

The principal operator, a middle-aged secretary, was still very cautious and would perhaps have had more serious problems if there had not been support on hand from the outside advisor (i.e. external accountant) and the supplier. The problems felt were related to the pressure from existing workload, caused by the lack of administrative slack, and the operator's lack of skills in both the accounting functions and computer operations.

The outside advisor was able to establish a clear understanding of the way in which the system operated and was thus able to map each of the business's data processing operations on to the way the system would handle it. This clear vision into the system model enabled him to assist with problems and explain system operations to the clerical staff who were reticent first time users.
When unable to obtain the assistance of the outside advisor, the staff found a poor source of assistance in the software manual and chose on many occasions to seek direct help from the supplier, with whom a personal relationship had been established. The main area of assistance was knowledge of when to undertake discretionary tasks, such as making security copies and clearing the system of unwanted data.

The close relationship with the supplier enabled the early hardware problems to be overcome, without diminishing the confidence level of the operational staff. The team of supplier, outside advisor and operational staff jointly contributed to a controlled period of implementation.

(d) **System conversion:** Successful

The fact that the company accounts had already been based on a computer, albeit on a bureau basis, meant that the company financial data was available in a suitable format to facilitate early establishment of the data files. As the company chose to build on the supplier skeleton structure, the staff had limited coding problems to sort out. There were few input errors to rectify at the end of the first financial year before the system was deemed to be a live operation.

(e) **System testing:** Successful

Direct conversion from one computer system to another also meant that the outside advisor, taking the role of MIS project coordinator, could manage the initial batches of input and reconcile them with the existing
computer produced output. An atmosphere of confidence in the system prevailed but the company still chose to implement each phase with a thoroughness they considered necessary.

(f) Additional Criteria: (e.g. staffing)

Early doubts expressed in the selection phase of the ability of the clerical staff and management to have sufficient time and discipline to successfully reach a stage of live operations were overcome by the teamwork effort supported from several quarters in an environment of continued business growth. The responsibility for implementation was in fact shared, between the internal clerical staff and the outside advisor, with the production management being completely uninvolved.

8.8 Company F

8.8.1 Implementation Phase

Company F did not proceed to the implementation phase having abandoned the project of MIS development after a nine month Selection Phase.

8.9 Company G

8.9.1 Implementation Phase

Company G had serious problems of implementation which led to a long period during which the management strove to get established. The installation was a speedy decision of the management, in the hope of taking advantage of an imminent vacation period but plans to become quickly implemented were largely
unrealised. Training was erratically undertaken by management, who was quick to understand the system but found it difficult to spare the necessary time. Reliant on external accountants for the supply of initial system data, the conversion was hindered with both mistakes and late deliverance. Little evidence of the testing of the operations by the company followed from the general lack of progress.

The implementation phase in Company G was thus UNSUCCESSFUL over the period of research.

8.9.2 Reasons for Judgement

(a) Installation: Reasonably Successful

The weakness of strategic planning operations within the management of small companies is evident from the spontaneity of the decision to purchase a particular system made by the owner/manager of Company G. The owner/manager had a preconception of being able to switch on and receive instant management information from the system with little effort on behalf of the company, which was perhaps attributable to the mass commercial marketing of microcomputers generally.

However the simplest configuration of hardware was successfully installed together with a MIS based around a skeleton company with similar requirements to Company G. The supplier had in fact provided a partial system for the benefit of this very small business in accordance with the limitations placed on the total budget.

(b) Implementation period: Unsuccessful

Throughout the implementation period Company G faced
economic hardship and failed to realise its previous growth targets, largely because the severity of the miner's strike in the South Yorkshire area resulted in a scarcity of work. Faced with these conditions, the owner/manager was compelled to place most administrative duties secondary to the necessity of seeking work. Such high boundary spanning activities disrupted the process of implementation. When eventual abandonment of the first attempt at implementation occurred after several months of unrewarded effort, a sense of failure also established itself. The owner/manager perceived a need to apologise for lack of progress, to both the supplier and the researcher, at this time.

(c) Training: Reasonably successful

Initial training sessions were short and purposeful and the owner/manager found little difficulty in understanding the actual operation of the software, finding the most problems with an initial fear of damaging the hardware itself. This ease of acceptance of the system was attributable to the formal management training the owner/management had had prior to establishment as a business.

However the owner/manager found increasing difficulty in finding any time to fit in the training being offered to him. Without any clerical assistance, the owner/manager was solely responsible for the total administration and daily supervision of the contracts, and these extensive boundary spanning activities were characteristically unpredictable and volatile, frequently leading to training appointments not being
kept. The lack of momentum of the learning process for the owner/manager led to a severe loss of confidence and a disruption in the acquisition of the skills of operating and managing the MIS.

The MIS supplier, also a small firm, appreciated the organisational difficulties of Company G and a relationship of mutual collaboration was established since the supplier was eager to establish a larger user base for the product. The problem of loyalty-guilt arose, as with Company D, when progress was not as anticipated.

The size of the organisational change, which the owner/manager was expecting, is important to note. The company, a very new enterprise, had had only a skeleton manual system, but the system being implemented, was both sophisticated and flexible. The gap between the previous structure (the "what was") and the target structure (the "what was to be") was extremely wide in the case of Company G. Company G was extremely constrained by the fact that there was no administrative slack at all, no previous bookkeeping or computing experience to be called upon, and the only source of system expertise was the supplier, whose services must be paid for if required.

The cycle of lack of training feeding through to lack of progress and eventually to lack of willingness and ability to devote time was soon established as no support or assistance was available within the organisation. The need for resources and skills was recognised, when the company called upon the supplier to provide assistance, but the expense had been
neither anticipated nor budgetted for.

(d) **System conversion:** Unsuccessful

The small firm relied on external organisations and was consequently vulnerable to the quality of cooperation they chose to provide. The company accountants, employed by Company G, had not been involved in the decision to select or the actual choice of MIS and, when asked for audited company financial data, provided inaccurate figures due to a misunderstanding of the nature of the system. Such a mistake lead to two abortive starts with extremely detrimental effects on the small firm who expected to reap benefits very early.

The training deficiency resulted in an unstructured approach to implementation, which could not take advantage of the experiences of other small firms, since little contact was kept with the supplier. The widening gap between the expectations of the company and the actual achievements over the 18 month period had a low motivational effect, stretching out the times between each attempt to convert the system. In an attempt to use the limited time available to the best advantage of the implementation, the decision to abandon manual record keeping was made. This put further stress on the owner/manager when information was needed for daily decision making but progress with the replacement system had not been made.

On one occasion the supplier was asked to assist in the conversion of the system, by using the company data to establish a position from which the company could
operate live. However this strategic advantage was again lost when the company found itself unable to proceed because of the severe lack of time. The system was thus not completely implemented some 18 months later having been, on the face of it, abandoned.

8.10 Company H1

8.10.1 Implementation Phase
The only element of the MIS which needed installation in Company H1 was the software as the company already had the necessary hardware. The implementation phase resulted in the abandonment of the project in the selected form as the system testing revealed future difficulties for the management. In spite of this end result however the company had been able to successfully convert the system prior to testing.

Overall the company experienced an UNSUCCESSFUL implementation phase.

8.10.2 Reasons for Judgement
(a) Installation: Reasonably successful
The installation of the construction industry software package, purchased by Company H1, was undertaken by the company management rather than by the supplier. The only source of information of how to create a new company system using the disks, supplied by the local dealer who had merely demonstrated the skeleton system, was the written manual. With the background of previous minicomputer installations of software and a positive attitude to technical documentation, Company H1 management did not find this a difficult task.
(b) Implementation period: Unsuccessful

The organisational situation in which the implementation was attempted was in many aspects very favourable. Company Hl had an established administrative routine and was not making a large step forward in terms of system sophistication. There was some considerable level of administrative slack and the company was operating at a generally buoyant level in spite of a general low level of activity in the construction industry. However the demand for boundary spanning activities by the implementing agent (director) frequently prevented the maintenance of continuity until a student assistant was given the assignment.

After considerable effort, to establish a system over a period of some 6 months using data relating to Company H1 and some thorough system testing, the decision was made not to continue with the MIS to its live operational status. The criteria upon which the decision to abandon implementation was made, were reported as the poor quality and speed of the processing operations and the weak support relationship with the developers rather than the poor task fit within the organisation. Companies without the same minicomputer experience as Company H1 might have found the latter criteria more paramount.

(c) Training: Limited but reasonably successful

The manner in which the company had acquired the system, involved no on-site training, with only the director being able to take advantage of a half day training in the London office of the supplier. Since
this training was given using demonstration data from
an imaginary company, the relevance was also removed
from the real situation of Company H1. The expense
and inconvenience of undertaking any further training
in this manner forced the company to rely entirely on
the documentation, published manual and the "help-line"
for the implementation support required.

The relationship with the supplier was only indirectly
established since the software had been purchased
through a local intermediary. Consequently, when the
telephone support line was called on, Company H1 found
the developers' support staff remote and unhelpful, as
they were unfamiliar with the actual circumstances in
which the company operated.

The remoteness of the relationship for support was
critical during system conversion and when the system
operations were being explored. The director found it
very difficult to establish the model by which the
software operated, from either the skeleton manual,
which was only a step by step instruction guide, or
from the user interface with the computer since little
explanation was provided as the system operated. The
previous computing experience, together with a
commitment to gaining the benefits of information
technology, enabled the company to undertake much of
their own immediate training needs for using the
system.

(d) System conversion: Successful
The company was able to locate and collect the
required data with some degree of ease as the manual

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system operating was both structured and of a similar level of sophistication, only lacking in integration and speed. The company clerical staff were thus able to provide the verified data from the existing system. Many of the minor difficulties of conversion were resolved using the skills and knowledge of bookkeeping available.

(e) System testing: Unsuccessful

The early exploratory testing sessions with the converted system revealed several minor bugs and restrictions in the flexibility of the software. Such events are unfortunately characteristic of the early microcomputer software in this specialist market. The implementing agent in Company H1 was intolerant, having higher expectations of the quality and support of the software selected.

8.11 Company H2

8.11.1 Implementation Phase

The company tried to simultaneously implement the MIS software for two companies, a small general building contractor and the larger steel fabrication unit. Occurring very shortly after the abandonment of the previous MIS project (Company H1), the installation of the second system involved a complete hardware and software installation, which was closely supervised by the supplier. The implementation period however became protracted when the company faced internal organisational problems and it was not fully completed in the steel fabrication company. Training needs were fulfilled with an unusual thoroughness but they had
much previous experience for guidance. The small building contractor did achieve a conversion to the MIS system whereas the steel fabrication company failed completely. System testing was not particularly systematically approached after the departure of one member of staff who had been dedicated to the implementation function.

The overall verdict was thus one of mixed success and failure in the implementation phase of Company H2, reasonably successful.

8.11.2 Reasons for Judgement

(a) Installation: Successful
The supplier installed both the hardware component of the system and the basic company structure required of the software. With close supervision by the developers no problems were incurred in any of the system components, in spite of the close location to the steel fabrication unit. The only complication was that the company installed the same software package for two separate companies within the group, a small building works company and a much larger steel fabrication company.

(b) Implementation period: Unsuccessful
In the small building company the implementation was slow but eventually effective. The implementing agent was the owner/manager of this organisation who provided the determination to successfully convert the manual system and although considerable work was involved the implementation was reasonably success.

In the larger business, the implementation was
unsuccessful, in that a new financial director with a different view of the company's requirements for management information, was appointed shortly after the implementation of the new MIS. The effect of this was that plans for the early conversion and acceptance testing of the software were thwarted and eventually the planned implementation was abandoned, when the new director proposed that another new more sophisticated MIS should be sought for.

(c) Training: Successful

In the case of both planned implementations the company recognised the real need for support in the form of a structured training programme. When the MIS was purchased they insisted on the availability of a clearly written manual. The implementing agent was assisted by an intelligent student, who had some computing experience and whose time was dedicated to establishing the system to an operational state prior to leaving the firm. A strong factor towards success in the MIS project was the creation of this role for an individual, who had the time, skills and aptitude to set up the system with a thorough understanding since there was no demand for any boundary spanning activities.

The approach adopted was to take the training offered by the supplier in short intensive sessions, on areas which it was felt most assistance would be required (e.g. end of month and end of year). Otherwise they relied upon the manual, their own previous experience and the close connection of the supplier to become operational. In this manner a detailed understanding
of the system model was established, which itself encouraged further understanding of how the system could be extended in the future, and facilitated the company to undertake its own trouble shooting with the inevitable early mistakes in operating the system.

Company H2 experienced many of the difficulties of the other companies in mapping the flexible processing practices of the small firm to the disciplined structure of the system.

(d) System Conversion: Successful
In a serious attempt to quickly become operational the system was converted by entering several months of previously dated transactions without any reconciliation of the management information results. Few problems of data collection were experienced as the company already had a structured system to work from.

(e) System testing: Successful in the smaller company; Unsuccessful in the larger company.
The non-routine processing operations of the system were the only real testing phases of the new MIS. This was thoroughly checked by the extra staff member who had the time to devote.

(f) Additional Criteria (e.g. staffing)
From the company's viewpoint this use of an outsider in liaison with the director produced a dependency on a key individual which resulted in problems later. Implementation progress was promising up until the student left but, without the administrative slack or any other person with the same qualities within the
organisation, the onus for successful implementation fell on the director. The company had left itself in an extremely vulnerable position since all the expertise, built up in the early weeks of implementing the system, was lost when no one was trained to succeed the student.

The manner in which the director had independently searched for and acquired the system without the total cooperation of the other working directors, who had traditionally kept to their separate areas of expertise, became a significant factor at the point when the student left the company. When the company, faced with some difficulties of changeover, a newly appointed director with responsibility for the financial functions in which the MIS was being implemented, and who had not been involved at all previously, renewed the questions of the company's requirements. Once such a division of management objectives occurred the implementation became destined to fail since the various parties were moving in different directions.

The importance of the establishment of an early expertise which remained within the company was clear. The small company however found it difficult to release even one member of staff to be dedicated to a MIS project and could not ensure that others also possess the same system model understanding and operational expertise.

During this time the company was undergoing a period of growth with several large contracts having been awarded. This assured the company of on-going
IMPLEMENTATION

a: Installation of system
   R R S S R S - R R S

b: Implementation time
   (in relation to plan)
   U S U R U S - U U U

c: Training:
   - general system appreciation
     S S U S R R - R S S
   - routine operating skills
     R S U R R R - R R S
   - non-routine operating skills
     R R U U U R - U R R

d: System conversion:
   - data capture/encoding
     S S U S R S - U S S
   - master/library file creation
     S S U S U S - R R S
   - establishment of working system
     R S U U U S - U U S

e: System testing:
   - trial processing
     S S U U R S - R U R
   - reconciliation with requirements
     S R U R U S - U U R

IMPLEMENTATION JUDGEMENT
   S S U S U S - U U R

Key
   S = successfully achieved / undertaken well
   R = relatively successful
   U = unsuccessful / badly undertaken

Table 8.11a Functional Activities of the Implementation Phase
viability. Dramatic changes in the scope of operations naturally affected the requirements for the nature of the system. Company H2 in this situation in late 1984, having no real corporate commitment to the current system as a result of their "try it and see" philosophy, found that they were facing the problem of defining requirements once more in a changing world of the emerging technology and without any consolidated expertise from the operation of early system to build on.

8.12 Conclusion

The results of the Implementation Phase evaluation are collated and summarised in Table 8.11a, shown opposite. In conclusion the evaluation of the Implementation Phase revealed that only four small companies were successful in reaching a position of relying on a live microcomputer-based MIS. This phase appears to have been the most critical in terms of the overall success since many companies had severe difficulties in achieving the tasks in a reasonable time. The burden of extended activity on staff and management proved to be important in assessing the success. Problems were varied although many companies found the conversion of the system most difficult.

At the end of the implementation phase four more companies had either abandoned the MIS development or were still attempting to reach a live operation. This leaves five small companies to be evaluated in the final Live Operation activities in Part Nine which follows.
PART NINE  LIVE OPERATION PHASE

9.0 Summary

Part Nine follows the final stage of the MIS implementation, which comprises of the live operation activities. Full details of the experiences reported by the companies are found in Appendices A through H2. The criteria for evaluation of MIS success or failure are first established. Each live operation activity undertaken by the small companies are then evaluated in turn with the reasons for the judgement being further explained.

9.1 Analysis and Evaluation of the Live Operation Phase

A MIS becomes live when a manager utilizes the management information from the system (Carter and Silverman 1980). By 1985, after a minimum research study period of two years, only five companies out of the initial ten involved, had reached full dependency and operation of the MIS. Three had been formally abandoned by the management concerned and a further two were still striving to implement the system but had considerably overrun time schedules. One of the five companies reaching this phase (Company H2) showed signs of weak commitment to the system and it was anticipated that the system would be replaced in the near future and so could not be considered successful overall.

The companies were regarded as being in the live operation phase when management had completely abandoned the former system and were using the information generated in the daily operations of the company. The organisational effectiveness of the implemented system was analysed and evaluation was on the basis of the following criteria.
a: Abandonment of old system - this event had to occur and be acknowledged by the management concerned. Such features as decisiveness, achievement of planned live dates and the confidence of the company to adopt total dependency of the MIS were considered in judging this aspect of the MIS development.

b: Evaluation and tuning of the system operation - After a period of use, the system facilities may be reviewed with regard to how far they continue to meet management's needs and some redefinition and tuning of business and computer operations may result.

c: Use of the management information - the extent to which the early expectations of management, regarding the effective use of information generated, are in fact realised form the basis for this aspect of evaluation.

d: Enhancement of the system facilities - the extent and nature of the extension of the initial system, both in terms of extra functions and new users, are evaluated. In some cases the companies were forced to contain the scope of the system, whereas others found it beneficial to implement new MIS applications in other areas of management and administration.

Each company was evaluated on the basis of the above criteria to be either UNSUCCESSFUL, REASONABLY SUCCESSFUL or SUCCESSFUL.
9.2 Company A

9.2.1 Live Operation Phase

Company A began to operate in live situation, being totally dependent on the implemented MIS after a period of two and a half years. The management considered the system a successful venture and were making regular and considerable use of the management information provided. The MIS had been enhanced from the original scope of financial accounting and costing applications and had also acquired more users within the organisation.

The overall assessment was therefore of a SUCCESSFUL project for Company A in the long term.

9.2.2 Reasons for Judgement

(a) Abandonment of old system: Successful

The management information, provided by the system which Company A implemented with the cooperation of the software house, became an integral part of the administrative system of the small company as originally intended. Indeed it may have been responsible for the actual survival of the company during the period of economic depression in 1983–85, since the management recognised the full benefit of timely information in decision making.

(b) Evaluation and tuning of system operation: Successful

The system was evaluated by management on a continual basis as the implementation took place but, after some period of live operation, the staff began to trust in the integrity of the system and reduced the amount of printed reports which they generated.
Management had reviewed the decision concerning the need for an integrated payroll and labour costing module and decided to collaborate further with the software house to extend the original accounting system.

(c) **Use of Management Information: Successful**
Management and employees now rely totally on the information generated by the MIS and all old methods of bookkeeping and record keeping are no longer maintained. The output from the system was used in many situations where the company needed to provide information to the outside world (e.g. final balance sheet and trading accounts to the external accountant to approval; statements to clients and payment certificates to subcontractors).

The enquiry facilities were frequently used to answer the management questions regarding cost of particular jobs and amounts owed by creditors.

(d) **Enhancement of System Facilities: Successful**
The eventual success of making the system work to the benefit of the company was observed, when the management furthered the scope of the original system to include payroll, estimating functions and many applications of word processing.

Further evidence of success was attributed to the spread of actual users within the organisation to both secretarial staff, the managing director and eventually to a production director, who had hitherto been unconcerned with administrative systems. The initial accounting system was able to operate on a
daily basis without the continual support of the managing director, as had been necessary during early phases. The management information was thus obtained at the cost of lower skilled clerical staff with only supervisory intervention by the director. This situation was however only able to be possible on the basis of all participants having a considerable knowledge of the detailed software system and its application within the organisation.

9.3 Company Bl

9.3.1 Live Operation Phase

Company Bl was clearly successful in the achievement of a live operation stage, since the former visual record system was abandoned after only three months of implementation activity. As the confidence of the system grew, the company proceeded to evaluate reasonably well the operations of the system in the light of their usage and top management made effective use of the information given. However some serious problems were experienced by Company Bl when the software house chose to enhance the system facilities and operations.

Hence the researcher assessment of the live operation phase of company Bl was SUCCESSFUL, but with some reservations regard the experiences of system enhancement.

9.3.2 Reasons for Judgement

(a) Abandonment of old system: Successful

An early establishment of live operation of the MIS
was made possible in Company Bl with support being supplied, both from within the company and from the supplier. Being an early customer, the company received considerable assistance when required from the developers of the software, who were able to make up for the lack of detailed documentation. Later users (e.g. Company H1) of the same package, who had bought through a dealer intermediary, did not receive the same degree of personal support and were entirely dependent on the written documentation and their own skills and knowledge.

Dependence on the microcomputer-based MIS was a top management commitment and the appreciation, by those involved of the pioneering nature of the project, provided the impetus to abandon the unmaintainable former system.

(b) Evaluation and tuning of system operation: Reasonably successful

Management had clear ideas about how the information should be reported and took steps to ascertain how the system should most efficiently produce this. As the management learnt of the system model, they were able to reduce much of the volume of information generated, relying upon the exception reporting principle. The early end of year reporting requirement proved a suitable milestone, for the consideration of many aspects of the system's operation, but some modification of operations were forced upon the company when the system itself failed to function adequately (if at all) when the disk storage capacity was exhausted. Company Bl was able to draw on
expertise from the supplier and another known user where the written documentation was deficient in warning of such situations.

These early live operation problems could be attributed to the inadequate evaluation of the details of the package, limited sizing of the company data storage needs and a failure to assess the growth potential of the computer hardware. In this predicament however, the company had acquired sufficient system knowledge to be able to define adequately well some minor tailoring of the software, which the supplier were willing to do inexpensively for their early customers to maintain a good reputation. In a similar situation, a company later would find the supplier reluctance to make any changes, due to difficulty in maintaining support.

Timing of the processing involved with the full operation of the system was a feature not assessed during the evaluation of potential systems and Company B1 found themselves in difficulty to actually process the total company information requirements in the working time available. Again, skills of this nature are unlikely to be possessed without detailed knowledge of the routine working of the same system with similar data volumes. The company might have found it possible to do this by contact with another user.

Time and knowledge is necessary to establish a trust in the system itself. The company reached this point when it chose to reduce the printed reports of the system generated each month. This was early evidence
of some success for the system since the management were confident that the more detailed information was possible to retrieve should it be needed.

(c) **Use of Management Information:** Successful

The top management acknowledged many benefits from the use of the system. These were in the form of more reliable and accurate planning and budgeting for the company's future operations, up to date information on contracts and actual use of this information by staff involved, staff savings and a disciplined routine. Indeed it was noted that expectations of the quality of information had been considerably raised as a result of the system's operation and use.

The company found some variation in the way staff were able to adapt to the introduction of the system. The age of the staff appeared important in assessing the degree to which an early and careful involvement in the selection and implementation of the system should occur. The older clerical staff, despite knowing the detailed requirements and operations of the administrative section of the company, were less able to accept a sudden changeover in the method by which this was achieved; the younger staff however adapted to the change more efficiently in spite of a more superficial knowledge of the company information processing needs.

(d) **Enhancement of System Facilities:** Successful

The use of the system was extended to other small companies within the group, much smaller than they would have anticipated it being beneficial. The
company also extended the application of microcomputers in other areas of administration and management information, notably estimating (Company B2) and later word processing.

The trust relationship with the supplier was a source of problems, some 18 months after live operation commenced, when the company agreed to act as a test site for a rewritten version of the software. The resulting catastrophic events cost a great deal of management time, in an attempt to salvage a working system, which only a firm with sufficient knowledge and administrative slack to absorb the impact could survive. It was these skills and detailed operational knowledge of the company staff, which the supplier had hoped to take advantage of.

The company staff had lost the appreciation of the system model and needed to acquire the skills once more. The net effect was a re-implementation phase since all the activities of system conversion, testing and training had to be undertaken. The management did not appreciate the potential problems involved when the agreement was made.

9.4 Company B2

9.4.1 Live Operation Phase

Company B2 did not proceed to live operation of the MIS since the system was abandoned during the implementation phase.
9.5 Company C

9.5.1 Live Operation Phase

Company C took longer than anticipated to rely on the new MIS, in fact a small section of the manual system was never formally abandoned. The company however did successfully evaluate the actual operation of the system, since there was some evidence of a continuation of the problem of local authority payments which was eventually resolved. A major evaluation of the operation of the system occurred some two years after the original live operation, when a changing environment required this. Management showed much evidence of the use of the information generated within the company although the computer was not fully utilised in some other application, as was anticipated.

The assessment of the live operation phase for company C was that it was SUCCESSFUL.

9.5.2 Reasons for Judgement

(a) Abandonment of old system: Reasonably Successful

Company C's speed with which they reached live operation was only enabled by the involvement of outside skills and knowledge in the implementation phase.

Overall the company was unquestionably successful, since the benefits anticipated had actually been achieved and the system was fully operational in the company (with the exception of the managing director's lifeline of the manual sales ledger since he believed if all else failed the information of 'who the company was debtors were available').
(b) Evaluation and tuning of system operation: Successful

Considerable problems were found in the early stage of live operation, which could be traced back to the outside staff employed earlier. The real skills and knowledge acquired in the early efforts of implementation were not invested in the core staff of the company and thus when left to operate independently problems arose. Examples of this are found in the decisions made on the account structure by the accountant and supplier. At the time the management had to accept the decisions made on their behalf since they had no experience or knowledge themselves.

The needs of management in terms of skills are twofold, those associated with the operation of the computer and associated software which were provided to some degree of adequacy by the supplier and those associated with the use of the system to enable the anticipated benefits to be actually realised. Company C, like many other small companies, found itself to be lacking in the latter respect once the outside assistance was not at its disposal. Having invested all the skills in one operator, the company however lost this expertise through uncontrollable factors. Company C management was thus forced to take a real part in the system operation and found that their previous strategy had left them vulnerable to collapse at this point.

Many early decisions were able to be reassessed by management, on the basis of a much fuller picture of how the system operated, and what type of information needs the company management actually had. Both these
areas of knowledge were unavailable to the company when it was actually needed at the time of implementation. Company C found that they needed to reimplement the system, but practicalities of staff shortages and demands for ongoing information prevented this being a real option.

The lack of involvement with the accountants at the initial stages of implementation produced a problem of incompatibility of information structure at the end of the first financial year. Once more the knowledge of the capability of the software purchased to be able to produce the desired format for the accountants was only acquired after considerable use of the system, when the use of the information initially provided was being evaluated.

(c) Use of Management Information: Successful
In spite of the successful implementation phase, Company C was extremely vulnerable to the particular environment in which they operated and the early use of the installed system was hindered by the need to search for work for the company. The company thus failed to reap the full benefits of the MIS until a full year had passed.

(d) Enhancement of System Facilities: Reasonably Successful
Management extended the scope of the original system when faced with a mismatch of the requirements with system facilities. Other plans were made to use the computer to aid the company in estimating and a second set of hardware was purchased, but the company found that time and resources involved in the establishment
of such a system was unavailable in the prevailing economic climate.

9.6 **Company D**

9.6.1 **Live Operation Phase**
Company D did not proceed to live operation of the MIS during the research period since the company was still attempting to achieve a full system implementation.

9.7 **Company E**

9.7.1 **Live Operation Phase**
After a period of thorough implementation, the management achieved the abandonment of the manual system of bookkeeping when deciding to rely entirely on the information of the system. The outside advisor continued the substantial contribution to the company by establishing a evaluation of the processing operations and the information generated by the MIS. The system was not however fully used by management who chose to use the reports as backup to management intuition in many cases. The full application of the MIS was also restrained in the light of continued economic difficulties.

The overall assessment was therefore of a SUCCESSFUL live operation phase for Company E.

9.7.2 **Reasons for Judgement**
(a) **Abandonment of old system**: Successful
The abandonment of the former bureau based information system was gradually achieved on the instruction of the outside advisor. Company E were supported
throughout the transfer from implementation to live operation by the accountant although they found that they no longer needed the continual support of the supplier. The skills of use of the system were invested in three individuals within the company thus giving some degree of protection against the loss of key staff.

The subcontract requirements continued to be satisfied by manual generation of certificates although the associated contract costings were established as part of the MIS.

(b) Evaluation and tuning of system operation: Successful Tuning of the system requirements took place within the implementation phase which was thereby extended in elapsed time. The long term evaluation of the production of reports needed further time to elapse before judgement could be made although plans were made to do this after a full year's live operation.

(c) Use of Management Information: Successful
The production management continued to make use of the information without acquiring any detailed knowledge of the system structure. The company group accountant continued to use the system information for his auditing purposes. This is a risky situation since the detailed knowledge remains technically outside the company.

Some curtailing of the initial information needs was undertaken as the subcontractor reports were not being generated. The operational staff were reticent users and did not explore the system model to find unplanned
or unanticipated information benefits.

(d) **Enhancement of System Facilities**: Reasonably successful

No enhancement of the financial system's use was in evidence although this may occur after some longer period of use. The staff were well supported but lacked confidence in their own ability to extend the computer's application. Management had originally planned to use the computer for other database applications concerned with pricing of work but no evidence of this being achievable was available. The principal need was for skills in the ability to define management requirements and support in the search for a solution. The management found no slack in their time schedules to be able to undertake such tasks and hence the system remained underutilised.

### 9.8 Company F

**9.8.1 Live Operation Phase**

Company F did not proceed to live operation of the MIS since the company abandoned the development at the **Selection phase**.

### 9.9 Company G

**9.9.1 Live Operation Phase**

Company G did not proceed to live operation of the MIS since the company abandoned the development during the **Implementation phase**.

### 9.10 Company H1

**9.10.1 Live Operation Phase**

Company H1 did not proceed to live operation of the
MIS since the company abandoned the development during the implementation phase.

9.11 Company H2

9.11.1 Live Operation Phase

Company H2 management was split in the decision on whether to abandon the former manual information system and the result was that the smaller company became dependent upon the MIS, whereas the larger company failed to proceed to this stage. However the smaller Company H2 application did evaluate its performance reasonably well, particularly in the area of payment reconciliation and made requests to the suppliers for modification of the system. Management made only restricted use of the information generated in particular areas (e.g. contract costing) and remained interested but uncommitted to the extension of the system software by the suppliers.

The overall assessment of the live operation of Company H2 in the smaller application was of REASONABLE SUCCESS with some reservations.

9.11.2 Reasons for Judgement

(a) Abandonment of old system: Reasonably successful

Company H2 abruptly abandoned the old clerical system forcing complete dependency on the implemented system after only a few months. The knowledge and experience of the owner/manager of the smaller company was able to support this decision, together with his very forceful personality.
(b) Evaluation and tuning of system operation:

Unsuccessful

The area of cash flow management was critical, as expected, and the company management concentrated the effort of system evaluation and tuning in this area. Several suggestions were made to the supplier regarding the speed of operation and the flexibility of the procedures involved. The close relationship with the supplier enabled this and the owner/director was able to define a specialised report written specifically for the smaller company H2. The live operation did not follow the normal cyclical processing routine of monthly accounting periods, as the company operated in a very unstructured manner, entering large amounts of data in one session without resort to the generation of the reports available. Only a particularly flexible software package would enable this manner of operation and the small company was unable to reap the information benefits of such effort until some time later. Management were forced to operate in this manner, as the administrative slack was limited and periods of intensive activity followed by little use was normal in any system.

(c) Use of Management Information: Reasonably successful

The management did not engage in any detailed consideration of the information provided, using the computer more for the storage of data which might later be required. Some reports were well relied upon (e.g. VAT reports) whereas others were completely underutilised (e.g. contract cost reports). The company was committed to computer-based information and continued to use a collection of non-integrated
## LIVE OPERATION

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B1</th>
<th>B2</th>
<th>C</th>
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<th>E</th>
<th>F</th>
<th>G</th>
<th>H1</th>
<th>H2</th>
</tr>
</thead>
<tbody>
<tr>
<td>a: Abandonment of former system</td>
<td>S</td>
<td>S</td>
<td>-</td>
<td>R</td>
<td>-</td>
<td>S</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>R</td>
</tr>
<tr>
<td>b: Evaluation/tuning of system operation</td>
<td>S</td>
<td>R</td>
<td>-</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>U</td>
</tr>
<tr>
<td>c: Management use of information</td>
<td>S</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>R</td>
</tr>
<tr>
<td>d: Enhancement of system facilities</td>
<td>S</td>
<td>S</td>
<td>-</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>R</td>
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### LIVE OPERATION JUDGEMENT

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<th>F</th>
<th>G</th>
<th>H1</th>
<th>H2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>R</td>
</tr>
</tbody>
</table>

**Key**

- **S** = successfully achieved / undertaken well
- **R** = relatively successful
- **U** = unsuccessful / badly undertaken

---

**Table 9.12a  Functional Activities of the Live Operation Phase**
software to achieve the company's needs.

(d) Enhancement of System Facilities: Reasonably successful

The owner/manager considered the extension of the system to include an integrated payroll but the split decision with regard to the main company prevented the purchase of such software. A demonstration package was loaned from the supplier but, without the assistance of the former student employee, time prevented the company from establishing a payroll for evaluation.

The owner/manager was interested in many potential applications (e.g. spreadsheet and data management requirements) for the further use of the microcomputer which was not operated for much of the available working time, but was unable to devote the time necessary to explore the full implications.

9.12 Conclusion

The results of the evaluation of the live operation phase of the five small companies who reached that phase are tabulated in Table 9.12a shown opposite.

Four companies were evaluated as successfully operating on a live basis having completed the MIS development during the research period. Only one company (Company H2) was not fully successful in the live operation phase, all others having abandoned or not progressed further than implementation. The overall evaluation of success is presented in Part Ten which also differentiates between the features of the successful companies and the less successful ones.
PART TEN  ANALYSIS OF THE CASE STUDY EXPERIENCES

10.0 Summary

This section summarises the analysis of the experiences of the ten small companies throughout the MIS development. The companies are divided according to the success achieved and features of both the successful companies and the unsuccessful companies are drawn out. The section also contains the paramount issues concerned with the problems and experiences of the small companies.

10.1 Case Study Analysis

The ten small companies clearly varied in the structure and business environment within which they operated, the nature of the information system which they developed, and the process which they undertook to achieve this development. These three aspects of the information system development were found to be influential in the small companies' ability to satisfactorily perform the basic functions of the system selection, implementation and live operation. Each phase of information system development was evaluated by the author on the basis of the extent and ease with which the companies were able to fulfill the fundamental developmental requirements previously shown in Table 6.2a.

The results may be summarised as follows:

Four companies proceeded to a successful live operation of the information system during the five year period of research.

Five information system projects were abandoned during either the selection or implementation phase.

One other company continued to try to achieve live
operation but experienced serious difficulties.

The degree of overall success for each company's information system development was assessed on the basis of having been successful, in the selection, implementation and achieving a live operation of the information system. A summary analysis showing the categorisation of each company's information system development profile is shown in Table 10.1a which follows. These groupings of the companies are used later in this section to identify the common features of organisational context, information system application and system development process and issues raised in similar companies.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Selection</th>
<th>Implementation</th>
<th>Live Operation</th>
<th>OVERALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>B1, B2, E</td>
<td>A, B1, C, E</td>
<td>A, B1, C, E</td>
<td>A, B1, C, E</td>
</tr>
<tr>
<td>Reasonably Successful</td>
<td>A, C, D, H2</td>
<td>H2</td>
<td></td>
<td>H2</td>
</tr>
<tr>
<td>Unsuccessful</td>
<td>F, G, H1</td>
<td>B2, D, C, H1</td>
<td>H2</td>
<td>B2, D, F, G, H1</td>
</tr>
<tr>
<td>Abandoned</td>
<td>F</td>
<td>B2, C, H1,</td>
<td>H2*</td>
<td></td>
</tr>
</tbody>
</table>

* = H2 partially abandoned the MIS during live operation by proceeding only with a subsidiary company

Table 10.1a Analysis of Each Company System Development Experience by Phase

The achievements of each small company were ranked in order of success by considering the performance in each phase of the development. Success or failure of achievement is clearly a relative judgement, made only in a particular context and when related to specific judgement criteria. The four overall successful companies therefore varied in
|                  | A | B1 | B2 | C | D | E | F | G | H1 | H2 |
|------------------|---|----|----|---|---|---|---|---|---|----|----|
| **SELECTION**    |   |    |    |   |   |   |   |   |   |    |    |
| a: Determination |   |    |    |   |   |   |   |   |   |    |    |
| of requirements:|   |    |    |   |   |   |   |   |   |    |    |
| identification of problem area and system objectives | S  | S  | S  | U | U | S | R | U | R | R |    |
| assessment of mandatory and desirable information needs | S  | R  | S  | R | R | S | S | U | R | S |    |
| sizing of data storage | S  | R  | R | S | R | S | R | R | U | U | S |
| b: Selection of system: |   |    |    |   |   |   |   |   |   |    |    |
| location of potential systems | R  | R  | S  | S | R | S | U | U | U | R |    |
| evaluation of alternatives | S  | S  | R  | U | U | U | U | U | R | R |    |
| negotiation with supplier | S  | S  | R  | R | S | U | R | U | S |    |
| selection time (in relation to plan) | R  | S  | R  | S | S | U | S | S | S | R | U |
| **SELECTION JUDGEMENT** | R | S | S | R | R | S | R | U | U | R |    |
| **IMPLEMENTATION** |   |    |    |   |   |   |   |   |   |    |    |
| a: Installation of system | R  | R  | S  | S | R | S | - | S | S | S |    |
| b: Implementation time (in relation to plan) | U  | S  | U | R | U | S | - | U | U | U |    |
| c: Training: |   |    |    |   |   |   |   |   |   |    |    |
| general system appreciation | S  | S  | U | S | R | R | - | R | S | S |    |
| routine operating skills | R  | S  | U | R | R | R | - | R | R | S |    |
| non-routine operating skills | R  | R  | U | U | U | R | - | U | R | R |    |
| d: System conversion: |   |    |    |   |   |   |   |   |   |    |    |
| data capture/encoding | S  | S  | U | S | R | S | - | U | S | S |    |
| master/library file creation | S  | S  | U | S | R | S | - | R | R | S |    |
| establishment of working system | R  | S  | U | S | U | S | - | U | U | S |    |
| e: System testing: |   |    |    |   |   |   |   |   |   |    |    |
| trial processing | S  | S  | R | U | R | S | - | R | U | S |    |
| reconciliation with requirements | S  | R  | R | U | U | S | - | U | U | S |    |
| **IMPLEMENTATION JUDGEMENT** | S  | S  | U | S | U | S | - | U | U | R |    |
| **LIVE OPERATION** |   |    |    |   |   |   |   |   |   |    |    |
| a: Abandonment of former system | S  | S  | - | R | - | S | - | - | - | R |    |
| b: Evaluation/tuning of system operation | S  | R  | - | S | - | S | - | - | - | U |    |
| c: Management use of information | S  | S  | - | S | - | S | - | - | - | U |    |
| d: Enhancement of system facilities | S  | S  | - | R | - | R | - | - | - | R |    |
| **LIVE OPERATION JUDGEMENT** | S  | S  | - | S | - | S | - | - | - | U |    |
| **OVERALL PROJECT JUDGEMENT** | S  | S  | U | S | U | S | U | R | U | R |    |

Key:
- S = successfully achieved / undertaken well
- R = relatively successful
- U = unsuccessful / badly undertaken

Table 10.1c Functional Stages in the Information System Development
the degree to which they were successful in achieving the functional requirements of information systems development. All had some difficulties of varying importance but they were able to make compensations for unfavourable circumstances or weak decisions to secure overall success. The cases of failure themselves also varied with the problems they met, and were seen to be unable to take successful action to remedy the situation. Table 10.1b below shows the company success/failure judgements of the researcher in rank order. The full evaluation results of each company's performance in undertaking the essential tasks of each development phase are shown in detail in Table 10.1c shown opposite. The basis of the judgements reached are developed fully in the section 10.4 onwards.

<table>
<thead>
<tr>
<th>Rank Position</th>
<th>Company</th>
<th>Selection</th>
<th>Implementation</th>
<th>Live Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>2</td>
<td>C</td>
<td>R</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>3</td>
<td>B1</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>4</td>
<td>A</td>
<td>R</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>5</td>
<td>H2</td>
<td>R</td>
<td>R</td>
<td>U</td>
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<td>6</td>
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</tr>
<tr>
<td>10</td>
<td>H1</td>
<td>U</td>
<td>U</td>
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</tr>
</tbody>
</table>

Key
- S = successfully achieved / undertaken well
- R = relatively successful
- U = unsuccessful / badly undertaken

Table 10.1b Rank Order Analysis of Phased Company Performance
10.2 Reader Analysis

The possibility of bias of the researcher was checked by asking several eminent information systems academics and practitioners to review the company experiences and, on the evidence given (see Appendices A-H2), make a judgement of the degree of success or failure in each phase for each company involved. Whilst it was not possible to enable these external readers to experience the same intensity and detail as the researcher, no research judgements were recorded in the description of events supplied and only the opinions of the participant companies themselves were recorded. The researcher's own judgements were thus isolated from those of the readers in an attempt to check on the possibility of bias arising. The Table 10.2a below gives the distribution of the reviewers' assessments of the performance for each phase of development of the companies' information systems and indicates a large degree of agreement on the overall assessment of the company performance and experiences.

<table>
<thead>
<tr>
<th>Company Phase</th>
<th>A</th>
<th>B1</th>
<th>B2</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H1</th>
<th>H2</th>
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</thead>
<tbody>
<tr>
<td>Successful</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>4</td>
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<tr>
<td>Reasonably</td>
<td>5</td>
<td>6</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Successful</td>
<td>1</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 10.2a The Distribution of Reviewers' Assessments

The reviewers' overall judgements also proved to be closely associated with the evaluation judgement made by the researcher as is indicated by the Variance column in Table 10.2b, following. A detailed explanation and analysis of the correlation between the judgements of the researcher and
the readers is found in Appendix J.

<table>
<thead>
<tr>
<th>Company</th>
<th>Ranking Reviewer</th>
<th>Ranking Researcher</th>
<th>Variance</th>
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<tr>
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<tr>
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</tr>
<tr>
<td>H1</td>
<td>9</td>
<td>10</td>
<td>-1</td>
</tr>
</tbody>
</table>

Table 10.2b Comparative Ranking of Companies by Reviewers and Researcher

10.3 The Route to Information System Development Success

An examination of the differences in the achievements of the companies over the three phases of system development, indicates that the final successful company need not have been previously considered successful in the initial selection phase. The data indicates it was also possible to retrieve a successful information system development position by a company from only a reasonably successful initial selection.

Companies B1, B2 and E were the most successful in performing the activities of determination of requirements and subsequent selection of a suitable system. Companies A, B1, C, and E however finally achieved an effective successful live operation following a successful period of system implementation. Company B2 was initially successful
but found unsurmountable problems of implementation whereas Company A was able to compensate for some degree of difficulty in the selection phase, by a successful implementation reaching an effective information system operating live.

Thus it is by no means certain that a company, who starts off well with all the advantages of organisational infrastructure, determining the systems requirements and leading to the adoption of a successful system solution, will eventually lead to an overall successful implementation and live project. The functional requirements of the implementation phase also need to be successfully accomplished to be overall successful. Companies A and C were both able to retrieve a potentially hazardous development after a weak selection.

Table 10.3a The Information System Development Route of the Ten Small Companies

The most critical phase was the implementation phase since these were the activities, in which companies were able to improve on earlier weaknesses in selection or, deterioration in the ability to undertake essential conversion and training functions lead to the final abandonment of a
previously successful or reasonably successful selection. The route by which each company progressed with information system development is therefore important and is shown in Table 10.3.a above.

The categorisation of the small companies shown in Table 10.1.a previously, forms useful data sets for further examination to identify similar features of organisational circumstance, strategies adopted for information system development and the nature of any problems overcome. In many cases, the common features raise important issues with regard to the effect on information system development success, had these features been absent. The cases have been examined therefore, phase by phase, through the development of the information system to draw out the major issues, whilst it is recognised that others are possibly still embedded in the case material.

10.4 The Profile of Successful Companies and the Issues Raised

Four companies (Companies A, B1, C, and E) were judged to be an overall success on the basis of the effective use of the information by the management, the extension of the system to other application areas and users, and the abandonment of the former system.

10.4.1 Selection Phase Successful Companies (B1,B2,E)

(i) Level of Economic Stability

The overall level of economic stability of all three successful companies was able to support the desired organisational change. Company E was a relatively new company, with a buoyant demand for its services, but it operated within a stable group of related
construction companies. Company Bl and B2 were more stable in the level of construction activity, although the market for their services became more competitive during the early 1980's. The stability of the economic environment in the successful companies enabled them to be able to establish the desired goal towards which they wish to progress and also supported them in their undertaking of such fundamental organisational change.

ISSUE 1: How can a small company, planning to introduce innovation in the form of information technology, ensure the necessary stable and supportive environment throughout the process?

(ii) Assessment of Needs and System Objectives
Each company had clearly identified a specific problem area and been able to establish company objectives for introducing the microcomputer system. The management of Company Bl were able to draw on internal experience of formalised information system, in most cases this was computer related. The existance of a formal administrative system, with established business procedures and data collections routines, presents a good framework on which to define system needs.

ISSUE 2: How can the small organisation with an inherently flexible, informal administrative system define its needs for a formal, computer-based information system?

(iii) Consideration of Feasibility
The successful companies adopted a definite strategy of conducting an independent feasibility study of the
proposed change in information system. Specification of requirements for information and the estimated costs and benefits were drawn up and considered by management in all three companies. The assessment of feasibility was based primarily on economic considerations.

**ISSUE 3:** How are small organisations, with limited skills and knowledge of the area of information systems and scarce management time available, able to ensure sufficient attention is given to the analysis of the problem area and assessment of their requirements to solve such problems?

(iv) **Internal Level of Skills and Knowledge**

The management of all three successful companies were highly committed and involved in the activities of defining the information requirements and selecting a system to meet these. A period of at least six months of internal assessment of information needs and review of the construction industry computing market was undertaken by the management, having first discounted the possibility of being able to find a solution in the general business market. The managements all recognised a severe lack of internal skills and knowledge in the tasks of the selection phase.

When faced with a system demonstration given by a potential supplier, the companies needed considerable knowledge of the desired information requirements, in order to assess both the feasibility and suitability. An inexperienced small company is in danger of being tempted into defining requirements on the basis of the facilities of the first system.
demonstrated by persuasive sales staff, with little knowledge of the company itself.

ISSUE 4: How can deficiency of skills and knowledge of the small company be compensated for in any negotiations with suppliers?

(v) Role and Choice of Outside Advisor

The management of all the three successful companies relied heavily on, and were directed by, an outside advisor/consultant, who undertook to identify alternative solutions and make recommendations on the most suitable available alternative. Companies B2 and E adopted the strategy of formally appointing a consultant to provide the skills, knowledge and time which was unavailable from within the organisation. Company B1 liaised with a university department but felt they had sufficient skilled resources internally not to make that agreement formal and contractual.

Two common problems were experienced by the companies.

Firstly, the problem of locating the specialist system providers was raised. The construction industry is a fluid and dynamic industry with a high bankruptcy rate and small companies enter and leave the industry at a high rate since relatively little capital investment is necessary. The small firms were relatively isolated and guidance on the introduction of computers is difficult to afford and locate.

ISSUE 5: How should the small organisation make an appropriate choice of advisor?
Secondly, the relationship between the outside advisor/consultant was difficult to establish in the small organisations. Independent advice was sought, but reliance on external participants produced long term problems, since the skills and knowledge were not established internally, and end user involvement and commitment were less firmly established.

**ISSUE 6:** What is the best balance between internal and external sources of advice?

**(vi) Administrative and Managerial Slack**

The three successful companies experienced some difficulty in releasing sufficient management time to participate themselves in the tasks assigned to the outside advisor/consultant. Activity was frequently disrupted and the lack of continuity of management involvement placed the companies in positions of reliance on the external professional skills and knowledge. Company Bl was very fortunate in retaining a relatively large staff and management overhead which enabled management some degree of freedom to pursue the selection activities without pressure. Company E was unable to meet this need from within and was compelled to rely on the services of the outside advisor for a significant contribution.

**ISSUE 7:** How can a small organisation with little management and administrative slack fully participate in information systems development?

**(vii) Management Planning Skills and Background**

The three successful companies in the selection phase consciously planned for the tasks involved and set
targets, which were realistic in relation to the organisation resources available. This overt recognition of the complexity of the activities required by the organisation, to achieve such a change, was largely based on professional management experience.

ISSUE 8: How can the small organisation ensure it has sufficient necessary management skills to recognise and embark satisfactorily on an information system development process?

10.4.2 Implementation Phase Successful Companies (A, B1, C, E)

(i) Implementation Support

All the successful companies in the implementation phase were able to establish a close contact with the chosen system suppliers. They relied heavily on this relationship during the early decision making activities concerning the system structure to be implemented in their organisation. In each case, the company was one of the initial twenty clients of a recently established software developer. There was a close correlation between the amount of advice and guidance given by the supplier in this phase and the relative position of the company on the client list. When the company lacked expertise internally, this continued high level of accessible support was of considerable importance in establishing a successfully implemented system. Company A was fortunate in the establishment of a strong supplier support relationship to their mutual advantage. The existence of such knowledgeable support throughout the implementation period generated a feeling of
confidence which was later built on.

**ISSUE 9:** Where can a small organisation obtain such extended implementation support?

**ISSUE 10:** How much support can be expected from the supplier, considering the overall budget for the information system is likely to be restricted?

(ii) **Transitional Strategy**

The management of the successful companies established realistic implementation plans, for the conversion of the former company data records to the proposed information system in view of the resources available to them. This enabled them to control the difficult implementation period. Company C soon experienced severe difficulty in keeping to their targets and found the need to devote considerable extra skilled staff to maintain the desired progress. Company A chose to allow the time period involved to be extended, when planned work was not achieved on time. The management of all the successful companies were highly disciplined in their approach to implementation.

The companies found the changeover of a continuous process required considerable planning and monitoring to ensure a smooth operation. Where the management experienced considerable boundary spanning activities with clients and suppliers this was a difficult requirement. Problems of dual operation of manual and computer systems and actual synchronisation became an extra burden, in Company A in particular. Company C management detected problems of progress and decided to draw on outside expertise, to enable them
to achieve the implementation as planned. The
success of this decision depended upon the location
of suitable staff and incurred the extra cost burden
in addition to the loss of some degree of control
over the system's implementation.

ISSUE 11: How can a small organisation balance the need to
maintain two systems for testing purposes with the
resultant strain on the organisation?

(iii) Management System Training
In all the successful companies the training was
initially undertaken by the senior management, who
had been concerned with the selection of the system.
The nature of this training was primarily the basic
operation of the microcomputer and the installed
software. The business procedures were left to the
management themselves to design and establish. The
contribution of the previous experience with a formal
information system enabled these procedures to be
established to suit the company not the computer.
Company C, who lacked a previously formal system,
changed the advisor concerned during this phase when
they faced a deficiency in expertise in the area of business procedures and implementation
strategy.

ISSUE 12: The source of skills and knowledge is a critical
factor in the success of the implementation phase for
the small firm. How, and from whom, are such skills
to be obtained?

(iv) Staff training
Clerical staff who were intended to operate the
system were only involved after some expertise and
support had been established by the management themselves. Companies A, B1 and E were able to reinforce their understanding of the internal system model by a slow training programme. However, due to the competitiveness of the microcomputer system market, the suppliers of systems lost some interest in, and incentive to provide, such a high level of support over an extended period of implementation.

ISSUE 13: How can a small organisation, with limited resources, secure the necessary technical and business skills to successfully implement an information system, when faced with a highly competitive supplier market?

(v) System Conversion
The data capture techniques required to establish the master files or data base were already present and in suitable form for direct conversion in all the successful companies. Companies B1 and E had been previously using a computer system in a limited way and therefore had suitable data already encoded, making it unnecessary to design new code structures for data. Companies A and C had formal manual systems which were relatively easy to convert.

ISSUE 14: How do small companies with flexible systems and limited skills and knowledge establish the most appropriate data coding structures for the information requirements needed?

(vi) Resource Level
The extra resources required for the implementation activities were essentially management supervision and administrative staff time. The successful companies were able to provide these by absorption of
organisational slack from within the company, working extra hours by management and owners or employing temporary staff from outside the organisation. The presence of slack, particularly administrative, within a company minimised the strain on the companies and was essential in the case where the company chose to undertake in-house collaborative system development.

(vii) System Development Strategy
Specialised software development for a small company, as undertaken successfully by Company A, but unsuccessfully by Company B2, generated organisational problems particularly if the requirements are fuzzy and not formally built into a contractual agreement.

ISSUE 15: How are small organisations, who are accustomed to flexible business procedures, to sufficiently formalise these in order to establish a clear specification of requirements?

(iiix) Timing of Implementation
The successful companies timed the implementation activities to coincide with the commencement of the new financial year and operated a parallel run for a limited and short period of time. This strategy minimised the strain on the organisation but required high staff input of time, knowledge and skills to achieve sufficient, not extensive, system testing and reconciliation of results. The successful companies accepted a close match of system requirements, in order to operate on a live basis at the earliest comfortable date.
ISSUE 16: When small organisations are dependent upon other external bodies for the provision of starting data, and are advised to run a dual system to a point of full reconciliation, the company is frequently placed in a self-defeating situation if resources are scarce.

(iix) Software System Structure
The use of skeleton system structures, which are then customised to fit requirements, was adopted by the system suppliers in all four successful cases. The use of such structure may not provide the most suitable and effective information for the organisation in the long term, but they provide a firm foundation on which to build. Identifying deficiencies requires considerable knowledge of the system facilities and the internal model of the software at an early stage. Once committed to a particular manner of working, the task of restructuring the implemented system demands retraining, conversion of stored data and a full reassessment of the environment and information provided.

ISSUE 17: How can the small company management, lacking in appropriate time, skills and knowledge, judge where the provided structure fails to meet their needs?

10.4.3 Live Operation Phase Successful Companies (A,B1,C,E)
Only four companies (A,B1,C,E) were judged as successful in the live operation phase and were those evaluated as successful overall.

(1) Disciplined Routines
All four companies had firmly established a
disciplined approach to the use of the information system within the organisation. The business procedures, system knowledge and skills were established internally during the implementation phase and the companies placed a high degree of importance on the maintenance of business routine.

(ii) System Effectiveness

The systems concerned were generally not fully utilised, in all the facilities envisaged by the software developers, and although the management were aware of their possible further effectiveness, a restricted operation was accepted in order to ensure control of the system within the organisation. The management accepted that to operate the system at maximum effectiveness many extra resource and skill demands would be incurred. The issues of lack of skills and knowledge and the need for organisational slack would reappear when the companies need to replace or extend the system, as occurred in Company B1 and was expected to occur in Company E.

(iii) Long Term Support

All companies continued to receive a high level of support from an outside advisor or professional person within the organisation. Thus further tuning and evaluation of the system operation and the match between structure and the organisation's objectives could be periodically undertaken.

(iv) Supplier–Company Relationship

A sound relationship with the system suppliers or developers was also a feature of the successful companies throughout the live operation phase. All
companies were called upon by the suppliers at some point to act as a reference site for potential customers, an indication that the supplier judged them as successful. Systems are rarely sufficiently transparent in structure to enable even a knowledgeable purchaser to make accurate estimates of data storage, in order to make a suitable choice of hardware. The trust relationship established with the supplier is a critical factor when evaluating the adequacy of such a decision long term.

(v) Economic Environment

The economic environment of the four companies continued at a lower but stable level throughout a difficult recession period. This was achieved by considerable management activity to diversify into other related types of construction business. When the circumstances of the organisation changes, as is inevitable, the same needs of extra resources, skill levels, planning and control are repeated. The dilemma arises when the small organisation must change from the working system it knows well to keep up with the information technology progress.

(vi) System Responsibility

The operating responsibility of the system was transferred to a trained clerical assistant, who could devote full attention to the procedures involved, without fear of being drawn into other activities as the management would be. However, having been the person to be initially trained by the supplier and successfully implement the data base and procedures, the role of a system manager was
FEATURES OF SUCCESSFUL COMPANIES

Organisational context

1. Considerable administrative slack within the company. *
2. High professional skill level of management involved. **
3. Recent related previous systems experience *
4. High management commitment level in the face of immediate need.
5. Low boundary spanning activities of management involved in selection
6. Stable economic environment ensuring continued demand for products

Application context

1. Small gap in functions between old and new system. ****
2. Company data was already available in a suitably coded format.
3. No pressure was exerted on the company to become operationally live too soon.
4. Technological solution was simple and proven.
5. Software solution was simple but flexible
6. Supplier support was on hand when required

System development process

1. A carefully planned strategy to introduce a clearly specified organisational change. ****
2. Outside advice and support ****
3. Training was gradual ****
4. Reconciliation of short period of results ****
5. Clear assessment of needs ****

Evidence of Information System Success

1. Gained an early understanding of the system model of the software. ****
2. System was able to be flexibly extended to match needs ****
3. High user confidence ****
4. Management use of information generated ****

Key * = feature present in company experience
- = feature not applicable since company failed to reach this stage

Table 10.4a Common Features of the Successful Companies
effective in all the successful companies. Thus there was at all times a source of expertise and knowledge within the company to deal with any further problems arising.

ISSUE 18: How does a small organisation deal with extreme vulnerability surrounding an employee who possesses the skills and knowledge and therefore access to the total company information?

(vii) System Model

Finally a sound system model was acquired by all operating staff which provided a sound knowledge base for the understanding and rectification of system errors and other problems.

In summary successful companies were found to have the several common features as shown in Table 10.4a shown opposite.

10.5 Reasonably Successful Companies

The performance of several companies varied during the system development period. Company A and C were only reasonably successful in the selection phase but during the implementation phase were able to become more effective, leading onto a successful live operation in the end. Company H2 maintained a level of reasonable success throughout all the phases whilst Company D deteriorated in its achievements after a reasonably successful selection phase. In contrast Company C deteriorated during the implementation phase.

Examination of these fluctuating companies has enabled several common issues to be drawn out. These are described in the section that follows.
System Development Strategy

Company A was required, by the nature of their collaborative effort, to formally identify system objectives. Small organisations' work patterns are frequently informal, undocumented, and flexible. This context means that small organisations are likely to omit or weakly define objectives at the commencement of system design, leaving no possibility of measuring the effectiveness at a later date.

Management Background

Small company management are unlikely to possess the required analytical skills and business and systems knowledge, to specify precisely the functions of software in sufficient depth for development. Management of Companies H2, C, and D had a craft background rather than formal management skills.

Vertical Markets

Vertical market software is less well publicised than general business software. The small firm owner/manager is more likely to conduct a search for a system in the immediate vicinity of the company operations and may not become aware of the provision of specialist industry software until it is too late.

Management Commitment

Considerable management time and commitment is involved in the evaluation of alternative solutions to the company problems. Small firm management normally work in excess of 80 hours/week leaving very little free time to dedicate to this extra function, due to a wide range of boundary spanning activities and little administrative slack within the organisation.
(v) **Outside Advisor**

Where an outside advisor is drawn in, as in Company D, to provide the needs of management but has no detailed experience or knowledge of the specialist information systems in a particular industry the danger of being left vulnerable is a matter of concern to the small firm.

(vi) **Internal Skills and Expertise**

Companies A, D and C found difficulty in facing an immature vertical market in the specialist industry concerned. The lack of internal expertise was thus a contributory weakness when selecting a system. The difficulties of those concerned with the small organisation to identify the real problem areas of information when faced with ready made solutions in the form of ready made packages.

(iii) **Prototyping Development Strategy**

Prototyping as an approach to the design and implementation of systems requires a firm commitment from the company. The small company, such as Company H2, has few of the skills and knowledge necessary to evaluate the performance of the prototype and little time to undertake the necessary iterative process of design and reimplementation involved in prototyping.

10.6 **Unsuccessful Companies**

This section examines the companies who abandoned the information system development either in the selection or implementation phase, to identify similar features of organisational circumstance, strategies adopted for
information system development and the nature of any problems faced. Once more the common features of some cases raise important issues with regard to the effect on information system development success.

Companies A, C, D, and H2 had some degree of difficulty with some selection activities whilst Companies F, H1 and G were judged to be unsuccessful since they did not proceed to live operation.

10.6.1 Selection Phase Unsuccessful Companies (F,G,H1)

(i) Economic Environment

The three least successful companies in the selection phase were operating in a very unstable and unpredictable economic position at the time, with consequent cash flow difficulties in a specialised construction market. Management were thus under severe pressure to maintain the viability of the company and activity at the boundary of the organisation was demanding. The essential high level of management and staff commitment to the investigation of the problem area, determination of needs and location of a solution was a considerable extra strain.

ISSUE 19: When the responsibility for the long term company survival and the activities of MIS development are simultaneously invested in the same individuals, how can the small organisation perform the necessary activities adequately and without detrimental long term strain?

(ii) Trigger of Information System Development

The initial conception of the proposal to introduce a computer based system was prompted in two companies
(F and H1) by an outside contact with the computing industry. Consideration of the feasibility of such an organisational change at the time was neglected in the spontaneity of the decision. Hence the real problem area was not investigated in the unsuccessful companies. The motives were not related to the problems experienced in Company G, who purchased for tax savings reasons, and Company H1, who acquired the system from a position of technological curiosity.

ISSUE 20: Where does the small organisation acquire the advice on when and where information technology can be beneficially introduced?

(iii) Level of Internal Skills and Knowledge

The location of the system solution was undertaken without the support of any outside advisor in two cases (G, H1) in spite of the acknowledged deficiency in the internal skills and knowledge concerning such systems. Each company only viewed one commercial system prior to the decision to purchase and a reference site was not investigated to confirm the fitness for the desired purpose.

(iv) Management Background

Management of all three companies were essentially craft or production oriented, with little experience of the administrative aspects of company operation. There was thus a tendency to allow a backlog of administrative tasks to build up under the pressure of lack of clerical assistance and, in some cases, to be uncommitted to change. Company F and H1 had some structure in the current information system whilst Company G had none at all. The magnitude of change
desired within the organisation was thus considerable in all the unsuccessful companies. The problem arises when the management of small companies operate a flexible division of responsibility and therefore find it difficult to draw together the requirements of all areas.

(v) Company Expectations

There was evidence of very high expectation of the effect of the information technology revolution by the management of the unsuccessful companies and the aspirations of achieving a new, all powerful system to solve their problems of lack of resources and time was common to all three.

ISSUE 21: How are small organisations, with little relevant experience to draw on, able to distinguish between the exaggerated claims of the computer system suppliers in competition with each other?

10.6.2 Implementation Phase Unsuccessful Companies

(B2,D,G,H1)

Company F failed in the venture at the selection phase and did not proceed further. Company G and H1 proceeded to attempt implementation on the basis of a previously unsuccessful selection phase and Company D suffered severe delaying difficulties in the implementation of the system.

(i) Organisational Circumstances

As with the selection phase the unsuccessful companies continued to be under economic strain in their attempts to maintain sufficient work for the company. Lack of administrative slack exerted
further pressure when two systems were being operated in parallel. Little outside support was available and all companies found it a time problem to take advantage of what training and support was available. Such contextual features set the scene for poor achievement of progress throughout the implementation.

(ii) Planning Difficulties
The companies were all unaccustomed to organisational planning, with respect to the new experience of system implementation and found difficulty in setting realistic targets, which could be achieved in the time expected. Company D and B2 struggled for some time with the resources available, whereas Companies H1 and G tried to draw in the extra needed from outside. The problems of the latter strategy were soon felt in that the skills acquired were not fed back into the organisation. The planning of interfaces between external participants, such as accountants, to meet the requirements at the critical times can result in a stop-go implementation route which had detrimental effects on training and morale.

(iii) Out of date Present System
The unsuccessful companies were not up to date in the operation of the present systems and therefore the necessary company data was not available for conversion into the new information system format. There were problems of retrospectively collecting data for the new information system when the records were not available.
(iv) **Training Difficulties**

Training in the unsuccessful companies was uncompleted due to the demands on management time. The training supplied to Company H1 was limited to the initial demonstration whilst further training was undertaken outside the company at the supplier's premises. Companies G and D had basic training for operation but not for the use of the information within the organisation and both companies failed to take full advantage of the supplier's support in this request. Training is an essential but labour-intensive element of information system implementation which was overlooked or underestimated by both the supplier and the company.

**ISSUE 21:** Where and in what form should training take place in small organisation information system development? Small organisations find it difficult to spare the time and resources to take full advantage of training and suppliers find it uneconomical to provide suitable, evolutionary training on the site of the user.

**ISSUE 22:** The issue of training difficulties becomes more important as the trend is towards more specialised, flexible and complex microcomputer software.

(v) **MIS Strategy**

The approach to system testing made by Companies G, D and H1 was to check large sections of the system with large volumes of retrospective data. The companies were thus unable to isolate discrepancies by step-wise validation of each transaction input. Only Company B2 started to check the system by this technique using a test contract.
(vii) Management Commitment Levels
Companies B2, G and H1 suffered from a problem of ensuring adequate commitment from both the management and those responsible for the implementation. Small companies have little opportunity to match aptitude of individual staff members to various tasks involved, a position which the larger organisation is less likely to find itself.

(iiix) Low Business Skill Levels
The continued lack of internal business accounting skills was apparent throughout the unsuccessful implementation in the four companies. The companies generally chose not to use external assistance and eventually this was a significant factor in their inability to sort out the problems they faced. Small companies have traditionally not supported such skilled staff and subcontracted their requirements periodically.

(iix) New Technology
The quality control of microcomputer hardware and software has often been left to the first users of the product. The small firm faced with the need to rely on an emerging technology has neither the skills nor the administrative slack to undertake such a function. Companies H1, G and D all found themselves in this position.

10.6.1 Live Operation Phase Unsuccessful Companies (H2)
The only company to achieve live operation but which still lacked success by the criteria established in Part Six was Company H2. The circumstances of the
### FEATURES OF FAILURE CASES

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<td>4. High degree of boundary spanning activities</td>
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<td>5. Economic pressures demanding high management input</td>
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### Application context

| 1. Lack of formal information reporting structure | * | * |
| 2. High expectations of computer system facilities | * | * | * |
| 3. Complex technological solution | * | * | * |
| 4. Complex system solution | * | * | * | * | * |

### System Development Process

| 1. No consideration of economic or operational feasibility | * | * | * |
| 2. Reliance on internal skills and knowledge | * | * | * |
| 3. Limited training/habilitation of system | * | * | * | * | * |
| 4. Extended backdating of system data | * | * | * | * | * |

### Degree of MIS failure

| 1. Failure to achieve expected implementation progress | * | * | * | * |
| 2. Limited use of system facilities | * | * | * | * | * |
| 3. Mismatch of facilities and needs | * | * | * | * | * |
| 4. Early abandonment of system | * | * | * | * | * |
| 5. Early discovery of system limitations | * | * | * |

**Key**
- * = feature present in company experience
- - = feature not applicable since company failed to reach this stage

**Table 10.6a**  Common Features of the Failure Cases
live operation of Company H2's information system are described below.

(i) Management Commitment
The company was subjected to a split in the management responsibilities on the appointment of the son of one director onto the board of directors. The new director differed in the motives for the introduction of the system and therefore the objectives to be met became disputable. This position of political strain in the organisation placed further strain on the adoption of the information system. Under such conditions of lack of management commitment the system could not proceed to effective use by any of the management.

(ii) Strive of New Technology
The initial management emphasis on the latest technological system placed the system under severe pressure since the evaluation and tuning of the live system was undertaken on the basis of such technical criteria as response times, rather than how well the system met business objectives.

In summary, unsuccessful companies were found to have the common features shown in Table 10.6a shown opposite.

10.7 Conclusion
The analysis described in this section has identified a range of issues which face the small business owner/manager when implementing microcomputer-based MIS. Some of the case study companies coped well with the range of activities necessary for achieving a successful MIS, whilst others
faced the difficulties unsuccessfully. The issues raised are developed further in Part Eleven, which builds a grounded model of the critical variables which differentiate between the successful and the unsuccessful.
11.0 **Summary**

This section builds a grounded model from many independent variables discovered to be influential on the overall level of success or failure of MIS development in small construction companies. The variables were derived from the pertinent issues raised in Part Ten and are categorised as organisational, application or system developmental variables. Each category of variable is seen to contribute to the degree of overall MIS success. Having built the model from the grounded data, the different experiences of three case study companies are then used to illustrate the application of the grounded model.

11.1 **Modelling the Qualitative Research Data**

The common characteristics of the successful and unsuccessful companies and the pertinent issues, which were able to be drawn from the case study data, provided the opportunity to generate a data driven theory which would explain the MIS development experiences of the small companies involved.

This section builds a grounded model of the interaction between many variables, empirically identified from the real data. The variables, extracted from the case studies as explanations for the varied degree of success and failure throughout the three phases, were able to be categorised into three groups, the organisation, the application and the development process by which the company selected and implemented the MIS.
Many MIS development problems experienced by the small construction companies were related to the circumstances in which the organisation existed. Such factors as the management's professional and educational background and the pressure from the environment, were found to be influential in the nature of selection and implementation problems experienced and are included in the Organisation Context variables described below. A further major influence was found to be the scope and nature of the information system being developed and is described as the Application Context in the section below. Finally, there is a relationship between the actual system development process adopted by a particular company and the eventual success rate, which may be identified as the System Development Process variables.

11.2 Organisation Contextual Variables

Several features of the organisation itself were seen to have a direct influence upon success of the three phases of information system development. Whilst each company was not characterised by all the organisational features, a cumulative effect was seen to occur in the unsuccessful companies.

Each feature of the organisation context which influences the information system development success is described below.

a: Economic Stability of Work

Some companies had more stable and reliable sources of work, and consequently, the activities of the principal directors and management in ensuring the continuity of the organisation was not so intense or critical. Other
companies however, were either experiencing or seeking rapid growth, which either involved considerable management time and entrepreneurial dedication or suffered variability of work levels. Where the company was experiencing a declining market, through economic or political reasons then considerable strain was placed on the management to seek more contracts or diversify into others markets. In such circumstances, the management had little time to devote to development of an information system.

(i) Selection Phase:

Companies found an unstable work environment drew on management time and presented constant interruptions to the flow of attention required, in both determination of the system requirements and the labour-intensive activity of matching a solution to their particular problems. Company E found this to be particularly difficult and experienced a disrupted selection phase. The management finally delegated the responsibility of the final decision to the two external advisors involved. Company C also found that growth, both intensified the need for the system and prevented the time being available to search widely to find the closest solution match. Companies Bl and A, however were economically stable throughout the selection phases and management felt no critical need for a quick, unconsidered decision. Both these companies were able to consider all aspects of feasibility, to conduct a company search, and to establish early support relationships with potential suppliers.

(ii) Implementation Phase:

The demands on management to maintain worklevels during periods of economic depression, were also found to draw on
the management time and skills needed for the control of the implementation. The management of Company D experienced a slump in the level of company activity at a time when the same individuals were responsible for actual conversion to the new system. Company G found it particularly difficult to spare the time to take advantage of training being offered, when the company suffered from a localised construction industry depression associated with the National Union of Mineworker’s strike in 1984–85.

(iii) Live operation phase:
The few companies reaching this stage were less susceptible to changes in workload as the computer system had become an established part of the organisations’ framework, which would now support the management decision-making activity and therefore long term viability. Companies Bl, A and C were all able to effectively use the information from the live system to minimise costs and control cash flow more effectively during the general recession of the 1980's in the construction industry.

b: Management Orientation and Decision Style

Several members of the small firm management originated from craft or production employment and the orientation of such management, appeared to be less concerned with the administrative system than the main operations involved in construction. Those companies, with staff experienced in larger companies or professionally trained in general management or accountancy, placed a higher importance on the information system as an organisational support.
(i) Selection phase:

This background difference was seen to influence the extent of the analysis of needs undertaken by management. Companies with professional-orientated staff, such as Companies B1, B2 and A, made efforts to document the needs of the company with regard to management information and also sought consultant advice, where the professional skill internally was considered deficient or inappropriate. Craft-orientated management frequently failed to pay attention to a thorough, objective analysis of needs when searching for a solution. Indeed, craft-orientated managers were apt to make quick decisions on a system, as if acquiring any other item of plant. Company H1 management was highly craft-orientated and selection of the system was assessed on the trial and error method of evaluation. Companies D and E had a craft-orientated background and each delegated the task of assessing needs to an external advisor with the result that little participation in the determination of needs led to later problems.

(ii) Implementation Phase:

The background of the management was also significant in the activities of the implementation phase. Craft-based management were more likely to hand over the responsibility, for undertaking training and the conversion of the company data, to secretarial or clerical staff, perhaps even those employed on a part-time basis, with the resultant vulnerability to lack of skills and knowledge should that employee leave. Professional-orientated management in Companies A and B1 saw the importance of understanding the system structure and operation from a management viewpoint and adopted a
top-down, phased training operation. They also
recognised the importance of reconciling the two systems
before abandoning the former.

(iii) Live operation phase:
Management with a professional orientation saw the
introduction of the computer-based information system as
a stepping stone to further effective use of information
technology in other areas, as exemplified by Companies
A, B1 and C, whereas the craft-oriented managers (such
as Company E) tended to seek instant solutions to
immediate problems and failed to secure full
effectiveness, even if they reached the live operation
phase.

c: Administrative and Managerial Slack
Small companies have few administrative resources available
to them to undertake the extra burden of introducing
Technological change. Those with some degree of slack
tended to be able to absorb the extra activities without any
repercussions on the organisation's ability to maintain
progress or ensure stability.

(i) Selection phase:
When the skills of administration were not solely
invested in the management, and clerical staff were not
over pressured with current responsibilities, the tasks
of sizing of requirements could be undertaken
thoroughly. A greater involvement of administrative
staff in identifying the closest match between needs and
available systems was also possible in these
circumstances. Companies C, E and B2 found that
pressures on staff left them unable to be involved in
the selection phase activities and decisions were made
without consultation of operational staff. Company G, being so small, had no administrative slack whatsoever and all the burden of systems analysis and location of a suitable system fell on the manager. These companies found that insufficient administrative slack limited the depth and scope of the selection phase activities, in contrast to a company, such as BI, with considerable slack to enable the careful determination of needs and evaluation of potential systems to be undertaken.

(ii) Implementation phase:
The greatest need for administrative slack was felt in the implementation phase, when the lack of manpower resources seriously curtailed the companies' ability to meet their own targets for achieving a live operation. The companies found difficulties in enabling staff to take training sessions, to collect necessary data to establish the system and to thoroughly check the system installed. Companies B2, D and G were significantly affected by the lack of resources to convert and test the acquired system to a point where it could be depended upon. These companies fell into a pattern of failure to meet implementation targets and their systems were never fully operational in spite of the need for them.

(iii) Live operation phase:
The lack of administrative slack was less critical once the company had reached the live operation, but extension of the facilities depended upon the lack of pressure on the operational staff, in that they could use their knowledge of the system to identify where its further potential lie. Only Company A, who maintained its staffing level throughout, was fully able to successfully
extend the system into other areas than the original application.

d: Internal Skill and Support Level

The level of skills and knowledge, which a company could rely on throughout the life of the system, was influential in the success or failure to accomplish the activities in each phase. Some companies were fortunate to have qualified accountancy staff on hand, either internally or from a parent company.

(i) Selection phase:

Where management had no guidance and support internally, the selection activities were problematic. The criteria for evaluation were weakly determined, by such companies as Companies G and F, where internal support levels were low. Choices of system were frequently made after unsystematic consideration of alternatives in relation to needs, when company management had no unbiased source of advice, as in the case of Companies D, H1 and G. Companies with long term support from within the organisation, such as Company B1, made less spontaneous and unconsidered decisions.

(ii) Implementation phase:

When the implementation support from the supplier evaporated, soon after system installation, the clerical staff sought guidance from within the organisation to deal with implementation problems, such as checking the accuracy of the system operations. Companies G, D and B2 had no internal expertise to motivate and support the activities in a controlled manner and achievements were low, since delays were inevitable, when mistakes were undetected and, when discovered contact with the supplier
was the only source of refuge. Companies, such as Bl and C, with a supporter/advisor were able to control the progress of implementation much more effectively with the result that management plans were achieved.

(iii) Live operation phase:

The activities of post-implementation evaluation of any system require support from internal staff, and the few "live" companies able to do this, all possessed an internal or permanent external advisor. The role of a system manager/advisor, developed in Companies A, Bl, C and E to provide the long term support, required to ensure full utilisation and extension of the information technology.

e: Formality of Administrative Practices

The companies varied in the existence of structured patterns of administration of financial and contractual information. The existence of some previous systems-related experience was seen to be a contributory factor to the successful introduction of information technology which by nature was structured. Small organisations with a tradition of informal administration activities were thus a high risk venture from the outset.

(i) Selection phase:

Where a company had either previous basic computing experience in the application field, as in the case of the second-time users Companies Bl, F and H2, the structure of company data was already thoroughly established and the requirements of the new system thereby more easily achieved. Knowledge of computer system operations was also an advantage in the
presentation of such requirements to potential suppliers. Companies G, D and H1, with no information system structure in existence, paid less attention to the specification of requirements to suppliers and were consequently less in control of the selection of a system to meet actual needs.

(ii) Implementation phase:

The experience of a previous structured information system was beneficial to Companies A and B1, since the need for a coding structure to meet the companies' reporting needs was already established and an easy conversion to a computer database resulted. Similar advantages accrued to Company E, in the availability of a template for reconciliation of test output from the system was a contribution to the ability to meet the targets, set for implementation of various system modules.

Without any previous experience of working in a structured routine of information processing, Companies G, D and B2 found serious difficulties in establishing test data and undertaking system testing, since they had no expectations to meet.

(iii) Live operation phase:

Three companies, who actually reached live operation, had introduced the microcomputer-based information system on the basis of an established information structure, which provided a basis for further tuning and evaluation of the live operation. Only Company C reached the live operation phase from a position of very informal administrative practices, and after a year of live operation, the company fortunately evaluated the system operation resulting in a significant structure...
change on the basis of the acquired information system formality and experience. Companies, such as Companies G and D, lacking in such a framework, did not achieve the position of live operation due to unsurmountable implementation problems.

f: Level of Management Boundary Spanning Activities

In a small organisation involved in contractual work, the management are involved daily in meetings with clients, architects and public authority personnel. This boundary spanning activity means less time is given to the management for internal matters and influences any form of innovation, such as the introduction of new information technology.

(i) Selection phase:

Where the management responsible for determination of requirements and selection of the system, were subject to a high level of boundary spanning activities, such as in the case of Companies G, D and E, the process became interrupted frequently by more urgent needs. The discontinuity resulted in weakness in specification of requirements, lengthy selection periods and abdication of responsibilities for decision making to others. Other management, who had more specialised responsibilities, involving little activity at the boundary, such as Company Bl, there was sufficient time and concentrated effort devoted to the selection phase activities and hence, a more successful outcome in terms of matching needs of management, was secured.

(ii) Implementation phase:

The supervision of, or actual conversion activity, frequently required continued effort on the behalf of management. Company D management in particular had a
high level of boundary spanning activity whilst trying to achieve implementation and the implementation phase became a long losing battle. Company C was forced to take on a system manager who was able to implement the system, thus freeing the director to maintain the necessary high level of boundary spanning activity.

(iii) Live operation phase:
A high level of boundary spanning activity is more compatible with a live operation of the system than any other phase since once established to the point of system handover, the equilibrium of the system can be maintained. Should the system facilities be extended or modified then demands are placed on management to determine the nature and direction of such change, which can only be done at a time of low management activity at the boundary, as occurred in Company C when the local council work became less important.

The underlying issue here is an obvious one. Any attempt at MIS development in small companies will be likely to result in failure if the management concerned are unwilling to become involved, unable to take an active role because of skills and knowledge deficiency, or the continual demands from both inside and outside the organisation.

11.3 Application Contextual Variables of Information System Development

In addition to organisational contextual variables described above, several aspects of the information system application itself were seen to have a direct influence upon successfulness of the three phases of information system
development. Whilst each company was not characterised by all the information system application features a cumulative effect was seen to occur in the unsuccessful companies. Each feature of the application context in which the information system development was set are described below.

a: Functional System Gap

The relative degree of change, for a particular company, was seen to be a contributory factor to the success or failure of the information system. Success was more difficult to achieve where a company had an elementary information system initially and the system development process involved the introduction of a sophisticated information system than where the change involved a simple automation of an existing information system structure.

(i) Selection phase:

Determination of precise requirements was more difficult for the company, where the system gap was large, and the negotiation with suppliers to select a suitable system more difficult, where more is expected of the system. Company F, for instance, had difficulty in conveying their needs to the consultant, since the desired state of the system was far more sophisticated than the present operations. In contrast Company A and B1 were able to precisely define requirements, on the basis of similar manual functions. A higher risk is also incurred when searching for the solution since some considerable trust is placed in the supplier or consultant.

(ii) Implementation phase:

Training for the operation of a considerably more sophisticated system is more difficult, as was experienced by Company D. The use of old data to test a
new system is also more difficult with a large system gap, since the data required was on occasions not actually collected, as with Company D's subcontract ledger back-dating. A simple conversion of data into a new format with very little extra added, enabled Company B1 to smoothly implement according to schedule.

(iii) Live operation phase:
Where the system gap is significant, it is tempting to the company to keep some element of the old system as security, as in the case of Company C's manual sales ledger. In Companies A and B1, the handover to the new system was easier and the scope for establishing opportunities for enhancement where a relatively small system gap exists.

b: Functional simplicity/complexity of requirements

The ambition level of the management, with regard to the desired management information system, was found to have a significant influence upon how successfully the company achieved the three phases of information system development.

(i) Selection phase:
Companies, with essentially basic functional requirements and little need for cosmetic features, found it easier to express those needs in the form of a specification of requirements and were also more likely to find a system to meet these basic essentials. Companies B1 and E realistically expressed the scope and operation of the desired system with the result that selection of a system was more successful and smoother than in Companies A, B2, F and D, all of whom had requirements for complex interrelated systems.
(ii) Implementation phase:
The tasks of training, conversion and system testing were all more problematic in the situation where the selected system was functionally complex in relation to the experience of the staff. Company D found it difficult to convert existing company data into a system, which was complex both in scope and interrelationships. Company E however, found it relatively simple to undertake successful training, since the functions to be undertaken were fundamentally simple.

(iii) Live operation phase:
The possibility of system evaluation and enhancement, where the initial system implemented was functionally basic in operation, is clearly more likely to be successful. Companies C and E had basic initial requirements to fulfill and, on the basis of such knowledge and experience, were able to consider the provision of further information to management. Only Company A, with sophisticated aspirations for the system were able to reach a live operation and then, only at the expense of considerable management effort and a prolonged implementation period.

c: Technological simplicity/complexity

The computer technology of the desired or acquired system add a degree of complexity to the ease with which the small organisation develops its information system. This is more apparent where the company is influenced by supplier claims relating to the capability of the "latest technology".

(1) Selection phase:
Companies, who aspired to introduce the very latest technology within their organisation in an attempt to
project a modern company image, found difficulty in establishing realistic company requirements and negotiations then became led by the suppliers. Companies H1 and F both sought a "hi tech" image and the software component of the system mistakenly became a secondary consideration in decision making. Companies B1 and E considered the hardware to be an additional potential risk in the process of organisational change, which should be minimised by selection of simple and proven hardware.

(ii) Implementation phase:

Difficulties of operator training, out-dated support manuals and early releases of latest computers occurred more often, where multi-user computers or latest models were being implemented. Several hardware-related difficulties due to the fact that the company was an early user of a particular system plagued Company D, in the initial stages of implementation. Company B1 in contrast implemented a series of well proven, independent microcomputers in a situation where it would have been easily justifiable to install a network or multi-user configuration, thus minimising the complexity risk to the company.

(iii) Live operation phase:

Simple configurations of technology are likely to operate more smoothly, with less maintenance problems in the long term. Companies will be motivated to extend the system in such circumstances, when the expandability of particular hardware will be required. Some degree of initial complexity may have been justified in such circumstances, if the company is able to overcome the earlier difficulties of selection and implementation.
Company D anticipated such development of their information system, but was unable to reap the benefits of this decision, due to severe implementation difficulties.

**System Support Base**

The existence and locality of the support from suppliers and other similar companies, who are also system users, provides a source of skills and knowledge for all phases of the information system development. Hardware support and proximity to maintenance depots, contributes to lessening the chance of system failure throughout the implementation and live operation of the system. The availability of such support was essential on a long term basis, if the company was to grow in confidence in its ability to rely on the operation of the system.

(i) Selection phase:

The evaluation of requirements, in relation to the features of a potential system, is a difficult task for the unfamiliar user and the availability of a local user of a similar size to the company, provides a source of advice for suitability, implementation, and operational tasks. Proximity to such a user enabled the company to firm up requirements, as Company E did by visiting the site of its actual operation and not depending on demonstrations.

(ii) Implementation phase:

Implementation support from the supplier, in the case of inexpensive microcomputer packaged software, varied from considerable, in the case of Company E and Bl where the company was any early user, to minimal, where the
software was purchased through an intermediate dealer, as in the case of Company H1. The danger point of abandonment of a system appeared to be most critical a short while after the installation, when all training had been taken but adequate knowledge and skills not established. Long term support was therefore essential to the success. Company H1 abandoned their system when they were unable to locate any realistic level of support long distance from a supplier to whom this activity was uneconomic.

(iii) Live operation phase:

The long term support of the supplier was required by the organisations to be able to undertake the task of evaluation and tuning since it was frequently the case that the company was unaware of the possibilities of the system. Company C was able to restructure the implementation after some evaluation and discussion with the supplier on maximising the effectiveness after changing circumstances of the company.

The underlying issue relating to the application context is that if small companies attempt, in the first instance, to make significant advances in the development of their MIS, either functionally or technologically, then the probability of difficulty and ultimate failure is high. This is more acute if the advances are unsupported.

11.4 System Development Processual Variables

In addition to organisational and application contextual variables described above, several aspects of the information system development process itself were seen to have a direct influence upon successfulness of the three
phases of information system development. Each significant feature of information system development process are described below.

a: MIS Strategy

Small firms gave varying degrees of attention to the feasibility of the proposed MIS implementation. In the more successful cases, management investigated the feasibility from economic, technical and operational viewpoints as a basis for decisions. Some managements were more solution-oriented in their approach, desiring more to install a computer than to solve an identified problem area. The mode of development for MIS was also seen as a critical contribution to likely success, with in-house development presenting the greatest risks to the small company. The acquisition of the computer and associated software was viewed similarly to other plant and office equipment purchases. The establishment of identifiable benefits, sought to be achieved by the management of the companies, enabled those successful companies to be able to refer back to these throughout the development activities.

(i) Selection phase:

The lack of consideration of economic, operational and technical feasibility in sufficient depth led in some cases to the poor match of problems to solutions. Company C paid little attention to the operational feasibility of the system, suggested by the consultant, with the result that the problem remained when the system had been installed. Company B1 likewise considered only the economic and technical aspects and soon after implementation discovered that the system was inadequate to cope with the volume of data. Company A
however carefully sized the system and established the total feasibility of use, failing to consider the feasibility of system development itself.

b: Use of Outside Advisor

The use of an external advisor, either formally or informally to provide an unbiased and independent source of advice and support throughout all the activities of system development, was a beneficial factor contributing to overall success. Small businesses were likely to be relatively new and inexperienced or when established for some time skilled individuals in the field of application of computers were unlikely to be attracted to such small organisations. Good advisors are likely to be experienced in the definition of information requirements of small companies in the industry concerned, have experience in the application of packaged software and be able to match a company's problems to the solutions offered by microcomputer-based MIS.

(i) Selection phase:

Most of the firms, who used a consultant/advisor did so in the selection phase, since this was the time when a lack of appropriate knowledge of available hardware and software was recognised. The companies who shared responsibility for selection activities with an external consultant, such as Companies E and B2, were able to match the problem to the solution more effectively, contributing to long term success. Companies C and D were less fortunate in their choice of advisor and both experienced difficulties in matching needs to systems. Without any source of external advice however companies, such as Companies G and H1, relied on the little internal expertise available and on the reputation of
the supplier in giving honest advice.

(ii) Implementation phase:

Very few companies continued with the use of outside advisors after selection activities had been achieved. Those who did, such as Companies E and C, found the source of support to be valuable in the internal training of user staff, the establishment of a structure for the system within the company, and particularly in the testing operations, where lack of appropriate expertise was severely felt in the small organisations. Where companies had no outside support, implementation tasks were frequently unmanaged and problematic, as in the case of Companies G and D.

(iii) Live operation phase:

A long term relationship with someone, who can maintain an up-to-date knowledge of the computing industry, will be a source of useful knowledge when consideration of enhancements to the system are reviewed by management, since state-of-the-art/market knowledge may have been acquired earlier by small firm management but it soon becomes outdated. Company C maintained such a relationship which was frequently called upon for support of the management. The other live operation activities, of evaluation and tuning to meet real needs of management, are also more effectively achieved when a company can be supported from outside the organisation by the provision of advice.

c: Involvement of User Staff

Where decision making is made without consultation and is autocratic in nature, a small company risks failure of technological change. The character of decision making in
small organisation was found to have a strong influence on the fit of the system to the problems experienced and in its eventual operationability. The possibility of resistance to the change resulting from the MIS implementation in small companies, who traditionally employ members of the owner's family and less qualified clerical staff, is also reduced by the conscious effort to involve those key members of staff at the outset of developmental activities.

(i) Selection phase:

The knowledge of the operations of data processing is often the intimate knowledge of the clerical/administrative staff of the small company rather of that of the management. Consultation with such staff in determining requirements, particularly sizing and exception handling, had a significant effect on successful selection. Few companies involved their staff in this phase, in the belief that technological change was the realm of management, and Companies C and H1 experienced matching difficulties as a result. Company F however was the only company to fully involve the operational staff, a decision based on a lesson learnt previously.

(ii) Implementation phase:

The ease with which training was achieved was directly related to the involvement of user staff. Where management undertook the training offered, worked to establish the system themselves, and conducted the testing, before the involvement of the operational staff, the implementation necessarily became delayed and the organisational learning was invested only in management. Companies D and C made little attempt to involve their clerical staff initially on the belief that the
implementation would be speeded when less involved. When the tasks of conversion and testing were forced to be handed to the clerical staff they had very little understanding on which to base their work and many mistakes were made. Company E however, involved the clerical staff from the outset and a sound basis for operation was established, since trained staff were responsible for conversion and testing with the supervision of the outside advisor.

(iii) Live operation phase:
Those most familiar with the system through training are able to determine where the system requires tuning and where enhancements are most easily achieved. Such activities are less successfully achieved by management alone, as in the case of Company H2.

d: Transitional Strategy

The strategy adopted by the organisation involves deciding upon whether or not to establish all the modules simultaneously, whether to establish the system data as at some date in the past and re-establish the current position by entering retrospective data, if so, how far back is sufficient to fulfill system testing needs and realistic in view of the administrative resources of the small organisation.

(i) Selection phase:
The timing of the actual selection is frequently prompted by the financial year end or some similar milestone. This puts pressure on management to meet such timescales as opportunity to make a fresh start is seen as lost. Small companies, such as Companies Bl and E, who have a definite strategy planned, will be more
likely to achieve the selection tasks on time than those who are less structured in their approach, such as Company G.

(ii) Implementation phase:
The appropriateness of a strategy of back-dating of data to reconcile results with existing information system records, appears to be related to many other factors such as the amount of administrative slack, the boundary spanning activities of the management and the use of an external advisor in the implementation phase. Company C was successful in the retrospective implementation of six months system data given the availability of much internal support and administrative slack, whereas Company D found that the six months became much more as implementation was retarded in very unfavourable organisational conditions. A similar strategy in Company G also proved to be impossible to achieve in the cumulative circumstances of poor support and little resources.

(iii) Live operation phase:
The abandonment of the former system may be prompted too soon if the transitional strategy proves to be too difficult to achieve, and further evaluation and tuning unachieved, as in the case of Company G which eventually failed completely.

The system development process can be the passport to MIS success by compensating for unfavourable factors in the organisation itself or the poor choice of application area. The ways, in which the system development process contributes to the overall MIS success level are notably via the choice of strategy and the use of outside advice and support.
A Grounded Model of Information System Development in Small Organisations in the Construction Industry

The successful companies and unsuccessful companies appeared on modelling to have many similar features. The cumulative effect of combining "favourable" aspects of many variables in the organisation context, the application context and the system design process determines the overall degree of success or failure of the MIS within the small company environment.

The variables were grouped into three sections as shown in Table 11.5a below.

1. Organisational Context
   a: Economic stability of work
   b: Management orientation and decision style
   c: Administrative slack
   d: Internal skill and support level
   e: Formality of administrative practices
   f: Level of management boundary spanning activity

2. Application Context
   a: Functional systems gap (degree of change from the old system to the new)
   b: Functional simplicity/complexity of requirements
   c: Technological simplicity/complexity
   d: System support base (hardware and software)

3. Systems Development Process
   a: MIS Strategy
   b: Use of outside advisor
   c: Involvement of user staff
   d: Transitional strategy

Table 11.5a MIS Success Variables in Small Organisations

The three separate aspects, the organisational context, the application context and the information systems design process, all contribute to the success or failure of the overall management information system throughout its life. They influence the relative size and location of the "MIS Chasm", (i.e. gap between the actual system development achievement and the desired state of information system
development), in the MIS development, as shown in Table 11.5c below.

![Diagram of the Information System Development Triangle]

Table 11.5c **The Information System Development Triangle**

Research data suggests it is the combination of elements of all three independent variable groups, and not the prevalence of a single variable or group of variables, which is associated with MIS success. Where a company has a favourable context (in both organisation and application), the MIS selected for implementation may still fail, if the systems development process is detrimental, by virtue of lacking essential aspects or by poor performance of some functions (as Company H1 did).

The organisational change resulting from MIS implementation in the small business environment can be viewed diagrammatically as triangle with an independent variable group on each side. The contributory features of each aspect can then be represented by filling up the MIS Chasm from the base up with positive or favourable features. Where a particular feature is not contributory to the phase in a particular case, then its absence will imply a greater MIS Chasm and thus represents failure. Thus a successful
company will have favourable aspects from all sides, filling the triangle and leaving no MIS Chasm. However a less successful company may have a favourable aspect on one side but the unfavourable combination of one or both of the other aspects will lead to the existence of a wide MIS Chasm representing the lack of information system success.

11.6 The Model in Operation

Having built a grounded model, from the data of the small companies developing MIS, it is now appropriate to try out the model on some examples. Three cases are described below to illustrate the range of MIS success in the small company environment. Company B1 which was successful throughout, Company A which was able to recover from a problematic beginning and Company G, which had serious difficulties throughout the developmental activities are used as examples.

Example 1 : Company A

Company A's favourable aspects lie on the organisational context as the company had strengths in its management orientation and decision making style, some evidence of administrative and managerial slack to provide internal support and a formalised information system prior to the computer system development. The system development process had the benefit of an evolutionary approach to training and conversion and considerable involvement of the staff throughout. However Company A was weak on the application context aspect since the mode of in-house system design and development was a high risk and lengthy strategy to adopt. Thus there was a small MIS Chasm in evidence from the model, and the company did follow a sub-optimal system development
path, eventually reaching a successful implementation from the view of the company. The application of the model is shown in Figure 11.6a below.

![Diagram of System Development Process](image)

Figure 11.6a The Application of the Information System Development Model in Company A

**Example 2: Company B1**

![Diagram of System Development Process](image)

Figure 11.6b The Application of the Information System Development Model in Company B1

Company B1 had an extremely favourable organisation context since the company was not experiencing the strains of either growth or contraction during the initial stages of selection and implementation, considerable administrative slack and professional internal support resulted from the company's previous background of larger scale operation and finally
the management concerned had few responsibilities at the boundary of the organisation. The application context was also favourable, since the company was not seeking to replace their former system with a high degree of sophistication in either the technology or the system concerned.

Example 3: Company G
The application context of Company G was found to be advantageous in the availability of extensive system support from the supplier, technological simplicity and high quality of the software involved, all other variables being lacking or disadvantageous in effect. Company G was seen to be extremely weak in all other respects. The organisational context variables of economic stability, management orientation and decision making style, presence of administrative and managerial slack, internal support, previous experience of formal systems and level of managerial boundary spanning activity are all unfavourable in this very small organisation. Finally the systems development process had no beneficial aspects to contribute to the long term success of any phase. Company G thus had a very large MIS Chasm, as illustrated in Figure 11.6c below.

![Figure 11.6c](image)

Figure 11.6c The Application of the Information System Development Model in Company G
### Organisational Size

<table>
<thead>
<tr>
<th>Organisation Context</th>
<th>Application Context</th>
<th>System Development Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>a: Economic and political stability of work</td>
<td>b: Management orientation and decision style</td>
<td>c: Managerial/administrative slack</td>
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<tr>
<td>d: Internal support level</td>
<td>e: Formality of work practice</td>
<td>f: Level of management boundary spanning activity</td>
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<tr>
<th>Organisational Context</th>
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### Organisational Context

- **a:** Economic and political stability of work
- **b:** Management orientation and decision style
- **c:** Managerial/administrative slack
- **d:** Internal support level
- **e:** Formality of work practice
- **f:** Level of management boundary spanning activity

### Application Context

- **a:** Functional systems gap (degree of change from the old system to the new)
- **b:** Functional simplicity/complexity of requirements
- **c:** Technological simplicity/complexity
- **d:** System support base (hardware and software)

### Systems Development Process

- **a:** MIS strategy
- **b:** Use of outside advisor
- **c:** Involvement of user staff
- **d:** Transitional strategy

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<tr>
<th>Systems Development Process</th>
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### Table 11.7a Likely Interactions between Organisational Context, Application Context and System Development Process Variables of MIS in Small Organisations

<table>
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<th>Organisational Size</th>
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#### KEY
- Numbers refer to the hypotheses postulated in the following section.
- MIS refers to the degree of MIS Success.
11.7 Postulation of Hypotheses relating to the Grounded Model

Variables

The most important variables identified from the research data, as contributing to the success or failure of the MIS at each phase, are presented in the form of a matrix in Table 11.7a, shown opposite. Such a format enables the consideration of the interrelationships between the variables and MIS success and also between the variables themselves. The experiences of the ten small construction companies enabled the postulation of the several hypotheses which correspond to the interactions between the variables in the matrix.

The framework of variable relationships is presented graphically below. The dependent variable is clearly MIS success and the independent organisational, application and system development processual variables are found to be themselves related in many cases in addition to their relationship with MIS success. The structure of the framework is thus similar to that presented by Ein-Dor and Segev (1981) which is discussed in more detail in Part Twelve.

It is evident that there exists a very large number of possible interrelationships between the organisation context variables, the application context variables and the system.
development processual variables. To list all these would produce an excessively long list for the reader and any future researcher, and repeat much of the discussion in earlier sections. A list of 15 principal hypotheses relating single independent variables to MIS success in the context of the small company is first presented without further discussion. Six further hypotheses (16 to 21) are postulated to link selected independent variables in the organisation context, the application context and the system development process. These were selected on the basis of having the best support in the qualitative data from the case studies of this research.

The overriding hypothesis emanating from the research however is that:

**Hypothesis 1**

Small companies are more likely than larger companies to have unfavourable organisational contexts and adopt weak system development strategies and therefore are more likely to experience MIS failure.

The size of the organisation involved in the development of MIS is considered to be directly related to degree of likely success. The high probability is that many of the unfavourable organisational factors, previously suggested as determining MIS success, are associated themselves with the size of the organisation. The strategy for system development in small companies is also likely to generate problems of achieving success due to organisational and application factors, e.g. the lack of funds available for the employment of independent advice from consultants, the orientation of management being unlikely to make realistic plans for implementation.
Hypotheses 2 - 15

A small company will be more likely to achieve a successful MIS implementation where:

- the economic and political environment is stable (2)
- the management orientation and decision-making style has a professional approach (3)
- there exists a degree of managerial and administrative slack (4)
- internal support is available (5)
- administrative practices are structured and formalised (6)
- the degree of boundary spanning activities required of the management is small (7)
- the gap between the existing and the planned MIS is small (8)
- the MIS is functionally simple (9)
- the MIS is technologically simple (10)
- long term system support is provided by the supplier (11)
- a packaged development of the MIS is selected (12a)
- operational aspects of feasibility in addition to economic and technical aspects are formally considered by management (12b)
- an outside advisor assists throughout the MIS development process (13)
- administrative staff are involved in all phases of MIS development (14)
- the strategy of lengthy parallel data processing operations is limited in duration (15).

Hypothesis 16

If the economic and political environment of the company is unstable and management choose to implement a MIS which exceeds their present system both functionally and in sophistication there will be a low probability of MIS success unless appropriate outside advice is sought.

The small company has been seen to be extremely vulnerable to the environment in which it operates, and where the
company is experiencing significant growth or decline the impact of this change in activity is immediately felt within the organisation, generating increased pressure on both management and staff alike. In such circumstances, the management of small company may attempt to introduce a MIS, which is a significant enhancement on its present system seeking more and better management information. Such an effort is likely to fail unless appropriate outside advice is sought. The volatile environment both draws on management resources, preventing any contribution or control of the MIS project and it also provides a continuously changing need for information to the manager. The support and advice of a consultant, parent company or outside advisor is thus vital to the company to be able to define the actual requirements of the system and the strategy itself. Otherwise the commitment and essential resources for many selection and implementation tasks are lacking where the management do not seek or obtain outside advice and support.

**Hypothesis 17**

If the small company management is craft-oriented and the internal level of systems experience and support is limited then MIS success is unlikely unless the system software selected presents a simple interface to user and is not installed on technological complex hardware.

The less experienced and unorthodox style of many small company managers, who originate from a craft or production background, is unlikely to possess sufficient skills and knowledge of the information systems, at least not initially. If the company itself has no other staff with information systems or computing experience then the
management is best advised to select a system, which is perhaps limited, but is very easy to understand. Emphasis on the presentation of a clear, familiarly-worded dialogue to the user and simple reports for the management to use, are more successful criteria for selection than extensive sophisticated facilities. This will enable the company to make the transition to a computer-based MIS more easily, and more effectively, by involving less burdensome training and testing of the system functions. State-of-the-art computer technology, which is complex and the unused by other small companies using the software, will frequently present installation, testing and learning difficulties to the craft-oriented manager and would be associated with MIS failure. The small company in this organisational environment will be more likely to succeed, where a simple system is selected both functionally and technologically.

Hypothesis 18
If a small company with little managerial and administrative slack selects functionally complex MIS then a successful implementation is more likely if a transitional strategy which draws in additional resources to support the implementation effort is adopted and the operation of two systems simultaneously is minimised.

Limitations on available resources presents the small company with severe problems if it simultaneously attempts to implement a MIS, which is significantly enhanced in both scope and facilities. Under such circumstances, the small company is most likely to achieve a successful implementation if it adopts a transitional strategy, which supplements those resources or make the minimum of extra demands. By employing the supplier to convert the master
data and timing the implementation to coincide with any slack periods of activity, the company may survive the strain of implementation and then be able to operate the live system on its available resource level.

Hypothesis 19
If administrative practices are unformalised and unstructured then a successful MIS will be more likely if the company selects a system which does not involve an excessive functional gap and involves its clerical staff extensively in the selection activities.

Administrative information systems in small companies which are immature will also lack structure and formal procedures on which a successful MIS can be built. The company will incur high risks of failure if it tries to adopt a computer-based MIS, which is very complex and sophisticated. In such an environment the choice of a simple MIS and involvement of the staff of the company will be more likely to produce a long term successful system, which the management can effectively use and the staff can appreciate and operate reliably.

Hypothesis 20
If management, normally involved in a high degree of boundary spanning activity, seek to implement a MIS functionally significantly different from existing information system then it is likely to be unsuccessful unless the company selects and implements a well supported system and encourages a high rate of involvement from its staff, particularly in selection activities.

Management with high commitments to interaction with clients and suppliers have little time to continuously devote to an
extended effort to develop an information system and the resulting level of management commitment is likely to vary. Such management frequently have high aspirations of the type of MIS they would like to support their decision making and the requirements decided upon may be very different from the existing information provided for them. Where the managers, who want the MIS, have these characteristics success will be more likely to be achieved where the company is well supported by the supplier of the chosen system and the company staff, who will eventually operate the system, are actively involved throughout. This should ensure that the many development activities required will have resources and committed people to fulfill them.

Hypothesis 21
If the current information system of a small company is unstructured and lacks formality and the present skills and experience of the staff is small then the use of an outside adviser or consultant to develop a workable MIS strategy for the implementation will increase the likelihood of overall success.

The contribution of a skilled consultant with relevant experience will be valuable in the environment of the small firm, who has a lack of experience and where the present information handling routines are neither formalised or mature. Thorough consideration of operational feasibility in addition to economic or technical feasibility are only possible where the company management can rely on the skills of someone outside the company whose view is objective. The company is more likely to be successful in the selection phase where a consultant is involved, as many small companies unwisely make the first decision relating to the choice of
computer.

11.8 Conclusion

The grounded model generates many appropriate hypotheses concerning the nature of the successful MIS implementation in small companies. These are helpful to the future researcher in this field by providing the evidence for further action research in the small company environment. They also are the basis for useful advice to the small company and methodological questions to be put to the information systems design community. These issues are dealt with in the concluding Part Twelve which follows.
PART TWELVE  CONCLUSIONS

12.0 Summary

The final section reassesses the previous published research described in Part Two. It examines the strengths and weaknesses of the research study before considering the possibility of generalising the findings to other companies, industries and circumstances. Some advice is offered to the management of small companies in the form of an implementation strategy for change. Suggestions are also made to the suppliers of commercial information system software in the small business market. In conclusion the implications of the research findings to the information systems design community are presented.

12.1 A Reassessment of the Existing Literature

The organisational variables suggested by previous writers (e.g. Ein-Dor and Segev 1978, Lucas 1973) were very similar to the variables identified in this research and it is important to notice that the common variables of large and small organisations are classified as primarily uncontrollable or partially controllable. Other variables suggested by Ein-Dor and Segev also correspond to the research findings. In particular the suggestion of the link between the appointment of a high level steering committee and the likelihood of MIS success was supported by the grounded model.

Recent survey results with small companies (Raymond 1985) however appear contradictory to those suggested by the current longitudinal research. Raymond suggests that an appropriate environment for improving the level of success
The research findings of Raymond's study are not fully consistent with the research data collected in the current research and several possible explanations are put forward by the author. Firstly the difference in the definition of "small" in terms of number of employees in the two studies reflects the differing perceptions of size by the researcher. The typical Canadian small firm is much larger than the U.K. equivalent and the concentration on the construction industry presents a different type of sample. Furthermore the use of the questionnaire technique will not reveal the processual nature of the implementation of information systems since it is a single view of the population, with no consideration of the long term nature of implementation in any size of organisation. The possibility of bias in the data obtained from questionnaires is a natural tendency of any management not to publicly admit any failure of a venture.

Finally there is some recent evidence of a little
recognition of the small business information system 
environment in the design of methodologies which are simple 

12.2 Some Strengths of the Study

The main strengths of the research work are described below.

(i) Small Organisation Research

In the field of information systems which is still only 
evolving as an academic discipline, there has been as 
yet no real attempts to research the particular 
environment of the small business, known to the author. 
This study is believed to be the first empirical 
research to be specifically aimed at the problems of 
information systems implementation in small companies in 
the U.K. Raymond (1984) commented on the acute lack of 
empirical research in the field of small business and in 
presenting several research proposals suggested:

"It is hoped that by answering such questions 
through empirical research, we can better evaluate 
the actual impact of information systems in small 
business, and ultimately better attune the practice 
of information systems to the specificity of small 
business."

(Raymond 1984 p. 40)

Literature relating to the implementation of information 
systems in small companies is very sparse (Raymond 
1984). With the diminishing costs of microcomputer 
technology, the small organisation is increasingly 
likely to seek the implementation of computer-based 
information systems to enable them to survive and manage 
efficiently. The research findings therefore represent 
a contribution to the understanding of the information 
system implementation needs and problems of the small 
organisation, which have previously been unrecognised by
both researchers and writers.

(ii) Contextual Longitudinal Case Studies
The choice of longitudinal case study methodology for the research itself, revealed evidence of many changes in managerial attitudes, perceptions and approach to the process of introducing information systems and the effective use of such systems in the light of actual experience which might have not been otherwise revealed. Both managerial aspirations represented by plans made and actual achievements were able to be monitored throughout the research period. It is characteristically contextualist research which Pettigrew (1983) suggests:

"... does not begin with a unilateral interventionist stance dominated by values of objectivity, control, and distance under the assumption that scientific truth is out there to be discovered by a process of knowing, like some plum to be picked from a tree. Rather the contextualist begins with a more mutual stance, attempts to steer a middle course between involvement and distance, and recognises the relative and multifaceted nature of truth amongst those in the research process".

(Pettigrew 1983 p. 6)

Other research methodologies, such as broad survey questionnaires, may yield much quantitative data, but the researcher is limited to capturing the management's views of the situation at a single point in time. The process of implementing information systems is in fact emergent, situational and continuous and cannot be understood without multiple case studies to provide empirical qualitative data on these situations, events, stages or phases at different points in chronological time. Thus Pettigrew (1983) suggested that longitudinal case studies will:
"...demonstrate how variability in context influences the shape, pace and direction of the social processes under investigation."

(Pettigrew 1983 p. 26)

(iii) Grounded Theory Approach

A further strength lies in the adoption of the grounded theory approach which freed the researcher from the constraints of a tight research methodology, thus enabling the problems of the companies to reveal themselves naturally with time. The descriptive model of information system success and the small company implementation strategy for change therefore emerged rather than being imposed by the researcher from the start. The qualitative data collected was available to the researcher to undertake a cycle of reexamination and reanalysis many times, to explore further possibilities of developing useful grounded theory since little data of potential value had been lost.

(iv) Hypothesis Generation

The emphasis was on the generation of hypotheses in preference to the testing of prestated hypotheses.

Glaser and Strauss (1967) clearly support this approach.

"We would all agree that in social research generating theory goes hand in hand with verifying it; but many... have been diverted from this truism in their zeal to test either existing theories or a theory that they barely started to generate."

(Glaser and Strauss 1967 p. 2)

12.3 Some Weaknesses of the Study

There are several limitations of this research study which must be recognised when considering the external validity of the empirical findings.

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(i) **Emergent Vertical Market for MIS**

The small companies in the research study introduced the information systems, at a time when the vertical market for systems in the construction industry was emerging. There is some circumstantial evidence that this market has stabilised since 1980 and new small companies are likely to be less affected by the actual quality of the technical system implemented. Since the results indicate that this feature is less important than the contextual environment of the small company itself and the process by which the company chose to develop any system it is considered that this limitation is not a significant problem.

(ii) **Possibility of Research Bias**

The possibility of bias arises from two aspects of the research. Initially, the selection of the companies was restricted to those, who were willing to be a long term participant in the research, and also coincided with the decision by management to implement a system. Secondly, the close association of the researcher with the companies involved must also be noted. In a few instances the researcher was drawn into the information system development process by the company management when they sought advice concerning current problems and care was taken to note the nature of such needs and, whenever necessary, advice was given by the researcher.

(iii) **Limited Identification of Variables**

The variables involved in the MIS success model previously described in Part Eleven were firmly grounded in the experiences of the ten companies and future research into the experiences of other small organisations may well reveal further variables in each
category. Further research is necessary to ensure the completeness of the list described.

12.4 Future Research Opportunities

The findings of this research study identify a need for further work to be undertaken in several related areas.

(i) the grounded model described in Part Eleven suggests the possibility of importance being attached to the position of the MIS Chasm, exposed by the identification of the contributory variables on the three aspects of the triangle. This suggestion assumes the recognition of an order of importance amongst the variables, reflecting certain MIS development decisions being of a more critical nature to the overall level of success. Further research into the management decision-taking throughout the system development process may yield support to this hypothesis.

(ii) similar studies in other sectors of manufacturing and service industry are required to establish how far the contextual variables identified in this study apply throughout the small firm sector. Small autonomous units within larger companies represent a further research environment in view of the recent trend towards end-user system development using powerful system generators.

(iii) the definition of MIS methodology suitable in the small organisation environment is clearly needed, since those methodologies used currently are both formalised and bureaucratic in nature. The subsequent design and development of a MIS toolkit for the designer in small organisations would yield considerable benefits in more successful information system implementation and use.
12.5 Possible Generalisation of the Research Findings

The usefulness of the findings of the research depend upon the possibility of generalising the findings to other areas of application, which are considered in the following sections.

12.5.1 To other small construction industry companies

The ten participant companies were very typical of the small sector of the construction industry and the information system development experiences during the research period 1980–85 are not considered to be unusual in any way by the researcher. Although many other small construction companies have since developed information systems, the penetration of commercial specialised software systems for the industry is still generally shallow, and the suppliers still find the market at a low level of demand. This could be caused by the continuing economic depression in the construction industry throughout the 1980's but it is also influenced by the difficulties experienced in the implementations achieved. The size and characteristics of the small firm sector of the construction industry remains relatively stable although the many firms may enter and leave. The management background may, with time, become conversant with computing but many problems are longstanding, such as the lack of managerial slack, the influence of the environment and the degree of boundary spanning activity. In an article in Computing The Magazine (28/2/85), a director of a small building company stated that:
"People will purchase a computer and expect immediate results. They forget that the whole organisation, discipline, even documentation, needs to be redesigned and they leave no time to train staff or employ different people".

(Coolley 1985 p. 13)

The findings of this study, although they have been slow to evolve by nature of the longitudinal approach, are thus considered to be applicable to other small construction companies who embark on MIS implementation in the foreseeable future.

12.5.2 To other small businesses

Other sectors of manufacturing and service industries also have a small business sector to which the lessons learnt from those in the construction industry are applicable in many ways. The problem of size with its influence on management activity at the boundary, limitations on the skill levels within the organisation and lack of support has been found to have a significant influence on the success of the implementation of information systems in many other organisations. Many writers of information systems development in small businesses such as a non-profitmaking group (Oxley 1985), a knitwear manufacturer (Bhatti 1985), and a printing company (Garner 1985), all report similar difficulties of the management in the selection phase of information systems development. Further evidence of similar problems of implementation in small organisations can be found in (Salmons 1983).

12.5.3 To companies undertaking innovative change

Innovative change in any organisation requires considerable resources in the form of skills and
time, which are thought to be particularly burdensome for the small company. Rothwell and Robson (1985) examine the role of the small firm in innovation and conclude that this sector of industry generally are increasing in innovative efficiency and now account for a share of innovative activities equal to their share of all business activities. However they also suggest that if small firms were stimulated across the board

"...without regard to their appropriateness as vehicles for technological development in their particular circumstances, then some of them would be left with an investment in technology which they could neither exploit nor appropriate".

(Rothwell and Robson 1985)

12.6 A Strategy for the Selection and Implementation of Management Information System Change in Small Companies

The following prescriptive model (Table 12.6a) is offered to the management of small companies as a tool to provide structure and guidance in the implementation of management information systems using microcomputer technology. The author believes that the practice of implementing MIS in small companies will be improved significantly by following the ten steps, which reflect the natural cyclical pattern of change. Within these implementation steps are key issues to be addressed by the company management or their consultant advisors. The issues are real and pragmatic since their origins lie firmly in the grounded data of the ten small construction companies who participated in the research study.

The value of such a strategy is considerable.

(i) It guides the management of small companies away from
### Table 12.6a A Strategy for MIS Implementation in Small Companies

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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<tbody>
<tr>
<td>1.</td>
<td>Recognise a need for change</td>
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<tr>
<td>2.</td>
<td>Establish support for change</td>
</tr>
<tr>
<td>3.</td>
<td>Establish the goals of change</td>
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<tr>
<td>4.</td>
<td>Determine the nature of change</td>
</tr>
<tr>
<td>5.</td>
<td>Develop a plan for change</td>
</tr>
<tr>
<td>6.</td>
<td>Secure a means of change</td>
</tr>
<tr>
<td>7.</td>
<td>Prepare for change</td>
</tr>
<tr>
<td>8.</td>
<td>Undertake the change</td>
</tr>
<tr>
<td>9.</td>
<td>Evaluate the results of change</td>
</tr>
<tr>
<td>10.</td>
<td>Make adjustments</td>
</tr>
</tbody>
</table>
the technical issues of selecting and installing computer technology in the first instance by ensuring such decisions are dealt with at the proper times.

(ii) The emphasis is on first ensuring that the best organisational environment for change is established, by directing attention to the variables of managerial and administrative slack, the availability of long term support and the degree of commitment to the planned change. This ensures a balance between the organisational issues and the technical issues in the implementation of MIS.

(iii) It provides a check list for both the management and their outside advisors to use at various stages of the development of a MIS. The simplicity of the model aids its likely use as a tool for the involvement of all potential users of the system.

(iv) Furthermore it emphasises the importance of system development variables in the eventual achievement of a successful live management information system.

The ten steps in the prescriptive model (shown in Table 12.6a opposite) involve the management being able to address the issues as follows:

1. **Recognise the need for change**

   **Issues:**

   Has a problem area in the organisation been clearly identified?

   Are those involved dissatisfied with the provision of information in the problem area?

   The requirements for a successful MIS are firmly rooted in the selection phase activities. The trigger to MIS development is clearly provided by the recognition of a
need for change in the present provision of management information, since the system is considered ineffective for reaching some desired company goal. The level of management commitment and the real or perceived need for change, are vital steps in establishing a firm foundation for success in the MIS implementation, without which the problems of adverse environment and organisational constraints are likely to prove overpowerful at a later stage.

2. Establish support for change

Issues:

Are there persons who can provide support throughout the process of change within the organisation?

Are those persons committed to the need for change?

Is there sufficient slack time available for those who need the system to give support throughout?

Are those persons who need the information system change involved in extensive boundary spanning activity?

Can the support of an outside advisor be secured for the project?

Has that outside advisor the appropriate skills and knowledge of the problem area and the information provision?

The level of experience within the company and available long term support is a critical factor in the later tasks of selection of a solution and implementation to an acceptable situation. The investment in the human skills and learning is given a high priority at an early stage although the continuation of the provision of support to the company is paramount.
3. **Establish the goals of change**

**Issues:**

Can the overall goals and objectives of the information system be clearly expressed?

Do the management, the outside advisor/consultant and the individual problem owners agree on the objectives of the change?

Can a list of benefits sought be produced? Is it possible to measure as many as possible?

Is the economic and political environment of the company sufficiently stable to support the envisaged change?

The timing of decisions relating to the overall strategic objectives of the information system change ensures management are able to make later judgements on the effectiveness of the actual implemented system. The vital issue of the stability of the environment is considered before management make decisions concerning the nature and definition of the change. The company is therefore given the opportunity to compensate for unfavourable organisation contexts by the establishment of less risky strategies for development.

4. **Determine the nature of change**

**Issues:**

Can the objectives of the desired information system be agreed?

Does the desired system represent a significant change in the functions supported and the level of complexity?

If so, can this be supported by the company?

Can a simplified system be adopted as an initial phase in a long term project of change?

Has the content and size of the data flows into and out of the system been estimated?

Can the mandatory operations be determined?

Can the desirable operations be specified?

Are all the users of the information known?
Does the desired change solve the problems of all the identified users?

The strategy adopted for specification of a desired information system to meet the management needs should be clearly established and agreed to be feasible for the resources of the small company. The involvement of all possible users of the system, enhances the likelihood of success by the agreement of measurable objectives and overt consideration of both mandatory and desirable features of the system. Such agreement on the requirements of the system meeting the company objectives ensures a firm analysis is undertaken before the company approaches potential suppliers.

5. Develop a plan for change

Issues:

Is the time scale for the implementation of the change agreed?

Does the company have sufficient slack resources to absorb the demand for extra manpower?

Do all those involved consider the nature of the change the "best"?

Has a project champion been identified?

The process of preparing an implementation plan makes explicit the consideration of whether the company's resources are sufficient to enable them to meet their goals. The importance of agreement within the company provides a bonding of commitment at the time when a large amount of management time is likely to be concerned with selection activity. The recognition of a "champion" of the future development also places a firm reliance on the commitment of management throughout the project (Curley and Gremillion 1983).

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6. Secure a means of change

Issues:

Can the change be fulfilled by a packaged computer software solution?

Is the technology base of the "best" solution sufficiently known and supported?

Is support for the accepted solution available on a long term basis?

Are the benefits sought likely to be achieved?

Are the mandatory features and facilities provided?

Are any of the desirable features provided?

The technical issues of selection of systems, hardware and suppliers are important once the majority of organisational and some developmental issues have been met, reflecting the relatively less importance attached to the application context. The small company has rarely sufficient resources to warrant the development of a specialist software component to the MIS. The small company is given direction for selection in the knowledge of what the organisation requires and is able to support with commitment.

7. Prepare for change

Issues:

Are those management requiring change committed to the solution?

Has the required data for the system been identified and coded ready for input?

Is extra data required to establish the system available?

Can the existing information system be supported during the implementation of the change?

Are the staff prepared and trained?

The real impact on the company comes when the system is to be implemented and so the step of making preparations follows. Staff training should be more easily undertaken.
10. **Make required adjustments**

**Issues:**

Can extra staff be engaged to support the present system if progress in conversion and training is too slow?

Is support on hand to explain why the solution is not meeting the desired objectives?

Has the system other possible forms which would generate information to meet the needs of the company?

How easy can these be implemented by further change?

Constant review of the provision of information from the system is an important contribution to the success of both the MIS and the company itself. The experiences of the first pass through the implementation cycle will be lost if the process of evaluating performance of the system does not take place.

12.7 **Advice to the MIS Suppliers and Developers**

The small company clearly requires support and assistance throughout the implementation of microcomputer based information systems. Much of this support can be provided by the developers of software for these companies and actual suppliers. The long term benefit to the developers for investment in the suggestions which follow, are in the establishment of a better educated and more prepared consumer, who in turn will be likely to develop further systems in this manner.

**Selection Phase**

(i) The difficulties experienced by the small companies clearly identified a need for a clear, understandable system model which is transparent to the inexperienced
user. Such a model would be presented to the new user in familiar terms and without the excessive use of computing terminology. Any mystique of processing or data handling should be avoided since the small company user has no internal support and few innate skills and knowledge on which to rely. This will enable the selection of a close match of the software package solution to the small company information needs.

(ii) Clear marketing literature will enable a knowledgeable selection of a suitable system. Such literature needs to be aimed at both educating the small company manager to identify the problem areas where computing could be beneficial and, in a more detailed format, provide information on the required business routines (to compensate for the lack of skills and knowledge), the computing routines (with timings and full descriptions of input required and output provided), the installation procedures (to enable planning of the necessary tasks).

(iii) A Risk List for small companies which gives information on the pitfalls of selection, implementation and possibly live operation is needed. The advice would be developed further to include strategies for each phase in the light of the experiences gained to date from small company installations. The tendency at present is to only pass on that information which presents the supplier or software in a creditable light, discarding all the feedback gained from small company users which are problem related.

(iv) The realised costs both direct and indirect, anticipated and unanticipated would be a significant feature of feedback advice, which only those who have experienced information system development can provide.
(v) Encourage the gradual firming up of firm specification for the eventual system structure within the possible alternative system facilities. It is expensive in time and effort to find that the system was inappropriately or too simply established, perhaps because the suppliers adopt a minimum fuss strategy of implementation.

Implementation Phase:
The tasks involved in the implementation of MIS are burdensome in the majority of instances for the small company. The supplier may therefore assist in improving the probability of success in the following ways:

(i) Provide support throughout the early conversion of data, training of staff and initial testing out of the converted system. Where considered necessary to maintain the smooth progress of implementation suppliers should offer a data processing and extended support consultancy service to meet the needs of those small organisations who find the external demands on management are so substantial that progress is minimal.

(ii) Extend the documentation of packaged systems to include clear strategies for the conversion of systems, to include such areas as times anticipated for converting a given number of records and suggested testing routines.

Live Operation Phase:
Suppliers have a reduced role to play in the live operation phase of any management information system but continued contact with the small companies will provide the long term support base for those companies who shed the support of the outside advisor and have little internal expertise. The following suggestions are made in the long term interests of both the suppliers and the small companies community.
(i) Establish user self help groups.
(ii) Encourage the re-examination of the live system with a view to promoting the effective use of the whole system by management.
(iii) Major changes to the system structure is an expensive activity which the small organisation is unable to afford in time. However the organisational circumstances sometimes change so substantially that the system needs to be reimplemented. The management are in a more advanced and experienced position and should be encouraged to make the necessary changes with the supplier support.

12.8 Implications for the Information Systems Design Community

Current Information Systems Design Methodologies (ISDMs) are firmly rooted in their application to the environment of the large or medium sized organisation which is well supported by a data processing department or computer services function. The ISDMs developed in the early 1980's are characteristically formalised tools and procedures and the trend is towards the automation of some aspects to improve productivity and consistency in the data processing departments. Although these methodologies, such as LBMS and SSADM (Yourdon 1975, Burcett 1985), are considered beneficial when used on small information system projects but they require considerable training and a formalised approach by the systems design team. There is little evidence in longitudinal case studies that any of the practices advocated by the ISDMs, reviewed in Part Four, are being widely used. The research findings presented in this thesis however present a very different environment in which such ISDMs would be inappropriate for the following reasons:
(a) the small organisation has very limited skills of systems management and computing knowledge to enable effective application of the ISDMs.

(b) an independent project team is a prerequisite to the use of such ISDMs since they frequently involve conceptual modelling in an environment removed from the real world problem.

(c) the organisational cost of the extensive logical and physical modelling and design activities for a given application is more than would be economically justifiable.

(d) in the packaged software solution environment, in which most small organisations find themselves, no strategy is offered by ISDMs for configuration of such packages to meet needs of business. The ISDMs are primarily tools for individual tailored information systems.

(e) most important of all, these methodologies seek to emphasise the importance of a thorough analysis phase and fail to meet the issues surrounding implementation of the resultant system design.

Benyon and Skidmore (1984) described a "toolkit" approach to information systems design. The research findings previously described, in fact highlights the need for a toolkit in preference to a formalised methodology in the small organisation. In such a toolkit would be:

(a) a language for the small organisation to use to determine and express clearly the information requirements to the supplier

(b) evaluation tools for the comparison of packages and matching to needs.

(c) planning techniques which are simple and yet highlight
the interdependency of activities in system implementation. The strategy outlined in 12.6 would be a valuable aid to the implementation of MIS in the small company.

12.9 Conclusion

The small business environment is rich in possibilities for the further application of microcomputer-based MIS in many areas of management decision making. Small companies however will need considerable help if effective systems implementation is to be achieved successfully. The research evidence gained from these longitudinal case studies indicated that this help should be in the form of tools and strategies for systems analysis and design, and implementation guidelines in the small company environment. The small business is thus worthy of further research to generate the more fruitful and appropriate information systems design methodologies which are clearly needed.
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APPENDIX A

COMPANY A

Selection Phase (January 1980 - September 1981)

Company A investigated the feasibility of using a microcomputer when a new managing director took over and judged the profitability to be low in comparison with the workload of the company. Over a period of two years the new management introduced a manual system of double entry financial accounting and job costing into the firm's administration and took a more positive role in the relationship with the external accountants who had previously been entirely responsible for the maintenance of the Company A's accounts.

Shortage of management and clerical time prompted the management to consider the feasibility of computing in 1980. The company had a family connection with a computer systems analyst and with his assistance, the company assessed their clerical problems and needs in order to locate and select a suitable microcomputer system and install it.

When the company's accountants were consulted in connection with the possible implementation of a computer system, initial doubt was expressed as to the advisability of this move in a company so small and later information regarding the accounts was not provided as willingly as it might have been.

The company described its strategic objectives as:

"To achieve consistency of information with regards to contracts, suppliers, subcontractors and clients....

to improve the company's cash flow by reducing the time lag between invoicing and the completion of work....

to acquire a new image associated with the use of new technology in line with the new generation of company management."

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Operating and control objectives for the use of a computer were:

"To reduce the costs of construction by providing management control information....

to maintain up-to-date and detailed information on contracts for surveyor valuation purposes....

to reduce bottlenecks in information requirements at the end of each financial year....

to reduce staffing overhead costs by reducing the duplication of data recording effort....

to replace obsolete office equipment....

and to delegate management information functions by creating a new position of responsibility (i.e. computer operator)."

Company A described their requirements for the computer system as:

"A flexible, integrated system for the purchase ledger (including subcontractors), nominal ledger and job costing. Payroll and sales ledger were both less significant clerical problems but would also require integration for job costing purposes."

September 1980

Management had assumed at this stage that an off-the-shelf package to meet the needs of the company could be found and installed without too much difficulty. However the search for a ready-made system of hardware and software proved disappointingly unsuccessful. There appeared to be no systems being marketed which suited the needs of a small building contractor although two packages were located which partially met the need. One package was incomplete at the time and the firm did not wish to be the first user of a system which was being developed some 160 miles away in London. It was also believed that the microcomputer on which it ran might present compatibility problems for expansion at a later stage. The other system was a very specialised system for one branch of the construction industry and had problems of inflexibility.
December 1980

The company management had decided to purchase the hardware independently with a view to writing specialist programs specifically for their needs. In September 1980 the company purchased a 64K microcomputer with CP/M operating system, appropriate programming language and the software development was commenced. An agreement was reached with an associate that although the system would be designed to meet the needs of the company it would be flexibly designed so that it could be sold to other small contracting companies. The copyright would belong to the developers (i.e. the managing director's associate) and no charge would be made for the programs written in exchange for testing being undertaken by the company.

The software development process was lengthy since each program was tested on very inexperienced operators in the environment of the contractor's own office. The system consisted of around 100 different programs. The level of complexity of the system grew as the management and developer realised the system's capabilities and then extended their specification of desirable features. The management also realised many omissions and difficulties in their original specification of the system. Examples of these amendments were the ability to make provision for the retentions held by other firms and the taxation complexities of dealing with subcontractors in the construction industry.

June 1981

Much clerical effort had to be put into reconciling the correct processing of the new system. Over a period of several months a manual system provided the details for detailed system testing before Company A was given the
software to install. The task of learning how to operate the system in stages without the necessary written documentation meant that operators had to continually consult the individuals writing the programs.

September 1981
The system had taken 18 months to develop before Company A was confident that they should become dependent on the computerised system. By this time Company A had concluded that it was not to operate payroll and labour costing systems manually. They had also purchased a standard payroll package which could run on their microcomputer. This move was believed be management to be relatively successful although there remained compatibility problems with the output of the package and manual adjustments were still necessary before the data could be used by their accounting system. Such problems led Company A to specify a series of payroll program which, when developed, could be integrated with their accounting and contract costing system. This involved the firm in considerable management time in discussion with the program developers.

Implementation Phase (September 1981 – June 1983)

September 1981
The implementation of the system for initial training purposes using dummy data took place over a period of several months as the system was developed and tested by the suppliers. Firstly an initial core of programs was supplied to provide facilities for entering accounts and jobs and some essential transactions e.g. invoices and payments. The company director was initially responsible for establishing that the programs were functioning as required. On many occasions areas where the specification had not been
clear, the problems only became apparent, when the program was supplied. Discussions then had to take place with the programmers and modifications were bargained for against the ease which which the needs could be satisfied. On many occasions the company felt in a weak bargaining position which he attributed to his belief that there was only one way to write programs. Major modifications (e.g. dealing with subcontractor payments) in the early stages caused several delays in completion of modules. The development of the working core of the system took 15 months to design and implement to a satisfactory stage in Company A.

April 1982
A close liaison resulted between the computer operator, a typist with no previous experience of computing, and the programming staff of the software house. Suggestions were made with regards to the ease of use, accuracy of the procedures and the flexibility of possible requirements. Initial implementation of the system for operator training purposes was undertaken without the benefit of any written documentation from the suppliers although operator errors did not appear to be troublesome. During the early period of implementation the company found that the relationship with its auditors who had previously been responsible for the preparation of the accounts, became strained. The auditor had no experience of computerised accounts and kept the records on a different basis to that of the computer system. Early hardware problems were frequent (e.g. power supply faults) and caused many system data losses. This forced the operator concerned to adopt the habit of making frequent security copies of data, an alien practice to manual record
keeping.
The part-time clerical worker employed by the company did not feel able to learn about computers very easily. She resisted with all her available power the use of the system e.g. by assigning a low priority to any task associated with the new computer whereas simple filing or typing would be assumed to be important and more interesting. When forced to operate the computer she worked very slowly, was extremely error-prone and would require step-by-step verbal instructions to be given by the director who inevitably decided on many occasions that it was more efficient to undertake the tasks himself.

September 1982
A senior secretary, with some experience of computer operation, had been employed and the responsibility for the computer system was given to her. She was highly motivated and skilled with regard to general office management and was able to undertake all system testing in conjunction with the programmers although her previous background did not include any accounting or bookkeeping experience.

Live Operation Phase (June 1983 - June 1985)

March 1984
The company was experiencing some hardship as a result of the continued economic depression which had meant many of the public bodies cutting back on the work put out (both maintenance and new projects). In March 1984 the miner's industrial dispute added to this as all work from the NCB was suspended. The company contracted its workforce to a level of seven which meant that the overhead of three on the administrative staff was too burdensome an overhead. Thus the company made the first part-time secretary redundant.
This was the person who had been very difficult to train and adapt to the use of computers within the office. The company purchased a general purpose payroll package on which much experience was gained but the lack of links into the job costing module of the tailored software ensured that it was only a temporary move. The company director meanwhile was able to specify the requirements of the payroll and labour costing with more clarity and precision than had been done with the earlier modules. This he attributed to the valuable experience of actually having used another package, it is easier to make suggestions for requirements on the basis of something tried and tested. The payroll was in fact run in parallel with the temporary package for several weeks before the director was happy to rely on it. The direct interface with the workforce was the first time the employees had become aware that the company was operating a computer.

The company extended the use of the computer to other business applications during the two year period. Estimating of planned work was the main area which drew in another director to be able to use the computer. Further extensions to the total management information system based on the computer were planned but the company began to find difficulty in providing computer time for the implementation.

Management reported that they were now in a position to know much more about the principles of accounting and were able to interpret the financial position of the company from the readily available information, whereas before they had managed more on intuition. The most valuable information obtained was that regarding the profitability of jobs which enabled more control over the costs of current jobs and
knowledge of the most profitable type of work for the company.
APPENDIX B1

COMPANY B1

Selection Phase (June 1981 – January 1982)

June 1981
The company's visual record computer had purpose written software to undertake the company weekly and monthly payrolls and the accounts of the separate companies. They had dealt with a major nationwide computer systems company who marketed one of the most established software packages for the construction industry although this was on a small mini computer at this time. When the maintenance costs of the early visual record system became too high an overhead in late 1979, the company began to search for a replacement in the microcomputer environment. Initial approaches to their present supplier indicated that the investment necessary to install a new system would be £20,000. The company management were subjected to much pressure as established customers to install on their mini system and software but the informal agreement between the National Building Trades Employers Federation and the supplier did not persuade Company B's management.

August 1981
In early 1981 the company secretary heard of a research project being undertaken a Loughborough University of Technology in the Department of Civil Engineering and agreed to participate in the project involving the application of microcomputers in construction management. In August 1981 the company's primary interests were to find a complete software package for accounting and payroll specially designed to meet the needs of the medium/small construction
Particular importance was attached to the facilities of the payroll programs which had to be written to comply with the National Working Rule Agreement for the Building Industry, particularly in regard to travelling costs to site, inclement weather payments and the holiday stamp scheme. They also required labour costs to be automatically allocated to job costs in some detail from a single input from time sheets. The purchase ledger was subdivided into material suppliers and supply and fix subcontractors. At present the company had no facility for preparing interim valuation certificates for subcontractors. These were prepared manually on a carried forward basis by the company surveyors before being entered into the accounting system.

**November 1981**

Initial investigations were made to locate a suitable system. During discussions concerning one proposal from a software house associated with a large building company, it became apparent that the printed reports which were credited to a software package operating on a 32k microcomputer were in fact the output of a much larger mini system. The software house were in the process of converting an established suite of programs to run on the smaller microcomputer and had been heavily marketing the new system in advance. There were as yet no users of the microcomputer system as yet in the construction industry. Company B consequently returned to the software house and were unconvinced that the proposed system was now a viable proposition. Subsequently Company B1 made visits to the only other construction industry software supplier known of to see a demonstration of a specialist accounting and payroll package.
January 1982
Two microcomputers and dot matrix printers were purchased from the latter company together with software for the Company B and also Company B's associate company.

Implementation Phase (March 1982 - May 1982)

April 1982
As the company had previously operated a visual record computer and fully appreciated the conceptual structure of computer based accounting systems the need for training on the use of computers generally was unnecessary. The software house supplied a set of disks containing the accounting programs and the payroll programs together with a manual of operator instructions. One half day's instruction was given by a director to the company accountant. This was principally concerned the setting up of the company master files, making security copies and getting into the system. From this point on Company B1 was supported by a "hot-line" to the software house who frequently guided the initial operator (a professional accountant) on the steps to follow over the phone.

The management felt that it was not necessary to undertake any rigorous system testing on dummy data as they understood what the necessary inputs and outputs would be. The clerical staff were not involved in this stage of introduction of the computer. Initial hardware problems concerned the use of the printer which appeared to be extremely slow.

The computer system installation was planned very carefully by management with each file conversion operation identified and scheduled to take place over a period of two calendar...
months. The management felt that the conversion had to be achieved quickly and effectively as they could not be "caught between two stools", trying to maintain input to two systems. The conversion was phased with payroll, sales ledger, considered as a relatively minor task, and some journal entries being done in the first month. The purchase ledger however was a little more problematic because of the various categories of subcontractor but this was also successfully installed in the following month.

June 1982

The management felt that the implementation was very successful as was outlined below.

"Implementation was fairly trouble free because it was on the basis of considerable knowledge gained over a period of at least twelve months prior to buying the system.... We knew exactly what was required,... We planned and budgetted for the changeover very carefully,... We had the organisation and the staff to achieve the plan,... and most important we had the data needed".

Live Operation (May 1982 —> )

June 1982

The early use of the package presented the company staff with few learning difficulties which could not always be overcome by using the manual but the software house staff were always available on the telephone to sort out difficulties as they arose. The company felt that they were building up a profitable and secure relationship with the senior staff of the system suppliers. The suppliers used the company as a reference site when dealing with prospective customers in the area.

Some early problems arose when the system was extended to be used for a subsidiary company operating from the same site. The new company was engaged in stone masonry supplying only
Company B1 but the labour was paid by a complex piece work arrangement for the quantity and degree of difficulty of the stones carved. Traditionally the employee payslips gave full details of the amount earned on piece work and associated bonuses but the new payroll software did not have any facilities for reporting this level of detail although it was possible to use the computer data to generate the information required. After some discussion with the authors of the software to specify the exact nature of the problem it was decided to commission a special payslip to be written for this subsidiary company at a cost of £300. Unfortunately there were later repercussion of this modification when new releases of the software were made.

September 1982
The overall processing speed when undertaking routine operations became problematic when all three related companies became installed on the two microcomputer systems. Critical points were at the month end and also leading up to payday each week. One more elderly operator was particularly slow at input and checked every step of each task associated with the computer use. She would resist inputting the next data item before the last one had been fully checked to her satisfaction. The operation of the computer presented considerable responsibilities in the mind of this operator whereas a younger girl was able to be responsible for both the other companies without similar fears or problems.

The first printer was replaced after much discussion with the suppliers regarding faults and replaced with a faster and less temperamental model thus assisting the problem of printerbound operations.

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After a system crash several months after installation, the company was surprised to find they were unable to continue to operate the contract ledger module. It was discovered that the company had not deleted any contracts from the establishment of the file and that no warning had been given until the software simply refused to operate any further on the full files. Once decisions were made by management to clear out past contract details no longer required and renumber some of the long contracts so that the file did not take up so much space, the company found a significant improvement in the time it took for operations such as listing the work in progress details.

Further time savings were made when the company decided that it was unnecessary to print out all the printed reports at the end of each month, many of which they found were optional.

February 1983

However by early 1983 it was decided that the hardware was not sufficient to support the number of invoice, payment and journal transactions which the companies were currently generating. Management decided to investigate the possibility of attaching a hard disk to one or both of the existing stand alone microcomputers. The director and senior accounting staff visited a user site, suggested by the system supplier, to evaluate the suitability of a hard disk in a company similar to their own. This proved to be a disappointing venture as the unit was very noisy and although much greater file storage capability would result the improvement in the processing time of the programs (particularly input) was not sufficient particularly when two computers were sharing the hard disk. When cost was also considered it was decided that this option was not a
viability economically or operationally and the company purchased a third microcomputer of the same manufacturer as the previous ones for the subsidiary company and also upgraded the disk drives to support double density disks. This hardware upgrade appeared to solve the bottleneck problems since most had been caused by the unavailability of operator access time to be computer.

In September 1983 Company Bl was approached by the suppliers and asked if they would be prepared to user-test the new version of the integrated accounting and payroll software. They took possession of the suite of programs in October and the resulting experience was reported as follows.

According to the supplier the benefits of the upgrade were claimed to be

"A 25% faster overall performance, a more comprehensive audit trail, input of purchase invoices at the speed of the operator via an input buffer, a new menu, a progress tick chart for user when lengthy reports/processes are involved and security checks for back up procedures".

January 1984

There followed a history of serious problems for Company Bl. From a relatively secure position when the company believed they had solved their information processing requirements they were left without any information for a few months and a senior accountant was loaned to the software house for system testing and the company's expense. The history of problems associated with the new releases of software were recorded in detail by the operator and was described as follows.

1. New release version 1

(a) There was a problem immediately as the security copy routine would not work. When the supplier was contacted the security checks had to be overridden before the
A conversion program required to convert the previous company data files into the new record format had a program bug which required rectifying by input Basic language instructions by the company themselves. Syntax errors were found on several other programs.

(b) The wages posting program did not function correctly initially since it could not be accessed from the menu and when it was run it ran out of memory and terminated. A loss of three weeks was experienced before the link was successfully achieved but it still required an operator to keep pressing the return key during the process. No details of the wages transactions appeared on the contract cost detailed report.

(c) In the purchase input program a syntax error message was displayed when an invalid supplier account number was entered. The ability to automatically post a batch of cash payments to the respective purchase ledger accounts was released in an amendment to the previous program. However when run the program terminated abnormally at the bottom of the first remittance advice being printed (i.e. maximum 10 invoices).

(d) A further problem on the purchase ledger occurred where an account had a debit brought forward balance resulting in the user being unable to pay any subsequent invoices. A journal entry was required in such a case. When making manual payments (i.e. individual invoices rather than account balances) a maximum of forty invoices could be specified for a single payment but if this was exceeded several cheques needed to be produced. On printing cheques for more than six invoices on a single payment the 1st remittance advice is printed with a
cheque, it cancelled the next cheque and the next seventeen invoices were itemised on the following remittance advice and so on. When amending an invoice status manually (normally password controlled) entry was impossible even with the correct password and subsequently was not able to display the following invoice.

(d) An amendment for the interim subcontractor certificate program gave appropriate double entries in the accounts but no audit log was provided. Where tax was involved the calculation displayed on the screen was two decimal places incorrect.

(e) When inputting a sales invoice the operator could abort or correct the details before the invoice was accepted to update the files. However if it was cancelled the original entry still appeared on the audit trail although not as actual double entries in the accounts.

(f) Journal entries produce a BASIC illegal quantity error but when this was questioned the supplier informed them that this bug had always existed in the software but had never previously revealed itself.

Many similar errors were discovered in the following releases.

2. New release versions 2 and 3 also gave errors.

(a) When running the month end processing routine in October 1983 major problems were discovered and the whole system disks and data disks were returned to the suppliers in London. They rectified the problems and ran the month end on the company data files and subsequently generated printed reports for Company B1.

(b) When the system was used further it was found than
the nominal ledger was in fact malformed and the order of transactions on each account was mixed up.

3. New release version 4
(a) No security dongle was sent with the new disk and the user was given information on how to bypass the security features.
(b) Link problems occurred with breaks in the printing of cost details which did not tie up with the heading details on a contract.
(c) Initially access to the programs from the main or subsidiary menu was not always successful.
(d) The month end routine still did not work and disks were returned to the supplier.

4. New release version 5
(a) The subcontractor certificate program was not initially accessible and then was found to have incorrect double entries.
(b) A volume error occurred when a large number of invoices were paid automatically (488 in this instance).
(c) A major problem concerning the index construction of the files was discovered when the next end of month process was run and records were found to be completely out of order.
(d) The wages link program still had errors in linking. PAYE entries and the tailored Bonus program was still the old version.

5. Version release 5.7 was eventually bug free.

The company had been promised a year's free maintenance on the software in return for the testing undertaken. However the company felt that they would not have agreed to the position of "guinea pig" had they known that it was going to be so troublesome and costly in management time (two months
of senior bookkeepers/accountant time had been required and
the loss of management time to the company had not been
estimated).

February 1984
The new software has had most of the faults ironed out and
it was felt that the software was now in a suitable for
general customer release. The year end routine had been
successfully achieved in one half day although it would take
another week to agree the accruals, prepayments and
adjustments and input the manually. The end of month print
routine did not produce correct details in the month end
report but the individual account balances could be printed
individually with only selective month end prints. Clearing
of old contracts could only be done if there had been no
movements on any of the ledgers in the previous period. The
suppliers were intending to relax this rule.
Board level management considered these benefits had been
realised by the company.

"Planning and budgetting for the future is much more
possible, reliable and accurate... Staff have been saved in the production of management
information for the directors. This was estimated at two
full time accounting/bookeeping staff...
Disciplined office routine and sharing of the "systems"
resulted...
Up to date cost information was available for contract
staff whereas previously they were several months behind
on the costing of contracts.
Wider use of the information produced in the company."

Other systems had been identified as the next stages in
achieving greater control. Some drawbacks were identified
and described as:

" Management who were not directly involved in the
computer had made further demands for information on the
expectation that the system would produce anything they
required. Manual systems had been gradually evolving
again to satisfy these requests. It was very easy to
get out of touch with software changes on the new
releases."
The company continued to expand the use of computers by purchasing wordprocessing software and new hardware for the secretarial staff.
COMPANY B2

Selection Phase (January 1983 - January 1984)

Company B2 had already some experience over several years of computing within the accounts department but the staff of the estimating section had no such experience. The department had a variable workload of tenders to price and sought to achieve significant time savings on the pricing of bills of quantities and preparation of tenders for clients. The board of directors hoped that this would enable the department to increase their throughput of tenders for work and result in an increased workload for the company workforce at a time of prolonged economic recession when margins were extremely tight. There were also many clerical computational errors in the manual calculations involved which the management believed would be prevented by using a computer. Management information in the form of reports on budgeted resources for each contract secured would also be a by-product of a computerised estimating system.

The company accountant employed a post graduate computing student (himself a former estimator for a small company) to conduct a feasibility study of the operations of the department in order to assess the potential costs and benefits of the proposed system. The student then located four microcomputer systems being marketed which were suitable for the company. Each had limitations and the company were therefore advised that whilst each system met the majority of requirements none could be recommended as an optimal solution. The company agreed to collaborate with a software house to develop a low cost microcomputer system for estimating which would overcome the limitations of the
packages currently available. Several meetings were held to agree the functional specification and details of all reports. Staff of the estimating department were of varying degrees of agreement with the proposed move.

Six months later the estimating department were trained for the initial module of the developed system on a hard disk microcomputer.

Implementation Phase (September 1983 – January 1985)
The estimating department of the building firm liaised with the software house who had agreed to design and develop a suitable system for pricing tenders on the basis of stored resource costs and performance rates. The liaison lasted about 6 months whilst a new package was developed and the Company B2 was to be the testbed user in exchange for the supply of the programs free of charge.

The estimating department employed 2 estimators and was very busy throughout the period as work was generally scarce and consequently profit margins were tight. The elderly estimator displayed a high degree of interest in the proposed system as the tasks were very repetitive and time-consuming and often undertaken under the pressure of set tender dates to be met. The chief however was rather less enthusiastic from the start and kept to the background of all discussions. He showed only a moderate amount of interest in spite of the fact that management at board level were keen to see the spread of computing throughout the company.

Throughout the system design phase the chief estimator preferred the other estimator to participate in the regular meetings with the software house but when the system was delivered (in February 1984) together with a single user
hard disk microcomputer he was trained to operate the system. Some difficulty was found in finding the time to build up the resources library from the manual records and the tasks was only undertaken in a limited fashion. The early stages of implementation was spadmodic and the only tender data to be used was in fact that belonging to the supplier as a demonstration for learning how to use the system. Three days of training was given by the supplier who was keen to set the system operate independently. The older estimator was made redundant in March 1984 when business was slow and this put more pressure on the chief estimator to get tender prices completed. The motivation to learn how the use the system to his and the company's benefit evaporated under pressure.

After six months without any progress on converting to computer-based estimating the management of the company considered employing the services of the software house in a consultancy role to retrain the chief estimator, establish the necessary resources library and use a new large tender as a pilot scheme. This move was further resisted by the chief estimator on the grounds of lack of time.

In January 1985 the computer was transferred to a subsidiary company and abandoned by the chief estimator. The software house was called in to investigate whether the system could be used by the subsidiary but it was soon established that their real need was for production control of the manufacture of building stone.
COMPANY C

Selection Phase (January 1983 – June 1983)

June 1983

When the company had grown to a turnover rapidly approaching of £500,000 p.a. principally from local authority contracts for small repairs, the management felt that they were in danger of losing control because of the massive amount of paperwork generated by the local authority work which in turn led to delays in obtaining payments due. The directors sought advice from a firm of management consultants who had been helpful when the company was established from the liquidated firm.

The response this time was positive and the management was advised to use the consultancy service of the building department of the local polytechnic. The lecturer/consultant contacted proved to be experienced in the still relatively sparse field of computer software for the construction industry. After an initial discussion with Company C's management concerning the problems of providing sufficient up to date information for controlling the company, the installation of a microcomputer with appropriate software was advised.

The consultant engaged evaluated and selected from two specialist software packages offered by different firms. The systems were essentially similar in function and operation but were installed on different manufacturer's hardware. The consultant advised the firm to buy from one where the hardware could be bought locally and was available on a larger hard disk at the time. A contractor's accounting package was installed on a 48K microcomputer with
five megabyte hard disk and tape stream back up facilities in July 1983.
The selection was made after a single demonstration of the software on the premises of the supplier who was based in Surrey. The consultant had previously used this type of hardware and had also dealt with the company concerned which provided some degree of confidence in the decision made by the company. The total cost involved was £8,300 for both hardware and software and the system was acquired by a leasing agreement with a finance company.
The directors felt that the acquisition of a computer without any extra administrative staff would prevent overheads becoming too burdensome for the rapidly growing company.

Implementation Phase (July 1983 – December 1983)

September 1983
The company experienced an unprecedented rate of growth (approximately double) in turnover over six month period when the accounting system was being installed. This is primarily due to the volume of work being done for the local council from whom over 250 orders for repairs and maintenance were being received each month. The result was a very significant increase in the volume of paperwork (mainly job records and invoices) generated. From experience the management estimated that around 70% of the company’s administration costs were incurred irrespective of value of the final invoice.
A number of related problems resulted from this increased volume of work.
(a) The company was unable to completely convert the present manual accounting system to the computer-based system as had
been previously anticipated.

(b) No time was available by management to take advantage of training offered by the system supplier (consequently the full features of the system were not entirely known).

(c) The backlog of outstanding jobs, which had yet to be invoiced to the client, was not being reduced.

(d) The problem of being able to reconcile the remittances from the local council with the payment advices sent was becoming an increasing burden which could only be dealt with by working weekends and evenings with family assistance.

October 1983

Serious delays were experienced in the implementation operations following the system purchase and in September 1983 the management decided to take emergency action. A management consultant was contacted in September when the company management felt that they were in a "Catch 22" situation, not being able to get the system going but needing it more than ever. They were advised to employ extra clerical staff immediately to cope with the ever-increasing backlog of paperwork. On this advice the company supplemented its office staff with

(a) a part-time secretary - to answer telephone and type
(b) a bookkeeper - to prepare the council cost records
(c) a certified accountant - to take over the conversion of the manual accounts to the computer system, reconcile the opening balances and agree the audit with the company's accountant/auditor and to bring the situation up to date by inputting all the transactions since July. The extra overhead involved was considered very expensive but unavoidable.

It had been discovered that the package purchased did not
alleviate the most significant clerical problem associated with council jobs. The problem was investigated by the hardware suppliers, the software house who supplied the package and the management consultant with whom the company had previously dealt with. The views of the first two were that no standard package was currently available which would produce a printed payment advice as prescribed by the client (i.e. the local council small works department) and in addition to write such software would be complex and consequently expensive. The latter however had recommended a database management package which he believed could be tailored and installed to achieve the desired requirements. In the meantime the local council jobs could not be processed as contracts with the accounting package installed and had to be manually recorded and reconciled as before. Several teething problems were experienced during the early stages of implementation.

(a) Time was being used trying to find relatively errors of relatively small amounts which resulted from mistyping figures in batches and no software facility was available to make the necessary adjustments later when the error was found.

(b) Accounts could only be opened at the current date of the system although transactions could be backdated on input. They would however be treat by the system as current cost data until the month end had been run. This was only a problem in the initial changes of conversion when a backlog of data needed to be input.

(c) A storage problem of the vast amount of printout was becoming apparent and the directors still did not have time to effectively use the information provided. The directors felt that they had little appreciation at the
outset of how much time would be involved in training and understanding the package and setting up the company data files. As a result of staff holidays no work training, converting or otherwise was undertaken during August and the backlog by September was increased significantly. The first phase of implementation (i.e. payroll) was successfully achieved within a month of the installation and the wages processing was soon "live" although the labour hours were not able to be allocated to council jobs. Purchase, nominal and sales account balances had been established as at 30th June 1983 (3 months backdated) although three months of transactions had yet to be input to the system to become "live". Management anticipated this would be achieved by the end of October 1983.

Some changes in the administrative operations of the firm had been necessary resulting from the introduction of the system. In particular suppliers had been informed that invoices should not exceed the five invoice lines since the software had a restriction on possible allocations to jobs. This request was not always adhered to by the suppliers. The management had undergone the specified training but they had experienced difficulty in switching from construction management tasks to computer operation tasks. Skills acquired by training had not been shared by other individuals on the staff.

December 1983

The company was very vulnerable to the fluctuations in the expenditure of the local council and six months after the purchase of the computer there was a freeze on the work from this principal client. With a workforce reduced to seven direct employees the management also felt that any further reduction contraction in operations would not generate
sufficient turnover to warrant the current investment in the computer.

After six months of extra resource requirements the company felt confident enough to abandon the parallel run on the purchase ledger and had managed to catch up with a backlog of three months transactions having been input. They had been reconciled "near enough" with the manual records but the company's accountants had yet to audit the half year's accounts resulting from the computer. The services of the extra staff employed during implementation were no longer necessary. The bookkeeper had left at the beginning of December and the accountant at the end of November although he was still coming at the end of each month end to supervise the computer processing.

The unanticipated costs of professional services involved in the implementation was estimated as:

- £ 1000 - accountancy fees
- £ 700 - business consultancy fees
- £ 300 - bookkeeping assistance

A school leaver with O levels had been employed under the Young Workers Scheme to operate the computer on the basis of training given by the certified accountant before he left. She did not find the computer operation and business routine difficult although had not yet undertaken the complexities of end of month processes. The net cost to the company for the operator was very small due to the government subsidy. School experience with microcomputers was found useful since the management had in fact left her to work independently. The accountant had detailed a procedure for the company for the end of the month which was of tremendous value when the extra staff was not employed.

The problem of council jobs has now been successfully installed on the computer using standard database software.
For a relatively small charge for installation the local hardware supplier had designed a simple file of council jobs which could be interrogated and used to monitor the status of each.

**January 1984**

The management felt that after six months a point had been reached where the computer would prove to be of real benefit to the company. The company expressed the anticipated benefits as:

"... the ability to improve the company's cash flow by providing information on account details,... the ability to identify when costs exceed estimated costs for work undertaken,... a reduction in accountancy fees involved in the annual audit and the minimisation of specialist management staff who are associated with growing companies."

These benefits were begun to be realised after the implementation period as management revealed:

"Clients' statements are now able to be used and an improvement in the cash flow is anticipated... the first costs of jobs are available... accountants fees have been agreed to be lower on the basis that the system is working as reported... specialist management staff has in fact been minimised now the system is operated solely by the junior office worker with occasional assistance from the myself (director)."

However there had also been some unanticipated benefits as listed below.

"A discipline has been imposed on the system... job information regarding cost of individual trades is now available... word processing is part of the data base package supplied although this has not yet been used... a real evaluation of which jobs are making the most profit is readily available rather than relying on the intuition of the management."

**Live Operation (December 1983 ——) **

**March 1984**

Business was reported as being rather low over the slack
months of January and February in the construction industry and the firm had in fact been undertaking a new promotional sales policy involving mail shots in the locality. It was anticipated that the local council would be making orders for work in April when the next financial year's budget was available. The company's turnover however was likely to be maintained at the level of £500,000 and they had been able to maintain a steady workforce of twelve joiners throughout the majority of the financial year.

Since January the company system had been fully operational although the management still kept a manual sales ledger which it felt provided necessary management control information. Management evaluation of operation of installed system was described as follows.

(a) The only real management information to be of direct use to the company was that concerning job costing. The other month end reports provided by the system was not directly used, particularly the Balance Sheet.

(b) On reflection the installation of the system was made with rather inadequate experience regarding the account structure on which to base management accounts although the software supplier had provided a skeleton account list. This had resulted in difficulties in the balancing of control accounts by the auditor at the half year end.

(c) Early transactions and accounts are made in haste and the implications had not been fully appreciated at the time. The company had required further assistance from the consultant in the reconciliation of account balances which the management felt should have been avoidable had their level of accounting/financial management knowledge been better.
(d) Learning how to "use" and "operate" the system is mixed up with the actual installation and needed a considerable amount of management thinking time. This had not really been available until several months after the system had been installed. However the directors felt that this was not caused by the computer but the fact that the company turnover had doubled during that period.

(e) The computer was a good image to present to new clients and to employees.

The software was found to be limiting in some cases:

(a) The format of the client statement which was produced by the sales ledger was felt to be unsuitable to be sent outside the firm. It was also out of date by the time it was produced (the closing off at the end of the month could not be undertaken until purchase invoices for that month had been received by which time several client invoices had been paid).

(b) The statement run was non selective i.e. involved printing all client account details. To avoid this the company must close off any accounts without balances (involved printing for audit and subsequent deletion of the record from the file).

(c) The software was slow in such operations as posting of the invoices to the respective accounts if it had been written in a language such as Pascal. (35 invoices took on average 10 minutes to post)

(d) Initial decisions on sizing was made without full information on how the system operated e.g. employee file had to be extended several times as records had to be kept on for the whole of a tax year when the employee left the company.
(e) On the purchase ledger an invoice is split into several physical records when it is posted to more than one nominal/job accounts. However when this is provided as information on an account breakdown the original total value is not provided.

(f) No remittance advices are provided.

(g) The contract cost ledger did not provide a true picture of work in progress since the records were not updated from any cash receipts from clients.

(h) No facility was available to cost expenses to contracts.

In order to achieve this the company had to input it via petty cash.

Management had made further plans with regard to the computer system. Estimating was seen as a natural progression to the use of the company computer. Control over the purchase of materials at more economic prices was to be pursued using the information on the purchase ledger. A saving of 5% represented £10,000 which it was felt might be attainable using the system. It was anticipated that the year end audit fee would be considerably reduced now that the control accounts had been reconciled.

**July 1984**

The firm was experiencing an upturn in the economic climate and had now a workforce of seventeen men. The company had diversified into the plastering trade to support the joinery work previously specialised in. The work had principally arisen from a local authority contract which amounted to some £17,000 in the month of June in comparison with £8,000 in previous months. The company director spoke of some concern over the growth of the company by his co-director but that his attitude was that the move was a very
profitable one.
The company had had the computer for one year now and its financial year had ended on June 30. The computer was being more fully utilised now for the production of real management information.
(a) A quarterly audit was now undertaken by the company's accountants in conjunction with the director rather than a six monthly figure. The management considered they would be more happy with this when the control account balances are understood. The firm employs the services of the accountant for one week for this purpose.
(b) Work in progress was reported to the employees at monthly meetings and the system now provided accurate data for this meeting. The split between labour plant materials and other costs was particularly beneficial for analysis and management decisions.
(c) The local authority job data base was now being fully exploited and the manager had become fully familiar with the facilities for selection and searching for the records. A split had been made in the code structure of all jobs so that the company could establish the profitability of both plastering and joinery work.
The company had employed the services of the consultant more recently. The consultant had been using a spreadsheet package on his IBM personal computer and had developed a model of the company's financial situation for the purposes of cash flow forecasting. The company was extremely pleased with this and had in fact used the information beneficially to negotiate funding from the bank. The company felt that, as the predictions for cash requirements had in fact been accurate, the bank now had a much higher opinion of the company.
Weekly planning of resources for the jobs undertaken was now being printed off by the consultant for the company. Both these applications were hoped to be implemented on the company's own computer when possible.

The director expressed concern over not being able to spare the time to get into the system himself since he felt that the real use of the computer depended upon himself being able to understand and exploit all the features and facilities of the software packages. It was also felt that the computer was no real substitute for understanding the system.

There was now problems of getting the information into the computer and staff had had to work late in order to get access to the system. The cause of this were identified as:

(a) Slow operation of the accounting software which was written in Basic.
(b) More business meant more paperwork to be entered.
(c) A slow printer speed.

The spare computer bought by the director was suffering from a hardware fault at the moment and had proved embarrassing when the system had been being demonstrated to a potential purchaser. It was hoped to get the system repaired and brought into the office to alleviate some of the access problems currently being experienced.

The slow operation of the accounting package was now felt in the light of experience of the database package. The director remained extremely loyal to the supplier and felt that on the whole his needs had been satisfied.

The girl who operated the system revealed a parochial attitude to the system with little enthusiasm or understanding of what was being done.

The first year's costs for the system were:
October 1984
The computer operator had been involved in a road accident and as a result was likely to be in hospital until the end of the year a period of six months. This had caused considerable difficulty in the company as great reliance had been made on this young operator. The manager and his secretary had been forced into operating the computer to keep up with the information flow but an unemployed ex-student had been temporarily engaged to meet the need. This person had been able to keep up to date with the council work whilst the manager and secretary had undertaken the wages and invoice payments.

The company now realised their susceptibility to problems and it was now thought that the new employee would be kept on after the return of the operator and use the other Apple computer. There were problems of insufficient time available to use the computer for all the company's needs and it was foreseen that the company would be able to support an individual in a management position thus releasing the manager to be in closer contact with the job operations and thus ensure sufficient gross profit margin was maintained on the work undertaken. The staff problem had arisen at a time when the operator had become so proficient that she could get through the work in sufficient time to be able to experiment with retrieving the management information.

It had been discovered that initial setting up of the system had been inappropriate and the system parameters had had to be changed to cost the various types of labour. When the system was installed the company were not in a position to
know their real information requirements and decisions had been made incorrectly.

An unexpected benefit of the operator's absence was that the manager had been forced in refamiliarising himself with the facilities of the accounting package. He believed the programs to be slow in operation (noticed particularly when a lot of input was required) and had taken steps to discuss the matter with the suppliers. He had arranged a meeting with the supplier at a London exhibition but the supplier had not kept the appointment. The use of an accelerator card and a buffered printer had been suggested by the supplier but the manager felt that the cause of the slowness was much more deep rooted.

January 1985

At the start of 1985 the company employed sixteen workmen and two and a half office staff with a turnover reaching £440,000 during the last year. This represented a growth of 56% in one year. It was felt that this was rather too fast and that 10-15% expansion was preferable in the long run as a competitor had been forced into liquidation because of cash flow problems resulting from too rapid expansion. The next financial year was hoped to one of consolidation and ensuring a higher profit margin on the current turnover rather than expansion further.

They had been involved in some £3000 accountants fees but this was not expected to reoccur. The electrical side of the business was to be expanded.

The temporary operator was still employed with the company due to the continued incapacity of the normal operator resulting from her road accident. The management felt that this person had a different attitude to the use of the
computer which benefitted the company. e.g. he had a probing, enquiring mind which lead to much greater understanding than the previous operator; he was planning to take the other computer (spare) home over the holiday to experiment with estimating and databases; he frequently consulted the manual and understood the basis of the systems structure to such a level that little need for consulting the manager was now necessary; he acted on his own initiative when organising the work load with the result that he had some free time now to "play". No other person was needed to input the data.

The management would like to keep this employee as he has become an unofficial "computer manager" and they are prepared to second him on a part-time training course should one become available.

The economic situation had again been depressed as the council have little funds left until the start of the new financial year. The company was now advertising to keep the work flowing and some jobs had been undertaken on the company premises and directors' homes.

After the end of the financial year the company had been forced to make five pages of journal adjustments to ensure that the closing balances on the accounts were correct. This had involved the staff in much aggravation and around three days of accountant time. Much of this effort was blamed on the temporary bookkeeper who had been employed to get the system going the previous year. There was an account named "Mr X Cock up account" which appeared to be a suspense account to which large amounts of money had been temporarily posted and left until the end of the financial year when they had to be sorted.

The accountants were not being very helpful and were
considered to be even hostile throughout the process. They had insisted that the final accounts were presented in their own style event though the computer presented the same information. This meant that the fees for auditing were not being reduced as expected as a result of the computer system. The management consultant therefore prepared the information in the required format using the output of the accounting package. When this dilemma was discussed with the computer system supplier it was discovered that, had the installation routine taken account of these requirements when the system began, the package could have been producing this information in the format of the contractor's accountants. The change now would involve changing the structure of the accounts as set up and although possible it was not going to be an easy task. On reflection the accountants had been very reluctant to become involved in the installation and had tried to keep the structure very simple.

The suppliers were going to send a program to produce the new format accounts at the end of each period but it is still doubtful whether the accountants will trust the information produced. It had also been discovered that the local council jobs could be entered as a lump sum value into the package as "applications for payment" as they did not form part of the accounts until a sales invoice became applicable. Thus the real financial position was apparent to the management immediately. The database system was still required for a detailed record of the jobs done for the council.

The management felt that the accounting package was very powerful and they needed a refresher course on its facilities and manner it can be used periodically. It was
suggested that this could be part of a day's consultancy paid for in the maintenance of all software systems. The initial training had been too complex to take in and fully understand when the system was first delivered. Too much reliance had been made on the accountants knowledge of what was necessary.

The system was now fully used to produce regular monthly accounts which were fully investigated rather than taken on trust. These were reconciled with the management figures for cash flow given by the consultant's spreadsheet program. The council had on occasion contacted them to find out whether a particular jobs had been given to them. It was known that the computer could retrieve this information very quickly.
APPENDIX D

COMPANY D

Selection Phase (January 1983 - September 1983)

July 1983

The company had a limited manual system in operation and growth of the company had generated problems of keeping the manual records up to date to maintain the control over suppliers, clients and subcontractors. The management consisted of two individuals neither of whom had previous business experience of operating their own companies although one had worked for a larger company in an office capacity but on the contractual rather than the financial side.

Both managers felt that they needed to automate in some way the labour-intensive operation of keeping financial and contract costing information if the company was to be able to grow as planned over the next five years.

However there was a high degree of early confusion concerning the facilities and operation of general business systems which made the problem of selecting a computer system by the management very difficult.

The company visited a general computer systems exhibition in early 1983 but felt that they were no nearer locating a suitable system. At the exhibition they located a firm of consultants from Bolton who agreed to undertake the task of evaluation and selection of a suitable system. The consultant had no previous experience in the construction industry although he had been involved in the selection and installation of small and medium business systems in companies of a similar size to Company D.

The consultant made an outline specification of the
requirements of the company in terms of volumes of inputs and files and the reports required and then attempted to find a system. The initial systems suggested and demonstrated to the company were of the general business type and were found to be completely inadequate when the problem of managing payments to subcontractors, costing both materials and labour to contracts, the practice of retaining payment from subcontractors and having monies retained by other contractors were considered. The management of the company looked to the consultant for advice on how to judge the effectiveness of systems demonstrated but found that they were themselves able to discount all the systems suggested on the grounds non-provision of essential requirements. The services of the consultant was eventually dispensed with when the company felt they had to locate a very specialist system or possibly commission tailor written software.

The consultant offered no advantage in this respect as he had no experience in the business practices or requirements of the construction industry and would have had to acquire this knowledge from the management themselves. This was a time-consuming activity at a time when the company had a target for implementing the new system before the end of their financial year in a few months time.

The management subsequently made enquiries with their professional organisation (The National Federation of Building Trades Employers) who provided contacts with suppliers of specialist computer systems for the construction industry. The management attempted to arrange for demonstrations to be given through local appointed dealers but found that they were dealing with inexperienced staff and so they decided to deal with the software
developers whom they felt would be able to answer detailed questions and have the expertise to be able to assure them of the systems abilities to deal with the company's requirements.

Only two suppliers were located to arrange demonstrations on the premises of the company. The first company provided a "very unstructured illogical demonstration by a salesman who did not fully understand the software or a contractor's requirements".

The company felt they were being "sold" something which would later prove to be slow, difficult to operate and inflexible to use.

The second company provided supporting literature prior to their demonstration which provided the company with a conceptual understanding of the operation of the system. The demonstration was considered to be systematic and logical and clearly presented. The sales staff appeared to have experience and expertise in both the computing and construction fields. The system was able to cope with the company's requirement for multiple accounting periods although little evaluation of other aspects of the system appeared to be undertaken. The computer hardware was a new small hard disk system with tape stream backup facilities rather than floppy disk which the management believed would be advantageous. The system was not demonstrated on the actual version of hardware intended to be installed (an Onyx microcomputer) but this was assured would be identical in operation.

Implementation Stage (September 1983)

September 1983

Company D was not quite as busy as normal when the computer system was delivered and management hoped to have the time
to "dwell" on the system implementation. Two day's initial training was given by the supplier, a national computer company, when the computer system was supplied at the beginning of September 1983.

October 1983
Installation and training progress was not as had been anticipated although management were nonetheless happy with the system. Supplier support was considered good and all the problems raised so far had been resolved by representatives before the next training visit. At this point management felt that their expectations of the system were high but that they were, as yet, not in a position to judge whether they would be fulfilled.

By working weekends and evenings during the first two months the staff had only been able to partially establish the master files on the purchase and nominal ledgers and input the backdated invoices for a period of five months. The volume of transactions was relatively high (200-300 per month) but no analysis was made of these costs in the nominal and contract ledgers.
Some problems had been encountered during the implementation.
(a) A series of early data file losses was eventually tracked down to function keys not being disabled by the software. The operator had on several occasions accidently depressed a key located immediately adjacent to the numeric key pad with the resultant loss of the several batches of data and corruption of master files.
(b) The company were instructed that they should keep the computer switched on throughout the office day rather than switch it on just before use. It was suspected that the
transformer installed in the early days was not in fact of significant operational use. Some system facilities (e.g. reformat and revert) have in fact been withdrawn temporarily from the company by the computer supplier. The management believed this to be a security precaution in view of their inexperience.

December 1983
Progress was definitely behind and the management reported that only one day each week had been available for using the computer and the necessity for manual month-end payments and other administration (e.g. the necessity to maintain manual account for the on-going transactions) meant further delays. There had been little opportunity to continue with the implementation as had been planned but management hoped to use the construction industry shut down period of two weeks at Christmas to recover some of the lost ground.

The purchase ledger invoices had been input up to the half year (i.e. end of September 1983) but little progress had been made on the subcontractors ledger. No payments had been input as yet and it was planned that a single payment would be recorded to reconcile the files with the half year financial position. This method of parallel processing meant that the company had very little opportunity to reconcile the real facts with the computer files until the backlog was caught up and no management information was available in the interim period.

At this time plans were made to get the sales ledger followed by the company payroll installed early in 1984 in order to be operationally "live" by April 1984. In hindsight the directors believed that it would have been better to start the computer system from the financial half year i.e. September 1983.
The company workload had changed since they acquired the system and the trend was towards smaller jobs which unfortunately required more administration and a larger clerical staff to undertake. Delays were experienced in raising current invoices to clients because of the time commitment to the computer. Six months after the delivery of the computer one director commented that the company would soon begin to feel cash flow problems as a result of the implementation struggles.

Some problems were recalled by management.

(a) Hard disk problems arose during the first three months and the supplier maintenance personnel visited the office on many occasions to reformat sectors of the hard disk. On one occasion the computer was taken to their workshops and a replacement fixed disk fitted under warranty. The consequence of these hardware faults are that time is lost on the implementation schedule, actual data or programs are lost and recovery procedures were implemented. The telephone charges were expected to be significantly higher for the period when the computer was being installed.

(b) The subcontractor ledger was felt to be cumbersome to establish and operate and in a few instances the user interface appeared illogical when compared with the accepted industry practice. A problem had arisen when the company decided NOT to print the subcontractor certificates as the manual versions were satisfactory. This had resulted in no update of the nominal ledgers and transactions were left on the disk until the sector became full and the system terminated abnormally. No warning of this possibility was found in the manual.

(c) The subcontractor ledger proved to be a difficult task.
to establish. This is a particularly volatile ledger and new subcontractors (particularly nominated ones) were set on for work on specific contracts throughout the year. This is rather different from the position with suppliers who tend to be the same ones who are dealt with throughout the year. Subcontractors are a complex area of administration for the staff of any building company and in order to reap the long term benefit of managing subcontractors with a computerised system the company forfeited some of its flexible working practices (e.g. present procedures allow the subcontractors to collect several payments before they submit a voucher to the value of the total receipts. It is unknown whether this will be permissible in the computer system).

(d) The software was found to provide no internal audit trail on the subcontract ledger. Individual payments had to be made for each subcontract certificate. Batch numbers were complex. Some management information needs omitting from the reports. Some useful reports had been discovered, almost by accident, eg. m/e creditor analysis and contract valuation listings.

(e) A significant problem involved in the establishment of the computer data files was the search for the actual information within the office to put into the computer. Building company offices operate traditionally on a flexible and informal manner with regard to subcontractors.

March 1984

The implementation was still progressing at only a steady rate. The software supplier had recently visited with new
support personnel who, the management felt, understood their needs far better. The management reassessed their situation and thought that "they knew where they were going" even though they had not in fact made any significant progress in getting up to date in the backdating procedure of the accounting ledgers. It had been time-consuming to get the opening balances of April 1983 (a year ago by then) sorted out with their accountants.

Cash purchase transactions had been entered as totals but no further progress had been made on the purchase ledger. Some progress was achieved by March 1984 with the sales ledger invoices and payments but implementation short cuts were being taken in posting to the contracts. Journal entries were still proving problematic e.g. Holiday with pay on the payroll and VAT payments on subcontract certificates. A month-end routine had not yet been performed by the company staff although this was planned to be done before the end of March with telephone guidance from the supplier.

Serious plans were being made again by the company management to remedy the worrying situation. The second six months of accounting data was going to be input as a single batch to bring them up to the end of their financial year on April 1984. The possibility of abandoning the backdating exercise and going "live" fresh at the beginning of April had been considered by one director but dismissed on the grounds that they had learnt a lot about the system without "damaging" the data or the company's situation and this would have had to be done anyway. They also felt that they were on top of it now.

June 1984

Progress on implementation was still very slow and the system was actually at a standstill for more than a week.
when the hard disk had developed a fault during use during a
major thunderstorm. No further progress on the purchase
ledger had been made since entering invoices up to September
1983. They attributed this to partly their own accountant's
fault for having to wait for audited figures and partly the
supplier's fault in not providing sufficient implementation
guidance and training.

No sales ledger had been established and all receipts were
being posted to the contract ledger which was reported to be
"online and live" in June 1984. A decision had been made to
install the subcontractor ledger and run live without any
parallel running or back-dating. This contained all
invoices up to September 1983 and all current subcontract
payments until July 1984 in the hope of being able to catch
up at some time.

An attempt had been made to operate the direct labour
payroll on a live basis from April 1984 but several problems
had prevented any more than two trial weeks being run.

(a) The supplier did not train the user until the first week
in May due to other customer pressures.

(b) Staff holidays from mid May had prevented much progress.

(c) Management commented that:

"it's quicker to do it manually when you don't
know what you're doing".

(d) Training for payroll had been "one very hectic day" when
the customer support representative had tried to get the
system established but did not fully understand herself
how to implement the company's requirements. The
consequence was that the senior development manager had
had to make a subsequent visit and reinstall the system
correctly.

(e) Salary processing had been run once but there were some
problems concerning the various pensions which needed sorting out and the problem had prevented further progress.

(f) The payroll package meant that several alterations to the normal manual operations were being forced on them. The company did not operate on a standard week and did not normally pay overtime other than by special arrangement although the supplier had offered to show them "how to get over that" by establishing dummy contracts for booking the overhead surcharge to.

July 1984

As the system had not been worked on since visits from the supplier in May one director felt some embarrassment by July 1984 when letting the supplier know that progress was not as expected. With such slow progress the director was also having difficulty understanding some aspects of the system's operation e.g. how the payroll fed costs through into the other ledgers. The manual was not very much assistance as it was currently being rewritten and was consequently out of date.

The continuing economic depression in the area had created severe pressure to obtain contracts and only one day per week had been available to operate the system and consequently the system was still being set up. The management now complained of disinterest by the clerical staff and in fact one director was solely responsible for the installation and operation at the present. One office girl did know how to operate the purchase ledger but this had been at a standstill for several weeks in May and June 1984.

Problems encountered were recorded as.

(a) Hardware problems were frequent during the hot periods
of the summer of 1984 and it was decided to install a cooling mechanism before the problems reoccurred next summer.

(b) Allocation problems associated with using data retrospectively had resulted in an ever growing "dustbin account" had been used for those invoices for which allocation details were not known.

(c) It has been noted that clerical transcription errors have been caught and checked in the computer. This had previously been a problem when recording accounts data. Several operating errors had resulted in misposting of transactions to accounts.

(d) The surprising amount of time that was absorbed manually encoding purchase invoices prior data input. It was not appreciated that separate records needed to be set up for each main nominal cost heading in addition to the sub-analyses. A similar need was for subcontractor trading accounts in addition to the creditor accounts.

(e) The company expressed a need for a structures set of skeleton accounts which might be used as a indication of how to design the reporting requirements as staff were unfamiliar with the procedures of the computer system which they are installing.

(f) The implementation procedure which the company adopted to install the system gave very little opportunity for reassuring feedback or management information until the system is live.

**September 1984**

The management felt that they were now in a position to make "real movements forward" and fresh plans were made:
"to devote a week to this in the immediate future in order to get transactions in up to March 1984, the company's year end."

It was hoped that most of the problems had now been sorted out and it was planned that the principal support representative from the supplier company should visit them in mid-October in order to "discuss what to do with the strange bits and pieces" and "supervise the end-of-year operation of the system." After this visit management felt that the payroll and subcontract ledger details could be "bashed in" until the end of July.

In September 1984 (one year after the computer's purchase) the management felt that they were now at a critical point with regard to the computer system and were determined to get it going regardless of the sacrifices that had to be made. Extra staff had been employed on the surveying side to release the director involved from some responsibilities. Progress had been held up by the economic situation of the company. The miner's strike had meant it was becoming very difficult to get work, placing greater external demands being placed on the director who acted as systems manager and leaving him with very little time to organise, operate and supervise the implementation of the computer. Holiday periods had also left the company with a shortage of available time for devoting to the computer.

The company accountant did not offer much support and the only driving force was that of the director himself. He had been the person who had investigated each area, undergone what training was available and sorted out the problems as they inevitably arose. The company still had not been to a user's group meeting. It was their impression that with a little bit of common
sense and accounting background company staff can sort out most problems and that the questions being raised at these meeting were trivial.

The principal responsibility for use of the computer lies with one director in the organisation who now wished for temporary clerical assistant to work in the office in order to get over the present problems.

(a) There was a problem with using outdated reports so no real benefit was being derived from the system yet although the nominal trial balance presented interesting information for management on overheads generally. They had discovered that the discounts derived from employing nominated and domestic subcontractors was posted to a sundry revenue account and the contract did not derive any direct benefit from it, a feature which management disliked.

(b) Management complained of lack of telephone support initially but this had been improved recently by a team of girls at the supplier's head office. The supplier gave the impression of being a smallish company with a big budget links were now more formally established with the Building Advisory Service a "so-called" independent service to employers. Although the company were happy with the functions of the software they felt dissatisfied with the supplier support they were given when problems arose. The initial reaction of a telephone call concerning a problem was that the problem was OK but on later investigation the supplier would usually find the company had not been supplied with a particular release of modification. This appeared to be caused by the particular configuration of computer being relatively new e.g. their printer did not operate in the
same manner as the program which printed Subcontractor certificates on special paper and the alignment had to be done by running a program to set up the printer before the system was started up.

(c) The initial sizing was discovered to be inappropriate and storage space for payroll and labour/only subcontractors had been extended.

The position by December 1984 was as follows:

1. labour/only subcontractor entry complete Dec 1983-Dec 84 (being checked back against the existing manual records)
2. supply/fix subcontractors entry complete Dec 1983
3. purchase ledger entry complete Dec 1983 and "cleared down" until November 1983.
4. payroll not yet used! It was admitted that they had now forgotten all the training for payroll and would need to get the supplier up again.

Contract sales ledger was proving to be a "right cock up" made by the supplier and it was discovered that the system was dumping large amounts of money into a suspense account. When this was investigated at length by the company management it was eventually traced to a mistake at the time of installation. A nominal account number had been recorded differently in two parts of the system. This was blamed on the firm by the supplier who had installed the account structure on behalf of the firm. In order to counteract this they were advised to enter opposite transactions to get the amounts out of the suspense account; even this telephone advice had been erroneously given!

Opening balances on the nominal ledger were not directly reconcilable as the purchase ledger appeared to be. Several hours of accountant time had been involved in the tracing of this feature of the system which was not explained in the
manual.
The figures produced by the computer were now being seriously examined rather than taken on trust as it appeared that the system was not infallible. Checks were made on where the system posted/allocated amounts in the system. The audit trail report relating to the purchase ledger went back to the beginning of the year not the month when being listed. This took several hours to print out and it was suspected that when the nominal ledger was "cleared down" (closed for the month end) this problem would be overcome. No sound advice was given in the manual.

December 1984
The company reported that the main bookkeeping person had left suddenly and had not yet been replaced. The firm felt that as business had not been particularly buoyant this was not yet critical but when the position improved they would "get a young girl" to do the job. This put more burden on the director who had become in effect the "computer manager/operator". The firm felt they had not valued the girl sufficiently whilst she was employed but still talked about employing a young person to use the computer. By the end of January 1985 it was planned to "definitely going to get 1983-84 cleared down" and then they can "start getting 1984-85 crashed through by the end of July 1985". Management has some retrospective thoughts at this point in time:

"The hardware was the right decision, particularly the hard disk. The software is far more complex than was really needed for the present requirements of the company. Long term however this will also be right, but by then the system will be obsolete. Insufficient explanation was given at the time of setting up the system."
July 1985

The company management were still having considerable difficulty in establishing a working system. No progress at all had been made on the payroll and the company did not see it being implemented within the foreseeable future.

Transactional data from the previous financial year was still incomplete and unreconciled. Consequently no management use could be made of the information and the former manual system was still depended upon by the staff concerned. The company continued to try to catch up but found this a difficult task since the manager/director with most knowledge was continually under demand from other areas of management.

The company continued to survive in a low economic state and the major effort of management went into securing sufficient contracts to enable the long term survival of the company.
APPENDIX E

COMPANY E

Selection Phase: (December 1983 – June 1984)

March 1984

The management decided to investigate the possibility of acquiring their own microcomputer to provide the management information they required in more detail and available when they required it. The two directors attended a seminar organised by the Contract Journal in February 1984 which gave background information on the areas to which computers could be applied in the field of construction management. The managers expressed a feeling that very little of what was said had any real relevance to the needs of a small company like themselves who had no previous experience in computing and had no source of immediate knowledge in computing from within the organisation. The most relevant of the speakers were a consultant (who outlined the hardware and software selection strategy) and a small firm director (who described the benefits to be derived by the smaller company from accounting and costing applications). The directors did not visit the computer system exhibition on that day as they felt that they were not in a position to make any comparative evaluations between systems being demonstrated.

The seminar gave the two directors a renewed view that a computer system should be the path taken in the light of their planned growth. They were able to contact a consultant at the conference who agreed to consider the feasibility of the move on their behalf and also assist them with the selection and evaluation of systems if appropriate.
The consultant discussed the requirements of the management which they described as best they could and a great deal of trust was placed in the skills and knowledge of the consultant. The directors had no previous experience in the use of computers in their previous employments and they accepted readily the advice of the consultant who suggested an evaluation of four identified systems.

On the suggestion of the consultant the company saw a first demonstration of a software package which they felt met the needs of their firm. Time proved to be scarce and the management attempted to economise on time and effort by looking at a local company which they knew had had a computer system as they were very concerned to make a quick decision so that the work could be started to get the system started. The consultant persuaded the firm that they should at least review and discuss the operation of another system with the management of another company. However when a meeting was arranged for the directors, their accountant and the consultant at a similarly sized contracting firm time proved to be critical and the firm's directors sent their agents alone.

May 1984

The company are under great stress in the selection process since they feel they have a great need for outside assistance in the evaluation of systems. This is largely due to lack of internal expertise or direct experience but also because the company is experiencing growth and therefore the management skills are required to run the contracts throughout this time period. There has been very heavy reliance on outside sources of knowledge and evaluation skills to date provided by the consultant and by the company's internal accountant. On
several occasions the management have said they are prepared to take the advice of outside advisors and they appear to be very reluctant to express their own views and have been consistently weak on expressing their requirements.

The managers directors had some difficulty in comprehending the demonstrations given by suppliers. Very little attention was given to the detail of the requirements specification and heavy reliance was made on the professional competence and integrity of the consultant and accountant in giving them the best advice. In addition to those demonstrations arranged by the consultant the managers attended a seminar held by Burroughs to demonstrate their construction industry software.

Confusion with regard to the most appropriate strategy was expressed in the comments of management below.

"Of course any system which we buy now will probably need to be altered or added to in about twelve months time when we know exactly what it is we want. So we need to buy from someone who will be prepared to write programs for us."

"Why can't we just go out and buy a computer which we know will be big enough for us and which someone can program the things we want it to do."

"You go and look at the system with our accountant and we are prepared to be advised by him whether it is what we want."

The last comment was made to the researcher when a crisis occurred in the company on a day when they had arranged to visit a firm to see a system being demonstrated. They decided to delegate the responsibility of evaluation to a third party again.

June 1984

The firm decided to purchase the initial system as management time was very scarce and they felt that they would gain no further benefit from the demonstrations of
further systems as they had no experience on which to judge one from the other. The directors relied on the advice of both the consultant and the accountant who were satisfied that the firm's computing requirements were met by the system. The only significant doubt which arose in the decision was that the supplier concerned was very small and they would be an early user of the system. The management felt optimistic about the ability of their current secretary to be able to learn the skills of computing and necessary accounting to operate the system single handed. Once the decision had been made the company paid cash on delivery the following week when the system was installed. The system chosen was a 128K Cifer microcomputer with 10 megabyte hard disk with an accounting and contract costing system. They expressed their expectations of the system at this point as

"It should lead to considerable reduction in the accountancy fees paid currently... provide us with quicker assessment of the cost of work undertaken... be able to be taken on by their current clerical staff without any real difficulty....and be used by other management staff such as the surveyor and the estimator. It may take some time (6 months?) to get the data into the system and operate on a live basis but once there it will be able to provide us with many answers to "ad hoc?" questions which currently take up considerable management time. The total investment is sufficiently small (£6000) to be an experimental venture."

**Implementation Phase (June 1984 - January 1985)**

**July 1984**

The company were given a demonstration system by the supplier on which initial training was undertaken. This consisted of data from an imaginary company whose financial position regarding suppliers, customers and contracts had been established on the master files.
The supplier had been on several occasions to train staff on various modules of the system. The secretary and the company accountant had been trained in the accounting modules and the company surveyor had been trained in the specialised subcontract module.

The operator was extremely cautious of the system at first and felt reassured by the fact that the supplier could be contacted by telephone at any time. She felt under considerable pressure to get the system operational and reliable although the workload at the company was such that she had very little time to spare to learn the new operations. Very little support was forthcoming from the directors who seemed to feel that it was now her job to get the system going.

On instructions from the supplier the master files for the suppliers and customers was established and the nominal ledger based around the skeleton framework provided with the system. The main source of support was from the company's accountant who had been involved in the selection and had a vested interest in getting the system operational (he had been previously responsible for the accounts but had found the workload increasingly burdensome).

It had been decided to start on the current financial year's transactions (starting July 1984) as soon as the opening balances were available from the accountant. They felt this was preferable to backdating information as they had no real manual accounts with which to reconcile the computer records. They felt sufficiently confident that the system would do what they required.

The accounts structure had been set up for the purchases, sales, nominal and contracts and the staff waited some time for the opening balance position from the accountant.
**September 1984**

After the initial month, during which frequent calls were necessary to the supplier to clarify what should be done, the secretarial staff were much more confident with the system and felt able to do minor trouble-shooting themselves when problems occurred. The reports which had been obtained from the dummy data were "fascinating" and they realised what a lot of time the computer was saving.

Both clerical staff were proud of the fact that they had been trained and felt they could now cope with the system in a live situation. The part-time assistant who was more logically minded had also been introduced to the system operation. The directors were "very impressed" with the system now that it has settled down and were looking forward to the management information particularly on the job costing aspects.

The computer had had some problems during the early weeks of installation, in particular the hard disk had developed some errors which the supplier had remedied by reformatting those sections of the hard disk but eventually the computer had been returned to the supplier's office where the maintenance engineer had replaced the disk unit itself.

The printer had also developed a paper feeding fault but on investigation by the office staff the situation had been rectified.

**December 1984**

The character of the main clerical staff was such that she would not take a step forward without first checking that there was no dangers involved. The result was a very steady progress as she became confident.

By December 1984 three months of data had been input into the system, bringing them up to September 1984. The system
was being verified by the company's accountant who had participated and taken a firm interest in the introduction of the system. He was continuing to maintain the manual books for the company until such a point that the system was truly live. He was very happy with the system and understood its structure although he did feel that the staff did not have such detailed knowledge yet.

The operator was now being freed from other clerical duties to concentrate on the computer although business was very buoyant and this was not always possible. She was gradually taking over many of the tasks given to the accountant as had been planned. It was eventually hoped that the accountant would just audit the quarterly accounts provided by the computer and all the day to day operations would be done internally.

It was planned that the system would be live by January 1985. The two directors appeared generally unconcerned with the progress of the system with full responsibility for the control being entrusted to the accountant. The supplier of the software had been called in to supervise the quarterly audit of the system.

The most useful information was provided by the general cost reports eg. purchases report and job cost breakdown. They were beginning to get the filing of information sorted out but as it was planned to move to new premises at the end of the month this was only temporary.

Problems reported were that the manual was difficult to read and understand, and also to find the relevant information in the case of problems arising. A short "crib sheet" with pointers to the relevant pages had been devised by the operator. (such as how to recover files in the case of problems)
The company's turnover had reached £2,150,000 during the previous financial year and the company was still expanding.

**Live Operation Phase (January 1985 — March 1985)**

**March 1985**

The company had abandoned the former bureau based accounting system at the end of January as planned. The accountant continued to provide a high level of support to the operator but she was now able to sort out the majority of queries raised during normal operations. The company felt that the local support provided by the supplier was now no longer of vital importance.

The system proved to be very reliable and the directors used the information generated by the computer as a check on their control over contracts. Both directors asked the operator for any information required rather than operate the computer themselves. One employee, a surveyor, was more involved with the system and was known to access the data stored to answer his information needs. The accountant checked on the operation of the system and audited the data after three months and was very satisfied with the system as a whole.

One concern of the operator was the capacity restriction on the data stored which meant that only three months cost could be stored on contracts. The early estimates on storage requirements had not taken into account the changing nature of the work being undertaken by the company. The growth path had been realised by the company but the large contracts had been more difficult to secure and small works had become a significant proportion of the workload. This small works generated more transactions generally.

The manager hoped to discuss this with the supplier of the
software who were planning to be called in to supervise the end of the financial year in June 1985.
APPENDIX F

COMPANY F

Selection Phase: (July 1984 - January 1985)

July 1984

The decision to consider the introduction of a new system to replace original microcomputer was made when the firm was visited by a local firm who were themselves considering becoming a first time user. A consultant had accompanied them to advise on the suitability and had been contacted some four months later to act on behalf of Company F. A meeting was arranged with the company accountant and the consultant to discuss the requirements and approach to be made in selecting the second system. It was expressed by management that they wished to "capitalise on the previous study undertaken" as they felt that many needs would be similar to the company concerned. They also preferred not to go to great trouble to make detailed evaluations of essentially similar systems, all of which could fulfill the needs of the company. They handed over the task of search and evaluation to the consultant who worked on the requirements with the accountant.

September 1984

The accountant had detailed requirements of financial type data rather than management data and made detailed reconciliation of costs and revenues every month. The company had problems of inputting the invoice and payments data in the existing computer system and considerable delays occurred at the end of each month before this reconciliation could be achieved.

The management discussed the possibility of keeping more
than one accounting period open for posting. It was felt that this would enable them to keep going throughout the month rather than be held up waiting for data. They enquired of the possibility of taking several systems from different suppliers and assembling a "home-made" system. The consultant advised of the problems of incompatibility. They had discussed the possibility of tailoring the system with a software house. Finally specifications for several modifications to an existing package were discussed and the firm decided to await a quotation by the firm for the provision of hardware and tailored software.

The firm seemed very reluctant to change any of the existing routine/requirements even if the alternative was practical as they believed that they needed very frequent provision of accounting statements to the management.

December 1984

The company had been involved in a major capital purchase for which the directors had invested £160,000 in an attempt to diversify the company's activities so as not to be so reliant on the contracting area of construction which was still is a period of deep recession when profit margins were virtually non existant. The strategy had therefore been modified to make economies on other non essential company expenditure, including the temporary postponement of the decision whether to replace the computer system. There were some problems with the current computer system which was diagnosed as possible software fault so they contacted the original author who came and checked the code of the system, did a fix to the transaction data which had been left in an incomplete state by an system error. No
firm diagnosis could be made of the error but later it was suggested by the consultant that as the company had never in fact changed the original program disks the error could have been a soft error on the media due simply to age and they were advised to make new copies of the whole system on new media. (By mid-January this action had not undertaken because Margaret the secretary had been just too busy!) The company had also had a recent power cut and suspected that the files would be corrupted but were not in a position to know for certain until the end of month routine was run. They were allowed by the programs to continue inputting transactions to the files. Again this was evidence of poor software which allowed the user to continue in a state of incomplete database.

The decision had been made to review the computer decision at the end of February.

February 1985

The management were have serious cash flow problems caused principally by a severe winter which had prevented all work for the large machinery being undertaken. The decision had been therefore to postpone indefinitely the plans to implement a new management information system. The company had made a loss in the previous six months and no funds were available.
COMPANY G

Selection Phase: (September 1983 – December 1984)

December 1983

Although the smallest company currently Company G was planning gradual expansion. The wife of the director was also to become involved at a later stage, perhaps late 1984, and then the financial aspects of the company's administrations would be delegated. The management functions of Company G were solely the responsibility of the proprietor and ranged from estimating, planning of jobs, purchasing of materials to the accounting procedures. Although no immediate benefits were expected from the introduction it was hoped that when the company grew the use of the system would enable the manager to concentrate on the real business of managing building contracts profitably.

The management felt a general awareness of the introduction of computers into small companies when the company was established. The possibility of a computer was considered initially a year ago but it was felt that the company then did not justify such a capital investment although the firm did not wish to be left behind. Information was obtained on various popular microcomputers and the management then realised that it needed software to use the computer. Further background reading established the priority of selecting software first. The manager had previously read an article in a construction industry journal some twelve months ago which had described local building company of a similar size which had implemented a
At the national building exhibition of 1983 the company was demonstrated a nationally advertised microcomputer system but thought it was too expensive at £6000 in total. At the same exhibition a representative of the CIOB suggested that spreadsheet package would satisfy the requirements of small organisation such as Company H. It was felt that the time taken to set up a system using this type of software would be considerable and the result might not be satisfactory. A further system was investigated but as no printed reports were included in the publicity literature no further action was taken. It was felt that this latter system might have been the cheapest solution but the supplier was London based and a nearby company was preferred.

An open evening was held at a local systems house and the firm visited this with a list of basic questions from the literature sent (this system was the one appearing in the article previously investigated). The decision was made to purchase this system on the grounds that:

(a) It was supported locally and help was easily available.
(b) A small company similar to his own had been using the system for 18 months.
(c) The supplier was a building industry person whom it was felt could be trusted.
(d) The software and computer was similarly priced to the previous system.

If the second company was acquired then the computer would be used for the accounting and costing functions of that company also.
Implementation Phase (December 1983 →)

January 1984
After a spontaneous decision to buy a computer with software from a local supplier the director hoped that delivery over the Christmas shut down period would enable him to become proficient in the use of the computer although it was realised that it would be some effort involved in establishing the books on the computer. The computer was supplied with a demonstration data disk on which the training was undertaken. Fitting in the training periods at convenient times to the contractor was problematic as the business had to continue over the winter, a slack period by normal standards.

April 1984
The owner/manager felt that progress had been rather frustrating because he had not had very much time available to concentrate on the computer system. He expressed a feeling of guilt as he believed the suppliers of the system would be disappointed themselves in the lack of progress. Some difficulties had been experienced in loading of the opening balances which had been provided by the firm's accountant. A misunderstanding had led to the wrong balances being set up on the computer data files initially. The result was that data had to reinput when the supplier realised the error. Purchase invoices had been input "en bloc" from the end of year in September 1983 up to December 1983.

No end of month routine had been undertaken and no job costing data recorded for these invoices as they were historical. Payments to suppliers had been entered for September and October 1983.
The firm felt that the initial setting up of the accounts and getting to a live situation required much more effort and time than had been anticipated. It was felt that as short a time as possible back dating of information was desirable and probably the best time to implement a system would be two months prior to the company's end of year. It was planned input the journal entries for the backdated data up to December. The supplier was going to supervise the first running of the end of month processing on the data up to the end of December 1983.

The company did not intend to keep any more manual accounts and this would act as an incentive to get live as soon as possible (probably in three months time). It was anticipated that more time would have to be spent on the computer and regularly. In addition his wife needed training from no computer knowledge or experience as she was to operate the system on a regular basis.

The director was concerned about some gaps in his business knowledge which he required to be able to operate a computer system. They were:

(a) some knowledge of accounting principles was essential e.g. debits and credit as these appear to be opposite to normal experience with the company bank statement.

(b) a limited degree of keyboard dexterity was required to speedily input data.

(c) some basic computer understanding e.g. disks, care of. Fear of wiping of data and the vulnerability to magnetic media was expressed.

(d) principles of code design to get the maximum benefit of the computer's information had to be acquired at an early date. The supplier had in fact advised on a suitable account format.
(e) an understanding of how the system stored data was needed in order that the firm could be confident in its operation and "audit" the information on file to establish the integrity was sound and reliable.

Although the manual for the system had been the first line of support when using the system the firm felt that because they were so near to the supplier a source of help was always available. On several occasions the suppliers had given assistance over the phone.

The manager soon realised that he did not have sufficient time to get all the data into the system to convert the files from a manual operation to computer based. He had found that he was getting into a general mess and had tried to enter several months of invoices in one large batch without running any end of month routines, making any payments or attempting reconciliation of the balances with the manual position. In the meantime he had failed to keep any manual records in the false hope that he would soon get all this information from the computer.

The action taken in May 1984 was to ask the supplier of the system to supply a skilled operator and supervision for the entering of the invoices etc to get the firm up to date. These skills had in fact being provided but the firm was still awaiting the results.

July 1984

Problems were now beginning to arise because the neglected bookkeeping was required to make out VAT returns, the invoice data was needed for job costing purposes but the source documents had had to be given to the system supplier to convert the files.

The manager was in the meantime not using the system at all and consequently a sense of fear was returning with regard
to the computer generally. No training had been given to his wife who was going to act as bookkeeper/operator and considerable reservations were evident. It was planned that the necessary night work would be given to the system as soon as the data returned. The director later decided that backdating the data input was only providing him with information too late and as a consequence a "fresh start" would be made to go live on the company's accounts in September 1984. Unfortunately the accountant would not have the opening balances available until November at the very earliest and the directors feared that the backlog would again build up before they could get started.

December 1984

By the end of 1984 no progress had been made in implementing the system. After the supplier had been subcontracted to establish the company's opening balances and first three months accounts the director felt that it was a waste of effort to continue with retrospective data as the new financial year was rapidly approaching. It was therefore decided that the project would be temporarily suspended until the opening balances of the new financial year was available from the accountants. This was anticipated to be in January which would mean inputting three months transactions retrospectively. The director felt frustrated not getting going but still it was he who was now not supplying the information to the accountant. He was planning to get down to it as soon as possible. He had been busy generally and work was hard to come by in the area as a result of the general economic situation and the continuing miner's industrial dispute.
His wife had been frightened by a radio report of a scare concerning the possibility of harming unborn foetus or causing miscarriages in operators of computers. She had since decided not to use the computer and so the director was now prepared to undertake the task himself when he was in a situation of being able to do so.

He expressed a feeling that knowledge of the hardware needed to be boosted by understanding how the system worked. A fear of not being able to correct the situation if he input something incorrectly was very significant. He felt that as a sole proprietor without any assistance he now realised that some extra staff was probably required to get the system going, probably on a temporary basis. The sum of £2000 would probably put off most potential users of a similar size as being unjustifiable.

He repeated his basic trust in the supplier of the system who were small and local. He felt this was important when he has no one to approach and needs to ring up for information. The supplier was also a user of the system as they were allied to a building company.

**August 1985**

The company director was considering a merger with another company as the demands of management to secure sufficient work to ensure long term survival had become severe. He claimed to be using the computer but was considerably behind in the establishment of a live system.
APPENDIX H1

COMPANY H1

Selection Phase: (May 1983 - June 1983)

June 1984 (reported retrospectively)

In 1979 the director of Company H1 had bought a 32K microcomputer to explore its possibilities at home. At the same time the company, a steel fabricator, was experiencing some difficulties in getting the design of portal frames done on time and the design being at a competitive cost. The software was available from a company in Bradford and they decided to buy time on a mainframe and installed a terminal to operate it. The payroll was also run online using the bureau package for three years.

When the connection charges became excessive the company bought a small mini computer with a basic draughting program for the design of structural steel sections.

Another 32k microcomputer was acquired with a file management system written by a local polytechnic lecturer and also for a payroll package.

The accounting functions were established on a commercial manual system which provided purchase, nominal and sales ledgers. However the management information was largely obtained from the file management system on the 32 k microcomputer.

In early 1983 the director of Company H1 read of a contractors' accounting package running on the same microcomputer in a manufacturer's software directory and as it was given a good write up he persuaded the local dealers with whom they had had previous dealings to arrange for a demonstration.
The system was demonstrated by the software salesman rather than the program writers for half a day on the premises of the company and the software was judged to be "OK at the time although they did not realise that its speed was the result of a very limited demonstration system with few accounts on disk. The software was purchased in June 1984 and the staff were given a half day's training on its operation with the promise of telephone support should it be needed. As support for their mini system had always been excellent the director was content.

**Implementation Phase (June 1983 – December 1983)**

Software was purchased in June 1984 at a cost of £1100 to operate on an existing computer and was found to be totally unsatisfactory and as a consequence the system did not progress to live operation. The company implemented the system to run parallel with the manual accounting system for a period of six months.

The main problems were:

(a) The slow operation when searching and retrieving any data.

(b) The programs were found to be inflexible and contained many bugs. Query facility was limited.

(c) The manual was found to be minimal and in places deceptive since it "doesn't mean what it says".

(d) When assistance was sought the suppliers were unhelpful only acknowledging limitations or bugs in the programs and making rash promises about new releases being due.

(e) The operation of security passwords was tedious and error prone and had not been revealed at the demonstration.

(f) No operation or implementation training was provided and 0.5 days had been taken on the suppliers' premises in
London at the client's expense.

(g) The system slowed down to an unacceptable level once the disks were over half full of data.

The director, who was familiar with computers, felt that computers forced a person to think logically and the operator had to understand some of the logic of the program in order to function efficiently. Logical thinking was the essence of a good manual system which must exist prior to computers being implemented.

The system was formally abandoned in July 1984 when the company decided to look for another system which would fit the needs better. This experience is reported in Company H2 following.
COMPANY H2

Selection Phase (June 1984 – July 1984)

July 1984

When Company H2 (Phase two of Company H1) found the previous system to be totally unsatisfactory they decided to purchase another. The firm had purchased a new 256k microcomputer with 10 megabyte hard disk and construction industry accounting and job costing system to replace a system tried out on their 32k microcomputer.

The selection process had involved looking closely at two systems being sold by software houses. Each was visited by the managing director with a graduate employee and the system was demonstrated in detail to enable the firm to consider the aspects of its performance to the full.

Special consideration was made of the speed and flexibility of operation since these had been the limiting factors of the trial system. Full data files was requested prior to the demonstration so that the true performance would be seen.

The system was selected on the basis of considering several aspects, cost, proximity of the hardware and software support and an evaluation of the supplier's reputation. The management objectives for the introduction of the system were stated as:

(a) the ability to retrieve quickly any piece of management information

(b) the preparation of profit and loss and balance sheet accounts at the end of the month/quarter to enable more effective management monitoring of costs.
(c) to reduce the role of the company accountants who would merely audit the accounts rather than fully prepare them from scratch.

Implementation Phase (July 1984)

September 1984

The company had purchased a new microcomputer based accounting and job costing system to replace a system tried out on their existing microcomputer computer. The system was installed by the supplier and accounts had been set up for all suppliers, nominal, customers etc. commencing June 1984. The month-end routine and also year-end routine had been tested out when the ledgers had been reconciled with the balance at the bank. The system was effectively now live from the beginning of July although the opening balances were not yet available from the accountant. 1200 invoices had been entered by a temporary student employee who had been very enquiring and systematic in his operation of the system. The training necessary was minimal as the company had experience in computers.

The manual system of accounts were still being operated involving one part time management staff, a clerical girl on purchase ledger and a clerical girl on sales ledger.

The computer system currently had the following staff:

: 1 part-time senior management
: 2 clerical girls
: 1 student
: 1 accountant

The student had been found to be not very careful/accurate in the system input although his investigation of the workings and operation of the software was extremely thorough.

By September 1984 the student previously responsible for installing the company data and operating the computer had
left to go back to college and the manager had taken over the task of running the computer in a parallel manner to the manual system. He felt it was vital that he personally should be able to understand how the system works and how to get out the information required in addition to the clerical staff. The girls would be expected to go for assistance initially to him.

Up to date (September 1984) he alone had operated the system. This decision was made on the basis of previous experience with their computer-assisted draughting system for which the principal designer had not been trained and subsequently had responded with a negative attitude towards its use in times of high workload, believing that it wasted time. The manager also felt rather that the departure of the student employee back to college had left the company without a full understanding of how the new accounting system worked since he had been the individual trained by the supplier. After the employee left the manager had tried to load up the system to get to know it and had initially been unsuccessful because he was unaware of the passwords set by the employee. This caused some embarrassment but the supplier had been able to provide a master password.

The manager was himself under some pressures to train other new employees on the draughting system and was facing some opposition from the newly appointed accountant who was not convinced of the suitability of the acquired system for the company. This accountant had previously worked in larger companies with computers supporting several terminals and believed this was essential to the current implementation. The system purchased did not support more than one user at any one time and it was difficult to physically site the system ideally as the sales and purchases operations were
located in two different offices separated by a corridor. The accountant had thus been investigating the availability of a multi-user system which was still within the planned budget of the company. A national computer company had given the staff a demonstration and quoted for the provision of two terminals, two printers and accounting software (£12,500) using the company's own brand of microcomputer. The manager was impressed by the promise of mini-support for the tailored software although he did not appreciate how problems could be solved over the telephone if the supplier did not have the appropriate data. The staff thought the system to be less friendly than the recently acquired construction industry software but the advantages lay in the promise of multi-user facilities.

The manager felt that the existing system was satisfactory and was resisting scrapping this as had been done with the earlier system (Company H2). This time it had to be made to be right and the success/failure depended on the staff's motivation to use the system, all systems had their idiosyncrasies and other than a bespoke system none would be perfect match.

Meanwhile the manager was inputting transactions for both his own small company and for the larger structural steel company and reconciling the output with the manual system. Problems had arisen

(1) When a supplier had informed them of the separation of the organisations which should be invoiced separately.

this had involved several corrections to be needed, generating made computer transactions as the software created another transaction to counteract the first. The manager felt this to be a waste of space on both disk and on all reports and thought that a
reverse/deletion process would be appropriate. Comparisons were made with the operation of a modelling package which allowed changes to be made and the results recalculated without showing all the previous versions (a highly dangerous request as accounts are auditable and clerical staff should not be allowed to delete entries made. The request was for a “system manager” status which effectively allowed the user to do anything with the data.)

(2) Keying in errors were the most common complaint and this was attributed to lack of concentration, understanding and in some cases training.

(3) Certain manual practices had been highlighted as a result of the use of the computer which were considered undesirable. e.g. Credit notes for an invoice being used against earlier transactions with the result that records were strictly not true and problems occurred if queries arose later.

(4) Discipline was critical within the supporting manual system and if this was lacking the computer generated information could not be relied upon. e.g. Recording transaction numbers on cheques referring to the invoices being paid for.

(5) The computer was thought to waste paper by throwing a page whenever a new report was to be printed and the supplier had been complained to about this. This had been temporarily solved by altering the linefeed of the printer but the manager had not taken transaction logs of all input as advised by the supplier because of this paper wastage.

The manager was hoping the catch up with the manual system so that the end of month routine (up to now ignored) could
be run and the system verified as to its operation with the manual system.

The company had also discussed the supply of a payroll with labour costing as it was becoming critical how much the labour content of jobs were to the management of contracts. The current payroll was entirely satisfactory but was not integrated with the accounts as it ran on a different microcomputer. It was planned to run test out a pre-release version of the payroll for the supplier in parallel with their own payroll program.

**December 1984**

The company reported being very busy with three very large jobs being currently undertaken for clients. The system was operating live according to the director but no end-of-month reports had been printed from the system. Apparently invoices and payments were just being stored indefinitely and the system providing information for enquiries. A girl in the office took half an hour a day to input the invoices/payments but the old manual system was still maintained as the other branch of the management was still unconvinced that the choice had been realistic. The director commented on the need for a disciplined approach to feeding through the input data as it came into the company in order to gain maximum benefit from the system. There was currently 6 months data on the system and no clearing off of transactions had been undertaken.

The other director had been continuing his search for a new system to undertake the financial management of the company. He had become disenchanted with one potential system because the system ran under its own operating system on their own computer which therefore tied any company into a supplier once the
initial system was purchased. The system was potentially multi-user but the facilities proved to be disappointing particularly with the number of discs involved in the back-up process. There was some aspects of the software which was not currently integrated and no plans were there to do so.

At times the manual did not assist the operator in running new programs and there had been considerable time since training had been undertaken on the less frequent aspects of the system. There was a need for pictures and stroke by stroke guidance through the programs, a feature rarely in manuals of packages. Clear communications was the essence of usability.

The director planned to take the payroll of the accounting system on a trial venture in order to evaluate it against the current package they had which was not integrated into the accounts and also had no job costing facilities. The director had built up a sound relationship of trust and cooperation with the developers of the software who were a small company themselves. The support given with this relationship was considered to be very valuable.

**August 1985**

The system was being used live in the small general building company but no live implementation had been achieved in the larger structural fabrications company where resistance continued to be met.
Instrument A

The following list of topics were used to guide the initial discussions with the management of the small companies. The did not constitute a questionnaire and were used freely to collect initial background knowledge of the company and it's motives for introducing a microcomputer-based MIS.

*** Selection Phase ***

ORGANISATION & MANAGEMENT/ENTREPRENEURIAL BACKGROUND

1. Management Background
   Education and training:
   - any professional qualifications?
   - any managerial training?
   - academic background?
   - attitude towards training/professionalism?
   - production/craft-based experience?

   Position within Company:
   - owner/director?
   - company responsibilities?
   - length of service?

2. Company Organisation
   Structure:
   - legal status?
   - Organisation:
     - independent?
     - parent company?
   - Administration:
     - family assistance?
     - office organisation?
   - Company attitude towards own structure:
     - desire for growth?
     - controllable?

3. Economic Environment
   Nature and variety of work:
   - specialisms?
   - market position?
   - size and type of contracts?
   - Area of operation?
   - Profitability, turnover, employees, subcontracted labour?

4. Approach to Management
   - planning techniques used?
   - degree of formality?
   - flexibility of procedures?
   - distribution of management responsibilities?
NEEDS FELT BY THE COMPANY (KEY AREAS OF CHANGE)

What are the long term plans of the company?

How intangible? e.g. promotional, outside pressure, improved information, improved planning, improved client relationship.

How specific? e.g. to reduce staff, to reduce costs of company accountant, to provide information on outstanding creditor balances.

TRIGGERS TO DECISION TO INTRODUCE COMPUTER-BASED MIS

Problems in the running of the operational system.
Insufficient time to undertake routine administrative tasks.
Government legislation.
Client information requirements.
Competitor action.
Equipment obsolescence.
Computer exhibition/supplier visit.

APPROACH TO MIS DEVELOPMENT

Approach to Selection of MIS

Problem areas
Management objectives
Selection techniques

Source of Advice?
internal?
consultant?
parent company staff?

Skills and Knowledge within organisation
business accounting, management area
computing
information systems

DECISION MAKING PROCESS

Evidence of quantifiable and detailed consideration of feasibility in terms of:
economic feasibility
operational feasibility
technical feasibility

Importance of costs?

APPRECIATION OF IMPLICATIONS

Consideration of time scale involved
conversion tasks necessary?
determination of actual report
requirements/
skills and training?
data capture and timing?
dependency on the system?
*** Implementation Phase ***

NATURE OF MIS DEVELOPMENT

Nature of System selected
Hardware features:
- hard/floppy disk,
- capacity,
- backup medium,
- scope for expansion?
- criteria for choice?

Software features:
- integration of functions?
- complexity?
- reporting flexibility?
- structure?
- scope for expansion?
- on-line help features?

Support features:
- nearness of supplier,
- hot-line availability,
- trouble shooting skills of supplier,
- training provided?

INITIAL PROBLEMS

Nature and severity of problems.
Trace back to supplier of hardware
supplier of software
misunderstanding of software design
system design
skills and training requirement
environment (openess of system,economic &
physical influences)

IMPLEMENTATION

Planning operations?
Control by supplier/company?
Outside assistance? Nature of?

OPERATION

Specialist task, personnel, area?
Is this appropriate?
Satisfaction of actual needs?
Ease of operation.
Evidence of further needs.

*** Live Operation Phase ***

Satisfaction with MIS provision?
Change in any organisational/environment circumstances?
Extension of Use of MIS?
Nature and severity of problems?
Triggers for change to MIS provision?
APPENDIX J Reader Analysis

The bias of the researcher was checked by asking several professional persons experienced in the field of information systems to read the records of the company experiences and on the rich picture of evidence given make a judgement of the degree of success or failure in each phase of the MIS project for each company involved. Whilst it was not possible to enable the readers to experience the same data collection methods as the researcher, no judgements were recorded in the description of events supplied only the opinions of the participants themselves were recorded. Thus the researcher's own judgements were isolated from those of the readers in an attempt to check on the degree of bias involved.

Of ten persons asked to participate five were able to review the case studies and make judgements on each phase and a further one gave overall judgements only. These persons were mostly experienced systems analysts who were now lecturing in the field within the higher education field. An active participation in consultancy and authorship in the area of implementation of information systems was a quality of all the readers.

Reviewer Judgements

<table>
<thead>
<tr>
<th>Company A</th>
<th>Selection</th>
<th>Implementation</th>
<th>Live</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>I</td>
<td>0</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>I</td>
<td>I</td>
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<tr>
<td>Reasonably</td>
<td>I</td>
<td>3</td>
<td>I</td>
</tr>
<tr>
<td>Successful</td>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>Unsuccessful</td>
<td>I</td>
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<td>I</td>
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</tbody>
</table>

Reviewers considered the abnormal relationship between the company and the supplier to be the principal cause of the
limited success in the selection phase. The "learning by doing" technique combined with the high motivation of the management were considered to have had some pay-off to the firm in the longer term as implementation and live phases were considered more successful by the reviewers. Several reviewers thought that factors beyond the control of the company (business downturn and industrial dispute) influenced any judgement of success in meeting the initial objectives set.

<table>
<thead>
<tr>
<th>Company Bl</th>
<th>Selection</th>
<th>Implementation</th>
<th>Live</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>I 1 I 3 I 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reasonably</td>
<td>I 3 I 2 I 3</td>
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</tr>
<tr>
<td>Successful</td>
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</tr>
<tr>
<td>Unsuccessful</td>
<td>I 1 I 0 I 1</td>
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</tbody>
</table>

A wide discrepancy of views of success in the case of Company B1. Views of "overconfidence and failure to quantify/specify needs" were expressed as reasons for the lack of success whereas "good appreciation of requirements, but inadequate search for solutions" was also given.

Implementation was more successful, "they did it right!" as a result of "good planning". Problems in the live operation were considered to be out of the control of the company itself.

<table>
<thead>
<tr>
<th>Company B2</th>
<th>Selection</th>
<th>Implementation</th>
<th>Live</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>I 1 I 0 I na</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reasonably</td>
<td>I 4 I 0 I na</td>
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</tr>
<tr>
<td>Successful</td>
<td>I I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsuccessful</td>
<td>I 0 I 5 I na</td>
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</tbody>
</table>

After a relatively successful selection phase, attributed to
a good appreciation of the nature of information systems, reviewers considered the implementation a clear failure. The reasons were mainly staff problems with "a lack of commitment from key personnel" and "a failure to involve staff initially".

<table>
<thead>
<tr>
<th>Company C</th>
<th>Selection</th>
<th>Implementation</th>
<th>Live</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Reasonably</td>
<td>2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Successful</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Again opinions concerning the success of the selection phase varied. "The selection suffered from lack of specification of real requirements", "benefits were accidental" and "company was not really aware of the difficulties of computerisation" were given are reasons for low success.

<table>
<thead>
<tr>
<th>Company D</th>
<th>Selection</th>
<th>Implementation</th>
<th>Live</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>0</td>
<td>0</td>
<td>na</td>
</tr>
<tr>
<td>Reasonably</td>
<td>5</td>
<td>0</td>
<td>na</td>
</tr>
<tr>
<td>Successful</td>
<td>0</td>
<td>5</td>
<td>na</td>
</tr>
</tbody>
</table>

A clear agreement from the reviewers on the lack of success in implementing the system was evident. Views expressed were "too much in the supplier's control" and "lack of specification of real requirement again" and "problems with systems, data conversion and staff".
Agreement on a reasonable degree of success in selection leading to achieved success in the latter phases was attributed to "good fortune of getting good advice and staff" and "the consultant was genuinely concerned with the company's needs". One reviewer summed up the views by "I regard this as being the most successful of the cases, though only relatively!". Potential hazards which seem to have been fortunately avoided or overcome were "overdependence on one person, lack of management involvement".

Total agreement on the failure of Company F at an early stage was attributed to "lack of management commitment" and "failure to have really learnt anything from their previous experience".

Company G gave the reviewers several problems of assessment
and the result was the variation in the judgments made.

"The selection is reasonably successful though no attempt is made to take a wide view or to think through implications (presumably through lack of knowledge). It reveals quite well the difficulty of a small business and demonstrates that computerisation is most effective when the senior manager is personally committed; the commitment makes demands for greater knowledge". One reviewer considered the firm to have "no comprehension of what is involved - Disastrous!".

<table>
<thead>
<tr>
<th>Company H1</th>
<th>Selection</th>
<th>Implementation</th>
<th>Live</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>I 0</td>
<td>I 0</td>
<td>I na</td>
</tr>
<tr>
<td>Reasonably</td>
<td>I 1</td>
<td>I 0</td>
<td>I na</td>
</tr>
<tr>
<td>Successful</td>
<td>I 1</td>
<td>I 0</td>
<td>I</td>
</tr>
<tr>
<td>Unsuccessful</td>
<td>4 I</td>
<td>5 I</td>
<td>I na</td>
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</tbody>
</table>

Most reviewers considered the project to be a system failure due to a haphazard selection lacking thoroughness which resulted in implementation problems.

<table>
<thead>
<tr>
<th>Company H2</th>
<th>Selection</th>
<th>Implementation</th>
<th>Live</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>I 2</td>
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<td>I na</td>
</tr>
<tr>
<td>Reasonably</td>
<td>I 3</td>
<td>I 4</td>
<td>I na</td>
</tr>
<tr>
<td>Successful</td>
<td>I 3</td>
<td>I 4</td>
<td>I</td>
</tr>
<tr>
<td>Unsuccessful</td>
<td>0 I</td>
<td>1 I</td>
<td>I na</td>
</tr>
</tbody>
</table>

Variation in views concerning the degree of success was apparent. One view expressed was "Selection appears to be ongoing. The approach throughout is reasonable, being based on previous experience, though not particularly well organised or logical, and too person dependent". Another commented on "a lack of involvement for the accountant and
separate initiative within the company was apparent".

OVERALL ASSESSMENT

<table>
<thead>
<tr>
<th>Company I</th>
<th>A I</th>
<th>B1 I</th>
<th>B2 I</th>
<th>C I</th>
<th>D I</th>
<th>E I</th>
<th>F I</th>
<th>G I</th>
<th>H1 I</th>
<th>H2 I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>0 0 0 3 0 4 0 0 0 0</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Reasonably Successful</td>
<td>5 6 0 3 4 2 0 3 0 4</td>
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</tr>
<tr>
<td>Unsuccessful</td>
<td>1 0 6 0 2 0 6 3 6 2</td>
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</tbody>
</table>

* includes the overall judgements of the reviewer who did not give separate phase judgements.

When individual phase judgements are ranked on the basis of allocating points of successful = 3, reasonably successful = 2, unsuccessful = 1 the following table is derived.

<table>
<thead>
<tr>
<th>Company</th>
<th>Points</th>
<th>No of Phases</th>
<th>Ranking</th>
<th>Ranking</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
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<td>+1</td>
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<td>2</td>
<td>3</td>
<td>-1</td>
</tr>
<tr>
<td>B2</td>
<td>16</td>
<td>2</td>
<td>6</td>
<td>9</td>
<td>-3</td>
</tr>
<tr>
<td>C</td>
<td>32</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>15</td>
<td>2</td>
<td>8</td>
<td>6</td>
<td>+2</td>
</tr>
<tr>
<td>E</td>
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<td>1</td>
<td>0</td>
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<tr>
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