INFORMATION TECHNOLOGY

AND

SMALL FIRM PERFORMANCE

by

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ABSTRACT

This study utilised both mail questionnaire and case study approaches to investigate propositions related to information technology (IT) in small firms. The major proposition investigated IT Sophistication as one cause of small firm success. Data was collected from 289 engineering firms by mail questionnaire, including 120 with at least one computer.

Multiple regression analysis gave no support to IT as a success factor. Similarly, non-parametric statistical tests suggested that firms with more sophisticated IT performed no better than firms with no or less sophisticated IT. Furthermore, among only the firms with computers, many negative rather than positive correlations were found between IT variables and financial performance. Therefore, rather than support the major proposition that IT was a success factor for small firms, the mail questionnaire provided evidence to the contrary.

An indepth analysis of six firms provided evidence that developing IT had, in some firms, increased operating costs and consumed important managerial time. Furthermore, there was evidence to suggest that some factors tended to encourage both IT growth and poorer performance simultaneously, which would explain the negative correlations found between IT and financial performance.

Two further propositions were investigated, both relating to IT success. Using path analysis, the following factors were found to influence IT success: external assistance in identifying IT requirements, owner involvement in IT planning and in control, planning IT development, and the use of IT for many applications. However, the measure of IT success was not found to be correlated with financial performance, and this must put in question how MIS researchers should measure "success".

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INFORMATION TECHNOLOGY AND SMALL FIRM PERFORMANCE

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Appendices (continued)

Chapter 1

INTRODUCTION

During the last twenty years, there has been a growing recognition of the economic importance of small firms. An example of their importance is that new and expanding small firms are considered to have been responsible for much employment creation in recent years. (Small Business Research Trust, 1984.) As a result, the small firm sector is no longer ignored by researchers and this thesis is one of many endeavours to gain a greater understanding of small firms, with the aim of encouraging a healthy small firms sector.

This thesis takes information technology (IT) in small firms as its particular focus. Rather than include all types of information technology, the study centered on computer applications, as the microcomputer has made computers readily available to small firms during the 1980s.

Despite computers being a relatively recent phenomenon for small firms, there have been a number of studies on computers in small firms. (E.g. Easton et al 1982, Cheney 1983, Delone 1984, Cragg 1984, Raymond 1985.) Many of these studies have aimed to offer advice to owners of small firms, so have looked at one or more aspects of "IT Success". However, previous studies have tended to view IT Success in terms of "system use", "user satisfaction" and "system problems". No prior studies of small firms have considered information technology in relation to organisational success, despite the arguments that information and information technology are most important organisational resources. (E.g. Galbraith 1977, Lincoln 1986, Scott-Morton 1984, Zuboff 1985.) Hence, this research aimed to study information technology and small firm performance. Rather than look at many aspects of performance, e.g. productivity, innovation and member welfare, the study concentrated on financial performance because many

performance variables are related. (Friedlander and Pickle 1968, Robinson 1983.)

Aims Of The Research

Experiences of larger firms suggest that IT should be used extensively. A recent example of this is the body of literature encouraging firms to use IT to obtain competitive advantage. (E.g. Ives and Learmonth 1984, McFarlan 1984, Porter and Millar 1985.) Some small firms have heeded this advice (Willis, 1986). Others have looked only for easily achievable gains, or even totally ignored IT (Massey, 1986). As a result, some small firms are more sophisticated than others with respect to their use of IT and researchers are suggesting that the more sophisticated firms would perform better than the less sophisticated firms.

Some of the early studies of small firms reported that managers considered better information as one of the major benefits of computerisation. (Easton 1982, Cragg 1984.) Authors like Galbraith (1977) have argued that information is a most important organisational resource. Thus a major argument underlying this thesis is that if information is so important to an organisation then this better information should have led to better managerial performance, which in turn should be reflected in improved organisational performance. Hence, a major objective of this study was to explore the relationship between the level of IT Sophistication adopted by a firm and its financial performance. A major proposition to be tested being:

> There is a positive and significant relationship between IT Sophistication and Financial Performance in Small Firms.

However, previous research of small firm success has found that many factors influence the performance of small firms, including planning activities, market oriented activities and the characteristics of the owner/manager. (E.g. Berryman 1983,

Dollinger 1984, Foley 1985). Thus, it was recognised that the study would need to consider a broad range of variables, providing an opportunity to consider propositions concerning:

* The determinants of IT sophistication;
* the determinants of IT success;
* the determinants of financial performance;
* the relationship between IT success and financial performance.

Need For The Study

As small firms constitute an important part of the economy of many countries, their behaviour needs to be understood in order that sound guidance can be offered to them. Many have acquired information technology and potentially could gain from greater utilisation of their IT. Others will acquire IT and they too could benefit. Through a greater understanding of the impact of IT on small firms, managers, and their advisers, could help firms develop appropriate IT strategies. In addition, as there has been relatively so little research of IT in small firms, much of the existing advice reflects conventional wisdom gained from the experiences of large firms. Such conventional wisdom needs to be tested in the small firm environment.

There is also evidence in the literature that too little is known about the impact of IT on organisations. In a review of MIS research, Scott Morton (1984) concluded that there had been virtually no research on the impacts of information systems aimed at supporting managers. Scott Morton (1984) claims that the value of systems supporting managers comes from their impacts. He argues that these impacts need to be studied and understood in order to use IT effectively in organisations.

Zuboff (1985) discussed the "automate" and "informate" roles of information technology, where the "automate" role emphasises the automation of operations, and the "informate" role the creation of information. Zuboff argued that both roles have significant

impact on organisations, but that the impact of the "informate" technology is not yet understood.

Thus more research on the impact of information technology was needed. This study aimed to make a contribution in this area, with the emphasis on the impact on small firms of information related systems.

The study looked at the organisational impact of information technology, which makes the research untypical of MIS research. Typically, previous MIS research has utilised measures of "MIS Success" which have been defined rather narrowly. (Delone 1983, Raymond 1985, and more recently, Lees 1987, and Montazemi 1988.) MIS success measures have been limited to concentrate on factors like decision-making satisfaction, usability, data-quality and EDP support. The instruments used have concentrated on the "system" and on "information satisfaction", rather than attempt to measure changes in organisational effectiveness. This is despite the fact that MIS Success has been used by MIS researchers as a surrogate measure of changes in organisational effectiveness. (Ives et al, 1983). Thus this study was untypical of MIS research as it looked at organisation wide impacts of computer systems. Burns (1984) provided a good argument for this approach, following the discussion of many supposedly successful systems that in fact played no real purpose in the organisation. The studies by Cragg (1984) and Easton (1982) suggest that managers in small firms were satisfied with their systems. This study aimed to go beyond mere satisfaction and to look at organisational impacts.

Research Methods

Following an extensive review of the literature, which is reported in Chapter 2, the research went through two cycles of data collection and analysis. The first cycle collected data using a mail questionnaire. The second cycle used evidence based predominantly on face to face interviews.

The mail questionnaire was sent to firms in the East Midlands region of England. It provided data on 289 eligible, small engineering firms. Of these, 120 used a computer. To be eligible the firms had to be in operation in 1984, be independent, have up to 50 employees, and be an engineering firm located in one of the counties of Leicestershire, Nottinghamshire, Derbyshire, Lincolnshire and Northamptonshire. The Engineering Industry Training Board's definition of "engineering" firm was used, limiting the firms to manufacturers of metal based equipment or parts.

The design and use of the questionnaire study is discussed in Chapters 3 to 6. The analysis of the data is the focus of Chapters 7 to 13.

Research Design

The Ein-Dor and Segev (1981) model of MIS success is discussed in Chapter 3 as it provided the research framework for the study. The three research propositions are also discussed in Chapter 3. Research design is the focus of Chapter 4, and this drew heavily on Dillman's Total Design Method (Dillman, 1978). The content and development of the mail questionnaire is reported in Chapter 5. For the benefit of other researchers who may wish to use Dillman's approach, Chapter 6 is devoted to discussing the difficulties of using such a detailed, but successful, approach.

Analysis of Mail Questionnaire Data

Rather than use one statistical method of analysis, a mix of methods was used. This analysis of the questionnaire data is reported in Chapters 7 to 13. Various descriptive statistics were used to indicate the nature of the small engineering firms in the study (Chapter 7). The major proposition investigating IT sophistication and other variables with financial performance is the focus of Chapters 8, 11 and 12. The statistical analysis

drew on various methods, including correlation, multiple regression and non-parametric significance tests. The influence of the owner on performance is discussed in Chapter 9. As cluster analysis was used to sub-divide the sample into smaller samples of similar firms, this is discussed in Chapter 10. Two propositions relating to IT success were tested using path and correlation analysis, and these are reported in Chapter 13.

Case Study Design and Analysis

The second part of the research study utilised the case study method. Six small engineering firms which had previously been visited in 1984 were revisited in 1988. These firms were used to provide complementary evidence to the mail questionnaire data. As well as using an adapted version of the mail questionnaire, face to face interviews were used to provide data on underlying forces and connections between variables.

The design of this part of the study is discussed in Chapter 14, with the findings reported and analysed in Chapters 15 and 16.

Limitations Of The Study

The study did not attempt to research the impact of IT on all types of small firms. Instead, one broad part of the manufacturing sector of small firms was chosen for study. Though findings could apply to other types of small manufacturing firms, this is less likely with other sectors, for example, retailers and service firms, where the nature of the business is very different. Also, these sectors may attract different types of owners.

A mail questionnaire was used to gather much of the data for the analysis. Mail questionnaires have strengths as well as drawbacks. It is possible that the results contain some bias or systematic errors as a result of self-reporting.

The study did not attempt to obtain a complete picture of the impact of IT on small firms. The study deliberately concentrated on financial performance as an indicator of organisational effectiveness. Other measures of organisational performance, like innovation, productivity and survival were not investigated. Probably more importantly, member welfare was not studied, thus ignoring variables like job satisfaction, quality of life and security. Friedlander and Pickle (1968) provide evidence that many of these variables are related. Nevertheless, the study made no attempt to look at the impact of IT on variables other than profit and sales growth.

Chapter 2

LITERATURE REVIEW

"Information Technology and Small Firm Financial Performance" defines the major thrust of the research. However, a comprehensive literature search in 1985 identified only three studies that linked IT with financial performance, and none of these had specifically looked at small firms. (Turner 1982, Cron and Sobol 1983, Kearney 1984.) With relatively so little prior work in the area, a broad search was conducted and the following three bodies of literature reviewed:

1. Information Technology and Small Firms
2. Information Technology and Financial Performance
3. Small Firms and Financial Performance

The reviews of each of the areas are given below, and have been updated to include material published since 1985.

Information Technology And Small Firms

There is a growing body of literature in the area of IT and Small Firms. Much of this growth has occurred since this research project began, when descriptive studies of use were dominant. The literature was classified into four areas:

1. Papers that report use of IT and related issues.
2. Papers emphasising MIS success and how to achieve it.
3. Papers that suggest research topics.
4. Papers and books aimed at advising prospective purchasers about software and hardware.

The first three groups were seen as providing important descriptive and theoretical background information to the project, so are reviewed below.

Literature on the use of computers by small firms

Many surveys, typically using interviews, have been reported on the use of computers by small firms. One of the first was the study by Easton et al (1981), which reported data from 100 small firms in England. Their coverage was broad, looking at reasons for acquiring a computer, experiences in the early days, problems, benefits, applications and advice to buyers. Similar studies were conducted in North America by Cheney (1983) Farhoomand and Hrycyk (1985), Malone (1985), Baker (1987) and Lees and Lees (1987). Cragg (1984 and 1986) reported a New Zealand study. Though the surveys were in different countries, the results presented quite similar pictures, as discussed below.

Most firms were using accounting-type software, with one or more packages in the debtors, creditors, invoicing and general ledger areas. Most companies had experienced problems, with software problems being particularly disruptive. The studies provided further evidence that small firms are not miniature versions of large firms. They lack computing expertise, which in part inhibits expanding their application areas. They do not have a separate data processing department - instead, data processing is seen as an important part of the office or part of the accounting function. Senior managers used the computer system interactively, both to assist with day-to-day transaction processing and to access information for decision-making. The group dynamics within the small firm had led to little, if any, resistance from employees to the new technology. These factors combined to bring benefits in the form of time savings and better information. The managers considered their projects a success - an encouraging result considering their initial lack of computing experience and the considerable growth in the computer industry. The studies showed that computers can benefit even very small companies. Users offered advice to prospective purchasers, particularly with respect to defining needs, evaluating software and guaranteeing availability of service and support. [Selected responses from Cragg (1986) are given in Appendix 1.]

Other surveys have tended to report use, but with an emphasis on a particular issue. For example, Suter (1985) also included firms without computers, with 80% considering their firms "too small" for a computer. Other reasons were also offered, including a lack of available software (25%), too costly (47%) and a lack of understanding of computers (47%). Nickell and Seado (1986) were particularly interested in prior experience and attitudes and use by managers. They found that the owner's age was negatively correlated to whether they had taken a computer class. Though two thirds of their sample of 121 firms had a computer, only 3% of the managers had a negative attitude to computers as measured on a 10 item scale.

Martin (1985 and 1989) was also particularly interested in the owner manager with the emphasis in their role in computerisation. Interviews with sixteen firms revealed five types of chief executive (CE):

1. CE remote from management of the computer resource.
2. CE involved in a managerial, overseeing capacity.
3. CE closely involved in implementation of the facility (i.e. detailed choice and/or design decisions.
4. CE directly involved technically in computer implementation (i.e. programming and/or spreadsheet development).
5. CE routinely interacts directly with computer (Martin, 1985, p.5).

Lincoln and Warberg (1987) investigated the types of marketing information kept by small firms, particularly on customers, sales, inventory and marketing costs. They concluded that much marketing data was held, but as little was analysed, there was considerable scope for further developments. This under-utilisation theme was discussed by Massey (1986), who argued for small firms to look at computers from a revenue generation angle rather than cost-oriented. Willis (1986) showed that this revenue generation orientation is possible in small firms, and

reported encouragingly positive results following seminars designed to address this issue.

An earlier paper by Raymond and Magnenat-Thalmann (1982) also questioned how well firms were using their computer support, this time in decision making. They compared information satisfaction for firms with and without computer support, and found a great similarity, concluding that data tended to be neglected in the decision making process.

More recently, Raymond (1987a and b) has investigated information systems sophistication, and end-user computing. The studies showed that many measures of sophistication were related, concluding that the number of administrative applications, rather than transactional, was the best measure of IS sophistication. Though Raymond (1987b) found few firms with end-user programming, the presence of end-user computing was greatest in decentralised and larger firms, with higher IS sophistication. Size could be the crucial variable as IS sophistication and size have been found to be strongly related (Raymond 1987a, Delone 1981).

Literature emphasising MIS success and how to achieve it

There is a large body of literature that has investigated the relationship between organisational characteristics and MIS success in large firms. Ein-Dor and Segev (1981) provided a comprehensive review of the literature related to MIS success. From their review, they proposed a model of MIS success which included four types of variables, under the headings of environmental, structural, behavioural and procedural. Thus, the Ein-Dor and Segev paradigm is a model of MIS success which encompasses a very broad range of variables.

Studies of MIS success in small firms have utilised prior research in large firms, but none have attempted to be as comprehensive as Ein-Dor and Segev. Typically, hypotheses have been tested with the objective of determining factors that affect

MIS success, and thus offer advice on how small firms should approach computerisation.

Raymond (1985 and 1987c) used "user information satisfaction" and "level of system usage" as two measures of MIS success, to test seven hypotheses. The study found MIS success to be positively correlated with: the proportion of applications developed and run internally, the number of administrative rather than transactional applications on the computer, preferably on-line, and under the supervision of a high ranking individual. Contrary to expectations, the study found a negative association between years of computer experience and user satisfaction.

Delone (1983 and 1988) measured success using reported use by the chief executive and their rating of impact, to test nine hypotheses. The study found that the chief executive's knowledge of computers and their involvement were important. On-site use was also important. However, there was no support for computer training, computer planning, external programming and employee acceptance, as being important for MIS success.

Montazemi (1988) attempted to test the somewhat ambiguous findings by Raymond and Delone. This study found end-user satisfaction positively associated with: the number of systems analysts present within the firm, the degree of analysis of information requirements, the level of participation, end-users' level of computer literacy, and with interactive application systems. The study found no correlation between MIS success and the years of computer use. In addition, MIS success was higher in decentralised organisations, i.e. those with more managers.

Lees (1987) also tested many hypotheses, though little detail of the methods of the study were reported. The study found success to be positively correlated to: user involvement, vendor involvement, length of time since computerisation and prior experience with computers. Use of consultants was found to be negatively correlated with success.

A weakness associated with much of the above research is that simple two variable correlations have dominated the data analysis. Delone's study (1983 and 1988)) is the exception where multivariate tests were conducted. By not controlling other variables in the analysis, the results are purely descriptive, rather than showing causality.

Other research into MIS success has tended to emphasise systems development. Fuller (1985) argues that the crucial factor is the relationship between the software suppliers and the firm. Kole (1983) provided case study evidence to suggest that packages rather than custom-made software were best for small firms. Taylor and Meinhardt (1985) argued for the use of the delphi method to define information needs, while Dickinson, Ferguson and Sircar (1984) suggested the use of the critical success factor approach.

Taking a broader perspective, Wroe (1986) conducted a longitudinal analysis using case studies to determine important success variables. Wroe identified three key elements as important for success, rather than one single factor or group of variables. The three key elements identified were:

* Application Context (degree of change from old to new, degree of simplicity)
* Organisational Context (economic stability, administrative slack and formality, managerial style, internal skills)
* System Development Process (MIS strategy, use of outside advisor, user involvement, transitional strategy).

Wroe concluded that all three elements had to be "favourable" for success to occur. The more favourable all three elements, the smaller the likelihood of failure.

Literature that suggest research topics

Raymond (1984) generated research questions after comparing small and large firms. The analysis emphasised differences and hence areas for further research in relation to organisation, decision, psycho-sociological and MIS function variables.

Cooley, Walz and Walz (1987) developed their research agenda from MIS theories relating to large firms. They focussed on stages of growth, IS structure, end-user computing, IS planning and decision support systems as areas in need of further research. Since their suggestions, Raymond (1987b) has reported on end-user computing and Pliniussen (1988) has looked at stages of growth, suggesting a two dimensional model, incorporating the number of systems and whether the system is the firm's first.

Information Technology And Financial Performance

A small number of the studies that have investigated financial performance have included computer related variables. Turner (1982) tested the hypothesis "firms that invest heavily in computer resources for operational functions will perform better than firms that invest less heavily" (p. 112). The study of 38 banks found that larger banks performed better than smaller banks, but found no association between relative DP expenditure and performance when controlling for size.

Another study which included some relatively small firms was conducted by Cron and Sobol (1983). Their data allowed the sample to be classified by the level of IT sophistication. They found that firms that made extensive use of the computer had a great tendency to be either very low or very high performers. Many of their non-computerised firms performed very well, particularly the small ones, which they surmised as being positioned in profitable niches.

The study by Kearney (1984) compared the performance of "leading" and "lagging" firms in the use of IT. They found that the companies lagging in the use of IT were six times more likely to have a poor financial performance in their sector than the leaders. Though they could not attribute the poorer performance to the use of IT, they did comment that the lagging firms would find it almost impossible to catch up with IT investment, and thus were destined to remain poor performers.

Yap and Walsham (1986) compared firms that were classified as either users or non-users of computers. Various industry sectors were analysed separately, with no "evidence to support the view that the use of computers improves profitability" (p 271).

A cost-benefit approach was adopted by Lincoln (1986) for the evaluation of 170 applications at a range of sites, including small and large systems. Conclusions from these evaluations are that about two-thirds reached break-even within one year of implementation. About 80% of all showed positive returns, with most above 100% per annum.

Kivijärvi and Saarinen (1988) analysed the relationships between the resources used in IS and financial performance. Though they found that the performance was greater in firms with more mature information systems, the longitudinal data over four years failed to reveal which was the cause and which was the effect.

Small Firms And Financial Performance

A number of studies of small firms have focussed on financial performance, with the intent of gaining a greater understanding of small firms and isolating factors which are important for success. (Dollinger 1984, Foley 1985, Hornaday and Wheatley 1986, Miller and Toulouse 1986a and b, Riggs and Bracker 1986, Robinson et al 1986a and b.) The studies have proposed and researched various "causes" of success, including planning and

oriented activities, and the characteristics of the owner/manager.

Previous research investigating small firm performance, has tended to either look for causes of failure or causes of success. A review of the "failure" literature by Berryman (1983) showed that many factors had been associated with small business failure. The majority of the apparent causes, such as lack of cash and inventory difficulties, were considered to be symptoms of managerial inability. Berryman grouped another set of apparent causes as "behavioural", including excessive optimism and a reluctance to seek help. A third set of factors was termed exogenous, referring to personal problems (for example, ill-health) as well as economic and seasonal conditions.

Studies of Organisational Success

Rather than study "failed" firms, other studies have looked at "going concerns". A search of the small firm literature since 1980 produced eight empirical, causal studies of success. Financial performance data had been used as a measure of success, and various hypotheses tested in an attempt to isolate causes of success. Three studies emphasised planning activities, testing the hypothesis that planning improves performance (Riggs and Bracker 1986, Robinson et al, 1986a and b, and Ackelsberg 1985). Hornaday and Wheatley (1986) emphasised goal setting rather than planning activities. Another four studies, by Foley (1985) Dollinger (1984), Miller and Toulouse (1986a and b) and Begley and Boyd (1986) included a broader coverage of organisational variables to study financial success. These studies used various data collection methods, with mail questionnaires being the most popular. In addition, different measures of performance were used with multiple measures being common.

The major conclusions to be drawn from these studies are:

1. That the planning activities undertaken by an organisation

are related to financial performance.

2. Market orientated activities would seem to be related to financial performance.

3. The characteristics of the owner/manager are related to financial performance.

The specific findings of these eight studies of small going concerns are summarised in Appendix 2. Also given in Appendix 2 is a summary of the methods adopted by the researchers. To gather their data, three studies used face to face interviews. The other five studies all used mail questionnaires. Various statistical techniques were used in the data analysis, with multiple regression being used in four of the studies.

Limitations Of The Methods Of Analysis Within Previous Research

A criticism of much of the hypothesis testing involving proposed causes of IT success, is that two variable correlations dominated the analysis. Therefore, the findings should be viewed as descriptive rather than inferring causality. This criticism also applies to some of the studies of small firm organisational success. Unless a more complex analysis is carried out, these associations can only be considered speculative, however appealing they may seem. One way of increasing understanding of the relationship under study is to "subject the speculation to systematic test". (Rosenberg 1968, pp 23-4). Rosenberg suggests that an appropriate strategy is to test whether the relationship still applies, even when other variables are introduced into the analysis. Only if the relationship still exists, can we then conclude that it is likely that better performance is associated, for example, with operational planning. To draw causal conclusions would require additional analysis to indicate the direction of the relationship.

Another aspect of analysis which some past research has ignored is that many variables are "block-booked". (Rosenberg, (1986) p. 26.) Rosenberg uses the term "block-booked" to describe the phenomenon that many variables tend to be associated with each other. For example, when studying small firms, younger owners may be more likely to adopt new methods by way of equipment and managerial practices. Hence it is likely that any data collected on these variables would be highly correlated. To treat each variable separately may be misleading, as it could suggest that one particular practice could be important and another unimportant. This is the problem of multicollinearity faced within multiple regression analysis. Grouping the variables using factor analysis may be more appropriate than treating each variable individually. Using independent variables individually may yield results which permit specific advice to small firms. However, if factor analysis is used to produce meaningful groupings of variables, then useful, although probably more general advice might be possible.

Summary

The research on small firm computer use provided evidence that many small firms use computers, particularly for transaction processing. Though firms reported better information as a major benefit, the studies presented a sceptical view of whether this information is utilised in decision making.

The studies on MIS success have produced somewhat ambiguous results, thus supporting Wroe's (1986) contention that many conditions have to be favourable for MIS success. None of the MIS success studies attempted to investigate the relationship between MIS success and organisational success. Furthermore, the review failed to locate a model which linked information technology with organisational success.

Of the studies that have investigated small firm organisational success, none had included IT as an independent variable. Though

studies in larger firms had found an association between IT and performance, they were unable to provide evidence of the direction of any causal links.

One aim of the previous research was to obtain a greater understanding of small firm performance. Advice based on such findings can have a major impact on small firms. Hence the study of small firm success is important. For this reason, a study investigating the relationship between IT and performance was warranted, especially if the study could utilise techniques which mitigated deficiencies identified in prior studies.

Chapter 3

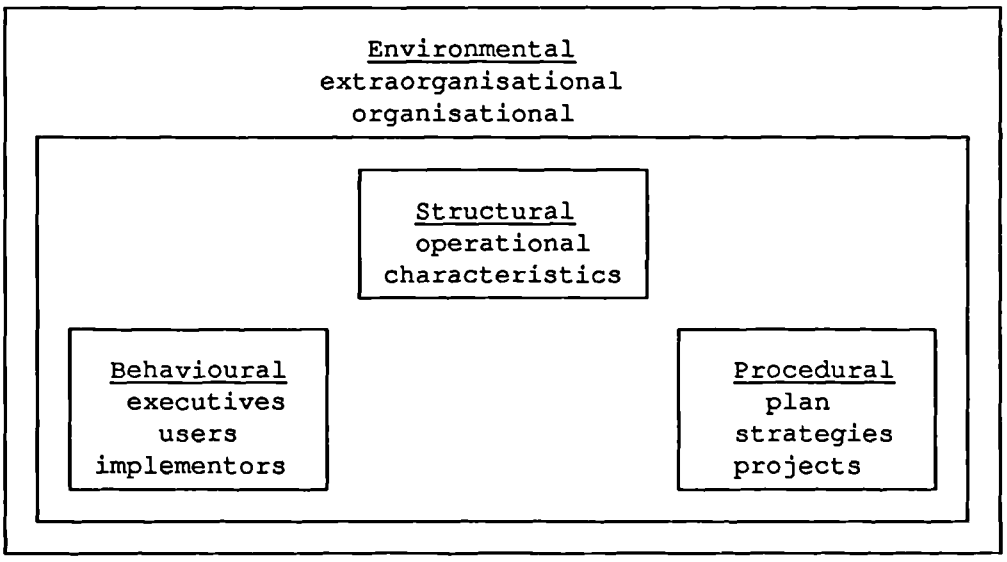
RESEARCH FRAMEWORK

The literature review in the previous chapter failed to find a model which linked IT (or MIS) with organisational success, though the studies by Cron and Sobol (1983) and Kearney (1984) suggested there was a positive link. The review did locate a comprehensive model of MIS success by Ein-Dor and Segev (1981) which included a broad range of organisational variables. This chapter discusses how the Ein-Dor and Segev model was used to provide the research framework for the study. The chapter then goes on to discuss the major variables, and to state the research propositions to be investigated.

The Ein-Dor And Segev Paradigm For MIS

Ein-Dor and Segev's (1981) book provided a comprehensive review of the MIS success literature. From their review, they proposed a model of MIS, consisting of four major subsystems, as depicted in Figure 3.1. Their model takes a broad view of MIS in organisations, and therefore it provided a good basis for this research study.

Figure 3.1: Ein-Dor and Segev's Subsystems of MIS

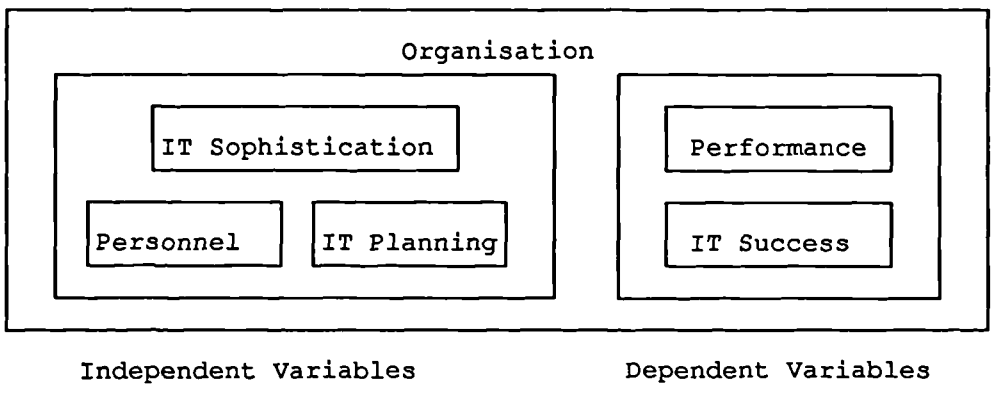


Adapted from Ein-Dor and Segev (1981, p 9)

The paradigm views MIS in terms of behavioural and procedural subsystems that are interfaced, through the structure of MIS, with organisational and extra-organisational environments. Ein-Dor and Segev argued that the structure of MIS is crucial to the success of MIS. Here the 'structure of MIS' describes the physical system that is the end product, including data characteristics, user interface characteristics, mode of operation, and integration. This is often referred to in the literature as IT Sophistication. Rather than argue that IT Sophistication is crucial for IT success, this research argues that IT Sophistication is crucial to organisation performance. The research also wished to test whether the often used variable MIS success, is a good surrogate for organisation performance.

Ein-Dor and Segev suggested specific variables for each of their subsystems. This research utilises some of their variables, particularly those relevant to the decisions facing small firms on information technology. The major variables of the research are Organisation (part of Ein-Dor and Segev's Environment), IT Sophistication (part of Ein-Dor and Segev's structural subsystem), Personnel (part of Ein-Dor and Segev's Behavioural subsystem), IT Planning (part of Ein-Dor and Segev's Procedural subsystems), Performance and IT Success. These variables are depicted in Figure 3.2, with the last two variables viewed as dependent variables, influenced by the others.

Figure 3.2: The Research Study's Major Variables



The variables IT Sophistication and IT Planning are important independent variables in this research. They are associated with many decisions facing small firms on information technology.

The impact of the variables Organisation and Personnel are not the focus of this research. However, as they are known to influence MIS Sucess and Organisational Performance, they are included for control purposes.

The variables Performance and IT Success are important dependent variables. As they are suspected of being different, IT Success was studied to test the validity of IT Success as a surrogate for organisation performance.

Major Variables

A major motivation for the research was for the findings to be of use to managers of small firms, including both those considering an initial acquisition, and those considering further developments. Hence the emphasis in this research on the variables IT Sophistication and IT Planning. A greater understanding of these variables could assist small firms with many decisions associated with IT acquisition and development.

IT Sophistication

IT Sophistication was seen as an important independent variable that attempts to describe the complexity of a firm's actual IT developments. An understanding of IT Sophistication could help managers determine the appropriate level of complexity for their IT. For example, is it worthwhile supporting many functional areas; should they acquire numerous terminals; should they seek information benefits?

IT Planning

IT Planning was seen as an important independent variable that attempted to identify the activities that preceded and accompanied IT developments. Small firms are advised to plan and to define their requirements for IT. However this advice is conventional wisdom, derived from the mixed success of IT in large firms, which have a very different hardware, software and support environment. Such conventional wisdom needed to be tested in small firms to help determine, for example, whether firms should plan to support clerical and/or managerial functions; whether firms should intend to support many functional areas; whether a written requirements statement is helpful.

Organisation and Personnel

Organisation and Personnel were both independent variables of lesser interest in this study as they are less controllable by the manager. However, based on the literature of both organisational and IT success, they were seen as important influences of Performance and IT Success. The literature review stressed the need to include planning activities and, more particularly, characteristics of the owner manager. However, the literature provided no consensus on managerial type, or its effect (Chell, 1985).

Many research studies have shown that individuals in organisations are important to MIS Success (Ein-Dor and Segev, 1981). Delone (1983) found that Chief Executive Knowledge of computers, and their involvement with computers (both correlated to each other) were directly associated with the success of computer operations. Other research, typically in large organisations, showed that users were important to MIS Success. Thus, another variable with restricted managerial control is Personnel, referring to the involvement and experience of the owner-manager and others.

Performance and IT Success

Both Performance and IT Success were the two dependent variables in the study. Prior research suggested that computerisation had brought many benefits to firms. Such studies, apart from Cron and Sobol (1983), had not attempted, or had failed, to research computerisation in relation to organisational performance. Robinson (1983) argued that many indicators of company health, for example, employment creation and staff morale, could be reflected in financial performance. Hence the study concentrated on financial performance (FINPERF), and neglected other benefits.

IT Success was included as a dependent variable because MIS Success/Effectiveness has often been used as a surrogate for organisation performance in MIS research. Many aspects of MIS success have been used. Ives and Olson (1981), in a review of research relating user involvement to MIS success, found four different types of measure of MIS success; System Quality, System Use, Perceived Quality/Information Satisfaction, and Changes in User Behaviour/Attitudes. With the emphasis of this study on information technology and organisation performance, the first three areas seemed relevant to this research. The fourth aspect of changes in user behaviour/attitudes were considered to be outside the scope of this research.

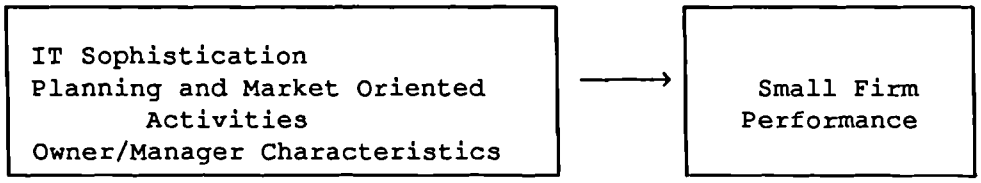
The Major Research Proposition

Authors like Galbraith (1977), Lincoln (1986), Scott-Morton (1984) and Zuboff (1985) argue that information is a most important organisational resource to firms. Studies of small firms by Lincoln and Warberg (1987), Massey (1986) and Willis (1986) suggest that small firms should aim to achieve benefits from their "information resource". The general implication of these authors is that information technology can benefit small firm organisational performance. However, the impact of information technology on organisational performance has not been studied in the small firm setting, and in large firms the

position is unclear. (Cron and Sobol 1983, Kearney 1984, Kivijärvi and Saarinen 1988, Turner 1982, Yap and Walsham 1986.)

The literature review did identify many other variables that would seem to influence small firm performance. In particular, planning and market oriented activities and characteristics of the owner/manager were identified. (E.g. Ackelsberg 1985, Foley 1985, Miller and Toulouse 1986a and b.) Therefore, any study of the impact of information technology on small firm performance, had to include a broad range of organisational variables, as depicted in Figure 3.3.

Figure 3.3: An Influence Model of Small Firm Performance



This suggested the following proposition to be researched:

Proposition 1: There is a positive and significant relationship between IT Sophistication, planning and market oriented activities and owner/manager characteristics with small firm performance.

The expected positive relationship within proposition 1 implied that firms with more sophisticated IT would perform better than firms with less sophisticated IT.

Previous studies, including Ein-Dor and Segev (1981), have used "IT sophistication" to reflect many aspects of sophistication. These included hardware capabilities, software features and IT diffusion throughout the firm. IT Sophistication was, therefore, a multi-dimensional variable with no single recognised method of measurement. However, with this study's emphasis on the potential information benefits of IT, the prior research

identified the following IT variables worthy of further study:

* number of sophisticated applications (Raymond, 1985);
* number of functional areas (Raymond and Magnenat - Thalmann, 1982);
* number of managerial applications (Higgins and Opdebeeck, 1984);
* use by managers (Srinivasen, 1985);
* sole rather than shared or off-site use (Delone 1983, Raymond 1985);
* diffusion (Ein-Dor and Segev, 1983).

Many organisational and personnel variables were identified in the literature. Bracker (1982), Foley (1985), and Ackelsberg (1985) drew attention to the importance to small firms for a business plan and for monthly forecasts. Foley (1985) also identified new products and the number of marketing/sales staff as important causes of success.

Managerial type has been recognised by many researchers as having an influence on success. Scase and Goffee (1982) found differences between managers who worked at a desk or alongside employees with machinery. Miller and Toulouse (1986a) linked owner motivation to performance. Boswell (1973) found the age of the owner was significant.

The model portrayed in Figure 3.3, therefore, contained many contributing influential factors, as summarised in Table 3.1.

Table 3.1 Influences on Small Firm Performance

Influencing Factors

IT Sophistication	Planning and Marketing	Owner
Number of sophisticated applications Number of functional areas Number of managerial applications Use by managers Sole or shared use Diffusion	Written business plan Monthly forecasts New Products Number of marketing/ sales staff	Owner works at desk or machinery Age of owner Owner motivation

Lesser Research Propositions

In addition to the major proposition, the project provided an opportunity to study IT success as well as organisational performance. Two areas were identified: investigating determinants of IT success; and testing whether IT success was a good surrogate for organisational performance.

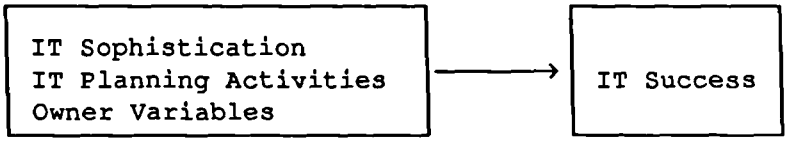
Determinants of IT Success

Four studies of IT success in small firms were identified in the literature. (Delone 1983 and 1988, Raymond 1985, Lees 1987 and Montazemi 1988.) These studies identified user-involvement and various IT planning activities as important determinants of IT success. However, many conclusions were based on two variable correlation analysis. This study aimed to re-examine these findings utilising more sophisticated methods of analysis. This re-examination needed to include variables which the owner/manager could influence to achieve the objective of offering advice to owners of small firms. This implied that IT planning and control activities in particular should be investigated.

Delone (1983) also found that the chief executives had had a considerable influence on IT success. This supported the

findings in larger firms where top management support has been recognised as important for IT success. (Ein-Dor and Segev 1981.) Therefore, personnel variables as well as IT variables needed to be studied in relation to IT success, as depicted in Figure 3.4.

Figure 3.4: An Influence Model of Small Firm IT Success



This suggested a second proposition to be researched:

Proposition 2: Among small firms with information technology, IT sophistication and planning activities and the owner/manager have a positive and significant influence on IT success.

The expected positive relationship in proposition 2 implied that firms which had planned their IT better would have greatest IT success.

Modern systems were seen as more likely to be user friendly, interactive and flexible. This would encourage wider use of IT in an organisation, which was found by Raymond (1985) to be positively correlated with IT success. Furthermore, through the learning effect discussed earlier (Malone, 1985) a firm's length of experience with computers was expected to influence IT success, despite the negative findings by Raymond (1985).

Owners of small firms already with computers advised prospective purchasers to determine their objectives first. (Easton 1981, Cragg 1984.) However, Malone (1985) found that this was difficult advice for owners to follow unless they had had some experience with computers. Firms were thus encouraged to seek advice from professionals. They should, therefore, plan their IT

developments and thus adopt the practices of larger firms. For this reason the following variables were seen as important aspects of IT planning: preparation of a written statement of requirements (Delone 1981); involvement of external assistance (Delone 1985); and plans for many applications, in a range of functional areas, particularly at the managerial level (Raymond, 1985).

The personnel variables that prior research had identified were the owner's prior experience with IT (Delone 1983) and their involvement with IT planning and control (Delone 1983 and Raymond 1985).

The likely influencing factors for proposition 2 are summarised in Table 3.2

Table 3.2: Influences on Small Firm IT Success

IT Sophistication	IT Planning	Owner
Modern systems Years of IT experience Wide use of IT	Written statement of requirements External assistance Plans for many applications - in a range of functional areas - at the managerial level	Owner's prior experience with IT Owner's involvement with IT planning and control

IT Success and Organisational Performance

The MIS Success literature has tended to use measures of MIS Success as a surrogate for organisational performance. This suggested the following proposition:

Proposition 3: there would be a positive correlation between the variables IT Success and FINPERF.

Rejection of this proposition would imply that IT success was not a good surrogate for organisational performance, suggesting the need for a redefinition of the term MIS Success.

Summary

Three propositions have been identified linking the six major variables of Ein-Dor and Segev's model of MIS. The major proposition suggests IT influences organisational performance, the second proposition looks at determinants of IT success, and the third proposition questions whether IT success is a surrogate of organisational performance.

The major proposition linking IT with small firm performance is the focus for many of the remaining chapters in this thesis. Propositions two and three are the focus in Chapter 13 only. However, all three propositions were considered in the research design, which is the subject of the next chapter.

Chapter 4

RESEARCH DESIGN

The previous chapter stated the three propositions that the research aimed to investigate. The research design is the focus of this chapter. Various approaches are reviewed, with the mail questionnaire method selected as the major vehicle for data collection. The chapter then discusses important aspects of the survey, including a definition of the population, the determination of a sampling frame and the development of a mail questionnaire.

Research strategies

Galliers (1985), following a conference which focussed on information systems research methods, identified and compared the following eight different research strategies in use in IS research:

Laboratory experiments
Field experiments
Surveys
Case studies
Future research
Phenonemological studies/humeuentics
Longitudinal studies
action research.

As the research aimed to provide empirical data from natural settings, the experimental and future strategies were deemed inappropriate.

The other strategies, apart from that of surveys, are typically practical for only a small number of firms. The main advantage to be gained from these typically intensive approaches is that they can provide rich data about underlying processes. They are good at identifying new variables and possible relationship. As a

result, these strategies have been found to be very useful for theory building. Their utility in theory testing is under question, as their small sample sizes restrict opportunities for the generalisation of any findings.

The research wished to compare financial performance across firms with different levels of IT Sophistication. Bracker (1982) attempted something similar when investigating the impact of planning activities on small firm performance. His experiences indicated a sample size of over 300 would be needed if statistical analysis was to be conducted with control variables.

The major strength of the survey approach was seen to be the ability to collect data from a large number of firms. Thus allowing quantitative analysis in the testing of inferences and also the potential to generalise the findings to many types of small firms.

A further advantage of the survey approach was that it had been proven as a method for the collection of data on financial performance. This is a problem that other researchers have encountered as small firms have very limited disclosure requirements, which make their annual reports of little use in data collection.

One of the major disadvantages of the survey approach was that the important variables had to be known in advance. Thus it can only be used in relatively well understood situations. However, the large literature in the area of MIS success in large firms, and factors affecting the performance of small firms, were viewed as a source of likely important variables.

The survey approach was seen to be powerful with respect to quantifying relationships between variables, but weak at providing insight about cases. Therefore it was deemed most appropriate to use a mix of approaches. A survey would be used to gather quantitative data, and case studies used in a second,

confirmatory stage of the research.

The selection of the research strategy was influenced by the researcher's prior experience of studying IT in small firms. A previous study of 33 small manufacturing firms, using face to face interviews with owners (Cragg, 1984), identified many benefits from IT and differences in performance. With many potential influences on performance, a large sample was viewed as the most likely strategy to identify genuine rather than spurious influences.

The remainder of this chapter discusses the survey design, including the methods used, the population under study, and the development of the questionnaire.

Survey Method

The survey method was selected to obtain data from a large number of firms. However, questionnaire surveys can be conducted in three very different ways: by mail, by telephone, and in face to face interviews. The relative strengths and weaknesse of the approaches are discussed, before reviewing the methods in light of the research objectives.

Three Questionnaire Approaches

As with research strategies, no one approach scores highly for all situations. Dillman (1978), based on many years of experience with large surveys, provided a comprehensive comparison of the three approaches, with 24 factors being seen as important when evaluating the merits of the three methods.

Dillman concluded that each method has merits as well as shortcomings, and the choice is very much dependent on the research objectives. The major strengths and weaknesses of the three methods are summarised below:

* In face to face interviews the researcher may probe for a clearer or more comprehensive explanation while this is impossible for a mailed questionnaire.

* On cost grounds, mail surveys have a high fixed cost but low marginal cost thus making large sample sizes possible. Marginal costs are relatively much higher for face to face interviews.

* Personal interviews are more likely to provide a representative sample than mailed questionnaires where non-response rate can be very high.

* The anonymity of mailed questionnaires is considered to increase the likely response on confidential or secretive issues.

* Telephone interviews have been used to obtain data quickly, much more quickly than with the two other methods.

* Mail questionnaires rely on the efficiency of the written word, rather than the interviewer. However, mail questionnaires do present a common stimulus to repondents and thus are free from possible interviewer bias.

In view of the research objectives, the mail questionnaire approach was chosen as the most appropriate data collection method. This decision was made primarily on practical grounds as the approach would seem most likely to provide a large sample of both computer users and non-users at a reasonable cost.

The method was considered to have a disadvantage of making it difficult to ask open ended questions, particularly about the process of change where computers had been implemented. However, the mail questionnaire approach was considered the most likely of

the three methods to obtain financial performance data. It was also hoped that annual company reports could provide financial performance data. However, the common delay in submitting annual reports, the limited disclosure required by small firms, and the fact that only limited liability firms submit reports, meant that company reports could not be relied upon or used as a source of financial performance data.

A response rate in excess of 70% was expected. Thus, the problem of potential bias from non-response was considered to be outweighed by the benefits of a larger sample. Following the advice of Sudman and Bradburn (1984), responses were monitored to compare the results of successive mailings. In addition, a random sample of non-respondents were telephoned to see if they differed in ways to respondents.

The Population

As Dollinger (1984) reached different conclusions for manufacturers and retailers, an intensive study of one sector seemed to be an appropriate strategy rather than attempt to cover many sectors. Other studies, for example Bracker (1982) and Delone (1983) had found that their analyses were limited by the small size of their samples. Hence the engineering sector was selected as it was likely to provide a large number of firms with computers. In addition, prior work by Cragg (1984) had shown engineering firms to vary widely in their use of computers and thus provide the desired range of levels of IT sophistication.

Small Defined

There is no one consistently used definition of "small firms". The committee of inquiry on small firms (Bolton 1971) investigated various ways of defining a small firm. As a result, their definition draws on three economic aspects:

(i) It must have a relatively small share of the market.

(ii) Owner management must predominate, with no outside control in decision making.

(iii) It should not form part of a larger enterprise.

For practical reasons the committee adopted an upper limit of 200 employees for manufacturing firms. However, Ganguly (1985) concluded that 100 may be more appropriate for some industrial sectors. Ganguly's analysis is based on the share small firms have of the total employment in a particular sector, and the average number of establishments per enterprise. As a result he recommended alternative employee thresholds for the UK; 100 for the Metal goods sector, 200 for mechanical engineering, and 500 for electrical engineering.

Alternative definitions have been used. The 1982 annual report of the US Small Business Administration recommended a 500 employee threshold. In Australia, manufacturing businesses are considered small if they employ fewer than 100 persons, while for non-manufacturing business the threshold is 30. (Johns et al, 1983). For New Zealand the recognised thresholds are 50 in manufacturing and 20 in other sectors. (Bollard, 1984). In view of a possible comparative study between the UK and New Zealand, the research adopted 50 employees, including working proprietors, as an upper size limit. In addition, in line with the Bolton (1971) guidelines given earlier, the firms could not be part of a larger enterprise.

The Type of Small Firm

Two further guidelines were used to define the population under study. One in terms of the type of firms, the other defined the geographical location.

The study adopted the UK's Engineering Industry Training Boards's (EITB) definition of "engineering firm". Using the standard industrial classifications (SIC) this meant that the study included all firms in division 3, excluding 361 (shipbuilding) and 348 (electrical contractors). In addition sectors 222, 223, and 224 were included as the remainder of the EITB's definition. Thus the study was of manufacturing goods, like steel tubes, metal doors, tin cans, steel fabrications, tractors, machinery, nuts and bolts, hand tools, typewriters, electrical equipment, motor vehicles and parts, cycles and instruments.

It was recognised that this mix of small firms competed across a number of markets, which would make statistical control difficult. However, the firms were selected because the results have the potential of being applicable to a very large number of small firms, not just in England, but also throughout the developed world. Having a mix of firms placed the research methodologically in the middle ground between studying one specific type of firm, eg. Bracker's (1982) dry cleaning firms, and a very broad coverage of firms, eg. Miller and Toulouse's (1986a) mixture from retailers, manufacturers and financial services.

It was also decided to limit the study to firms in the East Midlands. The area, with an estimated 700 small engineering firms, was considered sufficiently large to contain at least 100 small firms with computers. With a population of 3.5 million, and with no major centre of population, the East Midlands was also considered suitable for a comparative study with New Zealand.

Two practical reasons also favoured limiting the study to one geographical region. The limitation made it feasible to compile a complete list of all eligible firms in the region. Compiling such a list for a larger part of the country ran the risk of considerable bias. In addition, the area local to the University was chosen in order to encourage a high response rate as it

facilitated telephone communication and visits, as well as taking advantage of strong links between local firms and the University. Hence the study was limited to the East Midlands, encompassing the five counties of Northamptonshire, Leicestershire, Derbyshire, Nottinghamshire and Lincolnshire.

The Sampling Frame

The study needed a comprehensive list of small engineering firms in the area. Also, to implement the personalised approach as advised by Dillman, the name of the owner-manager was required, as well as the firm's name and address. Such up-to-date information was not readily available for small firms. Ganguly's (1985) analysis of the 127,600 production businesses registered for VAT in 1981 in the UK, suggested there were 9.6% "births" and 7.6% "deaths". As some very small firms, (in 1985 the turnover threshold was £19,500 p.a.) did not have to register for VAT, Ganguly's "births" and "deaths" could only be considered as indicators of new and dead firms. Ganguly's lifespan analysis of VAT registered firms in the production sector, suggested that 65% of company failures occurred within the first 2 years. For sole proprietorship and partnerships the equivalent figure was 51%. However, the data gave an indication of the difficulty of obtaining an up-to-date list of small firms.

In an attempt to achieve an up to date and informative list of all small engineering firms in the East Midlands, various organisations with lists were approached. The British Telecom's list was selected as the only up-to-date available list, with a named owner-manager, and likely to give a good coverage of small firms. Their list was supplemented considerably, and partially validated, by other data made available through engineering training groups and County Councils.

The Mail Questionnaire Method

Where possible, the study adopted Dillman's Total Design Method (TDM) for the development and use of a mail questionnaire (Dillman, 1978). Dillman devised the method through many year's experience of conducting telephone and mail surveys. The TDM is based on theories of social exchange which imply that there are three things that must be done to maximise survey response:

- Minimise the cost for responding;
- Maximise the rewards for doing so;
- Establish trust that those rewards will be delivered.

As a result, Dillman proposes a method which pays attention to all the factors which affect both the quantity and quality of response. Thus Dillman offers advice on the envelope, the cover letter, mailing dates, and many do's and don'ts. The advice is very comprehensive and recommends procedures which make the use of a questionnaire no easy option. Dillman argues that to obtain a useful response rate requires considerable attention to detail. It is not simply a matter of putting together a questionnaire and sending it out. In the absence of an accepted theory of mail questionnaire response, some of Dillman's detail is possibly unnecessary. However, his approach has been shown capable of consistently producing response rates above 60% in samples of the general public, and even higher in more specialised populations.

In Dillman et al (1984), an analysis is given of 11 studies using the same questionnaire and covering letter, but with differing adherence to the TDM. Dillman, concluded that the greater the adherence to the TDM, the higher the response. These findings suggested that the research should use:

- individual, one page, dated covering letter printed on headed paper;

- blue ballpoint signature added to each covering letter;

- a booklet type questionnaire with an attractive cover and no questions on the front and back covers;

- questions laid out spaciously in a vertical answer format;

- first class post on all mailouts;

- a postcard follow-up sent one week after the first mailout, with a date and signature in blue ballpoint pen;

- a second follow-up sent to all non-respondents three weeks after the initial mailout (a similar package to the original mailout, including a questionnaire);

- a third follow-up to all non-respondents, seven weeks after the initial mailout.

The next chapter discusses the development of the questionnaire, its content and its testing.

Chapter 5

QUESTIONNAIRE CONTENT

The research framework discussed in Chapter 3, identified six major variables. This chapter shows how questions on each of these variables were developed and incorporated into a questionnaire. The questionnaire is shown in Appendix 4.

IT Sophistication (Questions 3-9, 15, 16-19)

The literature search identified the following six different dimensions to the variable IT Sophistication, drawing on work by a number of authors:

* Hardware capabilities (Ein-Dor and Segev, 1981)
* Mode of Operation (Ein-Dor and Segev, 1981; Raymond, 1985; Alloway and Quillard, 1983)
* Software features (Srinivasen, 1985; Higgins and Opdebeeck, 1984; Cron and Sobol, 1983)
* Integration (Ein-Dor and Segev, 1981)
* Diffusion (Rice, 1983; Ein-Dor and Segev, 1981; Cron and Sobol, 1983; Higgins and Opdebeeck, 1984; Raymond and Magnenat-Thalmann, 1982)
* Purpose (Ein-Dor and Segev, 1981; Srinivasen, 1985; Higgins and Opdebeeck, 1984; Cron and Sobol, 1983)

Thus the variable IT Sophistication was viewed as a multi-dimensional variable with no one obvious or recognised method of measurement. Previous studies had used quite simple measures. For example Raymond (1985) used the number of administrative applications; Cron and Sobol (1983) classified users by both the number of applications and their type. The study adopted a broader approach by considering four measures: the number of sophisticated applications; the number of functional areas covered; the number of managerial applications; and an amalgamation of the dimensions hardware, mode of operation, diffusion and purpose.

Number of Sophisticated Applications (SOF)

Question 15 was used to measure the number of sophisticated applications (SOF). Applications determined as unsophisticated or sophisticated are shown below in Table 5.1 with sophisticated applications seen as more likely to support decision making.

Table 5.1: Unsophisticated/Sophisticated Applications (From Q.15)

Unsophisticated	Sophisticated
engineering analysis	stock control
NC/CNC/DNC programming	CAD - computer aided design
computer controlled equipment	job/work scheduling
invoicing/statements/sales order processing	capacity planning
purchase order processing	job estimating/quoting
wordprocessing	job costing/cost analysis
payroll	nominal ledger
	budgeting/financial planning
	mailshots to customers

Raymond's (1987a) findings suggested that this measure of sophistication, SOF, would have a very high correlation with the number of managerial applications as determined in Question 19.

Number of Functional Areas (FAA)

Applications were selected to cover six functional areas; production, design, costing, office administration, marketing and financial management. A functional areas score (FAA) was calculated by determining how many functional areas were aided by the computer. This was determined by allocating each of the application areas in questions 15 and 19 to a particular functional area. (These allocations are given in Appendix 5.) For example, if a firm only used the computer for engineering analysis (15.2) and CAD (15.3), then as both of these applications were classified under design, the FAA score would be 1, for one functional area covered.

Number of Managerial Applications (MST)

Question 19 was devised to determine how much support IT gave to managerial decision making. For each firm the total number of managerial applications (MST) was calculated.

IT Sophistication (ITSOPH)

In addition to using a measure similar to Raymond's, it was considered that a classification of at least three types would prove useful in the testing of propositions. Prior experience in researching 33 small manufacturing firms (Cragg, 1984) suggested a typology that emphasised the dimensions of IT diffusion and purpose rather than the technical features. Hence the breadth of use across the organisation was to be considered more important than, for example, whether the firm had many terminals and sophisticated software features. Raymond's (1987a) high correlations across numerous measures supported this view. Hence questions were devised to measure breadth of use across the company.

This scale was designed to measure IT sophistication so that firms could be classified by level of sophistication. The score of ITSOPH was determined by combining the results from questions 4, 6 and 16, with scores from FAA (the number of functional areas) and MST (the total number of managerial support uses, obtained from question 19).

The scoring for ITSOPH was:

Acquired for sole use (Q.4) 1; otherwise 0.
Two or more terminals (Q.6) 1; otherwise 0.
Q.16: Never or annually, 0; monthly, 1; weekly or daily, 2.
FAA: lowest tertile, 0; middle tertile, 1; upper tertile, 2.
MST: lowest tertile, 0: middle tertile, 1; upper tertile, 2.

IT Planning (Questions 10 to 14)

Malone (1985) found that adopting computers had involved organisations in a learning process. As a result the managers became more confident of being able to define their needs, an aspect which conventional MIS wisdom suggests is important for success, though notoriously difficult to achieve. As most managers of small firms were not familiar with IT, they had to gain this expertise somehow. Easton (1981) reported that most organisations (63%) did not carry out a formal feasibility study. Malone (1985) reported that some firms prepared for and planned their development extensively. Others had adopted a learning approach by deciding to see how things went. Thus the degree of IT planning was known to vary from company to company.

Conventional MIS wisdom suggests that firms should plan their investments in MIS. The research in small firms by Delone (1982), and Montazemi (1988) investigated the importance of IT planning. Delone's study included measures of the use of external support, the level of computer planning and the involvement by top managers. Montazemi included the presence of in-firm systems analysts, the level of analysis performed and the involvement of end-users.

Proposition 2 was devised to test the importance of IT planning for IT success. As well as collecting data on elements of IT planning, questions were devised to measure a firm's level of IT planning sophistication. An unplanned approach was defined as:

* unlikely to have a written statement of requirements (Q. 11)
* plans for one or two applications only (Q. 12)
* aimed at supporting only one functional area (Q. 12)
* emphasis on operational activities rather than managerial support (Q. 13).

A planned approach was defined as:

* a written statement of requirements (Q. 11)
* plans for three or more applications (Q. 12)

* aimed to support more than one functional area (Q. 12)
* aimed to satisfy both managerial and clerical needs (Q. 13)

The four questions were used to calculate a scale score for IT planning.

Question 11: written requirements, score 2; otherwise 0.
Question 12: 3 or 4 applications, score 1; 5 or more, score 2.
Question 12: 2 functional areas, score 1; 3 or more, score 2.
Question 13A: if better information most important, score 1; if provide a new product most important, score 1.
Question 13B: if to support managerial tasks most important, score 1.

IT Success (Question 20)

The MIS literature contained a number of instruments aimed at measuring MIS/DSS success. However they were considered to have the following weaknesses in relation to this research.

(i) Existing instruments were designed to evaluate computer based information systems, typically MIS and DSS. Some applications of IT in small firms, eg. dedicated word-processing and computer aided manufacturing, have no intended information benefits. Hence existing measures would be inappropriate in these circumstances.

(ii) The measures were developed for large firms, so parts of some instruments are not applicable to small firms. An example is the rating of EDP performance; most small firms have no such functional specialisation.

(iii) Many existing instruments made either little, or no, attempt to measure changes in organisational effectiveness. This is despite the fact that MIS Success is often used as a surrogate measure of changes in

> organisational effectiveness. Instead the measures concentrated on information satisfaction.

Therefore, existing MIS/DSS Success instruments were considered inappropriate for this research. However, some parts of them proved helpful in devising an instrument to measure IT success.

The rejection of existing measures suggested that any measure of IT Success should reflect objectives for the implementation. The literature located the following typical reasons for computerisation:

> Save time, make things easier, provide better information, reduce costs, increase sales, greater accuracy, expansion of the business, aid planning, help cope with workload, replace alternative system, solve a specific problem, improve customer relations, educational, promotional and external pressure. (Cragg, 1984; Suter, 1985; Wigley and Stewart-Smith, 1985; Easton, 1981).

As IT was usually acquired for a mixture of reasons, and the research required a broad measure of organisational effectiveness, IT success was measured using Likert statements.

Many statements were prepared. Finally, 10 were selected to cover a broad range of impacts. Six were phrased positively and four negatively. Each statement was scored from 1 to 5, with the total positive and negative scores being combined to give a final score for IT success.

Owner Characteristics (Questions 25 to 30)

Many studies in large organisations have shown that individuals in organisations are important to MIS success. Having top managerial support is one important factor. In small firms, Delone (1982) found that Chief Executive knowledge of computers and their involvement with computers (both correlated) were

directly associated with MIS success. In addition, much of the literature on small firms shows how important the owner is to the organisational culture. Hence, data about the owner was crucial. Question 14 on their involvement with computers was based on Martin (1985).

Questions 25 to 28 on their role in the firm were based on Scase and Goffee's (1982) analysis which identified different types of firm. Their four types being the "self employed" who employ no labour, "small employers" who work alongside their employees, "owner controllers" who administer/manage the business, and "owner directors" who do not perform supervisory functions. Chell (1985) and d'Amboise and Muldowney (1988) provide good reviews of the many typologies. The Scase and Goffee (1982) typology was selected as it seemed particularly relevant to the use of information technology, with the owner controller type of managers being expected to have a greater opportunity to use a computer.

The work by Boswell (1973) and Milne and Thompson (1984) showed the need for data on the age of the owner. Owner's age seemed particularly relevant to the study as it was expected that many older owners would have had no prior experience with computers. Finally, Question 30 was used to collect data on owner's motivations. This was based on Boswell (1973), Chell (1985), Milne and Thompson (1984), and Stanworth and Curran (1973) and attempted to determine whether owners wanted growth, job satisfaction or money. Previous research suggested job satisfaction would prove to be a major motivator rather than firm growth or money. Again, this was envisaged to affect their attitudes to IT. Cragg (1984) found that computers had facilitated growth.

Organisational Characteristics (Questions 31 to 42)

Three of these questions (Q. 35, 40 and 42) were used to determine the eligibility of respondents in terms of being

independent, with less than 50 employees, and an engineering firm.

Variables from other studies on small firm performance were included mainly as control variables but also for verification purposes. Planning activities (Q. 32 and 33), were based on Ackelsberg (1985), Bracker (1982), Foley (1985) and Robinson (1986b). These questions related to the existence of a written business plan, and the number of written monthly forecasts. These were expected to be positively correlated with performance and also the size of the firm. Marketing activities (Q. 31 and 39) were based on Foley (1985), where firms with new products and with more marketing/sales staff had performed well. Though there is no consensus from the many growth models of small firms, firm type and age questions (Q. 34, 36 and 37) were based on Chell (1985), Scase and Goffee (1982) and Stanworth and Curran (1973).

Financial Performance (Questions 43 to 47)

The literature review revealed that many performance measures had been used in studies of small firm financial performance. Cron and Sobol (1983) used four separate measures including return on assets, profit return on assets and on sales, and sales growth. Bracker (1982) used three measures: sales growth, owner's compensation and labour cost ratio. Dollinger (1984) formed a scale from ten different measures. The above studies, as well as others, showed that it was possible to collect data on financial performance. A more recent approach, which has so far produced ambiguous findings, is to request subjective evaluations from owners of the firm's financial performance. Dess and Robinson (1984) found high correlations between actual and perceived performance, but Sapienza et al (1988) failed to replicate such a potentially useful result.

Robinson (1983) provided a critical look at how small firm effectiveness should be measured. He found that return on sales and growth in sales were the two most popular measures used in

the literature. Robinson argued that these measures did in fact act as good surrogates for four separate, but interdependent views of effectiveness. These views were that of community involvement, customer satisfaction, owner return and employee satisfaction, based on Friedlander and Pickle (1968).

Sales growth and return on sales were thus adopted as the measures of financial performance for this study. As many firms may have only computerised recently, sales growth was collected for one year and for five years. The measures used were: sales revenue change 1984 to 1985, and 1980 to 1985; profit as a percentage of sales revenue for 1985; and whether net profit before tax decreased, remained the same, or increased from 1984 to 1985. The questions requested percentage responses where possible, partly to encourage the response rate, but also to avoid performance measures being related to the size of the firm.

Pilot Study

As suggested by Dillman (1978), the questionnaire was pre-tested by three different groups: colleagues, potential users of the data, and small engineering firms. In all, 15 sets of most useful feedback were obtained. As a result, the questionnaire was considerably revised before a pilot questionnaire was sent to 41 small engineering firms throughout the region. This was followed by a thank you/reminder letter one week later. A further two weeks later, 12 of the non-respondents were telephoned as a reminder.

An analysis of the 41 pilot firms is given in Table 5.2, showing many questionnaires were not returned and that some had been sent to ineligible firms.

Table 5.2: Types of response from the 41 Pilot Firms

Response	Number	%
Too large	1	
Ceased trading	1	
Gone away	1	
Wrong industry	1	
Not received	1	
Questionnaire returned	15	37
No Response	21	51
Total	41	

The return rate of 37% was considered sufficiently high to continue with a mailed questionnaire, especially as only 12 non-respondents had received a second reminder.

Pilot Study Analysis

The responses were analysed in relation to the time they were received. Table 5.3 shows that all three approaches proved useful in obtaining responses.

Table 5.3: Pilot responses from the three approaches

	Approach	Responses
1.	Initial mailing	6 (from 41 sent)
2.	Reminder letter	10 (from 37 sent)
3.	Telephone reminder	4 (from 12 calls)

The importance of personalisation was also investigated. Table 5.4 shows that more responses were obtained where the questionnaire was sent to a named individual rather than simply addressed to the "Managing Director".

Table 5.4: Responses by degree of personalisation (for all firms that did not receive a telephone reminder)

Addressed to	Returned	Other Response	No Response	Total
Named individual	8	2	4	14
"Managing Director"	3	1	11	15

The data in Table 5.4 suggested that personalisation was important in obtaining a response. It was also considered possible that the results were due to other factors. For example, the majority of firms for which a named individual was known were in Leicestershire. It was possible that the higher response was more a reflection of local affiliations rather than due to personalisation. However, the possibility of personalisation being of great importance could not be ignored, thus greater efforts were made to obtain details of named contacts.

The pilot study also provided feedback on the questionnaire itself. In particular the response rates to the financial performance questions were about 50% while other questions were answered by all respondents. To encourage an improved response on these vital questions, the financial performance questions were considerably simplified.

Other questions were found to be in need of revision. In particular the questions with 'NO/YES' outcomes provided inconsistent responses, possibly due to poor wording, or tiredness. These questions were revised to replace the 'NO/YES' choices with descriptive choices. Some other simplifications were made to hopefully encourage a higher response.

Conclusions from the pilot study

1. A mail questionnaire survey was feasible in that a response rate of 40 to 50% could be achieved, but not without at least two reminders.

2. Personalised requests should be sent where possible.

3. Revisions to the pilot questionnaire were necessary, particularly to the financial performance questions and those with 'NO/YES' outcomes. (The final questionnaire is given in Appendix 4.)

Chapter 6

DIFFICULTIES IN USING DILLMAN'S TDM

This chapter discusses the difficulties that were encountered in trying to adopt Dillman's TDM for the study. It analyses the responses and offers advice to researchers considering using a mail questionnaire.

Responses

1167 supposedly small engineering firms were sent questionnaires in April and May 1986. Responses, including refusals, ineligible and eligible returns were received from 578 firms (50%). 360 usable returns were received, giving a usable response rate of 31%. Data on responses by type is given below in Table 6.1.

Table 6.1: Types of response to the main survey

Types of Response	Number		(%)
Usable Returns			
Fully usable returns	289		(25)
Firm established since 1983	27		(2)
Not completed by owner-manager or M.D.	44		(4)
Total Usable returns	360		(31)
Non-Usable Returns			
Refusals/incomplete	25		(2)
Ceased trading/gone away	44		(4)
Non-engineering	69		(6)
Subsidiary	38		(3)
Too large	42		(4)
Total Non-Usable returns	218		(19)
Total responses		578	(50)
Non Responses		589	(50)
Total Questionnaires sent		1167	

Difficulties in Using the TDM

Dillman's TDM was found to be very difficult to implement in full. In particular, three areas of difficulty arose: personalisation, typing of envelopes, and reminder procedures. In addition, a number of other adaptions to the method were made.

Personalisation

Dillman (1978) advises that both the envelope and cover letter should contain the name and address of the intended recipient. The advice comes from conducting social surveys of the general population, and is very dependent, as with all surveys, on a detailed comprehensive and up-to-date sampling frame. However, such a sampling frame did not exist, though directories and other sources were used to create a list of firms in the region. It proved more difficult to obtain the owner's name, as only some sources gave the owner/managing director by name. As a result the survey could not be fully personalised, and many envelopes and letters were addressed to the "Managing Director". The response rate to the less personalised approach is discussed later.

Typed Envelopes and Letters

The TDM recommends that the "package" that a recipient receives should seem like a "business letter", and thus be worthy of attention. Hence Dillman (1978) argues that the address should be typed on to a typical business envelope; self-adhesive labels are to be avoided. For this study, no easy alternative to typing 1200 envelopes was found. With a database of names and addresses already on a computer it seemed expensive to type each envelope. No local printing business was found that had the necessary attachments to automatically feed and print on to envelopes. Direct mail companies with such facilities were located, but tended to consider minimum runs of 4000. Hence, the study used the simple alternative of labels, utilising the "labels" routine within dBASE III. The survey failed to use typed envelopes, justifying the use of labels on practical grounds, and on the assumption that many recipients would have their mail opened for them, and thus not even see the envelope.

Reminder Procedures

The TDM advised the use of three reminders. The first reminder, after one week, was designed mainly as a very gentle prod, but also served as a thank you to those who had already responded. The second reminder, after a further 2 weeks, was a similar package to the initial mailing, including another questionnaire, a return envelope and an amended cover letter. The TDM recommended that a third reminder be sent by registered mail to all non-respondents after a further 4 weeks. The use of registered mail being to emphasise the importance of both the survey and the recipient.

For this study, no third reminder was sent, partly because a good response had already been achieved, but mainly because the researcher did not wish to harm the relationship between researchers and organisations. It was obvious from the initial responses that some respondents found the questionnaire an imposition. This was communicated by a small number of respondents by telephone or by letter, or more typically, though comments on the questionnaire. However, following the second reminder, an even larger number of disgruntled comments were received; these far outnumbered the few managers who offered further assistance. As over 500 replies had been received, it seemed unwise to risk being viewed as an annoyance and therefore possibly harming the relationship between researchers and small firms. The disadvantages for the study was that nothing had been heard from about 50% of the listed firms, raising questions as to bias. In order to find out a little of this unknown 50%, a small and brief telephone survey was conducted, mainly checking the eligibility of non-respondents. As the telephone survey was very small and did not require the co-operation of an owner of the firm, the researcher viewed it as unlikely to cause offence. Though some telephone respondents knew of the survey, the cordiality of the brief conversations suggested that the researcher had not been considered a nuisance.

Other necessary adaptions

The researcher was able to follow in spirit most of Dillman's other recommendations though some minor details were not followed precisely. One example being the size of the stationery used. Dillman advises on the use of monarch sized paper rather than A4. The reason for such a size was to keep within the U.S.A.'s one ounce weight limit for cheaper postal delivery. As the equivalent limit is two ounces in the UK, no stringent controls were needed on weight. However, the advice on using a typical business envelope was followed, thus requiring folding of the booklet type questionnaire. Dillman's advice on using lower than typical weight paper made it considerably easier to fold and insert the questionnaires. A small second batch of questionnaires was printed using standard weighted paper, and these questionnaires proved difficult to fold despite being only three sheets of paper.

Resources Required For A Mail Survey

Dillman's recommendations on using a detailed personalised approach makes the survey very labour intensive. Surprisingly, Dillman seems to have used the approach on surveys of thousands, rather than hundreds, of possible respondents. As a result, the university where he is based has established a survey centre to handle these large surveys. In the absence of such a centre, this section discusses the resources needed to utilise Dillman's personalised approach.

Money helps: The computer survey was supported by a research grant of which about £2,500 was spent conducting the study. Without such funding it would have been hard to justify certain items of expenditure. First class postage was used for all mailings, including the Freepost returns. Dillman argues that the use of first class post reflects the great importance of the study. In addition, it would have been hard to justify the acquisition of company names and addresses from the British

Telecom Yellow Pages. [For a supposedly up to date, computerised list the data seemed just as inaccurate as other directories of small firms. Complete lists are not available for many reasons, but County Council Directories were found to be the most cost-effective means of compiling a sampling frame.]

The research grant enabled the researcher to employ part-time clerical assistance, utilised mainly to:

* computerise the name and address database

* type occasional letters in response to requests from respondents

* assist with the large task at each mailout, involving folding, checking, labelling, inserting and sealing (though self-seal envelopes were used for greater convenience). Once all resources were gathered together, a mailout of 1150 questionnaires required about 60 hours work.

Use of computers

Micro-computers were used to create and update a name and address database, as well as print the labels and standard cover letters. Here, dBASE 3 was found to be excellent at handling the major task of managing the database. Its features and its ease of use made the task quite simple. An indexed database of 1150 records just about filled one 360K floppy disk; hence it was useful to have an IBM PCXT available to store some files temporarily. Each record consisted of the fields; owner, company, address (four fields), telephone, source ID and a response ID. As the database was being used for research purposes only, it was considered not necessary to register it under the Data Protection Act.

The database was used for three major purposes: to print labels for mailings, to create a file to mail-merge the cover letters (on a laser printer with form feed for fast printing), and to

produce printouts to help control mailings and record responses to later amend the database.

Printing costs were another major expense. Along with postage and clerical help, the research funds were easily consumed. Thus the time spent searching and applying for research funds was a good investment.

Planning and Organisation

Implementing the TDM requires careful planning. For each mailing, resources like envelopes, questionnaires and cover letters must be available. The cover letter should carry the date of the mailing. (Dillman advises posting early in the week in the hope of avoiding the questionnaire being lost and forgotten over the weekend.) Thus printing requirements have to be determined well in advance and deadlines met. This involves a few forecasts with respect to the likely response rate. The system also requires a certain amount of continued monitoring of responses so that only non-respondents receive follow-up mailings. In order to check for possible response biases through time, all incoming questionnaires need to be dated. In addition queries, particularly by telephone, will need to be answered. Hence, the days between mailouts are far from idle.

Is The TDM Worth It?

Dillman's TDM contained many pieces of sound advice. The sections on questionnaire design, testing the questionnaire, and the discussion of the content of the cover letter contained excellent advice for the novice researcher. Whether the approach in full is worth following is debatable as no experiment has been conducted which could test every aspect of the TDM.

The approach did obtain a useful response rate of about 50%. However, similar response rates had been achieved by other small business researchers who had not used the TDM in full. For

example, Delone (1983) used a very crowded questionnaire layout and obtained a response rate of 49%. Dillman would no doubt argue that use of a very crowded questionnaire is likely to have resulted in a greater number of completion errors and omissions.

The importance of personalisation?

The research study was not intended to be a test of the TDM. However, the pilot study seemed to confirm the importance of personalisation. As a result, great efforts were made to obtain details of named contacts. For some firms, no named contact was available and as a result many letters were sent to the "Managing Director". An analysis by degree of personalisation is given in Table 6.2 below, showing that a slightly higher percentage of named owners gave useful responses (31% cf 28%), but overall, the less personal approach gained a higher response (54% cf 48%).

Table 6.2: Response by degree of personalisation

Addressed to	Usable Returns Number	(%)	Ineligible Returns* Number	(%)	Other Returns* Number	(%)	No Response Number	(%)	Total
"Managing Director"	105	(28)	76	(20)	19	(5)	172	(46)	372
Named owner/ Manager	250	(31)	73	(9)	50	(7)	417	(52)	795
	355**	(30)	149	(13)	69	(6)	589	(51)	1167

Notes

* Ineligible returns comprised firms which were too large for the survey, subsidiaries and non-engineering firms. Other returns comprised refusals, incomplete return, ceased trading and gone away.

** The total of 355 is 5 lower than the actual total response because 5 returns were anonymous.

Using χ^2, the differences in response rates are significant at the .1% level. However, the less personalised approach obtained the greatest response, suggesting that the search for the names

of owner-managers was not rewarded. The χ^2 difference is primarily due to the differing responses for ineligible returns, possibly reflecting quality differences in the sources of company information, which varied in the level of detail, and by compilation date. Another variable could be the proximity of the firms to the university conducting the research, with response reducing with distance. The study was not designed as a controlled test of the TDM, but the data failed to support the need for a fully personalised approach.

Rather than advise fellow researchers to implement the TDM in full, the above experiences suggest that the TDM has many merits. The work by Dillman et al (1984) suggests that the greater the adherence to the TDM, the greater the response. However, this conclusion was partially based on a rather arbitrary scoring system.

The importance of reminders?

One of Dillman's conclusions which is strongly supported by the data is that the number of reminders is important. Dillman estimates that each mailing achieves a similar response, of about 20%. Hence, the more reminders, the greater the response in total.

A breakdown of the returns for this study is given in Table 6.3. Of the total response, 40% were received within the first week. The second reminder, sent out on the Monday of week 4, made a significant contribution to the total response as returns had dwindled by week 3, but picked up considerably in week 4. A third reminder, as advised by Dillman, would have no doubt produced an even greater response.

With respect to the "quality" of response, Table 6.3 gives a breakdown and shows again how important the second reminder was in producing not just responses, but a large number of usable responses, i.e. responses from firms within the study's focus.

Table 6.3: Types of Response by Week

Week	Event	Usable Returns	Ineligible Returns	Other Returns	Total	%
1	Initial mailing	148	55	27	229	40
2	Thank you/reminder	70	24	17	111	19
3		19	9	2	30	5
4	Second reminder	99	47	16	163	28
5		13	9	6	28	5
6 onwards		11	5	1	17	3
Total		360	149	69	578	100

Therefore, the results of the computer study give support to Dillman's TDM in that the mailing process was important in obtaining good response rates.

Conclusions

The study attempted to use Dillman's Total Design Method (TDM) in carrying out a mail questionnaire survey of small engineering firms in the East Midlands region of England. The TDM could not be used in full, particularly with regards to the degree of personalisation and a third reminder. However, many other aspects of the TDM were followed and a total response of 50% was obtained. The usable response rate was 30%, mainly due to many responding firms being too large or subsidiaries, rather than through refusals and ceased trading. An analysis of the responses showed that the use of a second reminder significantly affected the response, while full personalisation did not. As a result, it is recommended that other researchers adapt and use Dillman's TDM when using either mail or telephone questionnaires.

Chapter 7

THE SAMPLE

This chapter discusses the descriptive findings of the questionnaire study. Fuller details are provided in Appendix 6, where summarised responses to specific questions are given.

The Responding Firms

A wide range of products was made and marketed by the companies within the study. As expected, many of the firms were in the mechanical engineering sector (64%). Electrical engineering firms represented 14%, and transport parts manufacturers 9%. 13% manufactured other types of metal goods.

It was possible to make a somewhat limited, validatory comparison with published statistics available for small engineering firms in the East Midlands. The VAT return data provided information on firms that volunteer to submit a return, and for all firms with a turnover (in 1983/84) in excess of £18,000. Business Monitor (1986) reported the number of local units, but as it does not use 50 employees as a classification point, 100 employees was used instead for comparison purposes.

Table 7.1: Number of responding firms by SIC, compared with 1983/4 VAT returns for the East Midlands

Industry Sector	Firms in Study		VAT Returns (East Midlands)	
	Number	(%)	Number	(%)
Mechanical Engineering (SIC=32)	184	(64)	1954	(49)
Electrical Engineering (SIC=34)	40	(14)	581	(15)
Vehicle Parts (SIC=35,36)	27	(9)	297	(7)
Other (SIC=31,33,37)	38	(13)	1131	(29)
Total:	289		3963	

Note 1: Source - Business Monitor 310, 1985, Size Analysis of UK Businesses, HMSO, 1986.

The data in Table 7.1 shows that, as expected, mechanical engineering firms were the most common. However, the survey firms seem to have relatively too many mechanical engineering firms and too few "others". SIC 31 dominates this "others" group, and itself covers a wide variety of goods. Rather than the questionnaire study failing to reach these firms, it is suspected that coding errors were more likely. For example, many respondents, rather than give their product, reported themselves to be precision engineers. All precision engineers were classified as SIC=32. In retrospect, many of these could have made products which should have been classified as SIC=31. For example, hand tools, bolts, nuts and springs.

Firm Size

Table 7.2 shows the distribution by number of employees.

Table 7.2: Size of firms, by number of employees

Number of employees	Study Firms Number	(%)	VAT Returns (East Midlands) Number	(%)
1-5	74	(26))	2741	(69)
6-10	68	(24))		
11-19	72	(25)	571	(14)
20-49	75	(26)	651	(16)
Total	289		3963	

As mentioned earlier, the Business Monitor data does not use 50 employees as a classification point. It does provide a breakdown by: 1-9 employees; 10-19; and 20-99. This data is given in Table 7.2 for comparative purposes, as it is the best available. This comparison suggests that very small firms should have been in the majority (69%). Instead they comprised 50%.

One point should be made before being too critical of the survey's ability to report findings from a representative sample

of the firms in the East Midlands. The Business Monitor data is for "local units" not "legal units". Many small firms will be both a legal unit and a local unit. However, larger firms could have many separate sites, thus many local units, but all being part of one legal unit. This may help explain why over 3000 units were reported to exist in Business Monitor, when the study could find less than 1200. The Business Monitor data included sites for large organisations, all of which were clearly outside the scope of this study. Therefore, it should be recognised that the Business Monitor data is really just the best available for comparison purposes.

Year Established

A small number of the firms were formed in the nineteenth century. Others were very young, so the sampling frame managed to reach firms of all ages. The distribution of firm age is given below in Table 7.3. The median was 1970.

Table 7.3: Age of firms, given by year established

Year established	Number	(%)
Before 1940	27	(9)
1940s	21	(7)
1950s	23	(7)
1960s	62	(21)
1970s	107	(37)
1980s	49	(17)
Total:	289	

The Owner Managers

The median age was 46 years. As with the age of the firm, a wide range of ages of owners was covered. Table 7.4 below gives the distribution, by year of birth.

Table 7.4: Age of Owner, given by year of birth

Year of Birth	Number	(%)
Before 1930	50	(17)
1930s	86	(30)
1940s	105	(36)
1950s	29	(10)
1960s	3	(1)
Not given	16	(6)
Total:	289	

As expected, many owners (69%) rated job satisfaction above firm growth and money as motivators. Firm growth was rated least important by 68% of the owners.

Financial Performance

As expected, the distribution of financial performance was skewed, with many firms reporting losses, and some others performing well.

Table 7.5: Financial Performance for all firms

Performance Variable	Lower Quartile	Median	Upper Quartile
Sales Revenue 1985/1984	5%	15%	27%
Sales Revenue 1985/1980	10%	45%	110%
Net Return 1985	4%	10%	15%

Difference by Types of Firm

As the firms produced a wide range of products, certain types of firm were therefore expected to report better results. Hence, firms were identified by Standard Industrial Classification (SIC). The major groupings are compared below in Table 7.6 where median values are given for a range of variables. The major differences between the groups were: the electrical and transport engineering firms tended to be younger and smaller.

The electrical engineering firms had performed particularly well both recently and since 1980 compared to the growth for the other firms. Not surprisingly, a greater percentage of electrical engineering firms used a computer.

Table 7.6: Types of Firm (by SIC) compared for a range of variables (medians, unless otherwise stated)

Variable	Mechanical Engineering	Electrical Engineering	Transport	Other	All Firms
Number of firms	184	40	27	38	289
Owners Year of Birth	1938	1942	1942	1941	1940
Year firm established	1968	1979	1976	1966	1970
Number of employees	11-19	6-10	6-10	11-19	11-19
% using a computer	39%	55%	41%	42%	42%
Sales revenue 85/84	12%	20%	15.5%	12%	15%
Sales revenue 85/80	42%	200%	40%	32.5%	45%
Net return 1985	10%	10%	7%	10%	10%

Non-Respondents

Telephone interviews were conducted with a random sample of 30 non-respondents to see if the questionnaire had failed to provide a representative sample. The interviews were kept deliberately brief to avoid being viewed a nuisance. As the questionnaire was clearly about computerisation, it was suspected that firms without a computer, and with no interest in computers, would have ignored the requests. And as prior research had shown firm size and computer ownership to be correlated, the survey of non-respondents was interested in this variable. In addition, as many ineligible firms had been included on the mailing list, firms were also asked whether they were an engineering firm. Thus the telephone interviews were based on three questions, computer ownership, size and eligibility.

Nine firms (30%) were found to be ineligible for one reason or another. [Five were not engineering firms, one a subsidiary, two had over 50 employees and one had gone away.] Of the eligible

firms, fourteen (67%) of the eligible firms were very small firms, that is, up to ten employees. This tends to confirm the earlier finding from the Business Monitor data, that very small firms at only 50% of the respondents, were under-represented.

Five of the eligible firms reported having a computer. Some others were considering computerisation. Hence it would be wrong to suggest that non-respondents were uninterested in the study topic. However, many did indicate that their lack of response was, in part, due to the nature of the topic, i.e. computerisation. Some comments were:

"could not afford one"
"not interested in computerising"
"firm too small"
"one man business" (twice)
"don't need one"
"too old for a computer"
"too busy to computerise".

Two further comments were of interest:
"policy not to answer"
"can't recall receiving anything".

Computer Users

Most firms had acquired a computer for their company's sole use, rather than to share with another firm. About half had acquired their first computer during the last 3 years, typically for less than £10,000. Partly because some had had a computer for over 5 years, over one-third of the computer users had either considerably upgraded or totally replaced their original system. Most owners had had no prior computer experience, for example with another firm, before acquiring their first computer.

As expected, administrative/accounting applications dominated the usage. 75% of firms were using their computer to help with sales

order processing, and over half were using it for payroll and nominal ledger. The usage shown in Table 7.7 reflects common perceptions of where computers can be used, and also where good, reliable, affordable software is available. The data also shows that there are few firms where the computer is used to support all aspects of the business. Areas of considerable neglect are design and production planning and control.

Table 7.7: Current uses for a computer

Application Area	Percentage of those firms with a computer
Sales processing	73%
Payroll	66%
Nominal ledger	61%
Wordprocessing	52%
Purchase processing	46%
Stock control	36%
Budgeting	34%
Costing	30%
Mailshots	28%
Estimating	23%
NC programming	17%
Production planning	15%
Controlling equipment	10%
Capacity planning	8%
CAD	8%
Engineering analysis	7%

The usage seems typical of both small and large firms and stems partly from managers' aims for computers. Very few firms had acquired their computer to provide a new product or service. Saving time had been a major aim, particularly in the area of clerical tasks. However, over one-third of the firms had seen the provision of information as a major aim, predominantly to support managerial tasks.

Most firms had a manager using the computer at least once a month. In some firms, as many as four managers were using the computer regularly. Typical managerial uses are shown in Table 7.8 below, reflecting the data made available from the sales and accounting systems discussed earlier.

Table 7.8: Managing Director's use of the Computer

Application Area	Percentage of those managing directors who used a computer
Assess financial performance	44%
Cost control	19%
Wordprocessing	18%
Sales order processing	18%
CAD and engineering analysis	16%
Programming	15%
Sales Analysis	10%
Production planning and control	10%
Financial planning	8%
Payroll	7%
Purchasing	7%
NC programming	5%

A significant finding from the survey was that for about 80% of the firms, the managing director/owner manager was either closely or highly involved in the process of computerisation, involving defining needs, selecting a system, implementation and on-going problems. Computerisation had been seen as too important to not be involved. Most of these managing directors were regular computer users themselves, particularly for assessing financial performance.

Benefits

Most users felt their computer systems had been worth it. For example:

79% felt it had been well worth its cost

58% felt it had significantly improved organisation effectiveness

50% felt it had improved decision making

39% felt it had significantly improved customer service

35% felt it had helped the firm increase sales

33% felt it had helped provide new services or products
20% felt they had achieved fewer benefits than expected

The above statements refer to the benefits of computerisation. However, the process of computerisation was not as easy as some television advertisements make it out to be. Results from the survey to support this view are:

31% felt it had failed to meet some of their requirements
21% felt it had created many problems
5% felt it had been a failure

Some firms have had bad experiences with computerisation. However, by far the majority recommend computerisation as being very good value for money.

IT Sophistication

The discussion in Chapter 5 suggested four different measures of IT Sophistication:
SOF the number of sophisticated applications
FAA the number of functional areas served
MST the number of managerial applications
ITSOPH a scale reflecting technology and use as well as FAA and MST

The firms showed differing levels of sophistication. Data is given in Table 7.9 for all four measures, as well as UNS, the number of unsophisticated applications. This data is shown for only those firms that had a computer prior to 1984. Therefore, the firms had had time to develop their information technology.

Table 7.9: Median and Range data for the measures of IT Sophistication (n=85, i.e. those eligible firms with a computer prior to 1984)

Variables	Lowest value	Median	Highest value
SOF - number of sophisticated applications	0	2	8
FAA - number of functional areas served	1	4	6
MST - number of managerial applications	0	3	9
ITSOPH - scale reflecting technology, use, FAA and MST	0	5	8
UNS - number of unsophisticated applications	0	3	6

The evidence by Raymond (1987a) suggested these measures of IT Sophistication would be highly correlated, both with themselves and with other measures of IT activity. Table 7.10 reports Kendall rank correlation coefficients for the IT Sophistication variables and other variables which could reflect IT Sophistication. The coefficients are very high between the measures of IT Sophistication. They are significantly high with UNS (the number of unsophisticated applications) showing that firms tend to develop both areas together rather than one at the expense of the other. The data supports Raymond's findings.

Table 7.10: Kendall Rank Correlations for measures of IT Sophistication and other IT variables (n=85)

Variables		Expected relationship with IT sophistication	With variable 1	2	3	4	5	6	7	8
Number of sophisticated applications	1	+	1.00							
Number of functional areas supported	2	+	.61	1.00						
Number of managerial uses	3	+	.56	.58	1.00					
ITSOPH	4	+	.52	.69	.60	1.00				
Number of unsophisticated applications	5	-	.15	.37	.28	.28	1.00			
Acquired for sole use	6	+	.06	.16	.02	.31	.08	1.00		
Number of terminals	7	+	.34	.36	.30	.47	.28	.23	1.00	
Owner's frequency of use	8	+	.12	.19	.18	.51	.14	.30	.22	1.00
IT success	9	+	.29	.14	.24	.20	.06	.04	.13	.15

Note: A correlation coefficient of 0.24 or greater is significant at the 0.01 level. The critical value at the 0.05 level is 0.18.

Two other sets of results in Table 7.10 are worth further comments. The owner's frequency of use of the computer was only marginally significant. (The 0.51 with ITSOPH should be interpreted with caution as the scale ITSOPH includes the variable owner's use.) The final row shows statistically significant correlations between IT Sophistication and IT Success. This relationship is discussed later in Chapter 13.

Chapter 8

CORRELATION AND REGRESSION ANALYSIS

The major research proposition linked many variables with small firm success. This chapter shows how these variables were tested as success factors using correlation and regression analysis.

Correlation Analysis

The first stage in testing the success factors was to calculate correlation coefficients between all the independent variables with the four measures of financial performance. This was expected to reveal many statistically significant correlations, as well as provide further descriptive data prior to regression analysis.

In order to keep the sample size as large as possible, firms from all four SIC groups were analysed together. As the performance data had already been noted to vary between SIC groups, the data was normalised for each SIC. This involved using logarithms to remove the skewness, and then transforming each set of data to have a mean of zero and standard deviation of 1. Furthermore, as many of the independent variables were measured on an ordinal scale, rank rather than product moment correlations were calculated.

Table 8.1 shows Kendall rank correlation coefficients for all the major variables with each of the four measures of performance. Of the 22 variables, 15 gave significant correlations. However, ten of these were with only one performance variable. The first column of Table 8.1 shows the direction of the expected relationship based on the prior research discussed earlier. The results from this study gave no statistically significant support for seven of the expected relationships. In addition, five significant results were in the opposite direction to that expected.

Table 8.1: Organisational Characteristics and Financial Performance: Kendall Rank Correlation Coefficients - For All Firms (n=289)[1]

Expected Direction of Relationship		Sales Change 1985/84	Net Profit Change 1985/84	Net Return 1985	Sales Change 1985/80
	Information Technology				
+	Presence of a computer	.08	.04	-.05	.11*
+	Number of sophisticated applications (SOF)	.01	-.03	.11*	.04
+	IT success	.08*	.03	.04	.11*
	Planning				
+	Written business plan	.03	-.09*	-.11*	-.12*
+	Monthly sales forecasts	.10*	-.08	-.01	.08
+	Monthly bad debts forecasts	.01	-.02	-.02	-.05
+	Monthly profit forecasts	.01	-.05	-.02	-.06
+	Monthly cashflow forecasts	.06	-.01	-.05	.04
+	Monthly material requirement forecasts	.03	.03	-.01	-.03
-	No monthly forecasts	-.11*	.03	.00	-.03
	Type of Firm				
	Limited company	-.04	-.02	-.20***	.06
	Year firm established[2]	.13**	.06	.12**	.20***
	Number of managers	.07	.05	-.13**	.09*
+	Number of marketing/sales staff	-.08*	-.05	.05	-.03
	Number of employees	.05	.06	-.10*	.08
	Sales Revenue (1985)	.01	.08	-.15*	.09
+	New products	.06	.02	.04	.01
	Owner/Manager Characteristics				
-	Works at desk or machinery	.01	-.02	.21***	-.09
+	Year of birth[2]	.15***	.05	.12**	.25***
+	Wants firm to grow	.08	.07	-.05	.05
-	Seeks job satisfaction	-.05	.01	.04	-.04
+	Wants to earn money	-.05	-.09*	.01	-.03

* Significant at 5%
** Significant at 1%
*** Significant at .1%

Notes: (1) Sample sizes varied from 192 to 273 depending on missing data.
(2) For the "Year of birth" variable a high value (e.g. born 1965) is indicative of a young owner, hence the expected +ve correlation. Similarly, high values for the variable "Year firm established" indicate a young firm.

In this initial test of the major research proposition, the number of IT variables included in the analysis was restricted to three as only 120 (42%) of the firms had a computer. Therefore, compared with the other variables, most firms had zero scores for the IT variables.

Two of the three information technology variables gave at least one positive, significant correlation. However, the measure of IT Sophistication had only one significant correlation, and that was negative. Similarly, the results gave little support to the importance of planning activities, with only two positive, significant correlations.

A somewhat perplexing result was gained with the owner/manager variable "works at desk or machinery". Based on Scase and Goffee (1982) it was expected that those managers that tended to work mainly at their desk would outperform those who spent much of their time working with machinery and thus paying less attention to some managerial duties. A strong opposite relationship occurred for one year net return. Further analysis of the data suggested that young owner/managers were managing effectively while still working with machinery, while the best performing older owner/managers had less contact with machinery.

Two variables which stand out as important in Table 8.1 relate to age. The variables are the age of the firm (i.e. the year in which the firm was established) and the age of the owner/manager (i.e. year of birth). The two variables were both significantly correlated to the same three measures of performance. The data suggests that younger firms and younger owners perform better than older firms and older owners. The results give strong support to the earlier findings of Foley (1985) and Miller and Toulouse (1986a). Boswell (1973) found evidence of many poorly performing old managers in old firms. However, Milne and Thompson (1984) found older managers <u>outperforming</u> their supposedly less experienced younger counterparts, but this was in start-up firms.

To analyse the situation further, each of the two age variables was split into three groups, giving upper, middle and lower tertiles. The middle tertiles were ignored, thus providing data on Old and Young firms, and Old and Young owners. The four performance variables were treated similarly, but by SIC, to separate the High performers for each variable. This analysis provided data of the form shown in Table 8.2, where 26% of firms run by older owners were high performers for one year sales growth. For firms run by younger owners, the percentage of high performers was 49. The data in Table 8.2 shows that young owners outperformed older owners for three of the four measures of performance.

Table 8.2: Percentage High Performing Firms by Age of Owner

	One Year Sales Growth	Five Year Sales Growth	Profit Change	Net Return
Old owners	26% (of 82)	19% (of 68)	57% (of 88)	21% (of 66)
Young owners	49% (of 73)	53% (of 55)	60% (of 84)	47% (of 64)

A similar analysis, but by age of firm, is shown in Table 8.3, where young firms performed better than old firms for three of the four measures of performance.

Table 8.3: Percentage High Performing Firms by Age of Firm

	One Year Sales Growth	Five Year Sales Growth	Profit Change	Net Return
Old firms	27% (of 86)	19% (of 78)	62% (of 93)	29% (of 75)
Young firms	51% (of 84)	53% (of 55)	63% (of 93)	43% (of 75)

Thus the two variables of owner's age and firm age have been shown to be clearly correlated with financial performance. These relationships were explored further. Taking initially all the older firms, the data in Table 8.4 shows that even when the age

of the firm is controlled, younger owners outperform older owners. [50 c.f. 21; 44 c.f. 13; 68 c.f. 60; 47 c.f. 18.] Among younger firms, younger owners again outperformed older owners. The data is given in Table 8.5.

Table 8.4: Old Firms Only - Percentage High Performers by Age of Owner

	One Year Sales Growth	Five Year Sales Growth	Profit Change	Net Return
Old owners	21% (of 44)	13% (of 40)	60% (of 48)	18% (of 39)
Young owners	50% (of 18)	44% (of 16)	68% (of 19)	47% (of 15)
All old firms	28% (of 82)	20% (of 74)	63% (of 89)	28% (of 72)

Table 8.5: Young Firms Only - Percentage High Performers by Age of Owner

	One Year Sales Growth	Five Year Sales Growth	Profit Change	Net Return
Old owners	39% (of 13)	13% (of 8)	64% (of 14)	20% (of 10)
Young owners	56% (of 36)	55% (of 23)	67% (of 42)	56% (of 34)
All young firms	51% (of 82)	52% (of 54)	63% (of 92)	43% (of 75)

However, the differences are much smaller when, instead of controlling for the age of the firm, age of owner is controlled. The data in Table 8.6 refers to only those firms with old owners. Table 8.7 shows the data for only those firms with young owners. Comparing the success percentages between old and young firms, shows that in most cases, young firms performed better than the old firms. [21% c.f. 39%; 13% c.f. 13%; 60% c.f. 64%; 18% c.f. 20%.] However, these differences are smaller and hence less convincing than those reported earlier in Tables 8.4 and 8.5 when the age of the firm was controlled.

Table 8.6: Old Owners Only - Percentage High Performers by Age of Firm

	One Year Sales Growth	Five Year Sales Growth	Profit Change	Net Return
Old firms	21% (of 44)	13% (of 40)	60% (of 48)	18% (of 39)
Young firms	39% (of 13)	13% (of 8)	64% (of 14)	20% (of 10)
All old owners	26% (of 82)	19% (of 68)	57% (of 88)	21% (of 66)

Table 8.7: Young Owners Only - Percentage High Performers by Age of Firm

	One Year Sales Growth	Five Year Sales Growth	Profit Change	Net Return
Old firm	50% (of 18)	44% (of 16)	68% (of 19)	47% (of 15)
Young firms	56% (of 36)	55% (of 22)	67% (of 42)	56% (of 34)
All young owners	49% (of 73)	53% (of 55)	60% (of 84)	47% (of 64)

The conclusion to be drawn from Tables 8.4, 8.5, 8.6, and 8.7 is that the variable of importance is Owner's Age. When the data was controlled for the age of the firm, the observed differences were still high. However, when the data was controlled for the age of the owner, the differences, if any, were less marked. Thus, financial performance is highly correlated to owner's age, with younger managers outperforming older managers. The age of the firm is a less important explanatory variable.

Multiple Regression Analysis

The second stage in testing the success factors was to conduct multiple regression analysis in order to select those independent variables which statistically best explained the variability in the dependent variable. Thus multiple regression analysis was seen as a way of isolating the variables which seemed to make a significant impact on performance.

The initial design was for all the potential success factors to be independent variables in the regression analysis. However, the literature review discussed in Chapter 2, threw suspicion on some prior studies of small firm success of ignoring the problem of multi-collinearity when using multiple regression analysis. If two independent variables are highly correlated, then it is possible that the association of one of these variables with the dependent variable could hide the importance of the other variable or the joint importance of the two variables. Under these circumstances, grouping the variables using factor analysis is more appropriate than testing each variable individually.

The pairwise correlations between the independent variables are shown in Table 8.8. In total, 103 of the 231 correlations were statistically significant at the 5% level, showing the expected high level of correlation between some of the independent variables. For example, larger firms tended to do more forecasting and have more IT, hence size variables were correlated with forecasting and IT variables.

To overcome the potential problem of multi-collinearity, factor analysis was used to group many of the correlated independent variables, prior to using regression analysis. The objective for using factor analysis was to find some uncorrelated factors which themselves contained correlated variables. The statistical package SPSSX was used, utilising the principal components (PA1) routine with Varimax rotation. Varimax rotation was used as the standard method of rotation to ensure that the resulting factors were uncorrelated, and thus suitable for multiple regression analysis.

The initial factor analysis run used all 22 variables listed in Table 8.8. Six factors with eigenvalues greater than 1.0 were identified. However, following the advice of Kim and Mueller (1978), three of these factors were rejected as each contained less than three variables with loadings greater than 0.5. The three remaining factors contained a total of 14 variables with

Table 8.8 Kendall Rank Correlation Coefficients - Pairwise for all independent variables

INDEPENDENT VARIABLES		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
IT Variables																						
Presence of a computer	1	1.00																				
Number of sophisticated applications	2	.78	1.00																			
IT Success	3	.87	.74	1.00																		
Planning Variables																						
Written business plan	4	.03	.11	.04	1.00																	
Monthly sales forecasts	5	.11	.16	.10	.33	1.00																
Bad debts forecasts	6	.01	.06	.02	.21	.40	1.00															
Profit forecasts	7	.11	.18	.11	.29	.52	.30	1.00														
Cashflow forecasts	8	.04	.09	.03	.24	.55	.44	.47	1.00													
Material requirements forecasts	9	-.02	.05	-.02	.17	.35	.26	.30	.36	1.00												
No monthly forecasting	10	-.05	-.11	-.06	-.28	-.69	-.44	-.55	-.77	-.46	1.00											
Firm Variables																						
Limited company	11	.24	.19	.21	.07	.17	.11	.14	.19	.08	-.20	1.00										
Year established	12	-.00	.01	.00	.11	.04	.10	.08	.10	.03	-.07	.02	1.00									
Number of managers	13	.39	.30	.32	.08	.19	.08	.12	.15	.10	-.14	.34	-.07	1.00								
Number of marketing/ sales staff	14	.01	.07	.02	.05	.12	.14	.05	.07	.05	-.07	.10	.09	.09	1.00							
Number of employees	15	.34	.30	.30	.08	.19	.12	.13	.20	.12	-.20	.38	-.20	.52	-.11	1.00						
Sales revenue(1985)	16	.34	.30	.28	.01	.22	.11	.16	.21	.16	-.19	.41	-.13	.52	.08	.67	1.00					
New products	17	.17	.19	.16	.11	.28	.08	.14	.28	.16	-.29	.10	.08	.09	.11	.10	.14	1.00				
Owner/manager Variables																						
Works at desk or machinery	18	-.27	-.26	-.23	-.06	-.22	-.03	-.17	-.14	-.15	.18	-.39	.01	-.30	-.02	-.33	-.37	-.17	1.00			
Year of birth	19	.07	.06	.08	.10	.03	.08	.05	.02	.03	-.06	.10	.24	.07	.05	.01	.01	-.05	.03	1.00		
Wants firm to grow	20	.14	.17	.12	.19	.14	.13	.01	.10	.11	-.18	.12	.06	.10	.05	.14	.07	-.03	-.06	.09	1.00	
Seeks job satisfaction	21	-.07	-.07	-.05	-.04	.01	.04	.01	.06	-.01	-.04	-.07	.03	-.09	.07	-.22	-.15	.01	.07	-.04	-.29	1.00
Wants to earn money	22	-.07	-.09	-.07	-.09	-.05	-.04	.06	.01	-.04	.07	.03	-.05	-.04	-.00	.01	.04	.00	.08	-.01	-.39	-.17

Notes: 1 Sample sizes vary between 265 and 288 depending on missing data.
2 A coefficient of 0.16 or greater is significant at the 0.01 level. The critical value for the 0.05 level is 0.12

loadings greater than 0.5. Following the practice recommended by Kim and Mueller (1978), the second factor analysis run used the same statistical routines as the first run, but forced the creation of three factors from the 14 variables identified in the first run.

The three major factors grouped the forecasting variables, the size variables and the IT variables. This accounted for 44% of the total variability in the correlations. The factors were easy to name, reflecting variables that other studies had found to be important. The composition of the factors is shown in Table 8.9.

Table 8.9: Composition of Major Factors and their respective loadings, after rotation

Factor 1 - Forecasting	
Variable	Loading
No monthly forecasts	-.88
Monthly cash flow forecasts	.82
Monthly sales forecasts	.78
Monthly profit forecasts	.70
Monthly bad debts forecasts	.62
Monthly material requirement forecasts	.57
Factor 2 - Size	
Variable	Loading
1985 sales revenue	.83
Number of employees	.81
Number of managers	.70
Limited company	.69
Works at desk or machinery	-.60
Factor 3 - Information Technology	
Variable	Loading
IT Success	.94
Presence of a computer	.91
Number of sophisticated applications	.83

Stepwise multiple regression analyses followed the factor analysis. The independent variables consisted of all eight

variables which had not loaded highly on either of the three factors, along with the three factors.

For each of the three measures of financial performance measured on a continuous scale, a separate regression analysis was conducted. The significant relationships are shown in Table 8.10. 0.1 was used as the cut-off value for variable selection.

IT variables did not appear in any of the three equations. The owner/manager's year of birth appeared in all three equations, giving support to owner/manager characteristics being important. The forecasting factor was present in one equation. However, the only other planning variable to appear was that of a written business plan, but negatively in two equations rather than the hypothesised positive relationships. Similarly, the only market oriented variable to appear was the number of marketing/sales staff, and again negatively rather than positively. The size factor appeared in the model for net return in 1985, with a negative coefficient.

Table 8.10: Results from Stepwise Multiple Regression with the three dependent Financial Performance variables - all firms

Dependent Variable	Significant independent variables	Effect	Significance	Change in R^2	Total explained variance	Sample size
Sales revenue change 84 to 85	Owners year of birth	+	.000	.048		
	Number of marketing/ sales staff	-	.045	.014		
	Forecasting factor	+	.079	.013	.075	222
Net return 1985	Size factor	-	.000	.064		
	Owners year of birth	+	.005	.031		
	Written business plan	-	.040	.020	.115	198
Sales revenue change 80 to 85	Owners year of birth	+	.000	.117		
	Written business plan	-	.015	.028	.145	181

As the age of owner variable appeared in all three models, the multiple regression analysis was repeated, controlling for age of owner. MRA was conducted for three separate groups of firms; those with old, medium and young owners. The resulting significant variables are shown in Table 8.11. Many variables had negative coefficients, when positive coefficients would have been expected. Hence, this final piece of analysis failed to improve the understanding of the factors important to success.

Table 8.11: Significant Variables from multiple regression analysis, controlling for owner's age

	Firms with old owners		Firms with medium aged owners		Firms with young owners	
Dependent Variable	Independent Variables	Effect	Independent Variables	Effect	Independent Variables	Effect
Sales revenue change 84 to 85	no variables		no variables		wish to earn money	-
Net return 1985	size factor owners year of birth	- -	wish to grow new products size factor	- - -	size factor new products	- +
Sales Revenue change 80 to 85	wish to grow	+	written business plan year firm established number of marketing/ sales staff	- + -	written business plan	-

Overall, the regression results gave very low multiple R^2 values, of between 7 and 15%. Thus only a very small percentage of the variability in financial performance could be explained by independent variables like owner's age. These weak regression results are similar to those obtained by Begley and Boyd (1986), but much smaller than the 36% to 82% range reported by Foley (1985) and Robinson (1986b). The studies by both Foley and Robinson involved much smaller sample sizes and were of a specific type of firm. The weak regression results of this study may indicate the benefits to be gained from studying a specific type of firm, and hence automatically controlling many variables.

Summary

To summarise the correlation analysis, the data gave very mixed results. Financial performance was found to be positively associated with two of the IT variables. However, unexpected statistically significant negative correlations were found with some variables. A strong relationship with firm age and owner's age was found.

Further analysis of the relationship between the age and financial performance variables showed that the important variable was owner's age. The multiple regression analysis confirmed this by including owner's age in all three regression equations. Thus the results gave mixed support to prior studies of factors affecting small firm success. Instead, the results were dominated by the owner's age variable. This suggested that the owner's age relationship be investigated further, prior to propositions relating to information technology variables.

Chapter 9

TOWARDS A CAUSAL MODEL OF SMALL FIRM FINANCIAL PERFORMANCE

Before continuing the data analysis concerning IT Sophistication, this chapter reflects on the significant, negative correlation that was found between owner's age and financial performance. Other studies have reported negative correlations, showing that on average, younger owners perform better than older owners. [Begley and Boyd, 1986; Foley, 1985; Hand et al, 1987] As such, the result is of little help to managers and advisors of small firms. However, a causal explanation of the finding could provide a greater understanding of small firms and thus provide an improved framework for researchers. The chapter, therefore, attempts to answer the question "why is there a negative correlation between the variables owner's age and financial performance?".

Miller and Toulouse (1986a) surmised that executives grow stale in their jobs, and become used to methods of the past. However, Miller and Toulouse could provide no evidence to support this, but did recognise the need to establish "Causal links between performance and the independent variables" (p. 60). By discussing potential causal links, this chapter is a step forward towards a causal model of small firm performance. Some potential explanations are rejected. Others look more hopeful, so the chapter concludes by considering the implications for this and future studies.

Elaboration and Explanation

With a strong correlation between owner's age and financial performance, it was appropriate to search for a causal explanation. Davis (1985), the author of a book on causal logic, views Lazarsfeld's elaboration as the classical strategy for investigating causal relationships. The approach is to test to see if an observed correlation still exists when controlled for

test variables. For example, we test to see if the correlation between age and performance still exists when controlling for owner's motivation. The objective of the analysis is to find a set of control variables that reduces the correlation between the two original variables to zero (or trivially small). If this is achieved, the control variables are said to "explain" the original correlation.

As it is difficult to find variables that reduce the correlation to zero, Davis (1985) offers advice to selecting the best test variables, by investigating the direction (sign) of relationships. In this study of small engineering firms, we have a negative correlation between the two original variables. Davis (1985) suggests we look for test variables that support this negative correlation by having "opposite signs" with the two original variables. Taking motivation as an example; we might expect motivation to decrease with age, but performance to increase with motivation. Thus motivation has "opposite signs" with the original variables and therefore has the potential to be an explanatory variable. A corollary being that a test variable is an unlikely explanatory variable if it is not related to both the original variables. This corollary could exclude variables like race and sex which cannot be related to age.

Potential Explanatory Variables

Previous research reported in the small business literature suggests a number of potential explanatory variables. Those used in studies of small firm performance are given below in Table 9.1 in the three groups of Social, Experience and Psychological/Managerial.

The list of variables in Table 9.1 shows that many characteristics of the owners of small firms have been investigated empirically. 21 of the variables have been found to be correlated with performance. Appendix 8 shows a summary of the results. A limitation of many of the findings reported in

Appendix 8 should be recognised. Some studies reported only observed correlations. Many of the correlations were not tested with control variables, so these correlations may be spurious.

Table 9.1: Owner Manager Characteristics used in studies of small firm financial performance

Social Characteristics	**Psychological/Managerial Characteristics**
Married	
	Goal
	Need for achievement
Experience Characteristics	Flexibility
Founder	Locus of control
Years in position	Type A
Years with firm	Speed and impatience
Education	Job involvement
Previous experience	Hard driving competitiveness
Product familiarity	Use of time
	Innovativeness
	Entrepreneurial values
	Managerial skills
	Interpersonal skills
	Craft v Promotion v Administrative
	Teamwork
	Owner Authority

It is likely that there is overlap within the variables, particularly amongst the psychological/managerial variables. Researchers have used many different instruments to measure overlapping concepts. For example, Miller and Toulouse (1986a) used "locus of control" as a measure of "innovation", while Dollinger (1984) measured "innovation" based on Maidique (1980). In addition, Hornaday and Wheatley (1986) used the managerial typology based on Filley, House and Kerr (1976) to classify managers as one of Craft, Promotion and Administrative. This typology attempts to incorporate many individual characteristics, including motivation and work priorities.

Using interviews rather than questionnaires, Boswell (1973) looked for an explanation of why some firms had not grown. He found evidence of elderly founders staying on too long, with no

wish to be better off. Among 14 declining firms that had been in operation over 40 years, Boswell found "conservative attitudes were almost universal" (p. 133). Many firms had failed to adapt to increasingly competitive conditions. Boswell concluded that the owner's age was only part of the problem. The wish to not grow was due to many factors ("blocks") rather than saying they had had enough.

This supports the theses by Chell (1985) and Curran and Stanworth (1982) that it is how the situation is interpreted which is important in understanding the behaviour. This model of small firm behaviour is supported by much of the research into newly formed firms. Many employees seek autonomy and independence, so start their own firm (Scott, 1980). For many, the threat to their autonomy and independence is a reason for resisting later opportunities for the firm to grow. Scase and Goffee (1982) found that many of their construction industry self-employed resisted the move to employ labour to overcome the intensity and length of their working day. They did not want to change personal relationships with customers, or to employ a potentially unreliable person. The move to hire labour was often due to market circumstances, e.g. increased workload, rather than an active initiative. Hayes (1982) found many small hotel managers did not want to organise other people.

Other inhibitors to growth have been observed. Scase and Goffee (1982) investigated the important role of the family, with the wife carrying out much of the administrative work. This was seen as an inhibitor to growth as no-one acquired the necessary administrative skills required for long term growth. Many of Scase and Goffee's examples saw administrative work as "unproductive" (p. 109). The small business owners saw themselves as manual workers, not white collar workers or capitalists. Boswell (1973) noted that older firms often made obsolescing products or depended on declining industries, so were facing difficult external pressures. Gill (1985) concluded that both managerial capability and motivation were needed for growth.

Variable Reduction

To aid the building of a causal model, it would be useful to have a shorter list of variables which are likely to explain the observed correlation between age and performance. The experience and the psychological/managerial groups of variables are discussed separately below.

Experience Variables

One would expect experience to be positively associated with performance. Furthermore, older owners would be expected to be more experienced than younger owners. However, these two positive associations would suggest that older owners would perform better than younger owners, which is in direct conflict with the observed relationship. Using Davis' (1985) logic we would exclude experience from our list of potential explanations of the negative correlation between age and performance.

However, Foley (1985) found both positive and negative relationships between experience variables and performance. Foley concluded that the type of experience was important. Some experience variables had not made a positive contribution to the owner's ability to run the company. These included: physical age, age when joined or founded company, time with the company, and previous years' electrical engineering experience. Other variables gave a positive contribution to success, these being; previous years' electrical marketing experience, product familiarity, post school education and development of other business. Foley considered that these latter "positive" variables relate directly to particular skills or understanding required to make a company more successful. Foley's research suggests that an owner's "direct experience" is important to small firm success. Milne and Thompson (1984) found that older owners did better than younger ones in their sample of business start-ups. They felt this was the "result of management

training, experience, contacts and capital, rather than some sort of entrepreneurial vigour" (p. 10).

Should "direct experience" be used as a test variable? To be eligible it should be related to both age and performance. It has already been argued that experience and performance are likely to be positively correlated. Hence for age and performance to be negatively correlated, the relationship between age and experience must be negative. This implies that older managers must have less direct experience, and younger managers more. This seems unlikely, but maybe there are some circumstances which could have created such a situation.

A possible explanation of older managers having less direct experience is that they had not sought to change their position due to, for example, contentedness, complacency or less education. To explain this further, an older manager could be more likely to be content financially, and hence less motivated to change. In this situation, any relationship between age and direct experience could be explained by another variable. Similarly, older managers may have had fewer educational opportunities available to them, particularly when young. They may now feel excluded from educational institutions, and thus, compared with younger owners, less likely to have sought current, valid direct experience. Overall, it seems that any negative relationship between age and direct experience must involve intermediate variables, particularly motivational factors. The proposition that older managers may have less direct experience must be investigated further.

Psychological/Managerial Variables

As already noted, researchers have used different measures of similar constructs to measure psychological and managerial variables. This suggests there is potential for reducing the list of 16 psychological/managerial factors given in Table 9.1 Ideally, this reduction should produce a small set of variables

which not only explains the relationship between age and performance, but is also useful to advisors and managers of small firms. For example, if "innovativeness" was found to be crucial, then advice could be offered on developing and maintaining levels of innovation. A potential methodological problem associated with some of the behavioural variables is that the owner may have recognised personal limitations and built a balanced "managerial team". Hence, research should be at both the individual and organisational level.

It is difficult to present a full analysis of the content of the constructs used by previous researchers as some research papers provide little detail on specific constructs. A resumé of the constructs is provided in Appendix 9. Motivational aspects are reflected in four different constructs; goals, need for achievement, type A personality and whether of craft, promotion or administrative type.

An alternative approach is to analyse the nature of the expected relationships for each construct with the two variables financial performance and age. For many of the behavioural/managerial variables it is easy to hypothesise a relationship with performance, but less obvious to say with confidence there is a relationship with Age. Or being more specific, that older managers would score lower on a particular construct than younger managers.

Table 9.2 shows, for each construct, the direction, if any, of the expected relationships. For example, goals/motivation would be expected to be positively related with financial performance. The expected relationship with age is likely to be non-existent or negative. That is, as an owner gets older their motivation is likely to remain the same or decrease, possibly due to factors like financial security, lack of energy and wish for an easier life. For the use of time variable, different relationships could be hypothesised. For example, an owner may spend more time at work if there are new challenges, but less if an appropriate

Table 9.2: Psychological/Managerial characteristics and their expected relationship with performance and age

Construct Name	Expected Relationship with Performance	Expected Relationship with Age	Notes (Why?)
Goals/Motivation	+	0, -	Possibly affected by other factors, like financial security
Need for achievement	+	-	Due to financial security
Flexibility	+	0, -	Due to motivation
Locus of Control	+	0, -	Or is it due to education
Type A	+	0, -	
Speed and Impatience	)	)	
Job involvement	)	)	Insufficient knowledge of
Hard driving competitiveness	)	)	construct
Use of Time	+	-	But due to firm size/age, maturity
	+	-	Due to financial security
	+	+	Due to motivation and training
Innovativeness	+	0, -	Due to financial security
Entrepreneurial values	+	0, -	Due to financial security
Managerial skills	+	0	Experience
Teamwork	)	)	Insufficient knowledge
Owner Authority	)	)	of construct
Craft/Promotion/Administration	+	0, -	Due to financial security

managerial structure has been set up, or when their financial rewards are sufficient.

The net result of this analysis suggests that:

1. Few factors would seem to have a direct relationship with Age.

2. For most, the relationship with Age is somewhat tentative, and almost certainly due to intermediate variables.

3. Motivational aspects are likely to dominate any negative relationship with Age.

These conclusions are supported by Boswell (1973), who found a link between "old age and opposition to progress" (p.85). Boswell concluded that age was not the major factor, but rather "market constraints; lack of managerial energy and ability, mainly because of inheritance; other human problems inside the firm; and impediments to the recruitment of new blood" (p. 151). The negative impact of age would seem to be through other variables, in particular motivational variables.

Motivation and Performance

Several variables have been discussed in an attempt to suggest a short list of likely explanatory variables for the negative correlation between age and performance. For most of the variables considered, any relationship with age is not obvious. It would seem that motivational factors could dominate the relationship between owner characteristics and performance. However, due to an inadequate understanding of the causal process, many studies of financial performance have taken little consideration of motivational factors when studying small firm performance.

The current study of small engineering firms was no exception, but it did provide some data on owner motivation. This data is discussed below, before being used to partially test the hypothesis that motivational factors could help explain the negative relationship between owner's age and performance.

Owners and Their Objectives

Owners were requested to rank in order of importance the three objectives of firm growth, job satisfaction and earn as much money as possible. [Ranking was used in preference to a Likert scale to discourage respondents from rating all three objectives similarly. This strategy was considered successful as only 8% of respondents ranked all three equally. An additional 42% ranked two of the objectives equal.] A score of 1 was used to indicate the least important, and 3 to indicate most important.

Job satisfaction was ranked most important by both old and young owners. Firm growth was ranked least important. Average scores are given in Table 9.3 for old, young and all managers; where "old" refers to the oldest third, and "young" to the youngest third.

Table 9.3: Average Rankings[1] for Each Objective, by Age of Owner

Objective	Old Owners (n=91)	Young Owners (n=89)	All Owners (n=289)
Grow into a large firm	1.32	1.43	1.37
Gain job satisfaction	2.66	2.59	2.65
Earn as much money as possible	2.23	2.26	2.25

[1] A low value indicates low importance.

The data in Table 9.3 shows that old and young owners have similar views. Firm growth was rated least important by both old and young owners. This supports Stanworth and Curran's (1973) findings that many small firms want to stay small. Job satisfaction was rated most important, and earn money quite important.

Owner Objectives and Performance

Data for the two sales growth variables was investigated in relation to the owners wishes for firm growth. Table 9.4 shows the data, where the percentage of high performing firms (i.e. the top third) can be compared for each measure of sales growth. Taking one year sales growth, more of the older owners who wanted growth, achieved it (39% cf. 20%).

Table 9.4: Percentage High Performers for Growth by Age of Owner by Ranking on Firm Growth (all firms)

	One year sales growth		Five years sales growth	
Ranking of firm growth	Old owners	Young owners	Old owners	Young owners
Those not wanting growth	20% (of 59)	46% (of 48)	12% (of 49)	58% (of 36)
Those wanting growth	39% (of 23)	56% (of 25)	37% (of 19)	42% (of 19)

The last row of Table 9.4 shows smaller differences in performance between old and young managers for those wanting growth. For these firms, the variable "owner objective" has partially explained the relationship between owner's age and performance. Table 9.4 also shows a very strong but unexplained effect of age for those owners not wanting growth. However, the "earn money" objective fails to discriminate when investigating the relationship between owner's age and the profit measures

(Table 9.5). The data in Table 9.5 shows that the differences for net return between young and old owners still remain, even when controlling for the earn money objective.

Table 9.5: Percentage High Performers for Profit by Age of Owner by Ranking on the "Earn Money" objective (all firms)

	Profit Change		Net Return	
Ranking of Earn Money	Old owners	Young owners	Old owners	Young owners
Low or medium	65% (of 55)	60% (of 55)	23% (of 40)	47% (of 45)
High	42% (of 33)	59% (of 29)	19% (of 26)	47% (of 19)

Implications for future research

The above suggests that the relationship between age and performance is not a simple one, though there was some support for motivation being a partial explanatory variable. Generalisations cannot be made about small firms and their owners. The different behaviours have implications for future research into small firm performance. These implications are discussed below, initially regarding independent variables, and then for dependent variables.

The Selection of Independent Variables

Curran and Stanworth (1982) concluded after ten years of research following the Bolton report, "There is no single entrepreneurial or owner-manager type but rather, a range of entrepreneurial identities" (p. 13). Some of the eight typologies found in a review by Lorrain and Dussault (1987), to which Scase and Goffee's can be added, could be a starting point for researchers. However, as discussed by Chell (1985), they are too simplistic as they replace one "type" by two or more types. For example, many of the typologies include a "craft" type. It would be erroneous

to assume all "craft" firms in a sample were similar, unless other person and situation variables were considered. Curran and Stanworth (1982) lists the following variables as important: "type of economic activity, period of establishment of the enterprise, level of success and whether the small firm executives are first generation entrepreneurs or those who have inherited ownership" (pp. 14, 15).

Chell (1985) also suggested a number of person variables, including: skills and abilities; environmental influences affecting his or her behaviour; expectations of the viability of the business; valued outcomes, e.g. growth; plans to achieve goals. Chell believes that such variables "would clearly distinguish between entrepreneurs in different sorts of businesses" (p. 49).

Therefore, a major implication for future researchers is to determine a set of person and situation variables specifically for their study, rather than relying on existing typologies. This is likely to require a multi-staged approach for projects with a number of intensive interviews being followed by data collection in a larger sample.

The Selection of Dependent Variables

There are also implications for the choice of "dependent" variables to be used in any study. Robinson (1983) concluded that profitability and sales growth were both useful and practical measures of small firm performance for strategic planning research. He felt that both could "be viewed as surrogate measures of a small firm's effectiveness in meeting the needs of key constituencies" (p. 29). These key constituencies include community, customers, owner and employees. Robinson's conclusion is partially supported by Pearce, Robbins and Robinson (1987) where strong correlations were found between actual and perceived financial performance.

With so few owners desiring growth, an implication for future research is that measures of success which reflect earnings rather than growth are likely to be of greater relevance. Profit measures are likely to be more relevant than measures of sales growth. However, collecting valid data on profit is difficult as profit can be altered easily through changing the owner's earnings/take.

Wood and Laforge (1979) argue for industry specific performance measures, rather than a smorgasbord of measures. Feeling that performance criteria should match the primary objectives of the organisations being studied. Bracker (1982) followed this advice to find measures that were most effective in differentiating between high and low performance firms. As a result, appropriate performance measures for drycleaners were determined to be sales revenue growth, owner compensation and labour expense as a percentage of sales revenue. However, these do not clearly allow for firms intent on survival, or those with no wishes for growth. Research by Cooper, Dunkelberg and Woo (1987) compared small start-ups (two employees or less) with large start-ups (eight or more employees). Though their relative performances were different in both absolute and percentage terms, relative to expectations, there was no difference between the small and large start-ups. The owners were equally satisfied, though their firms had performed differently. This may be due to the owners accepting the situation. It may though be more a reflection of their differing goals when they started up.

It can be argued that many studies are using inappropriate measures of performance for some of their firms. It is inappropriate to measure sales growth for a particular firm if growth is not desired by the firm. Cameron and Whetton (1983) feel that the researchers must ask whose perspective of effectiveness is being considered. They argue that there are no best criteria for effectiveness because different parts of the system, e.g. owner, employee and customer, define effectiveness differently. In the small firm's sector, different owners are

very likely to suggest different criteria. However, it is likely that these could be ascertained and they may be highly related to owners' objectives. The implication is that studies should determine appropriate measures of performance for each of the identified types of small firm in their population.

Conclusions

The strong negative correlation between owner's age and performance has not been explained, but several potential explanatory variables were discussed. Their relationship with performance seemed justifiable. However, any relationship with age was much less obvious. *The most likely explanation of the* negative correlation between owner's age and performance will be through intervening variables associated with owner motivation. Past studies have given inadequate attention to a real understanding of motivational factors.

Results from empirical studies of small firm performance have been of limited value because the studies have given inadequate attention to the many types of small firms. If future studies are to gain a fuller understanding of small firm behaviour, then both person and situation variables need to be considered. Chell (1985) and Curran and Stanworth (1982) have suggested some variables of significance.

In addition, some commonly used measures of financial performance do not reflect the objectives of many small firms. If future studies are to lead to a greater understanding, they will need to reflect the specificity of the population. A multi-staged approach will be required for survey work, with in-depth interviews being used to confirm or identify the various types of small firms in the population. The approach by Boswell (1973) would serve as a good model, where the list of causal influences included a careful selection of person and situation variables. A single stage questionnaire approach to data collection is unlikely to identify all the factors of importance due to the

lack of homogeneity within a sample of seemingly similar small firms.

Implications for this study of small engineering firms

The above discussion suggested that the existing sample of firms must be broken down into a number of sub-samples. Rather than just by age of owner and age of firm, objectives could assist in this split. Despite growth being a relatively unimportant objective, it would seem to be a useful explanatory variable. One sub-group could be those firms wanting growth. Another sub-group could be the remaining younger firms, leaving a large group of medium and older firms. The objective must be to group similar firms. Further analysis could then assume that many variables were controlled.

Chapter 10

CLUSTER ANALYSIS

The previous discussion concluded that the sample could be usefully broken down into a number of differing sub-samples. Similar firms would be in the same sub-sample, with each sub-sample representing different types of firms. The discussion also suggested that person and situation variables should form the basis by which firms should be judged as similar or not.

What was needed was a method to group the firms into sub-samples. The method of Cluster Analysis was selected as it is a statistical technique which has been designed to produce clusters or groups of highly similar entities. This chapter introduces the statistical approaches called Cluster Analysis and shows how it was used to create five clusters which were then validated using methods recommended by Aldenderfer and Blashfield (1984).

The Cluster Analysis Approach

For this study of small engineering firms, the objective was to group any similar firms together. The cluster analysis approach to the problem is to use any descriptive data of the firms to determine which firms are similar. For example, if the only available data was on owner's age, we could have four firms with owners of the following ages; 40, 45, 47 and 60. Initially the four firms each constitute a cluster of one, on their own. If fewer than four clusters were required, then two of the initial clusters would have to combine. Various clustering methods have been developed to combine cases. Each method works in a different way to combine existing clusters. For the data quoted above, one approach would be to compare the mean value for each cluster, and combine the two most similar clusters. This would result in the two firms with owners of ages 45 and 47 forming a cluster of two firms. Thus, instead of the four initial clusters, there would now be three, one with two firms, the other two clusters with one firm each. The next step would be to

combine two more clusters to reduce the total number of clusters to two, and then subsequently to one cluster of all four firms.

The example discussed above was a simple case in two ways. First, there were only four firms. For the 289 small engineering firms, the starting position would be 289 clusters of one firm each, ending up with one cluster of 289 firms. A second simplification was that only one variable, that of owner's age, was used to compare cluster similarities. In practice, many variables are used to create a similarity index.

Early experiences with cluster analysis using SPSSX

Cluster analysis is a relatively recent statistical approach and its literature has grown in the last ten years. Accompanying this growth has been an increase in the number of methods within the topic. Hence cluster analysis is not a name for one specific technique, though the goal of creating groups of similar cases is common to all the methods. In their review of cluster analysis methods, Aldenderfer and Blashfield (1984) concluded that "most cluster analysis methods are relatively simple procedures that in most cases, are not supported by an extensive body of statistical reasoning" (p 14).

Thus a cautious approach to the use of cluster analysis seemed appropriate. Some trial runs using the SPSSX routines gave considerable reason for caution. Examples of the unexpected behaviour were:

(i) As warned by Aldenderfer and Blashfield (1984), different clustering methods gave very different cluster "solutions". The methods called "Wards" and "Complete" tended to give similar sized clusters, while the methods "Centroid", "Median" and "Baverage" consistently produced one very large cluster and two or three small clusters, often with as few as one case per cluster. Disappointingly, the contents of these different cluster solutions were often not similar enough to consider the results consistent.

(ii) The removal of outliers often produced very different clusters, even for the same method. For example, the five cluster solution using the WARDS method for all the mechanical engineering firms produced clusters of sizes 20, 29, 42, 25, 33. Seven outliers were removed, and the new cluster sizes became 52, 14, 41, 23, 12.

This lack of consistency when using the same method, but with a slightly different data set, was cause for concern. Ideally one would like to use a method which gave similar clusters under slightly different circumstances, and whose clusters were similar to those obtained using other methods.

Though this ideal did not seem possible, some consistency was achieved. For example all of the above mentioned methods quite regularly produced a cluster of the same seven young firms with young owners, all wanting growth. Other clusters were similar across methods, but with sub-groupings combined in different ways.

Cluster analysis was persevered with for two main reasons. Firstly, the cluster solutions were validated statistically according to the process suggested by Aldenderfer and Blashfield (1984). This validation process is discussed later and showed the clusters to be significantly different with respect to a number of variables. The second reason for retaining the cluster solutions was because the statistical differences supported the earlier discussions. In other words, the clusters did represent different types of firms, as discussed later.

Choice of Variables

In the previous chapter, a number of variables were discussed which suggested similarities and differences among small firms. Boswell (1973) used age of owner and age of firm as classification variables. Scase and Goffee (1982) based their classification on the owner's role.

Though the questionnaire study was not designed with cluster analysis in mind, a number of person and situation variables were seen as appropriate to help identify different types of firms in the sample. The variables used were:

* Age of Owner
* Age of Firm
* Objectives of Growth, Job Satisfaction and Earn Money (reflecting size and aspirations)
* Partnership or Limited Company
* Size of Firm
* Work at Desk or Machinery

Other variables were rejected as inappropriate for clustering, mainly on the basis that they were dependent on one of the above variables. Their inclusion would have given undue weight to the independent (causal) factor.

New Products - this variable was likely to be correlated to the age of firm, and to the growth objective. This would seem to be a managerial response, hence a dependent rather than independent variable.

Written Business Plan - this variable was likely to be a reflection of managerial style/practices, though it could have been a requirement for a loan and hence reflect growth and age of firm. Like New Products, it would seem to be an intermediate variable.

Forecasting Activities - this variable was viewed as similar to written business plan; it is a managerial practice and hence an intermediate variable.

Number of Managers - this variable is related to size, and could also reflect managerial style/professionalism. However, invalid responses to this question made this variable unreliable, hence it was omitted.

Number of Marketing and Sales Staff - this variable was likely to reflect managerial or administrative structure and be correlated to size. As a response, it must be considered as an intermediate variable.

Sales Revenue - this variable was deliberately omitted as a measure of performance was likely to invalidate testing the original hypotheses.

Choice Of Methods

Two methodology decisions must be made in the use of cluster analysis. These concern selecting a 'measure of similarity (or proximity), and then selecting a clustering method which determines how cases are combined given their similarity.

The measure of similarity creates a score for each case (firm) based on the values of the descriptive variables. As the variables selected for this study differed considerably in scale, the data was standardised to a mean of zero and standard deviation of one prior to cluster analysis, as recommended by Aldenderfer and Blashfield (1984). The commonly used measure of proximity is "Squared Euclidean distance", being similar to many statistical measures as it is the squared difference between the values of the clustering variables. If two cases were identical, the distance between them would be zero.

The Clustering methods differ in how they combine clusters. Five methods were considered and the final choice was considerably influenced by the performance of each method. The conceptually most simple method was the "Baverage" linkage approach. In this method, a case joins the cluster which has an average value for the whole cluster closest to the case. The "Complete" method uses a more complicated rule, and a case joins a cluster where all members of the cluster must be similar. The "Wards' method uses variance within clusters and would join a case to a cluster which would show the smallest increase in variance.

No method showed a clear theoretical advantage over the others. Furthermore, according to Aldenderfer and Blashfield (1982), experimental studies that have compared the performance of different clustering methods with known clusters, have also failed to suggest one method is superior to another. As a result, various clustering methods were experimented with to see how each performed with the small engineering firm data. Centroid, Median and Baverage were all rejected as they tended to create one very large cluster, containing over 80% of the cases.

One very large cluster did not fit the expectations of the analysis considering the small firm theory discussed earlier.

Wards and Complete both provided meaningful clusters with statistically valid differences. The solutions obtained using these methods overlapped considerably, with some clusters being subsets of those produced by the other method. The solutions were never totally the same, usually as each method had combined smaller, earlier clusters in different ways. After much analysis, the Complete method was rejected for two reasons. The results appeared to be very unstable in that the composition of the clusters changed depending on which outliers/troublesome cases were excluded. Wards method proved to be less sensitive to outliers than Complete.

In addition, for these difficult cases, the Wards results using a distance measure (SEuclid) were very similar to Baverage using a correlation measure of similarity. This finding increased the level of confidence in the Wards results, though the fact that two statistically validated sets of clusters had been found was disconcerting.

Comparison of these differing results again favoured the Wards solution as all five clusters were seemingly different in nature.

The Cluster Analysis Results (n=271 due to some missing values)

The Wards method calculates cluster coefficient values. The values are shown in Table 10.1 for the final ten cluster combination steps; for example, when the move from 11 to 10 clusters occurs, from 10 to 9, etc. The final column shows how the Wards coefficient has changed due to two clusters combining. A large change in the value of the coefficient indicates that two dissimilar clusters have combined, while a small value depicts the combination of two relatively similar clusters.

Table 10.1: Cluster Analysis Proximity Values using Wards method. (n=271)

Cluster Combination Step Moving From	Resulting Wards Coefficient	Change in Coefficient
11 to 10	1006	41
10 to 9	1056	50
9 to 8	1107	51
8 to 7	1162	55
7 to 6	1218	56
6 to 5	1279	61
5 to 4	1439	160
4 to 3	1614	175
3 to 2	1837	223
2 to 1	2181	344

The step from 5 to 4 clusters produced a noticeable increase in the Wards coefficient. This suggested the five cluster solution was appropriate. The graphical presentation given by the dendogram supported this conclusion. The choice of five clusters also complied with Lehmann's advice that the appropriate number of clusters should be no more than n/50 (Lehmann 1979), that is, no more than 5.5.

Five Clusters

The five clusters are summarised below:

Cluster 1 (n=63) Owners that want growth not money.

Cluster 2 (n=76) Younger Limited Companies with owners that want job satisfaction not growth.

Cluster 3 (n=29) Larger, older firms with desk oriented, older owners.

Cluster 4 (n=63) Small partnerships with owners who work with equipment and seek job satisfaction.

Cluster 5 (n=40) Larger, Limited Companies, with owners who seek money rather than job satisfaction.

The above summaries are based on comparative data for all eight clustering variables, shown in Table 10.2. The median was used as a basis for comparison.

Table 10.2: The Five Clusters compared on all eight cluster variables (Medians in all cases) (n=271)

	Owner's year of birth	Year firm established	Wish to grow	Wish for job satisfaction
Cluster 1	1942	1971	medium	high
Cluster 2	1941	1973	low	high
Cluster 3	1928	1927	low	high
Cluster 4	1936	1970	low	high
Cluster 5	1943	1970	low	medium
	Wish to earn money	Firm size (employees)	Work at desk or equipment	Partnership or Limited Company
Cluster 1	medium	11-19	desk	Ltd Co
Cluster 2	medium	6-10	desk	Ltd Co
Cluster 3	medium	11-19	desk	Ltd Co
Cluster 4	medium	1-5	equipment	Partnership
Cluster 5	high	11-19	desk	Ltd Co

The clusters were compared statistically, using the Kruskall-Wallis test, which is similar to one-way ANOVA. It tests to see if at least one cluster was significantly different to the others. Rankings were used throughout the analysis as variables were ordinal or nominal. Table 10.3 reports the mean rankings for all eight cluster variables. The Kruskall-Wallis statistic was found to be significant in all cases, showing the clusters to be different.

Table 10.3: Kruskall-Wallis data comparing the five clusters
(Mean rankings in all cases) (n=271)

	Owner's year of birth	Year firm established	Wish to grow	Wish for job satisfaction
Cluster 1	155	147	228	118
Cluster 2	154	162	95	175
Cluster 3	66	23	107	156
Cluster 4	118	142	106	162
Cluster 5	151	140	138	37
Kruskall-Wallis	35.99	70.88	183.27	144.44
Significance	0.0000	0.0000	0.0000	0.0000
	Wish to earn money	Firm size (employees)	Work at desk or equipment	Partnership or Limited Company
Cluster 1	78	160	126	153
Cluster 2	148	138	115	173
Cluster 3	133	171	109	144
Cluster 4	144	70	197	50
Cluster 5	193	174	114	169
Kruskall-Wallis	75.58	70.48	77.55	174.44
Significance	0.0000	0.0000	0.0000	0.0000

Cluster Validation

Aldenderfer and Blashfield (1984) view tests on external variables as "among the better ways to validate a clustering solution" (p 66). The clusters were thus compared for five variables which had not been used in determining the clusters. The results are shown in Table 10.4. The data in the bottom row of Table 10.4 shows that four of the five variables show significant differences between the clusters. The Kruskall-Wallis results show that the clusters are different.

Table 10.4: The five clusters: Mean rankings for five non-cluster variables (n=266-271)

	Computer?	New Products	Business Plan	Monthly Forecasts	Number of Marketing & Sales Staff
Cluster 1	147	139	153	159	153
Cluster 2	148	139	131	149	148
Cluster 3	131	134	126	117	136
Cluster 4	99	120	127	94	96
Cluster 5	158	137	133	128	134
Kruskall-Wallis	27.32	3.84	12.74	29.45	23.21
Significance	0.0000	0.4278	0.0126	0.0000	0.0001

A further validation test was conducted on the cluster solutions by conducting the Kruskall-Wallis one-way ANOVA on the large sub-sample of mechanical engineering firms. The same four non-cluster variables were significantly different, providing further evidence that the clusters were different. The results are shown in Table 10.5.

Table 10.5: The five clusters: mean rankings for five non-cluster variables using mechanical engineering firms only (n=173)

	Computer?	New Products	Business Plan	Monthly Forecasts	Number of Marketing & Sales Staff
Cluster 1	96	86	98	98	98
Cluster 2	90	87	84	98	98
Cluster 3	91	91	81	77	86
Cluster 4	68	82	84	63	59
Cluster 5	98	83	81	77	80
Kruskall-Wallis	12.64	0.69	9.46	17.39	20.29
Significance	0.0132	0.9523	0.0505	0.0016	0.0004

Summary

The previous chapter indicated that further analysis of the small engineering firms may prove more fruitful if the sample was split

into sub-samples of similar firms. Rather than use only one variable like owner's age to determine sub-samples, it was appropriate to use a broader set of variables. Cluster analysis was used to analyse a total of six owner and firm variables to group the firms into five clusters. Statistical tests showed these clusters to be different. The largest cluster was of young limited liability companies. Another cluster was of owners seeking firm growth. The validation tests showed that the cluster analysis had achieved its objective of creating different sub-samples, which could then be used in further analysis to test the major research propositions.

Chapter 11

TESTING THE RELATIONSHIP BETWEEN IT SOPHISTICATION AND FINPERF

The major research propositions were stated in Chapter 3. The testing of these propositions, using the mail questionnaire data, is the focus of the next three chapters. This chapter reports the testing of proposition 1. The analysis is reported in the following three ways with the emphasis on the link between IT sophistication and financial performance:

1. Testing different levels of IT Sophistication, e.g. "no computer" through to "sophisticated IT".

2. Testing components of IT Sophistication, e.g. the number of terminals.

3. Calculating correlation coefficients between IT variables and FINPERF.

Testing Proposition 1 using different levels of IT Sophistication

The major proposition suggested that there was a positive and significant relationship between IT Sophistication and FINPERF - for all firms, rather than only those with IT.

The important variable IT Sophistication was discussed in earlier chapters. For the analysis, the firms were classified as one of the following four levels of IT Sophistication:

* No computer
* Unsophisticated IT
* Semi-sophisticated IT
* Sophisticated IT

The classification for those firms with a computer was based on ITSOPH scores. Typically, this involved a lowest third, middle third and top third.

In general, the higher the level of IT sophistication, the higher the expected performance. The exception being that the lowest two levels were expected to perform similarly, as there would be few information benefits from unsophisticated IT.

Where possible, the proposition was tested in three particular ways; for all firms, for individual clusters of firms and for individual SIC groupings. Some SIC and cluster groupings were too small to test, others could be tested in a limited way only.

All Firms

Prior to testing the hypothesis on the data for all the firms, two adjustments to the data were necessary.

* Performance differences between the various SIC group were reported in Chapter 7. Hence, for each SIC, the FINPERF data was standardised to give a mean of 0 and a variance of 1 for the log of FINPERF.

* There were some firms which had only recently computerised and thus their computer could not be expected to have influenced performance in 1985. Thus the firms which acquired their computer in 1985 or 1986 were excluded from the tests. [They could have remained in as non-computerised firms but were excluded on the grounds that they could be unrepresentative.]

Due to the skewed nature of the financial performance data, non-parametric tests were used where rankings rather than actual values are compared. Taking Table 11.1 as an example, the Mann-Whitney U Test is used to compare the results for two groups of firms, those without a computer, and those with a computer. The

test uses ranks to compare the two sets of data. Table 11.1 shows the mean rankings for each group of firms for all three measures of FINPERF. However, none of the calculated probabilities are sufficiently small to indicate that the observed differences in mean ranking are statistically significant. The probability value indicates the likelihood of obtaining such results if the two samples came from the same population. A very low value suggests two populations rather than one.

Table 11.1: A Comparison of Firms with and without a computer, using mean ranking data for three measures of FINPERF

	1 year sales		Net Return		5 year Sales	
No computer	103	(n=140)	99	(n=118)	83	(n=108)
Computer	113	(n=72)	89	(n=71)	93	(n=64)
		(n=212)		(n=189)		(n=172)
Mann-Whitney U Probability	0.225		0.226		0.174	

The mean ranking data in Table 11.1 also shows which group performed highest. For example, taking one year sales growth, the mean ranking for the no computer group was 103, which was lower than the 113 obtained by the firms with a computer. The direction of the relationship was as expected for the two sales growth variables, but not for net return. However, as discussed earlier, none of these differences were statistically significant.

With four levels of IT Sophistication, the appropriate test was the Kruskall-Wallis test, which is the non-parametric equivalent to one-way anova. Hence it tests to see if one group or more is different to at least one other. The data for the four levels of IT Sophistication is shown in Table 11.2, and no result was significant. The results in Table 11.2 for both sales growth variables gave weak support to the major hypothesis, as Finperf rises with level of sophistication.

Table 11.2: Mean Ranking by ITSOPH using Kruskall-Wallis 1 way ANOVA for three measures of FINPERF

	1 year sales		Net Return		5 year Sales	
No computer	102	(n=141)	99	(n=120)	83	(n=109)
Unsophisticated	107	(n=19)	84	(n=22)	90	(n=22)
Semi-sophisticated	118	(n=26)	94	(n=23)	94	(n=19)
Sophisticated	118	(n=26)	84	(n=24)	93	(n=22)
		(n=212)		(n=189)		(n=172)
Kruskall-Wallis Probability	0.500		.465		.712	

Individual Clusters and SIC Groups

Rather than analyse all the firms as only large group, specific subsamples were also tested. Where possible, similar Mann-Whitney and Kruskall-Wallis tests to those reported above in Tables 11.1 and 11.2, were conducted on individual clusters and SIC groups. The Mann-Whitney results are summarised in Table 11.3. The Kruskall-Wallis results are summarised in Table 11.4. Fuller details are given in Appendices 10 and 11. Some clusters and SIC groups were too small for meaningful Kruskall-Wallis tests. In others, instead of four levels of IT Sophistication, only three were possible in order to maintain reasonable sample sizes in all levels.

Of the results shown in Tables 11.3 and 11.4, only four were statistically significant. However, one of these was in the opposite direction to that hypothesised. The cluster results gave no significant relationships, suggesting that when factors like age and objectives were taken into account, then IT has no noticeable effect on these measures of FINPERF. It should be noted that much of the above analysis related to simple tests of the two groups "no computer" versus "computer". Small sample sizes restricted the level of analysis.

Table 11.3: Mann-Whitney U Statistics testing Proposition 1 for firms with versus without a computer for three measures of FINPERF using various cluster and SIC sub-samples

Sample	1 year sales growth	Net Return	5 year Sales growth
All firms (n=172+)	0.225	0.226	0.174
Cluster 1 (n=35+)	0.680	0.307	0.987
Cluster 2 (n=45+)	0.417	0.649	0.342
Cluster 3 (n=21+)	(+)0.017*	0.837	0.456
Cluster 4 (n=36+)	0.877	0.527	0.749
Cluster 5 (n=29+)	0.520	0.777	0.541
SIC 31 (n=23+)	0.412	0.402	(-)0.041*
SIC 32 (n=113+)	0.934	0.401	(+)0.068*
SIC 34 (n=20+)	0.597	0.440	0.703
SIC 35 (n=14+)	(+)0.012*	0.699	0.223

Table 11.4: Kruskall-Wallis probabilities testing Proposition 1 for 3 or 4 levels of IT Sophistication for the measures of FINPERF using various cluster and SIC sub-samples

Sample	1 year sales growth	Net Return	5 year Sales growth
All firms (n=172) (4 levels)	0.500	0.465	0.712
Cluster 1 (n=35+) (3 levels)	0.901	0.593	0.693
Cluster 2 (n=45+) (3 levels)	0.563	0.325	0.639
Cluster 5 (n=29+) (3 levels)	0.453	0.924	0.805
SIC 32 (n=113+) (4 levels)	0.711	0.713	0.471
SIC 34 (n=20+) (3 levels)	0.269	0.534	0.806

Testing Proposition 1 using Components of IT Sophistication

In the discussion of proposition 1 in Chapter 3, the following dimensions of IT Sophistication were expected to be associated with FINPERF.

Q4 Ownership of the computer, e.g. owned, shared or a bureau

Q6 Number of terminals

Q8 Year of first computer - showing length of computerisation

Q16 Frequency of use by owner (never, monthly, weekly)

SOF Number of sophisticated applications

FAA Number of functional areas covered

MST Number of managerial applications

UNS Number of unsophisticated application areas

Kruskall-Wallis tests were conducted for each of the above components of IT Sophistication. For each component, e.g. Ownership, the firms were classified as one of:

* No computer
* Unsophisticated
* Semi-sophisticated
* Sophisticated

The classification for a firm with a computer was dependent on its relative level of sophistication for that particular component. Typically, this involved a lowest third, a middle third and a top third. A firm could thus be rated as unsophisticated on one component and sophisticated on another.

Table 11.5 below reports the Kruskall-Wallis probabilities for tests of all firms.

Table 11.5: Kruskall-Wallis Probabilities Testing Proposition 1 by components of IT for three measures of FINPERF

All Firms (n=168+)	1 year sales growth	Net return	5 year Sales growth
(Typically 4 levels of IT Sophistication)			
Ownership (Q4)	0.344	0.454	0.196
Number of terminals (Q6)	0.283	0.200	(+) 0.070*
Year of first computer (Q8)	0.356	(-) 0.076*	(-) 0.085*
Use by owner (3 levels) (Q16)	0.304	0.874	0.446
Number of sophisticated applications (SOF)	0.194	(-) 0.040*	(+) 0.006**
Number of functional areas (FAA)	0.495	0.349	0.398
Number of managerial applications (MST)	0.642	0.177	0.524
Number of unsophisticated applications (UNS)	0.234	0.734	0.576

Three components of IT gave significant results. For the variable, number of terminals, the one significant result was for semi-sophisticated IT, performing higher than all other levels.

For the variable, year of first computer, the firms that had computerised in 1983 or 1984, i.e. the most recent to computerise, performed significantly higher. This was an unexpected result, as firms that had had IT longer, not shorter, were expected to perform best.

For the variable, number of sophisticated applications, the firms with a high number of applications performed worst for both net return and five year sales growth. However, for the five year sales growth the semi-sophisticated firms performed significantly better than the others.

The above results give a mixture of support and contradiction to the major proposition. As there were a number of negative results, further analysis was conducted to see if components of IT had positive correlations with FINPERF.

Testing Proposition 1 using Correlations of IT Sophistication with FINPERF

To explore the unexpected negative relationships reported in Table 11.5, Kendall rank correlations were calculated for each component of IT Sophistication with three measures of FINPERF. Rather than treat all firms without a computer with a value of zero, only the firms with a computer were included in this analysis. To simplify the presentation of the data only the significant correlations are reported in Table 11.6. The level of significance is indicated using one * for 10%, ** for 5%, based on a two tailed test.

Table 11.6: Significant Kendall Rank Correlations for Components of IT Sophistication with FINPERF - All Firms (n=60+)

IT Variable	1 year sales growth	Net return	5 year Sales growth
Ownership (Q4)			
umber of terminals (Q6)		-.12*	
Year of first computer (Q8)		.19**	.21**
Use by owner (Q16)			
Number of sophisticated applications (SOF)		-.19**	
Number of functional areas (FAA)		-.12*	
Number of managerial applications (MST)		-.16**	
Number of unsophisticated applications (UNS)			
ITSOPH (aggregate measure)			

Of the six significant correlations reported in Table 11.6, all indicate negative correlations rather than the expected positive correlations between IT Sophistication and FINPERF. [Though both coefficients for the variable "Year of first computer" were positive, the result implies that low values, e.g. 1980, are linked to low performance, and high values, e.g. 1984, are linked to high performance, which is contrary to expectations.]

With unexpected negative findings reported in Table 11.6, the analysis was taken further by considering various sub-samples rather than taking all computerised firms together. The group of mechanical engineering firms and three of the clusters provided large enough sub-samples for this analysis. The correlation results are summarised in Table 11.7. [The actual results are reported in Appendix 12.]

The correlation results summarised in Table 11.7 show that of a total of 29 statistically significant results, all but one were negative. This suggests that for firms with computers, lower IT Sophistication is associated with higher FINPERF. This was contrary to expectations as information technology was expected to provide benefits which would lead to better performance. This matter is discussed further in Chapter 14, with the objective of explaining such an unexpected result.

Table 11.7: Summary of correlation analysis for IT Sophistication with FINPERF for various sub-samples of firms with a computer

	1 year sales growth	Net return	5 year Sales growth
SIC 32 (n=39+)	2 negative	4 negative	1 negative
Cluster 1 (n=17+)	1 negative	1 negative 1 positive	5 negative
Cluster 2 (n=18+)	1 negative	3 negative	1 negative
Cluster 5 (n=15+)	none significant	1 negative	2 negative
All Firms (n=60+)	none significant	5 negative	1 negative

Chapter 12

A COMPARISON OF THE FINANCIAL PERFORMANCE OF IT USER FIRMS AND NON-USER FIRMS

The major proposition of the study was that investments in IT would be reflected in superior financial performance. Taken in its simplest form, this argument suggested that firms with a computer would perform better than those without, assuming all other things were equal. However, the analysis in Chapter 11 failed to find much statistically significant evidence to support such a proposition.

This chapter analyses the data in a different way, by comparing the performance of those firms with a computer versus those without a computer. The major objective of the analysis being to see if firms with a computer had performed better than those without a computer. However, before the financial performance analysis was made, other differences between the two groups of firms had to be understood. Otherwise, it would only be speculative to imply that any differences in performance were due to computerisation. Hence, the two groups of firms were initially compared on a number of descriptive variables prior to the comparison on financial performance variables.

Differences between firms with and those without a computer

The literature, particularly Delone (1981), Cragg (1984) and Suter (1985), suggested that size of firms was an important determinant of whether a firm used a computer. Thus, computer ownership was expected to be higher in firms that had more employees, more managers and greater annual turnover. There was no other prior empirical evidence of differences between firms with and without computers, but computer ownership was expected to be a reflection of the owner's attitudes. Thus, computer ownership was expected to be higher in firms that wished to grow,

where the owners worked at a desk rather than with machinery, and for firms with younger owners.

These expected relationships are explored in the analysis below, commencing with an analysis by size of firm in Table 12.1. As expected, very small firms were less likely to have a computer. Only 11% of the smallest firms had a computer, compared with 61% of the larger firms.

Table 12.1: Computer ownership by size of firm

	Number of Employees 1-5	6-10	11-19	20-49	All firms
No Computer	89% (n=62)	73% (n=44)	63% (n=38)	39% (n=25)	67% (n=169)
Computer	11% (n=8)	27% (n=16)	37% (n=22)	61% (n=39)	33% (n=85)
Total	(n=70)	(n=60)	(n=60)	(n=64)	(n=254)

A more detailed statistical comparison of those with and without a computer is given in Table 12.2 The table looks at variables other than firm size, and reports whether the difference was statistically different. In total, 14 variables were analysed, of which five showed significant differences.

As well as firm size being one of the significant variables, the other significant variables could all be related to firm size. The number of managers is likely to be a reflection of firm size. Furthermore, the other three significant variables, i.e., the introduction of new products, the amount of forecasting, and the percentage of owners who worked mainly at a desk, could all be a reflection of firm size. In some respects the two groups of firms were very similar. This was particularly so for the age of both the firms and their owners.

Table 12.2: Comparison of Firms - No computer versus With computer

	No Computer (n=169)	With Computer (n=85)	Difference Level of significance	Test Used	All firms (n=254)
Organisational variable					
Year established[1]	1970	1970	NS	M-W	1970
New products (% no/yes)	45/55%	21/79%	**	χ^2	36/64%
Written business plan "	89/11%	80/20%	NS	χ^2	86/14%
No monthly forecasts (%)	35%	23%	NS	χ^2	31%
Number of monthly forecasts[1]	2	3	**	M-W	2
Size - Number of employees[1]	8	18	***	K-S	10
Number of managers[2]	1	4	***	M-W	2
Sales Revenue in 1985[2]	$100,000-$200,000	$400,000-$500,000	NS	K-S	$200,000-$300,000
Standard Industrial Classification (SIC) (% mechanical/electrical)	69/11%	59/21%	NS	χ^2	65/15%
Owner-Manager variables					
Year of birth[1]	1938	1940	NS	M-W	1938
Percentage work at desk/machinery	59/30%	87/9%	**	K-S	69/22%
Objectives:					
Percentage wish to grow least important	71%	55%	NS	K-S	66%
Percentage earn money medium importance	54%	54%	NS	K-S	54%
Percentage job satisfaction most important	71%	69%	NS	K-S	70%

M-W	Mann-Whitney test for 2 groups and rankable scores
χ^2	Chi-squared test for 2x2 groups
K-S	Kolmogorov-Smirnov two sample test for 3 or more ordinal groups
NS	Not significant at the 5% level
*	Significant at the 5% level
**	Significant at the 1% level
***	Significant at the .1% level
1	Median
2	Mode

Computer use and financial performance

The data reported in Tables 12.1 and 12.2 showed that the SIZE of the firm could be the major difference between the firms that use and do not use a computer. This suggested that size of firm should be controlled in any further analysis. Hence, rank correlation coefficients between computer use and financial performance were calculated for the different sizes of firms. The two variables used were the no computer/computer variable and one year sales growth. The results are given below in Table 12.3.

Table 12.3: Rank correlations, computer ownership with one year sales growth, by size of firm

	Number of Employees 1-5	6-10	11-19	20-49	All firms
Kendall Tau b	-.0474	.0037	.0453	.2259	.0689
Sample size	56	52	49	55	212
Significance	.336	.487	.354	.023*	.113

The final column in Table 12.3, for all firms, suggests there to be weak overall correlation between computer ownership and financial performance. There would seem to be no relationship for the smaller firms, but for the group of largest firms a statistically significant correlation was found.

Taking only this group of larger firms, the relationship between computer ownership and one year sales growth is depicted below in Table 12.4. Firms with computers had a much greater chance of being high performers; 54% compared with 20%.

Table 12.4: Computer ownership by one year sales growth for the largest small firms (n=55)

	One year sales growth			Total
	Low Performers (n=16)	Medium Performers (n=16)	High Performers (n=23)	
No computer	30% (n=6)	50% (n=10)	20% (n=4)	n=20
Computer	29% (n=10)	17% (n=6)	54% (n=19)	n=35

The two groups of larger firms only were compared with respect to other variables. Though the groups were similar in many respects, differences were found in relation to year established, the introduction of new products, and the number of managers. The full comparison is shown in Appendix 13.1. The statistically significant differences are shown in Table 12.5 below.

Table 12.5: Differences between firms with and without a computer for large firms only (n=55)

Variable	No Computer (n=20)	With Computer (n=35)	Level of Significance
Year established (median)	1948	1968	5%
No new products/new products	47/53%	17/80%	5%
Number of managers (median)	3	3	1%
One year sales' growth (median)	15%	20%	5%

The significant difference in one year sales growth was explored further. Likely explanatory variables were controlled in the analysis. The results are shown in Table 12.6. These are discussed below, leading to the conclusion that the performance difference between those firms with a computer and those without, was not due to the presence of a computer but to other variables.

There are three important aspects to the results in Table 12.6, where for once, the "not significant" results are important. Prior to the control, these 55 firms showed a strong correlation between computer ownership and financial performance. Many of the controlled results suggest a much weakened relationship, unlike the partial correlations in Appendix 13.2. For example, for the age of the firm (indicated by the year established), amongst the medium firms there was no difference between those with versus without a computer. Similarly for the youngest firms. Many of the results in Table 12.6 are not statistically significant. Hence all the given variables would seem to be able to either totally or at least partially explain the observed relationship between computer ownership and one year sales growth.

Table 12.6: Testing with v without controlling for likely explanatory variables - using the Mann-Whitney U test (Large firms only, n=55)

Control Variables	Mean Rankings No computer	Computer	Direction of Relationship	Two tailed Probability
No control variables	22.08 (n=20)	30.44 (n=35)	+	.0617*
Year established:				
Older firms only	9.88 (n=13)	18.50 (n=15)	+	.0056**
Medium firms only	8.75 (n=3)	9.03 (n=15)	+	.9405
Young firms only	4.00 (n=4)	5.80 (n=5)	+	.3252
New product:				
No	6.72 (n=19)	9.92 (n=6)	+	.1730
Yes	14.50 (n=11)	21.29 (n=28)	+	.9071*
Monthly sales forecasts:				
No	7.06 (n=8)	9.07 (n=7)	+	.3829
Yes	14.72 (n=10)	19.76 (n=27)	+	.2140
Monthly profit forecasts:				
No	11.15 (n=13)	14.09 (n=11)	+	.3097
Yes	9.75 (n=5)	14.74 (n=23)	+	.2456
Monthly material requirements forecast:				
No	11.75 (n=8)	17.48 (n=23)	+	.1245
Yes	9.39 (n=10)	11.41 (n=11)	+	.4471
Number of managers:				
Two managers	6.67 (n=7)	6.33 (n=6)	-	.8726
Three managers	8.00 (n=9)	13.25 (n=12)	+	.0531*
Four managers	5.75 (n=2)	9.97 (n=16)	+	.2915

The second important aspect of the data in Table 12.6 is the nature of the variables which seem to explain the previous relationship between computer ownership and performance. Three aspects of forecasting all remove the previously significant relationship. This provides an important clue to what could provide an explanation of the earlier result.

The third important result in Table 12.6 is the result for the 28 oldest firms. The relationship between computer ownership and performance remained very strong amongst this subset of firms.

If this subset of firms is investigated further, any differences associated with computer ownership could provide strong explanatory findings.

The descriptive data for these 28 old, larger firms is given in Appendix 13.4. The differences between the two sets of firms are shown in Table 12.7 below. The computerised firms tend to be younger and more likely:

* to have introduced new products
* to forecast both sales and profit (see Appendix 13.5 for further details)
* to have a written business plan
* to have more managers

and for the owner manager to be still using machinery, and have a greater interest in both job satisfaction and firm growth.

Table 12.7: Differences between firms with and without a computer for the 28 old, larger firms

Variable	No Computer (n=13)	With Computer (n=15)	Level of Significance
Year established (median)	1938	1948	5%
No new products/new products	46/54%	13/80%	1%
Written business plan (no/yes)	92/8%	73/20%	5%
Number of managers (median)	3	4	5%
Work at desk/machinery	92/8%	73/20%	5%
Wish firm to grow	69%	53%	5%
One year sales' growth (median)	10%	20%	5%

Summary

As expected, larger firms had computerised more than smaller firms. For the largest firms, a significant correlation was found between computer ownership and one year sales growth. Of these larger firms, those that had computerised tended to be younger, to have more managers, and to have developed new

products in recent years. A strong correlation was found between computer ownership and performance for the oldest, large firms. However, forecasting activities within the firms could explain this correlation. As a result, though the data seemed initially to give support to the major proposition that IT investments could be reflected in superior performance, the proposition was not supported when tested with control variables.

Chapter 13

DETERMINANTS OF IT SUCCESS

The major thrust for this study was to investigate the relationship between IT and financial performance. However, for those firms with a computer, data was also collected on IT success. This provided the opportunity to study two further propositions. Proposition 2 related to determinants of IT success. Proposition 3 concerned the correlation between IT success and financial performance. Both of these propositions are explored in this chapter through analysis of the mail questionnaire data. The analysis attempted to answer two questions; what factors determine IT success, and is IT success a good surrogate of financial performance?

What Factors Determine IT Success?

The research by Delone (1983 and 1988), Raymond (1985), Lees (1987) and Montazemi (1988) all looked at determinants of IT success in small firms. Their major findings are summarised in Table 13.1, where it can be seen that many variables have been investigated as causes of IT success in small firms. Most of their hypotheses were based on findings in large firms. Some of these expected relationships were confirmed, for example, the importance of user involvement and IT planning. However, others were not, in particular, the number of years' experience with computers was not found to be related to IT success.

These studies provided a number of variables which could be re-examined in this study of small engineering firms. Their relationship with IT success could be investigated. Typically, the above studies used measures of information system user satisfaction to measure "success". This study of small engineering firms adopted a broad measure of IT success as discussed in Chapters 3 and 5. IT success was measured using ten

Likert statements reflecting a range of possible organisational impacts.

Table 13.1: Prior studies of the determinants of IT success in small firms

Raymond (1985) found MIS Success to be positively correlated with:
* the proportion of applications developed and run internally
* the number of administrative (rather than transactional) applications
* in-house processing
* on-line applications
* the MIS function at a high organisational level
- and negatively associated with length of EDP experience .

Delone (1983 and 1988) used loglinear analysis to control other variables, and concluded that success was related to:
* chief executive knowledge of computers
* chief executive involvement in computer operations
* on-site computer use
* computer planning and controls together - but not separately
- and no support for success depending on external support, personnel acceptance, longer use of computers and computer training.

Montazemi (1988) found MIS success to be positively associated with:
* presence of a systems analyst
* intensity of information requirements analysis
* end user involvement
* intensity of computer literacy
* interactive systems
* the degree of decentralisation in the firm
- and not related to duration of CBIS experience, or to the use of special purpose applications.

Lees (1987) also reported success to be correlated to:
* user involvement
* vendor involvement
* length of time since computerisation
* prior experience with computers
- with a negative correlation with use of consultants.

Note that the conclusions by three of the studies are based solely on correlations. Only in Delone's study were controls used to test relationships.

A Causal Model of IT Success

The above literature review identified likely important variables in the study of IT success. However, a weakness of such studies has been the reliance on two variable correlation analysis.

Delone's analysis was the only study to use control variables. Hence, a more sophisticated analysis was called for which could build on this prior research. With the purpose of discussing a causal model which links the important variables, the relationships between variables are now discussed.

Three factors were seen to influence the level and orientation of IT planning in a firm. IT planning was viewed as likely to benefit from owner involvement, and the existence of prior computing experience in the firm and assistance from outside. All three were seen as likely to give IT plans a broad perspective.

Engaging in IT planning was seen as directly influencing IT success as IT planning should improve the likelihood of a system suiting their needs. In addition, if IT planning encouraged wide use of IT by the organisation, then organisational success was likely.

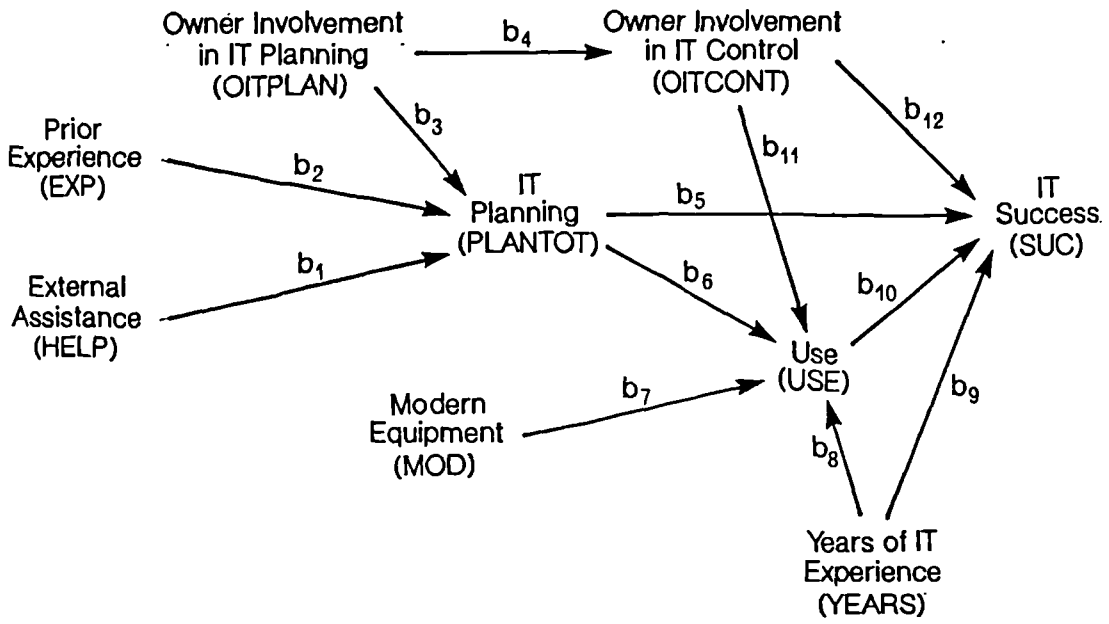
Modern systems were seen as more likely to be user friendly, interactive and flexible, thus encouraging wide use.

Despite other studies finding negative correlations between IS satisfaction and years of experience, the experience variable was retained for two reasons. Firstly, it was envisaged that use of IT takes time to spread throughout the organisation. Secondly, the benefits from IT are likely to take time to achieve. Thus a firm's length of experience with computers was seen as impacting on both use and success.

Another influence on IT success was the owner's continued involvement in IT management. It seemed likely that owners involved in IT planning were more likely to continue their involvement as well as influence success and the wide use of IT in the organisation. The major factors and their hypothesised influences are depicted in Figure 13.1 below.

The causal model in Figure 13.1 represents a number of hypotheses. Each arrow implies a significant influence. For example, taking the variable IT planning, the model implies that the level of owner involvement in IT planning, prior experience and external assistance influence the level of IT planning. In turn, IT planning influences the use of IT and IT success.

Figure 13.1 A Causal Model of IT Success



Path analysis is a technique that has been developed to test such a set of relationships. Often path analysis uses regression analysis to see which paths (influences, or relationships between variables) are significant.

The regression way of viewing Figure 13.1 is as a set of equations. These equations are given below, using path coefficients (b's) and variable abbreviations as shown in Figure 13.1.

$$\text{PLANTOT} = b_1\,\text{HELP} + b_2\,\text{EXP} + b_3\,\text{OITPLAN}$$

$$\text{OITCONT} = b_4\,\text{OITPLAN}$$

$$\text{USE} = b_6\,\text{PLANTOT} + b_7\,\text{MOD} + b_8\,\text{YEARS} + b_{11}\,\text{OITCONT}$$

$$\text{SUC} = b_5\,\text{PLANTOT} + b_9\,\text{YEARS} + b_{10}\,\text{USE} + b_{12}\,\text{OITCONT}$$

TABLE 13.2

The major variables in the causal model of IT success

Variable Name	How measured (Source)	Descriptive Statistics (n=85)
Prior experience (EXP)	Some or none (Q10)	44% had prior experience
Owner involvement in IT Planning (OITPLAN)	Sum of levels of owner involvement for defining needs and selection of system (Q14)	47% highly involved 10% not involved range 4 to 10
External assistance (HELP)	Whether someone outside the firm had assisted with initial requirements (Q11)	19% had help writing the requirements
Owner involvement in IT control (OITCONT)	Sum of levels of owner involvement in implementation, solving problems and further developments (Q14)	40% highly involved 11% not involved range 6 to 15
IT planning (PLANTOT)	Written requirements (no/yes): Score 0, 2 (Q11) Number of applications planned: 1 or 2, score 0; 3 or 4, score 1; 5+ score 2 (Q12) Number of functional areas planned: 1 only, score 0; 2, score 1; 3 or more, score 2 (Q12) If better information or new product most important, score 1 (Q13a) If managerial support most important, score 1 (Q13b)	Median 4 range 0 to 8
Modern equipment (MOD)	If recent equipment, score 1 (Qs 8, 9); If in house, score 1 (Q4); High number of terminals, score 1 (Q6).	Median 2 range 0 to 3
Years of IT experience (YEARS)	Years since first computer, with acquisitions in 1970s treated as 1980 (Q8)	Median 1982 range 1980 to 1984
Use of IT (USE)	Number of sophisticated applications, SOF (Qs 15, 19)	Median 2 range 0 to 8
IT success (SUC)	Sum of owner's ratings (Q20)	Median 35 range 16 to 44

A summary of how each of the variables in the model was measured is given in Table 13.2 The IT planning variable (PLANTOT) was a scale based on components of IT planning. Combining components was necessary to avoid problems from multi-collinearity. The scale was based on: whether a written statement of requirements had been prepared (35% yes, 65% no); the number of functional areas planned for (median 2); the number of applications planned (median 3); and whether effectiveness benefits were planned for (35% viewed support for managerial tasks as most important, 56% viewed providing better information or new product or service as most important).

A scale was also used for the variable modern equipment. Three factors were considered: whether their system was acquired or upgraded or replaced since 1983 but before 1986 (66% recent); whether the system was inhouse (89% inhouse); and whether the firm had more than the median number of terminals for a firm of its size. For firms with up to 19 employees, two or more terminals was modern. Three terminals were needed for a classification of modern for larger firms.

Product moment correlations for all the independent variables with IT Success are given in Table 13.3 (extracted from Appendix 14). Three of the correlations were statistically significant, suggesting IT success to be dependent on owner involvement in IT control, IT planning and IT use. Some other interpretations are also offered in Table 13.3.

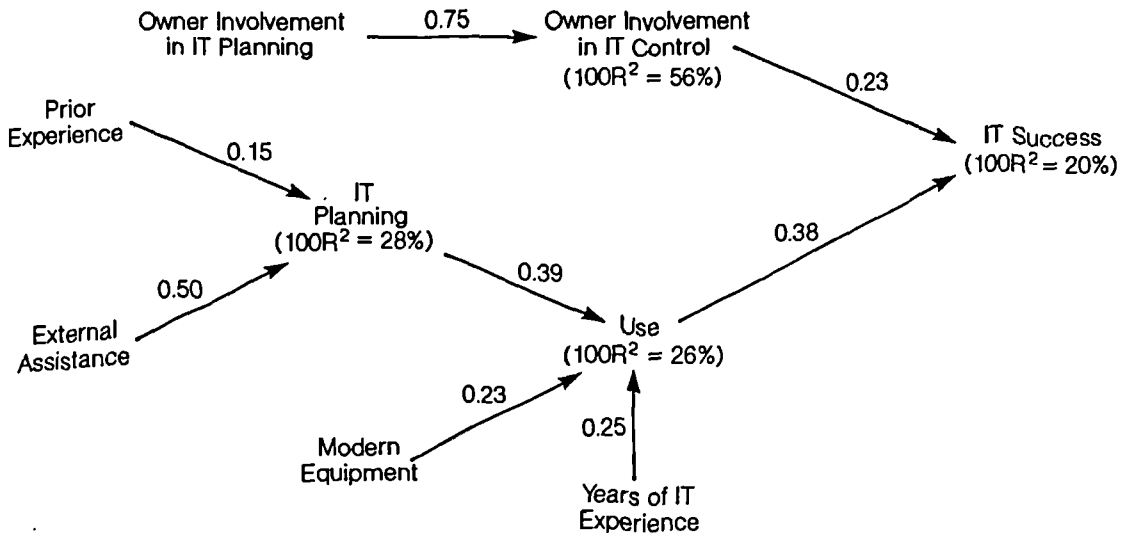
Regression analysis was conducted to estimate path coefficients. Following the advice of Asher (1983), standardised scores were used for all variables (mean 0, standard deviation 1). Each endogenous variable was regressed on all prior influential variables. Hence, four regression equations were created.

Table 13.3: Product Moment Correlations for all causal model variables with IT Success (n=85)

Variable	Coeffficient	Significance	Possible Interpretation
Prior experience	.063	NS	Prior experience is not needed for IT success
Owner involvement in IT planning	.041	NS	Owner involvement in IT planning is not needed for IT success
External assistance	.012	NS	External assistance does not influence success
Owner involvement in IT control	.233	5%	Continued owner involvement is important for IT success
IT planning	.189	5%	IT planning is important for IT success
Modern equipment	.086	NS	IT success can be gained with or without older equipment
Years of IT experience	.079	NS	A firm does not need many years of experience to be successful with IT
Use of IT	.387	1%	A large number of applications is important for IT success

One objective of path analysis is to determine which paths are significant, i.e. which relationships are significant. Due to random fluctuations, it is unlikely for a coefficient to be zero, even when no relationship exists. Four path coefficients were found to be very small at less than 0.05. These paths were eliminated from the model following the advice of Heise (1975, pp 194-5). The resulting paths, coefficients and multiple R^2 values are given in Figure 13.2.

Figure 13.2 Results of Path Analysis on Causes of IT Success



The data gave considerable support to the causal model discussed earlier. All the path coefficients given in Figure 13.2 were statistically significant, except that between prior experience and IT planning. The coefficient between years of IT experience and use was in accordance with theory.

Years of IT experience had a positive impact on use. With one exception, all the path coefficients shown in Figure 13.2 were statistically significant at the 5% (one tail) level. The exception was the path from prior experience to IT planning.

The most important conclusion to be drawn from the analysis was that all hypothesised influences on IT success were supported. This shows a relative strength of path analysis over correlation or regression analysis. The correlations given earlier in Table 13.3 suggested only three variables were significantly associated with IT success. The path analysis suggests all variables are important in their own way. For example, external assistance had a very low correlation with IT success, yet external assistance had influenced IT planning, which in turn influenced use of IT.

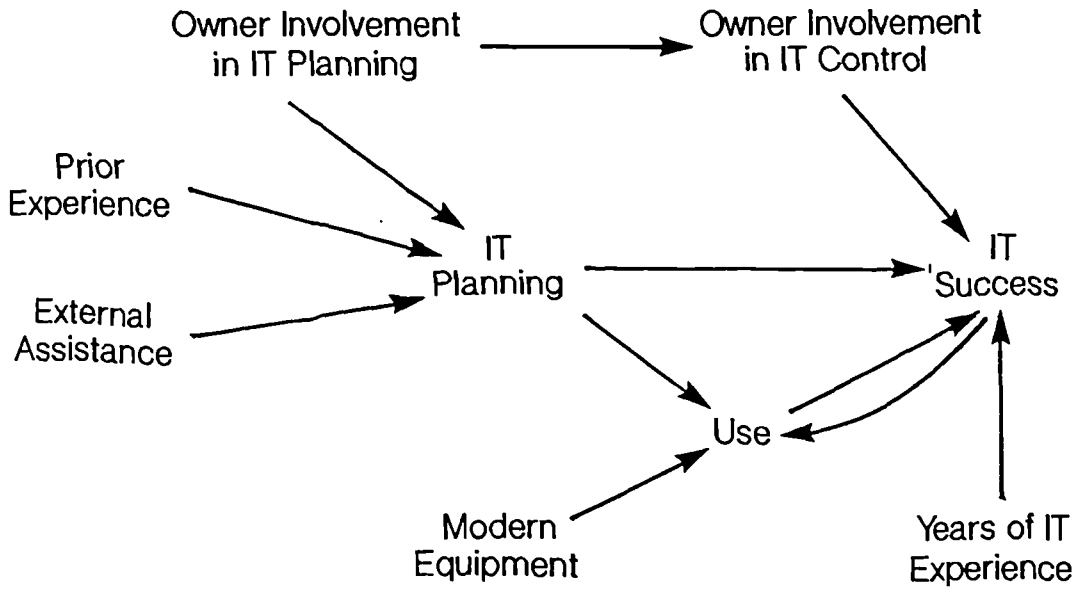
Use of IT had a significant influence on IT success. The only factor with weak support is prior experience. Owner involvement, particularly continued involvement, and IT planning are both important for IT success.

A Non-static Causal Model of IT Success

The causal model discussed earlier saw the relationship between use and success as a one-way relationship. It may be more realistic to consider that use leads to success, and in turn, success encourages wider use of IT in the organisation. Thus the form of the relationship between use and IT success is a feedback or loop.

This different view of the inter-relationship between use and success, has implications for other factors in the original "static" model. In particular the years of IT experience variable can be viewed as influencing use via IT success, rather than directly, if use is dependent on success. Similarly, any influence on use from the owner's involvement in IT control would be via IT success. This non-static model is shown in Figure 13.3.

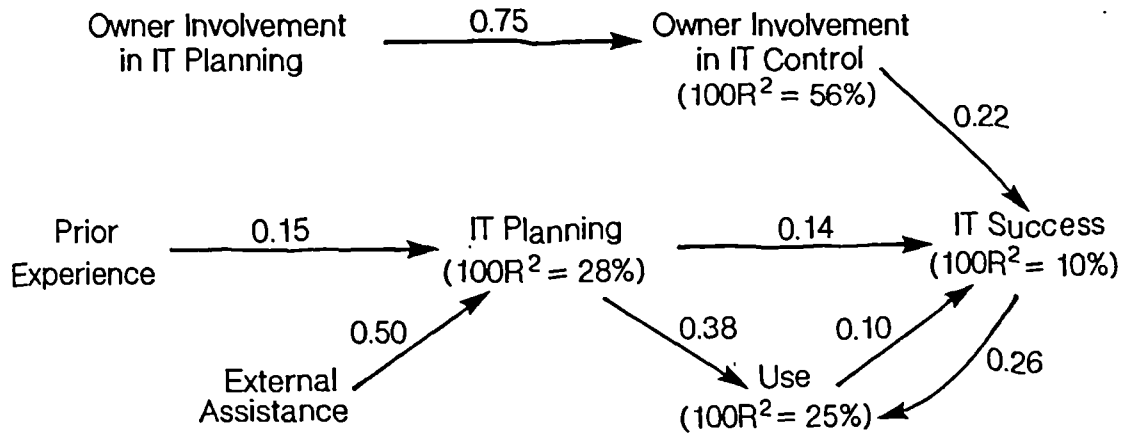
Figure 13.3 A Non-static Feedback Model of IT Success



The inclusion of a feedback loop required a different, but similar, method of analysis. As the variables Use and IT success are now related, two staged least squares was used to estimate path coefficients for paths involving use and IT success. Using Asher's terminology, (Asher 1983) the last two equations are over-identified as they involve fewer unknown path coefficients than there are exogenous variables in the model. Two stage least squares is appropriate in this situation. Instead of regressing Use on IT planning, Modern equipment and IT Success, Both use and IT Success were initially regressed on all five exogenous variables to provide estimates free of bias from other variable in the feedback loop. The second stage is to use these estimates in a normal regression equation. The use of standardised scores met the methodological requirements discussed by Kritzer (1976) when using two stage least squares in path analysis.

The results of the path analysis are given in Figure 13.4, where paths with small coefficients are excluded.

Figure 13.4 Path Coefficients for the Non-static Feedback of IT Success



This non-static causal model is different in three major ways to the earlier static model. Firstly, two variables have been

eliminated from the model. Modern equipment had a zero path with use. Years of experience had a zero path with IT success.

Secondly, there is a strong feedback relationship between IT success and use, particularly on success breeding greater use rather than use leading to success.

The third difference is the roll of IT planning. IT planning now has a small direct path with IT success, as well as a significant direct influence on use of IT.

The earlier, static model was close in theory to prior research, and suggested that all factors were important. This non-static model shows how important IT success itself can be in achieving further IT success. The model suggests that, particularly in the presence of good IT planning and owner involvement in IT control, firms can achieve IT success. Many years of experience and the use of modern equipment are not necessarily important. What is important is for firms to build on successes.

Both models suggest the following factors are important for IT success:

* External assistance
* Owner involvement in IT planning
* Owner involvement in IT control
* IT planning (incorporating a written statement of requirements, with plans for many applications, with effectiveness benefits rather than efficiency benefits in mind)
* A large number of sophisticated applications

Is IT Success A Good Surrogate Measure of Financial Performance?

As well as investigating determinants of IT success, the mail questionnaire data also provided an opportunity to explore the

correlation between IT success and financial performance. The motivation for such an analysis being that in many studies of IS success, there is an assumption that IS success is highly correlated to organisational success. Ives, Olson and Baroudi (1983) stated that user information satisfaction provided a "meaningful surrogate for the critical but unmeasurable result of an information system, namely, changes in organisational effectiveness" (p 785). After briefly reviewing the literature on measures of MIS success, the results of the correlation analysis are reported and discussed.

Measures of MIS success

Many studies have looked at MIS success in large organisations. As well as suggesting important variables for studies of small firms, the research in larger firms has provided tools to assist researching MIS success in small firms. The Studies by Raymond (1985) and Montazemi (1988) both used modified versions of the Pearson and Bailey (1979) instrument to measure user information satisfaction.

Ives and Olson (1984), in a review of studies using a measure of Information System (IS) success, identified four types of measure of MIS success:

* System quality - an attempt to measure organisational impact
* System acceptance - particularly systems use
* Perceived quality/information satisfaction
* Changes in user behaviour/attitudes

They concluded that user information satisfaction was the most commonly used dependent variable. The work by Ives, Olson and Baroudi (1983) promoted the use of an adapted, validated version of the Pearson and Bailey instrument to encourage researchers to use the same valid instrument. Srinivasan (1985) questioned the assumption that behavioural measures and perceived measures were

the same. He found little correlation between measures of "actual use and perceived system worth" (p 247).

One implication for this study of small engineering firms was that any measure of success should relate to the objectives for investing in IT. Hence an organisational perspective was taken in the development of an instrument to measure IT success. Such a perspective meant that no previous instrument could be used, though other instruments did provide ideas on style and content.

Correlations between IT Success and FINPERF

Kendall rank correlations are shown in Table 13.4 for all firms with a computer, and specific sub-samples. In general, the correlations are weak, and include both positive and negative signs. This is a surprising result as the scale used to measure IT success was specifically created to reflect broad organisational level impacts, rather than previously used measures of the quality of information systems in a firm.

Table 13.4: Kendall Rank Correlations Between IT Success and Measures of Financial Performance (n=85 max)

Sample	One year sales growth	One year net return	Five Year sales growth
All firms (n=64+)	0.04	-0.08*	0.09*
Cluster 1 (n=17+)	0.15*	0.05	0.07
Cluster 2 (n=18+)	-0.05	-0.17*	0.13
Cluster 5 (n=15+)	0.13	-0.08	0.02
SIC 32 (n=39+)	0.05	-0.08	0.07

* 10%
** 5%
*** 1% significance

An implication of such unconvincing correlations is that researchers should not just assume that measures of IT success

are good surrogates for organisational success. Srinivasan (1985) showed that behavioural measures and perceptual measures of IS success were measuring different concepts. This latest data suggest that a perceptual measures of IS success is different to measures of organisational performance. Correlations reported earlier showed that IT use was, if anything, negatively correlated with performance. If the ultimate goal of investments in information technology is to improve organisational effectiveness, then studies of factors of IT success should reflect organisational effectiveness. In such studies, a causal model, linking aspects of IT with organisational effectiveness, may be a most fruitful approach. For example, IT can lead to various forms of competitive advantage. Each type of advantage may impact on organisational effectiveness in a different way. The study by Willis (1986) showed that small firms could use IT to generate additional revenue. One success factor for those firms was attendance at a seminar specifically aimed at addressing that form of competitive advantage.

Chapter 14

STUDY DESIGN TO TEST THE NEGATIVE FINDINGS BETWEEN *IT SOPHISTICATION AND FINANCIAL PERFORMANCE*

Chapter 11 reported unexpected negative correlations between IT Sophistication and financial performance. It is possible that these negative correlations are a genuine reflection of what is happening in small firms. Possible explanations of these unexpected findings are discussed below in an attempt to understand them. Three possible explanations are considered: methodology problems, that IT helps promote poor performance, and that some factors promote both IT growth and poor performance simultaneously. This discussion is then used as the basis for the design of a study to investigate the negative findings.

Possible explanations of the negative correlations

(i) Methodological Problems

It is possible that the research is flawed with a methodological error that has created the negative relationship. One explanation could be that the FINPERF results were reported inaccurately. For example, those firms with poor information systems may have guessed optimistically. This has been recognised throughout as a weakness of the study, with no easy remedy due to the very limited financial reporting requirements for small firms.

(ii) IT helps promote poorer performance

It seems possible that the introduction and use of IT in a small firm, does have a detrimental effect on Finperf. A number of potential "detrimental effects"' are discussed below, with possible causes. These detrimental effects of IT are split into direct and indirect effects. Increased

cost and system problems could be direct results of IT. The indirect effects are symptoms of IT where the causal chain may or may not be well understood.

Direct Effects

* IT could increase costs. As well as the cost of the computer investment, the earlier study by Cragg (1984) reported examples of increased costs due to computerisation. Extra staff, system maintenance and stationery bills were examples of increased costs.

* System problems could absorb excessive managerial time, and thus leave important matters unattended.

Indirect Effects

* IT could decrease a firm's flexibility to respond to opportunities. An example of this would be a firm that had become too tied to old software which then hindered growth and thus impaired their performance.

* IT could increase customer alienation. It seems possible that systems were not used to improve customer service, but to improve internal efficiencies at some loss of freedom to customers. The system could take longer to sort out errors on invoices, or demand earlier payment, or need more time than in the past to respond to customer requests.

* IT could decrease employee performance. It seems possible that employees could become less productive because a system had been forced on them. Employees could feel that they had become less important, or that the fun had gone out of their job, or that the new system demanded a higher standard of work.

* IT could decrease owner-employee communication. It is possible that owners could use new systems to find their own data, resulting in a weakening of the team concept. Or employees could be blamed for system errors and problems.

* IT could decrease pricing flexibility. It is possible that the system could be used to determine prices. This, combined with a feeling that the cost of the system had to be recouped, could increase prices, with a resulting loss of customers.

* IT could increase debt collection problems. If poor payers were now less obvious or did not receive the same pressure or personal attention that they would have received in the past, then debt collection problems may have increased, causing a deteriorating cash flow position.

The above list of variables suggests that it is possible for the introduction and use of IT to create problems for the organisation. These problems may or may not be addressed and resolved by management, and as a result financial performance could be affected. If they are addressed by management, then this could absorb an unacceptable amount of managerial effort, to the detriment of the firm. Hence we have a situation where IT creates change in the organisation. Some changes may be unresolved and cause problems, others could absorb managerial effort.

(iii) Some factors promote IT growth and poor performance simultaneously

It is also possible that there are factors which could promote both the growth of IT and poor performance

simultaneously, and thus have led to a negative correlation. Possible environmental and behavioural factors are discussed below.

* Market forces

  If a firm was performing poorly, then it could turn to IT in an attempt to try and solve the problem. This could be excerbated if they planned their IT badly, or overcommitted themselves. Similarly, better performing firms could feel little pressure to improve their performance by investing in IT.

* Administrative type owner

  Different types of owner have been identified in the literature. Maybe some like to introduce important looking systems, which are in the end ineffective. As a result, their IT sophistication would increase, but any effect on performance would, at the worst, be negative as scarce resources could be diverted from more useful endeavour. King and McAuley (1989) discuss the concept of "technological fascination", when describing managers who seemed "to spend significant time ensuring the success of IT in order to meet personal needs" (p 116). King and McAuley recognised that this "seduction of technology" (p 16) had implications for the measurement of IT success. In the context of small firms, the motivation for an individual to develop an IT application may not be to score personal points or gain influence. However, as many owners have chosen to be their own boss, they may feel that they can do as they please. As a result, some may spend an inappropriate amount of their time developing IT applications.

* Wish to grow

  Another reason to computerise could be the wish for the firm to grow. Maybe IT is seen as a long term

investment. Initially, it could be seen as a learning exercise with the future in mind rather than short term benefits. Hence, a firm may be willing to sacrifice short term financial performance and decide to invest in technology with a view to longer term growth. Similarly, firms that have no wish to grow may feel that any investment in IT would have to be justified in terms of extra sales, which may not be desired as this implies growth.

* Managerial caution towards change
  Some managers are probably more cautious with respect to change and this could include attitudes towards information technology. This could be influenced by past experience, or lack of knowledge, or the experiences of others. Maybe these cautious managers opt for a small number of important and successful IT applications. Less cautious managers could overcommit their firm towards IT with negative consequences on performance, particularly in difficult market conditions.

* Lack of suitable software
  A lack of suitable software could hinder the development of IT applications, especially for unstructured applications. Hence those firms trying to develop more sophisticated IT could put resources into less successful systems. Their IT sophistication could increase, but their performance could reduce due to the inappropriate use of managerial time.

The above discussion provided the following possible explanations for the negative correlations between IT sophistication and financial performance.

* Methodological problems, particularly with data collection.

* Detrimental effects: on costs, managerial time utilisation, flexibility, customer relationships, employee performance, owner-employee communications, pricing flexibility and debt collection.
* Factors promoting IT and poor performance simultaneously: market forces, owner type, wishes to grow, managerial caution, and lack of suitable software.

With these factors in mind, a study was designed to test the hypotheses suggested in the above discussion.

Study Design

With so many tentative hypotheses, the case study research method was selected as the best way of gathering evidence on such a potentially large number of variables. Greater understanding of the impact of IT was obviously required, and as Bonoma (1985) stated, "the goal (of case research) is understanding" (p. 206). Bonoma's use of the word "understanding" refers to more than just description, but includes classification, theory development and limited theory testing.

Benbasat, Goldstein and Mead (1987) offer advice on how the case research method should be used. The unit of analysis was obviously entire small firms rather than some smaller unit. With theory testing as part of the objective, a number of firms were required rather than one single firm.

A number of factors were taken into consideration when determining the specific firms to be selected. As the initial correlation results referred to small engineering firms, small engineering firms were selected for study. Bonoma's process model (Bonoma, 1985) implied that at a later stage, another industry could be selected to test findings from the earlier cases.

It was important that IT growth varied across the firms so that simultaneous IT growth and poor performance could be examined. This implied that firms were needed that had used a computer for at least a few years. Following preliminary interviews with ten small engineering firms known to be using a computer in 1984, a sample of six were selected to reflect different levels of IT sophistication. As with the firms in the mail questionnaire study, all the firms had less than 50 employees, and were not subsidiaries of a larger firm. The smallest firm was a sole owner-operator, the largest had 40 employees.

Rather than one single data collection method, multiple methods were used. The firms had been interviewed in an earlier study (Cragg, 1984) so earlier data was available on questionnaires. The preliminary interview was used to gather information on their systems and their use, typically from the person responsible for daily computer operations. A second round of interviews took place with the owner-manager, and where necessary, with the person responsible for IT. In addition, observations were made at the time of the interviews. Furthermore, an adapted version of the East Midlands' questionnaire was used to obtain complementary data, including financial performance.

The variables discussed earlier formed an initial set of questions for data collection. In addition, authors like Pettigrew (1985) and Yin (1984) suggested further topics which could help explore underlying forces or connections between variables. As a result, questions were asked concerning major events in company history, products, market factors, company performance, owner's background, computer use and impact. To retain actual responses, all interviews were tape-recorded. Transcripts were made of each interview and telephone calls made to clarify or add to this data.

The case studies are discussed below. Indepth analysis is reported in the next two chapters. Case summaries are reported in Appendix 15.

The Six Case Study Firms

This section discusses some of the descriptive data about the six case studies. Three major areas are discussed: the organisation, their financial performance, and their information technology.

Descriptive Organisational Data

All six firms were small engineering firms, but of differing type. Of the broad categories used in the larger questionnaire study, two were mechanical engineering, two electrical, one in transport and one specialising in doors and windows. So the sample covered a range of engineering firms, as shown in Table 14.1

Table 14.1 The Six Case Study Firms: Descriptive Data

	THE SIX FIRMS					
	A	B	C	D	E	F
Type of firm Main product	Mechanical Cutting tools	Transport Engines	Other Doors & Windows	Electrical Monitoring tools	Mechanical Valves	Electrical POS terminals
Number of employees	15	8	40	1	40	35
Year established	1970	1975	1965	1984	1969	1966
Birth year of owner	1944	1949	1945	1939	1964	1946
Owner's education	University	Polytech	University	Polytechnic	Polytechnic	University
Owner	Founder	Founder	Founder's son	Acquired in 1984	Founder's son	Founder

Two of the firms had changed their product considerably since 1984. Firm C had moved out of the mass aluminium window market into more specialised doors and windows, including double glazing and stained glass. Firm F's major product in 1988 was point of sale terminals, while in 1984 it had been electrical switchgear. For the other firms, their product range in 1988 was very similar to that of 1984.

Most of the firms were a similar size to that of 1984. Firm C was the exception. In restructuring, they had sold off a major part of their business and now employed 40 staff instead of 120. Firm D had fallen from employing 5 in 1984, to being a one-man business in 1988.

Five of the owners were in their forties. The exception was Firm E where the founder's son had taken over in his early twenties after completing his trade apprenticeship with the same firm.

Financial Performance

Four of the firms were performing well, particularly Firms A and E. Firms B and D were on survival strategies, with Firm D losing money and the owner hanging on in hope, in preference to working for someone else. The two best performing firms, A and E, had increased their turnovers since 1984 and were making healthy profits. This data is summarised in Table 14.2

Table 14.2 The Financial Performance of the six firms

Measure of financial performance	A	B	C	D	E	F
1987 v 1986 sales growth (%)	+28	+2	+20	-25	+25	+20
Five years sales growth (%)	+94	+10	NA[1]	-	+78	+20
Profit (87 cf 86)	up	up	up	down	up	up
1987 Return on sales (%)	32	5	15	-40	20	8

Note 1: As Firm C sold a major part of its operation in 1984, their five year sales comparison was not analysed

IT Sophistication

The firms had been selected on the basis that some had developed more sophisticated IT than others. The growth of IT applications in the six firms is shown in Table 14.3.

Table 14.3 The growth in use of IT in the six case studies, showing the year each application was introduced

	A	B	C	D	E	F
1978			**Bureau** Invoicing			
1979			Creditors General Ledger			
1980						
1981					**Micro acquired** CNC Programming	
1982		**Micro acquired** Invoicing Debtors Creditors		**Micro acquired** Word Processing Design Calculations	CAD	
1983	**Micro acquired**	Profit Analyses	**Mini acquired** Debtors Creditors Invoicing General Ledger	Costing	Payroll Stock Control	**Micro acquired**
1984	Invoicing Debtors Design Calculations	Cheque Writing	Costing Stock Control			Design Word Processing
1985	Creditors			Budgeting Stock Control		
1986			**Replacement Mini acquired** Debtors Creditors Invoicing General Ledger	**Micro acquired** Product Testing	**Micro acquired** Invoicing & Debtors General Ledger Word Processing	**Micro acquired** Invoicing & Debtors Creditors General Ledger
1987	General Ledger		Costing Stock Control	Creditors	CAD	Word Processing Budgeting Payroll **Micro acquired** CAD
1988			**Micro acquired** Word Processing (mailshots) Payroll		Creditors	

Notes: CAD (Computer Aided Design) CNC (Computerised Numerical Control)

The earliest firm to computerise was Firm C. It replaced its bureau systems in 1983 through the purchase of a Wang mini-computer. Since then, the Wang has been replaced and the systems replicated on an Altos. In 1984, Firm C was the most sophisticated of the six firms. Three of the other firms (D, E and F) have also acquired new computers, and have in some ways joined or even overtaken Firm C in terms of IT sophistication. Of the other firms, B had made no developments since 1984. Firm A, the most profitable of the six firms, had also made little change with their IT, and had struggled for 2½ years to implement a general ledger system.

Table 14.4 shows the data for the six firms for the various measures of IT sophistication. It shows that Firms A and B were low on all the measures. Firm D's ITSOPH score was the highest at 7, reflecting the daily use by the owner for a broad range of activities. Firms C, E and F all scored well, predominantly because of their integrated accounting systems.

Table 14.4 IT Sophistication for the six firms

IT Sopistication (1988)	A	B	C	D	E	F
Number of Sophisticated Applns (SOF)	1	1	5	4	2	5
Number of Functional Areas (FAA)	2	3	4	5	4	4
Number of Managerial Applns (MST)	3	2	5	5	3	7
Sole user	Yes	Yes	Yes	Yes	Yes	Yes
Number of active terminals	1	1	5	2	2	2
Hands-on use by owner	Never	Never	Annually	Daily	Monthly	Annually
ITSOPH score	2	1	5	7	5	5

Notes:

1. The sophistication scores were calculated using the methods discussed earlier for the mail questionnaire study (Chapter 5).
2. Also, the same tertile values as used earlier were used for FAA and MST to calculate ITSOPH. [For FAA: -3; 4; 5-6. For MST: 0-2; 3-5; 6-9.]

The data in Table 14.4 also shows how measures of IT sophistication can be inconsistent. For example, if the number of sophisticated applications (SOF) was used, then Firms C and F would rank as the most sophisticated. However, the aggregated ITSOPH score placed Firm D as the most sophisticated. Both measures were reasonably consistent for the two least sophisticated Firms A and B.

The above and other data is analysed more fully in the following two chapters. Chapter 15 concentrates on attempting to explain the unexpected negative correlations reported in Chapter 11. Chapter 16 uses the case study data to explore IT growth in the small firms.

Chapter 15

CASE STUDY ANALYSIS

This chapter discusses the analysis of the case study data to test the previously found negative correlations between IT Sophistication and financial performance. The many possible explanations raised in the previous chapter are discussed in the light of this case study evidence. This evidence was, therefore, analysed with three particular objectives in mind:

* What evidence is there of a direct relationship between IT and financial performance?

* Does IT create detrimental effects that promote (cause) poorer performance?

* Are there some factors which promote both IT growth and poor performance simultaneously.

IT and Financial Performance

The case studies provided an opportunity to further explore the nature of the relationship between IT and financial performance. Did, for example, improved performance influence investment in IT? Also, was there evidence to suggest that benefits from IT were reflected in a firm's financial performance?

Owners reported little direct impact of IT on financial performance. However, questions on other factors like costs and debtor's control provided some evidence of a positive impact on financial performance. There was no evidence of IT having a direct, negative effect on performance.

However, a different picture was suggested by the financial performance and IT sophistication scores derived from the

questionnaires which the owners completed prior to the face to face interviews. The data, which was reported in the previous chapter, is summarised in Table 15.1

Table 15.1 Financial Performance and IT Sophistication for the six firms

Measure of financial performance	A	B	C	D	E	F
1987 v 1986 sales growth (%)	+28	+2	+20	-25	+25	+20
Five years sales growth (%)	+94	+10	NA[1]	-	+78	+20
Profit (87 cf 86)	up	up	up	down	up	up
1987 Return on sales (%)	32	5	15	-40	20	8
Finperf rank	6	2	4	1	5	3
Number of sophisticated applications (SOF)	1	1	5	4	2	5
ITSOPH score	2	1	5	7	5	5

Note 1: As Firm C sold a major part of its operations in 1984, their five year sales comparison was not analysed.

All the measures of financial performance present a similar picture; Firms A and E were the best performing firms, and that Firms B and D were the worst. The rank order, from best to worst, being: A, E, C, F, B, D. This rank order is depicted graphically in Figures 15.1 and 15.2 against two different measures of IT sophistication.

Figure 15.1: Scattergram for ITSOPH versus rank of financial performance for the six case study firms

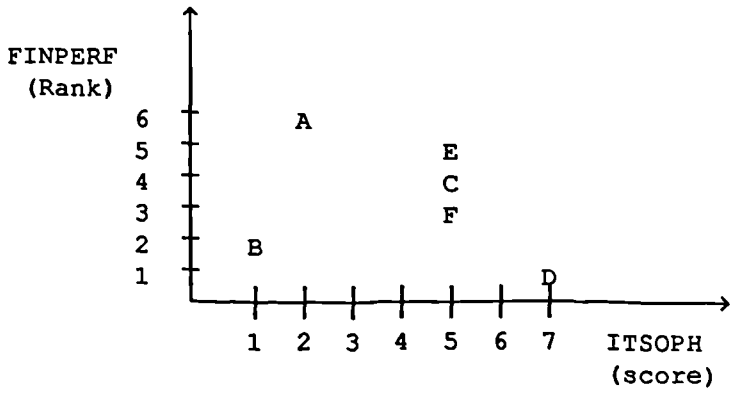
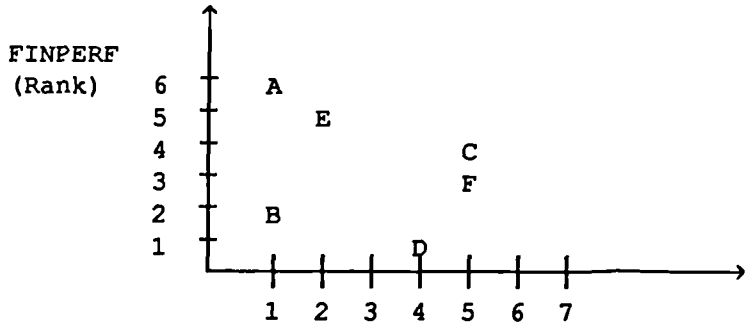


Figure 15.2: Scattergram for Number of Sophisticated IT Applications (SOF) versus Financial Performance



The scattergrams provide some support for the negative correlation between IT and FINPERF found in the larger questionnaire study. Firm A had unsophisticated IT but ranked highest for financial performance. Firm D was the worst performing firm but had sophisticated IT.

One reason Firm A had not developed their IT was because they were not interested in the technology. Firm D was quite the opposite in being fascinated with technology, despite their poor performance. It should also be noted that the owners' perceptions of their markets would differ considerably. At Firm A they were able to introduce new products. At Firm D, sales and marketing were controlled by another firm, making it difficult for Firm D to increase sales revenue.

IT affecting performance

The cost savings reported by Firms A and B were considered to have had a direct impact on profit. At Firm A, it was a reduced overdraft through earlier payment by debtors. Furthermore, Firm A used their system to identify customers who had not ordered recently. Additional sales often resulted from a sales call to these firms. Firm B had used expenditure records to help identify areas for cost reduction.

At Firm F there was evidence of IT affecting performance in a different way. IT developments were pushed by the need to be flexible and to cope with market uncertainties. At Firm F they had spent large amounts on buying technology for them to remain "lean and mean" as an organisation, and hence competitive.

Performance affecting IT

There was evidence also of financial performance having an impact on IT. At the two poorest performing firms, B and D, both wanted to invest in more modern IT, but knew that they would have to wait as the costs would be significant considering their poor financial positions. However, at Firm A, where their IT level was quite low, but financial performance high, there was no hurry to upgrade their outdated system. Firms C and E were examples of well performed firms which had been able to invest in IT. Here IT was seen as necessary support.

The case studies provided some evidence of IT affecting performance in a positive way through reduced costs. Furthermore, performance had affected IT investments, particularly by preventing the poorer performing firms from upgrading. Thus, the case studies showed there to be a two way relationship between IT and performance.

Detrimental Effects

Various possible detrimental effects of IT on financial performance were hypothesised in the previous chapter. They are now considered in the light of the case study evidence.

Direct Effects

* Could IT increase costs?
  The six case studies provided some evidence to support the hypothesis that IT increases costs. However, these cost

increases seemed minor, especially when compared to the large cost savings reported by two firms. The on-going system developments at Firm C were seen by the firm as a necessary short term cost increase in order to achieve the longer term benefits of one less clerical person on the payroll. The only cost reported by Firm D was the need to replace disk drives. However, at Firm A the view expressed was that the computer had paid for itself within one year in terms of reduced interest payments. Firm B had used their list of annual expenses to help them identify specific areas of expenditure where savings could be, and were, made. As in the case of Firm A their savings were a substantial percentage of the total system cost. The two other firms reported neither cost increases nor decreases.

Consideration was also given to the possibility that the process of IT sophistication increased costs. This seemed possible as firms would have to move into less obvious areas of application, possibly requiring more expensive hardware and software, and even extra staffing. There was evidence of significant costs: by Firm C for system acquisition and software development of their costing system, by Firm F for a CAD system, and by Firm E to acquire an MSDOS computer, plus software. Of the other firms, one had not increased their level of IT, while the other two had but from within the firm. None of the firms cited evidence of cost reductions associated with these moves to further develop their IT.

It can be concluded that, apart from Firm C with its ongoing costs of software development, there seemed to be little evidence of ongoing significant cost increases caused by IT. The process of IT sophistication had meant significant acquisition costs for Firms C, E and F. However, Firms A and B had reduced costs through IT.

* Could system problems absorb excessive managerial time? Another way that IT could be viewed as having a detrimental effect on company performance was through system problems absorbing an excessive amount of managerial time.

At Firm A, a lack of support and co-operation from the software vendor and from their accountant, meant the firm implemented the general ledger system themselves. As well as taking 2½ years to implement, the process absorbed much managerial time.

At Firm C, liaison with the software developers took time, but by a junior rather than a senior manager. This was the only firm where one person had computer systems as their major responsibility.

Both of the above examples are more to do with system development than system problems. As with the impact on costs discussed earlier, the evidence supports the idea that the process of IT sophistication, rather than problems caused by IT, does absorb managerial time. The other four firms provided no evidence of system problems absorbing managerial time. In the three Firms D, E and F, where IT development had taken place, the managers had been active in this process. Using Martin's (1989) typology of managerial involvement with IT, one manager had been closely involved in decisions (Firm F); both others had been directly involved hands-on. However, none of this development was reported as excessive, though the owner of Firm F claimed they tried four products before they found a suitable cash flow prediction package. While Firms A and C had experienced problems in developing their IT, for Firms E and F progress had been trouble free. The success of Firms E and F was partly because they had acquired single user systems, and partly because their acquisitions had been recent, reflecting the greater reliability of current packaged software.

Firm D was different. This firm, the one-person electronic engineering firm, had developed its IT internally using the owner's expertise and time. Again, this case provided evidence that the process of IT sophistication, rather than problems caused by IT, had absorbed managerial time.

In conclusion, the cases provide evidence that developing IT capability, rather than resolving problems, does absorb managerial time.

The above conclusion also had support from the questionnaire each owner completed. Four of the six owners disagreed with the statement that computerisation had caused many problems. In other words, they felt that computerisation had caused few problems. However, three firms (A, D and E) agreed that computerisation had absorbed more managerial time than they would have wished.

The important question to answer is whether this absorption of managerial time was sufficient to have an impact on performance. It seems likely that performance was only affected in one firm. Two of the three firms that reported excessive absorption of managerial time, A and E, had, in fact, performed well. The other firm, D, had performed badly.

Indirect effects

Various indirect effects of IT on performance were hypothesised in the previous chapter.

* Could IT decrease a firm's flexibility to respond to opportunities?

  This idea suggested that some firms become too tied to old software which then hinders growth. Firms A, B and D had remained with old hardware and software. Firms B and D had not grown. However, this lack of company growth seemed more through poor market conditions than through poor IT. Their

weak financial positions meant that system replacements could only be justified in the future. Firm A, despite its poor system, had doubled sales turnover since 1983.

* Could IT have increased customer alienation?
Maybe systems are not used to improve customer service, but to improve internal efficiencies at some loss of freedom to customers? Maybe it takes longer to sort out errors on invoices or that the system now demands earlier payment or it takes longer now to respond to customer requests? The interviews suggested that customers gained very little from computerisation except smarter, but possibly earlier bills. Potentially negative effects on customers were experienced by Firm A in that some early "foul-ups" had taken place, when invoices had been sent out after a payment had been received. Firm A felt that they could use the technology to identify customers whose business had dropped off for whatever reason, and hence use the technology to increase rather than decrease sales. The view at Firm C was that the computer had helped customers considerably by keeping specific customers informed of recent product developments and prices. The questionnaire data indicated that for three of the firms, the computer had improved customer service. It would seem that computerisation had not caused significant negative effects on customers.

* Could IT have decreased employee performance?
Maybe employees become less productive because a system has been forced on them? Maybe employees feel they are less important, or the fun goes out of the job as the new system demands a higher standard of work? The interviews provided no evidence to support this hypothesis. The attitude to computers was reported as positive as the computer had relinquished clerical staff from very repetitive tasks.

* Could IT have decreased owner-employee communication?
Maybe owners can find their own data now and the team

concept reduces; or maybe employees get blamed for system errors and problems? Only two owners (D and E) were direct hands-on users of the computer. Typically, owners still relied on office staff for information, particularly for computer printouts. Relationships seemed to be good. At Firm F, the owner argued that the computer had been acquired so he could receive more assistance from his secretary as she would now spend less time carrying out other repetitive tasks. The cases provided no evidence to support this hypothesis.

* Could IT have decreased pricing flexibility?
  Maybe the system now determined prices or that there was a feeling that the cost of the system had to be recouped, so prices were increased and customers lost? If anything the interviews suggested the opposite to this hypothesis. Firms were now more aware of their costs. One reason for computerisation at Firm C was to improve their job pricing by updating their costs and reducing the potential for human error. Similarly, the owner of Firm D kept a record of component costs to be recouped later on a particular job.

* Could IT have increased debt collection problems?
  Maybe poor payers were now less obvious and did not receive the same pressure or personal attention they would have had in the past? Quite the opposite would seem to be true. Identification of debtors was an important part of the companies' cash flow management, and very much an owner-manager responsibility. The computer played a significant role in this area at Firms A, B, E and F.

Conclusions

The cases were used to test eight hypotheses about possible detrimental effects of IT on financial performance. The analysis is summarised in Table 15.2, where any significant supporting or contrary evidence is reported.

Table 15.2 Evidence of Detrimental Effects of IT on Financial Performance

Detrimental Effects	A	B	C	D	E	F
Increased costs	No	No	Yes			
Absorption of managerial time			Yes	Yes		
Flexibility						
Customer alienation	No		No			
Employee performance						
Owner-employee communication						No
Pricing flexibility			No	No		
Debt collection	No	No			No	No

Notes: "Yes" indicates evidence to support the hypothesis while a "no" indicates evidence contrary to the hypothesis. Blanks indicate no significant evidence of either type.

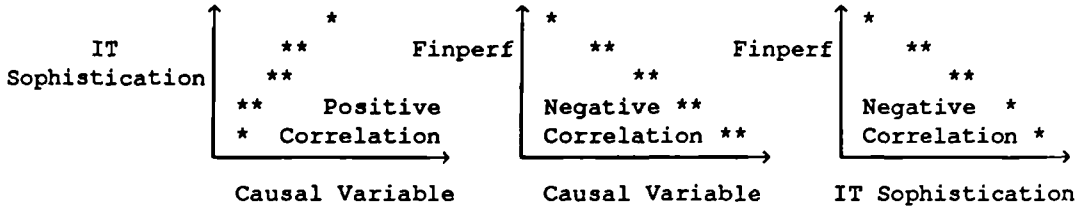
While none of the six hypotheses concerning indirect negative effects were supported, the cases did provide some evidence to support the two direct negative effects of IT on financial performance. Firm C had on-going costs associated with the development of their system, and at Firm D, the owner had spent a considerable amount of time developing systems.

Factors Promoting IT Growth and Poorer Performance Simultaneously

In the preceding chapter, five variables were hypothesised as potentially encouraging IT growth and poorer performance simultaneously, and thus supporting the negative correlation between IT growth and financial performance. The basic approach taken to test each hypotheses was to see whether any of the firms supported or refuted the particular hypothesis. For a causal variable to help explain the negative correlation between IT sophistication and financial performance, requires the causal variable to have opposite rather than similar correlations with IT growth and financial performance. If one is positive, the

other must be negative to support the negative correlations found earlier. Pictorially, the test was to see if each case supported the implied correlations depicted in Figure 15.3

Figure 15.3 The nature of the test of factors promoting IT Sophistication and Poorer Performance simultaneously



The basic data for the analysis is summarised in Table 15.3. The specific variables, their results and their analysis are discussed separately in the next five sections.

Table 15.3 Values for the Potential Factors influencing both IT Sophistication and Financial Performance

	A	B	C	D	E	F
Market forces	low	high	average	high	low	average
Administrative type owner	no	no	yes	yes	no	no
Technological fascination	no	no	no	yes	no	no
Vision for IT	short	short	long	long	short	long
Changes to product range	no	no	yes	no	no	yes
Lack of suitable software	yes	no	yes	yes	yes	yes
IT growth	low	low	average	high	high	high
Financial performance	high	low	average	low	high	average

Market Forces

Maybe poor performance promoted a move to more, rather than less IT; or better performing firms felt little pressure to improve performance by investing in IT? The support for this hypothesis was mixed. Of the two poorly performing firms, B and D, only Firm

D had turned to IT for support. Similarly, of the two highest performers, while Firm A had almost ignored IT, Firm E was taking IT quite seriously. Thus, two firms support the hypothesis (A and D) and two to the contrary (B and E).

Administrative Type Owner

Different types of owner have been identified in the literature. Maybe some have a greater liking for implementing systems, and thus run a greater risk of implementing ineffective systems? Subjective ratings were used to classify owners as "administrative" or "non-administrative", and whether they were "technologically fascinated". The owners of A and F were rated non-administrative as they *left the daily running of the business to others.* Similarly, the owners of Firms B and E were rated non-administrative as they expressed a real desire to stop sitting in a chair and do some machining work again. Firm C was rated administrative as it had built a team of seven administrators. Firm D was rated administrative as the owner had developed various systems, for which he was also rated as technologically fascinated.

Firm D gave clear evidence of supporting the hypothesis. The owner was administrative and technologically fascinated, their IT had grown, and the firm had performed poorly. However, at the other administrative firm, C, their IT had not grown. Their large number of administrators had not turned to IT for support. Of the "non-administrative" firms, Firm A did lend support to the hypothesis. They had a non-administrative owner who was not keen on computers, but the firm had performed well.

Wish to grow

Another reason to computerise could be the wish for the firm to grow. Maybe some firms invest in IT with long term rather than short term benefits in mind? And maybe those not wishing to grow feel that any investment in IT would have to be justified in terms of extra sales, that is, through growing.

This hypothesis was difficult to test as none of the firms expressed any great desire to grow, though there was evidence that the firms had grown in response to market success. Firms C, D and F sought long as well as short term benefits from their investment in IT. Firm C had acquired an expensive system, but was confident that it would pay its way after a few years. Firm D wanted to survive, and saw IT as a way of saving time in the future. Firm F was keen for everyone to be exposed to the technology with a view to being flexible. None of these three firms was a high performer. They therefore lend support to the hypothesis. Evidence to the contrary was provided by Firm A, which had been frustrated from hiring more skilled labour, a sign of wanting to grow, but had made no attempt to support growth through investing in IT.

Managerial Caution Towards Change

Managers, who are cautious regarding change, may also be cautious towards IT and opt for a small number of successful, important IT applications? Those less cautious, particularly in difficult market conditions, may have made too great a commitment to IT?

Without a recognised measure of the variable "managerial caution" this hypothesis was difficult to test with confidence. However, two of the six firms, C and F, had gone through considerable change during the last five years and had been very innovative with their product range. The other firms had tended to stay with the same products. Using this as a measure of caution, the hypothesis has some support. The two firms that had changed their product range, C and F, had both invested in IT, and their performance was average, lending support to the hypothesis. However, the other firms gave only mixed support to the hypothesis. Of the two best performers, both had remained with a similar product range, but one had done little with its IT (Firm A) and the other had invested in IT (Firm E). Similarly for the two poorest performers, though both had remained with a similar product range, one had and one had not invested in IT.

Lack of suitable software

A lack of suitable software could hinder progress, especially for unstructured situations. Hence those firms trying to develop more sophisticated IT could put resources into developing their IT, some of which could be ineffective and end up disadvantaging the firm.

Five of the owners felt that there was a lack of suitable software for their type of firm. The exception was Firm B which had made no attempt to change its IT since 1984, so was possibly unaware of the limitations of existing products. Firm C was the most adversely affected as they were still improving their job costing application,and their performance was only average. Firm A had been hindered, but as the best performing firm, could not be said to have suffered. Firm F had looked around for some years for their software. Again, as an average performer, this firm gives some support to the hypothesis.

Conclusions

The analysis is summarised in Table 15.4, where it can be seen that all the hypotheses gained mixed support, rather than a clear YES or NO.

Table 15.4 Evidence of factors promoting both IT Growth and Poor Performance simultaneously

Factor	A	B	C	D	E	F
Market forces	Yes	No		Yes	No	
Administrative owner	Yes		No	Yes		
Wish to grow	No		Yes	Yes		Yes
Managerial caution	No	No	Yes	No	No	Yes
Lack of software	No		Yes			Yes

Discussion

The summaries of the analyses were presented in Tables 15.2 and 15.4. Two of the eight detrimental effects gained some support. There was mixed support for all five factors investigated as having a simultaneous influence on IT growth and financial performance. Therefore, it would seem that the most likely explanation for the negative correlations between financial performance and IT sophistication would be found among the following seven variables:

increased cost
absorption of managerial time
market forces
administrative type owner
wish to grow
managerial caution
lack of suitable software

Many of these variables relate to owner characteristics, a topic which has received little attention in studies of information technology, even in large firms. This conclusion suggests that one area for further research is to study the interaction of owner characteristics with IT acquisition, control and development. The following paragraphs discuss relevant theory which could form the basis for these further studies.

Managerial Typologies

The suggestion that owner characteristics are important implies that IT developments are a reflection of managerial type. Other studies have shown that different managerial types had different managerial behaviour. For example, Routamaa and Vesalainen (1987) found craftsmen and classical entrepreneurs had different growth orientation and goal setting tendencies. Dussault and Dussault (1987) found that craftsmen entrepreneurs were mainly interested in operational matters, while opportunistic entrepreneurs were

interested in strategic, administrative and operational aspects. Carland et al (1988) found relationships between personality characteristics and planning activities. Similar studies should be conduced for IT variables.

Many different managerial typologies have been used in the studies of small firms. Dussault and Dussault (1987) identified eight typologies. The review by d' Amboise and Muldowney (1986) considered that there were only two "global models that interrelate several variables" (p 232). One, that by Sheitoyan and Côté (1976), has three tendencies of bankruptcy, survival and growth. The second typology is the more commonly known Filley and Aldag (1978) typology, of three organisation types - Craft, Promotion and Administrative.

Information Processing Typologies

Another approach to studying managerial characteristics and IT would be to consider characteristics of direct relevance to information processing. As Chell, Jackson and Baker (1987) noted "it would seem that little or no work has been carried out on the various psychological constraints associated with the behaviour of the owner manager" (p 18).

Pelham and Clayson (1988) found some relationships between planning, behaviours and information processing styles. Their typology was based on Slocum and Hellriegel's (1983) cognitive styles which reflect ways of gathering and using information. Slocum and Hellriegel (1983) viewed manager's information gathering styles as "sensory" versus "intuitive" and their processing styles as "thinker" versus "feeler".

Smith et al (1988) studied the decision comprehensiveness of individual managers, and found that as decision comprehensiveness declined, so too did performance. Their measure of decision comprehensiveness was based on Fredrickson and Mitchell (1984), who defined decision comprehensiveness as the "extent to which an

organisation or individual attempts to be exhaustive or inclusive in making and integrating strategic decisions" (p 402). Comprehensive decision makers tend to gather both internal and external information to evaluate alternatives in order to reach the best decision.

New models of entrepreneurship

Recently proposed models of entrepreneurship also offer guidance on how future studies should be conducted. The models by Keats and Bracker (1988) and Chell and Haworth (1988) discuss variables of importance. They also reflect the contingency view of entrepreneurial activity, arguing that different tactics, which could include the use of information technology, may work at different times. Chell and Haworth (1988) argue that "behaviour is now thought of as a complex consequence of personality in interaction with the situation" (p 18). Hence, further studies will have to give due consideration to both person and situation variables.

Weill's conversion effectiveness

The recently reported findings by Weill (1989) support this study's unexpected negative correlations between IT Sophistication and financial performance. Weill reported negative correlations between sales growth and the investment that large engineering firms had made in strategic IT, that is, IT invested to gain competitive advantage. Weill and Olson (1989) implied that many firms failed to convert IT investments effectively. They found that "conversion effectiveness" was an important variable. Firms with a high conversion effectiveness are able to achieve good results from IT investments. Weill and Olson (1989) reported the following factors as important determinants of conversion effectiveness:

"Top management commitment to IT
Previous firm experience with IT
User satisfaction with systems
The turbulence of the political environment of the organisation" (p 15)

Some of the variables identified earlier could well influence Weill's "conversion effectiveness". Weill's concept of conversion effectiveness may be a factor of critical importance, and thus worthy of consideration in any study relating owner characteristics with IT acquisition, control and development. Maybe some small firms have been able to convert IT investment into success, while others have not. The most likely systems to succeed are the simple, well structured transaction processing systems. The less structured information oriented systems would be more difficult to introduce and manage well. Furthermore, they may require a more sophisticated managerial system to reap real success. Maybe the more sophisticated systems exceed the information processing capability of the organisation; a concept discussed by Galbraith (1974), McGaffey and Christy (1975) and Tushman and Nadler (1978). Thus, the concept of conversion effectiveness could, in some way, bring together factors associated with the managerial and information processing typologies discussed earlier.

Kling's Web models

Kling (1987) provides a different perspective on the problem which again could help further studies fully understand the negative correlations. Kling is very critical of the typical models of MIS which tend to ignore the social context surrounding the acquisition and use of information technology. Kling prefers "Web" models, which "treat computerised systems as a form of social organisation with important information processing, social, and institutional properties" (p 309). Kling argues that Web models "draw larger boundaries" (p 309) than do other models of MIS.

The case study analysis earlier in this chapter supports Kling's concept of Web models. Complex social phenomena were likely explanations for the negative correlations. Kling's approach to studying the problem would be to seek answers to questions like:

> "Who are the key actors?
> What kinds of things do they do here?
> What incentives influence their activities?
> What organisational routines constrain their actions and choices?" (p 313).

In the case studies, owners had made decisions about their work which influenced the way technology was used. For example, the owner at Firm A saw IT, after much persuasion, as being of use in the office, where it would have low impact on his work. The opposite could be said of the owner of Firm D who wanted to work with technology all the time so took every opportunity to implement new systems. Chell and Haworth (1988) would argue that these decisions reflect the owner's value systems. A more obvious example would be the owner of Firm F who had no intention of using IT to reduce staff numbers. These views are the results of value judgements. The growing literature on organisational culture, Schein (1985), may also prove useful. As yet there has been no known research on owner's value systems in relation to IT in small firms.

Conclusions

The case studies provided mixed evidence to help explain the negative correlations between IT Sophistication and financial performance. The analysis of possible detrimental effects of IT found little evidence of a substantial influence on performance. However, some owner characteristics could be associated with both IT growth and poorer performance. This hypothesis requires further research. With so little understanding of the behaviour of owner-managers, it would seem that additional research could be based on managerial typologies and/or on information

processing typologies. Weill's (1989) concept of conversion effectiveness may prove to be one way of tying the research to the main body of MIS research. Kling (1987) provides a different but useful social perspective through the concept of Web models.

Chapter 16

GROWTH STAGES AND PROCESSES IN SMALL FIRM COMPUTING

The previous chapter used the case studies to test various hypotheses. This chapter, rather than test hypotheses, uses the case data for theory building. As data had been collected on IT growth over a period of years, it was possible to investigate growth stages and processes. Thus, the aim of this further analysis was to provide a greater understanding of the process of IT growth in small firms. The chapter proposes a model of the growth stages of small firm computing. The five stages of this model are discussed, along with the growth processes and the forces that encourage and discourage growth.

A growth model of small firm computing

In 1973, Nolan proposed a four stage growth model of computer usage in large organisations. In 1979, two further stages were added. (Nolan, 1973 and 1979). Despite criticism by Benbasat et al (1984) and King and Kraemer (1984), the model is still one of few MIS theories on IT growth. More recently, with the great spread of end-user computing in organisations, Huff, Munro and Martin (1988) have proposed a growth stages model for end-user computing. In the small business area, Pliniussen (1988) has proposed a stages model of small business computing. This model is discussed below.

Pliniussen's (1988) model is depicted in Figure 16.1 below, consisting of two dimensions and four possible cells, which are referred to as stages. One dimension concerns whether a firm is using its first computer system. The second dimension concerns whether the firm has more than one computer system.

Figure 16.1 Pliniussen's Four Stages of Small Business Computing

First System	More than one system: No	More than one system: Yes
Yes		
No		

Pliniussen found evidence of firms at different stages. The model is of interest as it begs the question, "what are the forces which encourage movement from one stage to another?". However, the model has an emphasis on the number of hardware systems. An important missing variable from Pliniussen's model is "system capability". Pliniussen's vertical axis of "first system" ignores system capability, as an acquisition by one firm in 1982 would be treated the same as an acquisition in 1988 by another firm, and thus takes no account of the likely differences in capability and flexibility. Similarly, referring to the horizontal axis of "more than one system", this would treat the acquisition of a second hand microcomputer for one task as equal to an acquisition that could change the way the whole business operated.

Rather than emphasise hardware, the case study data was used to propose a growth stages model of small firm computing based on system capability. One of the growth processes within the model could be the number of systems, but the emphasis was placed on application capability as a measure of sophistication. As a result the model is closer to those of Nolan (1979) and Huff, Munro and Martin (1988) than Pliniussen's.

Growth Stages

Five of the six firms showed growth in their use of computers since 1984. Furthermore, all had ideas for further growth in computer use, though for some this would not occur within the next year. Their year by year applications growth was shown earlier in Table 14.3, where for each firm, the year an

application was first introduced was depicted. For example, Firm A acquired a microcomputer in 1983 and used it for invoicing and debtors from 1984.

The data suggested the following growth stages of small firm computing.

Stage 1 - Start-up - one application.

Stage 2 - Stand alone applications - more applications but stand-alone.

Stage 3 - System integration - some system integration, typically of "accounting" systems.

Stage 4 - Additional Software - Additional applications, often serving other functional areas; possibly Decision Support Systems using spreadsheets.

Stage 5 - maturity?

Stage 1 - Start-up

The earlier visits in 1984 found that many firms started by computerising their invoicing system. For others it was stock control, and for some precision engineering firms it was for easy programming of numerical controlled machines. The arrival of the microcomputer in the early 1980s had made this possible for many small firms. Other firms though used computer bureaux or acquired a mini-computer.

Stage 2 - Stand-alone Applications

Most firms planned a number of applications when they acquired their first computer. Typically their initial application took

little computing time and saved staff time. Other applications then followed, some quite quickly. Creditors, payroll and stock control were common additions.

Stage 3 - System integration

After a period of stand-alone operation some firms were in a position to integrate some of their applications. This has been particularly possible with accounting packages; invoicing, debtors, creditors and general ledger being a common combination. Firms desired more information, often resulting in much less reliance on their chartered accountants for performance related data. Many firms moved quickly to this stage, usually helped by a wise or lucky choice of software that aided integration. Stages 1 and 2 were often seen as learning stages, with Stage 3 as the desired state. Some firms used a computer bureau during during Stages 1 and 2, but acquired their own system to both save on running costs and gain greater flexibility and control. By Stage 3 a firm is typically very reliant on computers.

Stage 4 - Additional applications

Once some applications were linked, then organisations saw the need to better satisfy a wider range of needs. Often this required considerable customising of packages with the emphasis on providing more information, predominantly through printed reports rather than on-line. In some firms, decision support systems would be built. An alternative development following Stage 3 was for firms to implement stand-alone software in other functional areas, e.g. computer aided design.

Stage 5 - Maturity?

None of the firms were using the computer to the full potential, though some had reached Stage 4, they saw the potential for support in other areas, particularly for production management. Marketing and sales were areas still relatively untouched by

computers. There were thoughts of decision support systems. Typically though, the firms had neither the in-house expertise nor the software to build such systems. Small firms often find it difficult to justify the expense of systems being built by an external organisation, particularly as the benefits will be less certain. As the situation is likely to be unstructured, it may also be difficult to price accurately in advance. Another area to explore would be the use of expert systems, often with the potential of releasing prime managerial time from activities, for example, job-pricing. There is also potential for focussing on revenue generation activities, rather than cost oriented activities, as suggested by Massey (1986). Thus the firms have opportunities open to them, but developments are likely to be slow owing to the lack of resources, including knowledge of the potential of information technology.

Growth Stages in the Case Companies

It was straightforward to identify when each of the six companies revisited in 1988 had moved into each new stage of the growth model. Indeed, evidence from the earlier visits in 1983/84 had been used to identify when the earlier stages were entered and this data was confirmed in the 1988 revisit, together with the acquisition of new data on movements into later stages. The dates of entry to each stage are shown in Table 16.1

Table 16.1 Year of Entry to each Growth Stage

	A	B	C	D	E	F
Stage 1	1984	1982	1978	1982	1981	1984
Stage 2	1985	1982	1979	1982	1982	1984
Stage 3			1983		1986	1986
Stage 4			1984		1987	1987
Stage 5						

To appreciate the significance of these stages it is worth considering the detail of three of these cases:

Firm B - This firm acquired an 8 bit computer in 1982. Until then the owner's wife carried out all clerical duties, but when expecting their third child they turned to computerisation to save her time. An invoicing and debtors package (Stage 1) was soon followed by a creditors and cheque writing package (Stage 2). Data was extracted from both these systems to provide monthly performance reports. These developments were completed in 1984. Apart from adapting the software for sales tax in 1986, there had been no system developments since 1984.

Firm C - After using a computer bureau for a few years (Stages 1 and 2) the firm acquired a mini-computer in 1983 for invoicing, debtors, creditors and general ledger (Stage 3). A custom built job-card and pricing system was added to the system (Stage 4). The initial computer was replaced in 1986 as the software house which provided all their support moved to new hardware and software. All the above systems were implemented on the replacement computer, with regular minor amendments to suit user needs. A stand-alone micro-computer was acquired in 1988 to replace a typewriter. It was likely that this computer would be used also for spreadsheets as the main system had a rather unfriendly spreadsheet package with limited functions.

Firm E - This company acquired a computer in 1981 for numerical control programming, i.e. the ability to write, edit, store and print a set of instructions for a machine to follow (Stage 1). The firm also implemented stock control and payroll packages on this computer. In 1986 another computer was acquired for invoicing, debtors and general ledger (Stage 3). Since then it has also been used for word-processing (1986), computer aided design of new products (1987) and creditors (1988) (Stage 4). It was likely that one of their computers would be replaced in 1989 to provide better support for computer aided design (CAD) and computer aided manufacturing (CAM). The firm has rejected the idea of using the computer for bill of materials and job costing.

The Forces Encouraging Growth

A number of studies have obtained information on the initial reasons for computerisation. For example Cragg (1984) in studying 33 small manufacturing firms found that saving time and satisfying information needs were important. Other major reasons were to reduce costs and gain better control. All these reasons were found to be motivators of further growth.

Save Time

Many firms had previously processed their sales orders manually. For some this took a considerable period of time. Firm A, for example, reduced the time it took to send out monthly invoices from over twenty days to about three days. As a result they considered that the computerisation paid for itself within a year solely in terms of reduced interest payments on their overdraft. Other transaction processing systems to save time were payroll and creditors. Firm E found it much easier and quicker to produce tapes for numerically controlled machines using a computer, hence CAM was a motivation. However, firms were not just interested in clerical time, they were also interested in managerial time. The manager at firm E implemented a CAD system for his use, and at firm D a stock control spreadsheet made life easier for the owner.

Reduce Costs

Firm C saw the time savings associated with transaction processing systems as a way of cost justifying their computer investment. Though, they saw the potential to reduce the number of office staff, it should be noted that some managers were not interested in reducing staff numbers. The owner at Firm F wanted to use staff more effectively, so saw time savings as a way of creating time to do other more important activities. Firms did view the fees they paid to either a computer bureau and/or a

chartered accountant as expensive; computerisation helped to reduce or eliminate such fees.

Provide better and more information

Prior to computerisation most firms had little actual data on company performance. Typically they received an annual statement from their chartered accountant, but six months or more after the end of the financial year. Accounting software made it easy to produce monthly performance reports. In addition, sales and debtors analyses often helped management recognise problems much earlier than before. There was a tendency for the firms to use the standard printed reports from the packages. An exception to this was at Firm F where they had sought out a cash-flow package to improve the budgeting and planning aspects of the company. This was the only firm which used the computer to support planning activities, possibly as their product range had changed totally during the last few years and they needed more sophisticated systems to help cope with uncertainty.

Control

Improved control occurred as a motivator in many firms, though it was not always expressed explicitly as a goal. At both Firms B and F, the owners hoped to implement systems to measure employee output. At Firm B they wanted to use this as a means of achieving higher performance, possibly linked to a bonus scheme. At Firm F it would be an attempt to gain quality improvements by information being made available at the shop floor level. The CNC equipment at Firm E had been introduced with quality improvement as a motivator. At Firm C the job-costing system was introduced to reduce the likelihood of human error. The debtors information was used by many firms for improved financial control.

Effectiveness Benefits

The six firms showed some or all of the above reasons for computerisation. These were apparent both for the initial start-up and also for further phases, though the potential for significant time and cost savings are reduced beyond Stage 3. In moving to the later stages, the firms are more concerned with effectiveness benefits, either by way of directly doing things better, e.g. improving decision making or better design, or through freeing managerial time so more important duties can receive their attention. There was no evidence of firms developing IT for competitive advantage through the use of IT to change inter-organisational links.

The stages where each of these growth factors were particularly important were identified, and are shown in Table 16.2. Time savings were often sought early on, and information benefits later.

Table 16.2: Stages at which Specific Growth Factors were particularly important

	Firm A	Firm B	Firm C	Firm D	Firm E	Firm F
Save Time	Stage 1	Stages 1 & 2	Stage 1	Stage 2	Stages 1 & 2	Stage 3
Reduce costs			Stage 3			Stage 1
Better information	Stage 2	Stage 2	Stages 2, 3 & 4	Stage 2	Stage 3	Stage 4
Improve control		Stage 2	Stage 4	Stage 2	Stages 1 & 2	Stage 2

Managerial Enthusiasm

The above discussion shows that many systems were being used to improve specific aspects of the company, with a view to improving company performance. However, the achievement of these objectives required commitment from individuals within the firm. The owner's attitude to computers was crucial and ranged from total disinterest to enthusiastic fascination. Martin (1989) noted five types of chief executive, based on their role in computerisation. The six cases included examples of all five types, from "remote" (Firm A) to "routine interaction" (Firm D). Their role reflects their attitude to computers, and had a considerable influence on IT developments. Their individual roles are shown in Table 16.3.

Table 16.3: Owners' attitudes to computers

Company	Owner's role in computerisation based on Martin's typology
Firm A	Remote from management of the computer (Type 1)
B	Involved in a managerial, overseeing capacity (Type 2)
C	Involved in a managerial, overseeing capacity (Type 2)
D	Routine interaction directly with computer (Type 5)
E	Directly involved technically in implementation (Type 4)
F	Closely involved in choice and implementation decisions (Type 3)

It was also considered important to see if market forces influenced IT growth. To do this, the performance of each company as measured by changes in its sales growth and was classified as Good, Average or Poor. Table 16.4 shows this rating of company performance, with also a rating of the owner's attitude to computers based on Table 16.3, and the number of new IT applications since 1984, from Table 14.3.

Table 16.4: Owner attitudes, company sales growth and growth in IT

	Firm A	Firm B	Firm C	Firm D	Firm E	Firm F
Owner's attitude to computers	low	low	low	high	high	average
Company sales growth	good	poor	average	poor	good	average
New IT Applications	2	0	2	4	4	7

IT growth tended to take place in firms where the owner was enthusiastic towards the technology (Firms D, E and F). Little growth took place in firms with disinterested owners (Firms A, B and C). The influence of the owner on IT growth was very strong. By comparison, the influence of market forces seemed minor or non-existent. Firm A, the best performing firm, showed little growth with their IT. Firm D, the worst performing firm, had continued to develop further applications, but had not been able to upgrade its computers.

Factors Which Discourage Growth in IT

Though other studies have reported motivations to computerise, few have discussed factors which have discouraged growth of small firm computerisation. Two exceptions are the studies by Baker (1987) for small firms, and King and McAuley (1989) for one large organisation. The data suggested the following negative influences; finance, software support, degree of structure in system, level of internal expertise and knowledge, and size of firm. For each firm studied, another reason surfaced, hence a larger study would be needed to produce a more definite set of categories. However, there was evidence to suggest that there

are some very strong forces, and others in various combinations which can halt the growth of computerisation in a small firm.

Finance

Because the firm was financially only "surviving", the owner of Firm B had given little consideration to upgrading or replacing their systems. Firm D was financially in an even worse position than Firm B. Though the owner was very keen to replace their oldest computer, he felt that it would be impossible to justify to the bank manager any expenditure on a computer, even though current system prices were lower in dollar terms than when the original system was acquired. Both firms recognised that their systems were old and had a limited capability. An MSDOS machine would open up a number of possibilities, but definitely "not yet".

Software Support

With little internal computer expertise, small firms are very reliant on the advice and support they obtain from vendors. There would seem to have been an element of luck associated with the initial choice of hardware and software. Some firms went for packaged software, which proved very reliable and useful. Others experienced serious problems (Cragg 1984) and may have been unfortunate enough to acquire a package which was no longer supported. Firm A found its chartered accountant totally uncooperative when it requested help in determining its needs when implementing a general ledger system. The software supplier also failed them and as a result it took 2½ years to implement the general ledger system. The firm is now understandably in no hurry to upgrade its system. In hindsight, they may have been better off by totally replacing the system three or four years ago.

Degree of structure in system

Packaged systems are ideal systems for many small firms. The firms often accepted software limitations and adapted to meet system requirements. For some firms the limitations were too great a sacrifice and a more customised solution was required. Typically this involved external design and programming, a process which is notorious for delays and errors. Often maintenance was required as their needs changed. This developmental approach (rather than a non-developmental approach using packages - Kole 1983) slows up the implementation process. It also effects growth as firms place resources, including time, into the development, which tend to preclude further development. Firm C had experienced problems in developing their job costing system. This had delayed any move to give computer support to the Marketing and Production areas.

Level of internal expertise and knowledge

Any training in computers tended to be limited to the initial period of hands-on use of a new system. None of the firms had anyone who had been on a course which would give them a broad view of computers, or even develop programming skills. Hence the internal level of expertise was restricted to that gained working with the computer. This tended to discourage the consideration of other applications or even of improvements. However, some managers had external informal contacts which had helped them recognise opportunities. The owner at firm E had a friend who worked for a computer vendor and as a result had explored many application areas. When asked if he used a spreadsheet, the owner of Firm B replied, "What is a spreadsheet?".

Size of firm

There was evidence that other potential applications had been considered, but rejected on the basis of an informal cost-benefit analysis. For example, firm E considered a bill of materials

package. The owner felt that to make proper use of it would require about one full-time person devoted to data entry and other tasks. For a firm employing 35 people this seemed to be too large a cost for the potential benefits. Firm D was a single person firm with very few sales orders per year, but each of high value. Here, a computerised invoicing system could not be justified for such a small firm.

Managerial time

Although some systems were acquired to reduce costs or save time, it was found that the installation and implementation of systems absorbed senior managerial time which the firm could ill afford. This problem is related to the previous discouraging factors of lack of support and level of internal expertise, as well as the size of company. Firm A would like a more sophisticated system. However, as their initial developments took so long to implement, they are very wary of introducing a totally new system. Firm C was waiting to complete their job costing system before moving into other applications.

The cases where each of these discouraging factors were identified are shown in Table 16.5. An X in a cell indicates that this factor was considered to have had a discouraging impact on computer growth at the particular firm indicated.

Table 16.5: Incidence of discouraging factors in cases

	Firm A	Firm B	Firm C	Firm D	Firm E	Firm F
Finance		X		X		
Software support	X		X			
Complex Structure			X			X
Low internal expertise	X		X			X
Size of Firm				X	X	
Managerial Time	X			X	X	

Growth Processes

The growth stages model emphasised aspects of integration, but it is primarily concerned with growth in the number of applications. Other growth processes, to use Gibson and Nolan's term (1974), were observed. The three main processes discovered were as follows:

Applications focus

The focus of the applications in Stages 1 and 2 is on specific functional areas. This broadens at Stage 3 to an organisational perspective, with applications at Stage 4 reverting to a concentration on functional areas.

User awareness

During the first three stages there is little change in who actually uses the computer. The applications at Stage 4 tend to be task specific, hence at this stage there are more hands-on users. Accompanying this, typically more people are benefiting from printed reports at Stage 4, so there is also an increase in the number of non-hands-on users at Stage 4.

Perceived role

Typically, simple easy to justify applications occur at Stages 1 and 2, with an emphasis on functional efficiency rather than effectiveness. By Stage 3, the goal is that of managerial effectiveness, with an emphasis on improved decision making and control. This emphasis on effectiveness continues into Stage 4 with functional effectiveness the goal.

The relationship between these three processes and the growth stages suggested in this paper are summarised in Table 16.6.

Table 16.6: Relationships between the three Growth Processes and Growth Stages

Growth Stages	Application Focus	User Awareness	Perceived Goal
1	Specific functional area	A few specific users	Functional efficiency
2	Specific functional area	A few specific users	Functional efficiency
3	Company wide	A few specific users	Managerial effectiveness
4	Specific functional area	More hands-on users	Functional effectiveness

Many of the growth processes referred to by Gibson and Nolan (1974) and Huff, Munro and Martin (1988) had little applicability to these small firms. This is mainly due to the lack of a recognised EDP/MIS functional area in firms of this size. The people who championed computerisation in the firm some years ago were still similarly involved. Responsibility had not noticeably changed over the few years. Typically the computer was located in "the office". Data entry and print runs were the responsibility of the "office girl/lady". Decisions on developments were made by the "manager". This "manager" was not always the managing director. Two of the firms had day to day "managers", with expenditure approval required from the managing director. However, as this was precisely the arrangement in 1984, it can be concluded that little had changed across all the firms, despite the growth in applications.

With no change in the organisational position of the computing function, other aspects had not changed. For example, there were few formal planning and control activities associated with computing, somewhat mirroring general practices in small firms. Also, in-house expertise had changed only sufficiently to run externally developed systems. Apart from computer aided design at Firms E and F, there had been no attempt to develop programming skills for either end-user programming or for upgrades.

There was some evidence that attitudes and feelings towards computers had changed. In 1984, those who received the benefits were very enthusiastic, despite problems that had occurred. (Cragg 1984.) This enthusiasm may have rubbed off on non-users. However, as this aspect of attitudes and feelings was not a focus of the study, the area was not explored. It seems likely that non-users' attitudes and feelings will have changed, considering the relatively close-knit nature of small firms. However, there seemed to be little evidence, unlike the experience in much larger organisations, to suggest that non-users were clamouring for computer support.

Concluding Comments

This small sample of firms showed growth in their use of computers. With such a small sample size the model must be seen as tentative. The case study approach has shown itself capable of providing a greater understanding of computing in small firms. Hence it is recommended that further such studies are conducted to validate the model. Areas in particular need of further information are de-motivators on the use of computers, and the influences on end-user computing. The model could provide a useful conceptual framework for further study. For example, maybe there are special types of firms and/or managers that progress to stage 2 only, or stage 3, etc.

The model shows that even among firms with IT, there is scope for greater use and for greater integration of systems. This has implications for various parties. Small firms must develop their IT expertise through education and training. They must also develop closer relationships with people who can offer advice on IT. This provides an opportunity for vendors of IT and others, including accountants.

An implication for developers of software is that small firms need integrated systems, and there is scope for more integration,

including electronic links between, for example, accounting packages, word processing and spreadsheet. Different types of small firms have differing but very specific needs which could be explored and exploited as niche markets. There is potential for quite specialised packaged software, rather than software aimed at, for example, all small firms, or all manufacturers, or all retailers.

Chapter 17

SUMMARY, CONCLUSIONS AND IMPLICATIONS

This study set out to explore the relationship between IT sophistication and financial performance in small firms. Theory suggested that information would be a major benefit from IT. Hence it was expected that firms with more sophisticated information systems would perform better than those with less sophisticated information systems.

Two linked studies were conducted to test this major proposition. A mail questionnaire survey provided data from 289 small engineering firms in the East Midlands region of England. Of these firms, 120 had acquired a computer. The second study was an in-depth case study analysis of six small engineering firms, first visited in 1984, and revisited in 1988.

Major Findings of the Mail Questionnaire Study

The initial statistical analysis gave no support to the major proposition that firms with more sophisticated IT performed better. Though significant correlations were found between the measure of IT success and both one and five year sales growth, IT variables failed to appear in any of the multiple regression equations. This suggested that non-IT variables were most likely to explain the reported differences in financial performance, with the owner's age being particularly important.

In another test of the major proposition, groups of firms with different levels of IT sophistication were compared. Using non-parametric methods similar to analysis of variance, no significant results were found. The analysis suggested that the three or four groups of firms with different levels of IT Sophistication performed similarly.

For those firms with a computer, correlation coefficients were also calculated for various measures of IT sophistication with measures of financial performance. Including results for subsamples, 29 significant correlations were found, but all but one were negative. This suggested that firms with low IT sophistication performed better than those with high IT sophistication. Therefore, rather than support the major hypothesis, the mail questionnaire data provided evidence to the contrary.

For a group of 28, old, larger firms, a significant positive correlation was found between computer ownership and one year sales growth. However, when this was tested with control variables, forecasting activities could explain this correlation, suggesting the initial correlation to be due to factors other than information technology.

Major Findings of the Case Study Research

In the light of the unexpected negative correlations, a second study was conducted using six small engineering firms for in-depth case analysis. All six firms had had computers for at least four years. They were selected as they showed different levels of growth in their use of IT since they were first visited in 1984.

Two major hypotheses were tested in the case study analysis with a view to explaining the previous negative correlations. Little support was found for IT creating detrimental effects which would in turn produce lower performance. However, there was evidence to suggest that developing IT capability had increased costs and had consumed important managerial time, at some firms.

Furthermore, some support was also found for the hypothesis that there are some factors which tend to promote growth in use of IT and poorer performance simultaneously. The mix of factors varied from firm to firm, with the following five identified as

encouraging IT growth and poorer performance simultaneously in some firms:

* Market forces
* Administrative type owner
* Wish to grow
* Managerial caution
* Lack of software

The case studies therefore suggested an explanation for the surprising negative correlations from the mail questionnaire study. There was evidence that IT developments are a reflection of managerial type. Some managers may show too great an interest in IT and fail to attend to other important matters. Furthermore, the evidence suggests that there is nothing wrong with firms taking a "lean and mean" attitude to IT by implementing only those systems which are viewed as essential. It may be inappropriate for small firms to turn too much to IT. It may be better for firms to ignore the general advice being offered to large firms of looking for competitive advantage through IT, or for seeking hard to evaluate effectiveness benefits.

Other Conclusions

The size of the firm was confirmed as being strongly correlated to computer ownership, with larger firms being more likely to use a computer. Of the larger firms in the study, those with computers performed better than those without. However, this difference was not solely due to the use of IT. The firms with computers also tended to have more sophisticated planning activities and were more likely to have introduced new products.

The age of the owner was found to be significantly associated with financial performance. The variable appeared in all three regression equations where many previously identified factors were included for analysis. Analysis of the literature suggested that the influence of owner's age was most likely to be through

motivational aspects, rather than through job experience characteristics.

The case study data suggested that IT use and financial performance influenced each other. A causal model of IT success was tested, which went beyond prior studies in the area. The following factors were identified as important for It success;

* External assistance in identifying IT requirements.
* Owner involvement in IT planning.
* Owner involvement in IT control.
* Planning IT development
* Using IT for many applications.

However, the measure of IT success was not found to be correlated to financial performance. In some way this supports the earlier findings of IT and financial performance being unrelated.

The case study data was also used to propose a five stage growth model of small firm computing. Forces found to encourage IT growth were the wishes to save time and money, and the need for better information and control. Factors identified which discouraged growth were lack of finance, software and internal expertise, and previous bad experiences with computers.

Theoretical Significance Of The Findings

The major implication of the findings to theory is that owner characteristics need to be given greater consideration in researching IT in small firms. Research in large firms has identified important behavioural aspects. In particular, IS success has been shown to be heavily influenced by managerial support and user involvement. The social dynamics of a small firm are probably so different to that of a large firm that factors like "user resistance" have not been a feature of IT in small firms. This study suggests another factor of importance, that of owner characteristics and their impact on IT acquisition,

control and development. The findings suggest that some firms, under the strong influence of the owner, have a tendency to use information technology poorly.

A second implication for theory, which could be related to the above, is the importance of the owner's age in studies of small firm performance. Quite why age and performance are negatively correlated needs to be fully understood. Motivational factors could be the key to understanding this result, and form the basis for classifying firms in future studies. They may also influence the appropriate choice of performance measure.

A third implication for theory concerns the assumption that IT success is a good surrogate for organisational success. This study found little evidence of IT success and financial performance being correlated, suggesting researchers will need to give renewed thought to their choice of measures of success.

Broader implications to theory of the findings, are that the evidence tends to support the recent strong interest in organisational culture. The case studies identified firms with a "lean and mean" attitude to IT. In other firms, the intention was for everyone to use the computer. The organisational culture literature has already identified the owner-manager as an important creator of the culture. (Schein, 1985). Studies of IT need to identify typical cultures to better understand how IT is affecting small firms. Kling's Web models may provide further understanding here (Kling, 1987).

The research also has implications for research methods. It shows the benefits of using both qualitative and quantitative approaches. More importantly though, the research shows that causal models should be built to make explicit the relationships between variables. The analysis of factors affecting IT success showed that causal models can be built and tested.

Limitations Of The Study

All studies have limitations. Most of the quantitative data was collected using a mail questionnaire aimed at one industry in a particular geographic location. Though this was conducted in a thorough manner, there was a high level of non-response. Telephone interviews with non respondents showed that very small firms with little perceived need for IT were under-represented in the sample. As this study found unexpected negative correlations, a repetition would be appropriate, but only if it could take greater consideration of owner characteristics.

Another limitation of the mail questionnaire method was that all data was self reported. The low level of detail required in annual reports for the limited liability companies meant that the financial data could not be validated. However, the case study interviews did obtain data which was consistent with the interviews conducted four years previously, suggesting some consistency in the reporting behaviour of owners of small firms.

A limitation of this study is the small number of case studies that were used in an attempt to explain the negative correlations found in the mail questionnaire study. Furthermore, these case studies highlighted difficult to identify variables like "administrative type organisation". Further in-depth studies of small firms should be conducted to test the hypothesis that some firms adopt a more administrative, rather than performance oriented, approach.

Areas For Further Research

Four areas for further research were generated by the study.

Owner characteristics and IT

The research suggests that IT growth in firms was influenced by owner characteristics. The discussion towards the end of Chapter

15 indicated relevant literature to help understand the influences that owner characteristics have on IT acquisition, control and development. The organisational culture literature may also prove useful. Maybe different organisational cultures of IT can be identified. If some cultures are considered more appropriate than others, then this could lead to suggesting ways by which IT cultures could be changed for the better of the organisation.

The study has shown that IT adoption and development is totally dependent on people. Their attitudes towards IT and their values influence the way firms use IT. Further studies could aim to determine how these attitudes are formed. Why are some owners keen on IT and others not? Currently there is insufficient understanding of processes associated with IT in small firms.

Critical information needs

The negative correlations indicated that many firms performed well, yet with low IT sophistication. This suggests that there are different ways of firms managing successfully. Study of how successful small firms use IT may prove fruitful. They may take a "lean and mean" or "no frills" attitude to IT, but make sure critical information needs are met.

Growth stages of small firm computing

The case research identified stages of growth for small firm computing. The small number of cases invites verification of these stages, as well as the processes and influences of the stages. Many factors were identified which had encouraged growth in IT and others which had discouraged growth in IT. These need further testing. The model has implications for the measurement of IT sophistication, and thus could influence further studies.

Owner's age and small firm performance

The study's verification that younger owners perform better than older owners requires explanation. Motivational factors rather than experience variables would seem to be more likely to offer an explanation. A fully tested causal model linking owner's age through to financial performance would be an appropriate goal.

Implications For Managers

A major implication for managers of firms already with IT is not to view IT as a panacea. Factors other than IT are likely to be more important for success. Firms were found with relatively unsophisticated IT and these outperformed firms with sophisticated IT. The growing literature on competitive advantage from IT in larger firms indicates that firms have not been able to sustain competitive advantages from IT as IT applications are relatively easy to copy. Thus to achieve advantages through IT involves continual innovation. This requires investment of time and money, which are two limited resources in small firms. Therefore, small firms should not be overly tempted to seek competitive advantage or effectiveness gains from IT.

The causal model of IT success has very definite implications for owners of firms that have not as yet invested in information technology. Planning is important. External assistance in determining requirements is particularly important. Furthermore, the owner manager should play an active role in the project, both before and after acquisition. Rather than attempt to implement systems throughout the firm, the firm should plan to build on success. Systems analysis methods are available which can identify existing weaknesses and indicate critical needs for IT to address.

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Appendix 1

SELECTED RESPONSES FROM THE EARLIER STUDY IN NEW ZEALAND OF 100 SMALL FIRMS

(including manufacturers, wholesalers, retailers, and the service sector, including accountants, lawyers, engineers and insurance)
Reported in Cragg (1986)

1. Type of business:

Manufacturing	33
Retail and wholesale	30
Business services	37
	100

2. Company size by number of employees

1-5	32
6-10	20
11-20	29
21-50	12
51-100	7
	100

3. Year of initial acquisition

	Mini-computers	*Microcomputers*
Before 1977	3	
1977	2	
1978	2	
1979	2	
1980	2	2
1981	6	9
1982	4	13
1983	4	26
1984	5	20
	30	70

4. Major Application Software: Usage by Number of Companies

Debtors/Invoicing	58
General Ledger	43
Word Processing	42
Spreadsheet	28
Stock Control	21
Payroll	18
Costing	17
Sales Analysis	15
Database Management System	10
Engineering Design	8
Basic/Cobol	6
Client Accounting System	6
Labelling	4
Computer-Aided Manufacturing	4

5. **Reported Hardware Breakdowns by Component**

	Major Breakdowns	*Minor Breakdowns*
Disk Drive	14	18
Printer/Plotter	2	17
Central Processor	5	9
Screen	2	6
Keyboard	0	3
	23	53

6. **Reported Software Problems**

Type of Problem	*Number of Occurrences*	
Errors in the software	25	Errors in
New errors when changes implemented	20	Software
Failure to work	10	logic
Requirements not met	13	
Processing too slow	13	Inappropriate
Specifications not met	5	System
Inflexible to changing circumstances	4	
Other	5	
	95	

7. **Benefits Gained from Computerisation**

Type of Benefit	*Number of Responses*
Time saving/ease	74
Better information	46
Cost savings	24
Better control of record systems	22
Revenue generation	8
Other	5
	179

8. **Advice to Prospective Purchasers**

Advice	*Number of Occurrences*
Work out what you want	17
Make sure software will do the job	16
Make sure you are going to get service and support	14
Take professional advice	14
Spend time with an existing user	9
Buy one as soon as you can	8
Be careful, rent first or use a bureau	8
Be wary of dealers	8
Do one application at a time	8
Read magazines, go on a course, etc	6
Plan the total development, including training	5
Involve other managers	4
Consider future use	4
Get a big enough and fast enough system	3
Others	10
	134

Appendix 2

Summary of previous empirical studies looking at small firm financial performance

Study	Authors	Major Hypotheses	Setting	Methods	Findings	Limitations
1.	Foley (1985)	Success depends on: a) personal characteristics of owner/manager b) marketing management policies c) size and age of organization	61 electrical engineering firms	Face to Face interviews followed by stepwise multiple regression analysis	Marketing management policies offered the best explanation of financial success - particularly new product development, written business plan, number of marketing/sales staff, existence of marketing/sales department. a) Size of business was important b) Age of controller also important	a) 32 independent variables used with 61 cases - no clustering. b) Age and size variables not analyzed in relation to owner objectives
2a	Miller & Toulouse (1986a)	Performance related to: a) strategies of firm b) strategy making style c) structure of firm d) chief executive personality	97 various firms, all with less than 500 employees (median 100)	Face to Face interviews, using some personality scale instruments, followed by correlation analysis	a) An explicit innovative product-market strategy is important to performance b) CEO years in firm correlated negatively with performance c) Delegation of decision making and use of experts was important to performance	Correlation coefficients used as main form of analysis, hence no rigorous analysis using control variables
2b.	Miller & Toulouse (1986b)	Chief executive personality is related a) strategy b) structure c) decision making methods d) performance	as above	as above, also with multiple regression analysis	a) Neither growth nor profitability were higher in firms with high CEO "need to achieve" b) CEO "flexibility" seemed to be related to absolute measures of performance, but relationships did not hold when control variables were used. c) CEO "locus of control" (internal-external locus) seems to be associated with performance.	Though no causal model was tested, some analysis was conducted using MRA, allowing control for certain variables
3.	Riggs & Bracker (1986)	Performance depends on the use of various operations management decision-making techniques	183 dry-cleaning firms	Mail questionnaire, followed by MANOVA, (multiple analysis of variance) and ANOVA	Firms using forecasting and aggregate planning techniques out-performed those that did not.	One way MANOVA, hence no analysis using control variables, though the study was industry specific and analysis limited to only the Opportunistic Entrepreneurs (Smith 1967)
4a.	Robinson et al (1986a)	Financial performance depends on: a) strategic planning b) operational planning across all functional areas	81 independent food retailers (average 12 employees)	Mail questionnaire followed by univariate comparisons	a) Operational planning across all four functional areas appears to be strongly associated with several indications of performance b) Not so for strategic planning	Little or possibly no control for other organizational variables.
4b.	Robinson et al (1986b)	Financial performance depends on specific planning activities	as above	Mail questionnaire followed by stepwise multiple regression analysis	Of 47 identified planning activities, 3 significant activities were in the marketing area, 1 in personnel, 1 in finance and 1 in inventory. Maybe some specific planning activities are crucial to success? (Specifically; customer analysis, competitor analysis, regular sales forecasting/monitoring, monthly cash flow projections, annual review of labour costs, periodic inventory reviews.	a) Variables were used individually rather than using clusters. b) No other organizational variables were analyzed.

Appendix 2 (continued)

Study	Authors	Major Hypotheses	Setting	Methods	Findings	Limitations
5.	Ackelsberg (1985)	a) A positive and significant relationship between planning and economic performance b) That the relationship will be different among types of business	135 various firms, most under 500 employees (median 11-25 employees	Mail questionnaire, followed by factor analysis on the planning activities, chi-squared cross-tabulations, and correlation analysis	a) Planners out-performed non-planners b) Analytical planning activities (eg, assessing strengths and weaknesses, identifying and evaluating alternatives, revising plans), are related to performance, but not formalized planning activities (written goals, written plans, budgets) c) No consistent results across types of firms	No control for organizational characteristics other than sector of economy
6.	Dollinger (1984)	That organizational effectiveness is positively correlated with innovativeness, teamwork, owner authority, use of consultants, formal goal setting, number of contacts across organizational boundary	53 retailers & manufacturers, owner operated, up to 100 employees (median 11)	Mail questionnaire followed by correlation analysis	a) Perceived effectiveness correlated to innovativeness, teamwork, direct use of owner's authority to make decisions, use of outside consultants and setting of formal goals. b) Perceived effectiveness and actual financial performance were negatively correlated for the manufacturing firms.	Controlled for age, size and type of firm. Analysis though limited to correlations with perceived effectiveness rather than actual performance
7.	Hornaday & Wheatley (1986)	Managerial type (craft, promotion and administration) influences organizational goals, which in turn affects financial performance	31 independent retailers, with between 5 & 49 employees (median 9), in business for the period 1978 to 1982. Turnover under $3 million per annum	Interview questionnaire, followed by Wilcoxon Rank-Sum tests.	In these firms which had survived, the owners had set goals to survive, or grow or be efficient. Goals had been achieved. However, managerial type could not be used to predict goal type. Organisational growth did not appear to be associated with higher organizational profitability.	No "promotion" type managers amongst the small sample of 31. No other organizational variables were considered.
8.	Begley & Boyd (1986)	What characteristics of the firm and of the CEO are associated with high performance?	471 various small firms with up to 100 employees (median between 25 & 99), with turnover less than $10 million pa (median $1-2 million pa)	Mail questionnaire, followed by correlation and multiple regression analysis	Owners running the firm they founded, performed higher than non-founder owner-firms. Experience indicators and age indicators showed little effect. Type A scales (competitiveness, achievement, etc) were associated with growth and profit trend.	Not clear whether the instrument measured perceived performance, or, if actual performance, whether adjustments were made to allow all industry sectors to be included in the analysis.

Appendix 3

COVER LETTER SENT WITH QUESTIONNAIRE AND FREEPOST ENVELOPE ON INITIAL MAILING

University of Technology

LOUGHBOROUGH LEICESTERSHIRE LE11 3TU Tel: 0509 263171 Telex: 34319 Telegrams Technology Loughborough

DEPARTMENT OF MANAGEMENT STUDIES
Head of Department: Professor Geoffrey Gregory

SMALL BUSINESS UNIT

DIRECTOR: CHRIS McEVOY

Mr. R. Lippitt
C.I. Fasteners Ltd.
Butlers Leap
Rugby
Warks.

21 April 1986

To help firms learn how other similar companies are managing with computers, we are conducting a study on the impact of computers on small engineering firms in the East Midlands. The findings will also help advisory and other organisations give sensible and effective assistance to small engineering firms.

We are asking for your firm's position on computers. So the results represent the thinking of all types of small Engineering firms, it is important that each questionnaire be completed, ideally by the owner-manager/managing-director/general manager. We would like you to complete the questionnaire and return it to us, preferably within the next week. Even if you have no interest in computers, or feel unlikely to acquire a computer, your views are sought as a full picture of the industry is required. Even very small firms have computerised, so we feel that all firms will benefit in some way from the study.

A number of questions refer to either you or your firm. This information is required to allow for a detailed analysis of the results. You can be assured of complete confidentiality. Although the questionnaire has an identification number, it is there so that we may check your name off the mailing list when your questionnaire is returned. We will never use the firm's name in any report.

A summary of the study's findings will be made available to interested individuals and organisations. You may receive a summary by writing your name and address on the back of the return envelope. Please, to preserve confidentiality, do not put this information on the questionnaire itself. I would be most happy to answer any questions you may have. Please write or telephone, my telephone extension number is 615. Thank you for your assistance.

Yours sincerely

Paul B Cragg
Visiting Lecturer

Appendix 4

MAIL SURVEY QUESTIONNAIRE

Engineering Firms in the East Midlands:
The Impact of Computers

The study aims to gain a greater understanding of the impact of computers on small engineering firms in the East Midlands.

Department of Management Studies
Loughborough University of Technology
Loughborough
Leics. LE11 3TU

Please circle the number alongside your answer, for example

1 NO
(2) YES
3 DON'T KNOW

If you wish to comment on any question, or qualify your answer, use the margins or the space provided on the back cover.

For office use only

—1

— — —

_1

1. Are you aware that grants are available from the Manpower Services Commission to help small firms plan computerisation and to provide computer training to staff? (Circle number)

1 NO

2 YES —

2. Has your firm acquired any CNC or Automated equipment? (Select one or more answers and circle the number(s))

1 NC/CNC/DNC MACHINE

2 AUTOMATED ASSEMBLY OR WELDING OR MATERIALS MOVEMENT OR PRODUCT FINISHING Etc.

3 NONE OF THE ABOVE — —

3. Computers are being used by engineering firms for numerous applications, including stock control, CAD, CAM and accounting. Does your firm use a computer, possibly at a computer bureau? (Circle one number)

1 NO ----------> IF YOUR FIRM DOES NOT USE A COMPUTER, SKIP TO QUESTION 21 ON PAGE 8

---------- 2 YES —

IF YOUR FIRM USES A COMPUTER, PLEASE CONTINUE WITH QUESTION 4 ON THE NEXT PAGE

Now we would like to ask a few questions about your computer(s). If your firm does not use a computer, skip to Q-21 on page 8.

4. Has the firm acquired a computer for its sole use, and/or does it share a computer, possibly at a computer bureau? (Circle number(s) for your type(s) of use.)

   1 ACQUIRED FOR SOLE USE

   2 SHARE - WITH ANOTHER FIRM

   3 SHARE - THROUGH A COMPUTER BUREAU

   4 OTHER - Please specify

   _____ — 10 — —

5. If the firm has purchased, or is purchasing, any computers, what make and model are they? (If not applicable, skip to Q-6)

   Make and model of most important computer:_____ — —

   Other computer(s): _____ — —

6. How many terminals (i.e. screen and keyboards combined) does your firm have?

   _____ —

7. If you have purchased, or are purchasing, your computer(s), approximately how much was the combined total cost for hardware and software.

   £_____ — — —

8. In which year did the firm <u>first</u> start using computers? — — —

   _____ — —

9. Has the firm since replaced, or considerably upgraded, its computer? (Circle 1 number)

   1 NO MAJOR CHANGE

   2 CONSIDERABLY UPGRADED

   3 TOTALLY REPLACED ----------> Year(s) replaced? —

   4 DON'T KNOW _____ — —

   — —

The following questions refer to the acquiring of your most important computer.

10. Before the acquisition of your most important computer, had anyone in the firm, including yourself, previously worked with computers? (Circle number)

    1 NO PREVIOUS COMPUTER EXPERIENCE
    2 SOME PREVIOUS COMPUTER EXPERIENCE
    3 DON'T KNOW

    —31

11a Before the acquisition of your most important computer, did anyone prepare a written statement of your firm's requirements for a computer? (Circle number)

    1 NO WRITTEN REQUIREMENTS
    2 WRITTEN REQUIREMENTS PREPARED
    3 DON'T KNOW

    —

    ↓

11b If a written statement was prepared, who wrote it?

    1 YOURSELF
    2 SOMEONE ELSE WITHIN THE FIRM
    3 SOMEONE OUTSIDE THE FIRM
    4 DON'T KNOW

    —

12. At the time of acquiring your most important computer, what applications were planned? Examples being: CAD, stock control, payroll, invoicing, nominal ledger, job costing, NC programming, wordprocessing, mailshots, job scheduling.

    — —
    _____ — —
    — —
    _____ — —
    — —

13. Firms often have a number of aims when planning to computerise. Two sets of broad aims are given below. Taking each set of aims separately, please rank the importance of each aim for the time when you acquired your most important computer. Give a score of 1 for the least important of the three aims, 2 for medium importance, and 3 for the most important. (If you were not with the firm at the time of acquisition, please skip to Q-14).

	LEAST IMPORTANT		MOST IMPORTANT	
13a. To provide new/better information.	1	2	3	—
To save time/speed up tasks.	1	2	3	—
To provide a new product or service. . . .	1	2	3	—
13b. To support clerical tasks.	1	2	3	—
To support technical tasks	1	2	3	—
To support managerial tasks.	1	2	3	—

14. How involved have you been in the acquisition and implementation of your firm's most important computer? For each of the various stages of the process of computerisation, please select from the following 5 statements, the one statement which best describes your personal role.

Key:
- A NOT WITH THE FIRM AT THE TIME
- B NOT INVOLVED
- C A MANAGERIAL/OVERSEEING ROLE ONLY
- D CLOSELY INVOLVED - PROBABLY SHARING THE RESPONSIBILITY WITH OTHER(S)
- E HIGHLY INVOLVED - YOU TOOK FULL RESPONSIBILITY

	Circle one number for each stage					
Definition of needs	A	B	C	D	E	—
Choice of hardware and software	A	B	C	D	E	—
Implementation of major system(s) . . .	A	B	C	D	E	—
Solving problems since implementation .	A	B	C	D	E	—
Planning of further developments . . .	A	B	C	D	E	—

One of the important aims of this study is to learn how firms are using their computers. The following question relates to your firm's current usage of all computers.

15. For which of the following applications is the firm currently using a computer? (Circle number where computer is used)

1	stock control	—
2	engineering analysis	—
3	CAD-computer aided design	—
4	NC/CNC/DNC programming	—
5	computer controlled equipment	—
6	job/work scheduling	—
7	capacity planning	—
8	job estimating/quoting	—
9	job costing/cost analysis	—
10	invoicing/statements/sales order processing	—
11	purchase order processing	—
12	nominal ledger	—
13	budgeting/financial planning	—
14	wordprocessing	—
15	mailshots to customers	—
16	payroll	—
17	none of the above - please specify:	—
	_____	— —
		— —

2 5

Now we would like to learn of the current managerial use of the computer facilities.

16. How frequent, if at all, is your personal typical use of a terminal? (Circle one number)

    1 NEVER ----------> SKIP TO Q-18
    2 ANNUALLY
    3 MONTHLY
    4 WEEKLY
    5 DAILY — 31

17. If you personally use a terminal, please state your type(s) of use, for example, assessing financial performance, programming, design calculations, planning production, etc. (If you never use a terminal, please skip to Q 18.) — —

    _____ — —

    _____ — —

18. How many managers in the firm, other than yourself, use a terminal, on average, at least once a month?

    _____ —

19. In which of the following areas, if any, is your computer used to provide managerial support? (Circle number(s) where computer support is provided)

    1 when to order materials/stock —
    2 monitoring production output —
    3 monitoring machine utilisation —
    4 assessing employee productivity —
    5 analysis of production costs —
    6 sales analysis —
    7 forecasting future sales —
    8 debtors analysis —
    9 forecasting cash flow —
    10 monitoring profit —
    11 forecasting profit —
    12 none of the above — — —

20. In this question, we seek your opinions on the benefits and problems of your computer systems. Please select the response that best indicates how you feel about each of the following statements. Do not linger with a particular statement, as your initial impression is required. | 54

Key: SD Strongly Disagree; D Disagree; U Undecided; A Agree; SA Strongly Agree

		Circle your answer					
1	Computerisation has improved the quality of decisions in this organisation.	SD	D	U	A	SA	—
2	Computerisation has helped this firm provide new services or products	SD	D	U	A	SA	—
3	The system has failed to meet some of our requirements	SD	D	U	A	SA	—
4	The system has been well worth its cost	SD	D	U	A	SA	—
5	Computerisation has created many problems	SD	D	U	A	SA	—
6	Computerisation has helped the firm increase sales	SD	D	U	A	SA	—
7	So far, the computer system has been a failure	SD	D	U	A	SA	—
8	We have achieved fewer benefits from the computer than expected.	SD	D	U	A	SA	—
9	Computerisation has significantly improved organisational effectiveness	SD	D	U	A	SA	—
10	Computerisation has significantly helped this firm improve customer service	SD	D	U	A	SA	—

Please now skip to question 25 on page 9.

For those firms not using a computer, could you please give us your attitudes to computers.

21. Is the firm likely to acquire a computer during the next year? (Circle number)

1 DEFINITELY NOT
2 UNLIKELY
3 POSSIBLY
4 PROBABLY/QUITE LIKELY
5 DEFINITELY
6 DON'T KNOW

22 Have you personally had any experience with computers?

1 NO PERSONAL EXPERIENCE
2 SOME EXPERIENCE

23 Has anyone else in the firm had experience with computers?

1 NO COMPUTER EXPERIENCE
2 SOME COMPUTER EXPERIENCE

24. Please select the response that best indicates how you feel about each of the following statements. Please do not linger with a particular statement as your initial impression is required.

Key: SD Strongly Disagree; D Disagree; U Undecided; A Agree; SA Strongly Agree

		(Circle your answer)
1	I can see a need for a computer in my firm	SD D U A SA
2	I know very little about computers	SD D U A SA
3	My firm could afford a computer.	SD D U A SA
4	A computer could help me manage the firm	SD D U A SA
5	I do not have time to learn about computers. . .	SD D U A SA
6	I like computers	SD D U A SA
7	The firm is too small for a computer	SD D U A SA
8	A computer could probably save money for the firm	SD D U A SA
9	My firm's operations cannot be computerised. . .	SD D U A SA
10	Computers waste more time and effort than they save	SD D U A SA

FOR ALL FIRMS TO ANSWER
Now, we would like to ask some questions about you and your firm, so that we can see whether certain types of small firms have favoured computerisation, and thus possibly need different advice or help.

25. What is your job title? For example, managing director.

_____ — 19

26. Do you personally spend most of your time either working at a desk or working with engineering machinery?

1 MAINLY AT A DESK
2 MAINLY WITH ENGINEERING MACHINERY —

27. Are you an owner who manages the firm, or are you employed to manage the firm?

1 OWNER-MANAGER
2 EMPLOYED AS A MANAGER
3 OTHER - Please specify —

_____ — —

28. Are you personally involved in the day to day management of the firm, or is your involvement predominantly that of an overseer/Director?

1 DAY TO DAY INVOLVEMENT
2 OVERSEER/DIRECTOR ONLY —

29. In what year were you born? _____ — —

30. Managers have differing objectives for themselves and their firms. We would like you to rank the importance of each of the following 3 objectives.Give a score of 1 for the least important of the three objectives, 2 for medium importance, and 3 for the most important.

	LEAST UNIMPORTANT		MOST IMPORTANT	
Grow into a large firm.	1	2	3	—
Gain job satisfaction	1	2	3	—
Earn as much money as possible.	1	2	3	—

31. Has your firm developed any new products during the last 5 years to extend its product range?

1 NO NEW PRODUCTS
2 NEW PRODUCTS —

32. Does the firm have a written business plan? (A document which contains an analysis of the firm's current position, where it would like to be in the future, and how it plans to get there.)

    1 NO WRITTEN BUSINESS PLAN
    2 A WRITTEN BUSINESS PLAN

    — 31

33. Does your firm make written monthly forecasts for any of the following? (Circle number(s) for which forecasts are made)

    1 SALES —
    2 BAD DEBTS —
    3 PROFIT —
    4 CASH FLOW —
    5 MATERIAL REQUIREMENTS —
    6 NONE OF THE ABOVE —

34. Which of the following best describes your type of firm? (Circle one number)

    1 A PARTNERSHIP
    2 A SOLE PROPRIETERSHIP/TRADER
    3 A LIMITED LIABILITY COMPANY —

35. Is the firm a subsidiary of another firm? (Circle number)

    1 A SUBSIDIARY
    2 AN INDEPENDENT FIRM —

36. In approximately which year was the firm established? _____ — —

37. Does the firm formally employ labour other than members of the family?

    1 FAMILY ONLY
    2 NON FAMILY EMPLOYEES —

38. How many managers, including yourself, are there in the firm? ____ —

39. How many marketing and sales staff, including managers, does the firm employ.

    _____ FULL TIME EQUIVALENTS — —

40. How many employees, including managers, in total? (Circle number)

    1 1 - 5
    2 6 - 10
    3 11 - 19
    4 20 - 49
    5 50 - 99
    6 Over 99 —

41. What was the firm's annual sales revenue in 1985, excluding VAT? | 4 5

1	Under £50,000
2	£50,000-£99,999
3	£100,000-£199,999
4	£200,000-£299,999
5	£300,000-£399,999
6	£400,000-£499,999
7	£500,000-£749,999
8	£750,000-£999,999
9	£1 million - £2 million
10	£2 million - £5 million
11	Over £5 million

— —

42. What kind of engineering firm is your's? For example; steel tube manufacturers, automotive engineers.

_____ — —

— —

Finally, to see if growing firms have computerised more than others, we are asking some questions about your firm's recent performance. You may need to refer to company records for some data which will, of course, remain totally confidential.

43. In your opinion, has the total market for your major type of product or service decreased, stayed the same, or increased, in recent years? (Circle one number)

1	DECREASED IN RECENT YEARS
2	STAYED ABOUT THE SAME
3	INCREASED IN RECENT YEARS

—

44. Comparing 1985 with 1984, please give the approximate percentage change in sales revenue since 1984.(Delete either 'up' or 'down' to indicate rise or fall)

In 1985, Sales revenue was up/down _____% on 1984. —

— — —

45. Comparing 1985 with 1984, did net profit before tax decrease, stay the same, or increase?

1	DECREASED SINCE 1984
2	STAYED ABOUT THE SAME
3	INCREASED SINCE 1984

—

46. For 1985 only, what was the firm's net profit before tax as a percentage of total sales revenue? (Include a + or - sign to indicate profit or loss)

_____% —

47. For those firms operating in 1980, could you please give an estimate of how much your annual sales revenue has changed since 1980. (Indicate rise or fall) — — —

—

In 1985, Sales revenue was up/down _____% on 1980. — — —

48. Would you like us to send you a summary of the results?

1 NO SUMMARY
2 SUMMARY PLEASE — 26

If so, please print your name and address on the back of the return envelope, so that this questionnaire remains anonymous.
We will send you a copy as soon as possible.

Are there any further comments you wish to make on the matters dealt with in this questionnaire? If so, please use this space for that purpose.

— —
— —
— —
— —
— —

THANKYOU FOR COMPLETING THIS QUESTIONNAIRE. YOUR CONTRIBUTION TO THIS STUDY IS GREATLY APPRECIATED

Please post the questionnaire in the FREEPOST envelope provided.

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Appendix 5

IT APPLICATIONS AND USES BY FUNCTIONAL AREA
(used to determine FAA, the number of functional areas supported by IT)

Functional Area	Applications (from Question 15)	Managerial Uses (from Question 19)
Production	stock control NC/CNC/DNC programming computer controlled equipment job/work scheduling capacity planning	when to order materials monitoring production output monitoring machine utilisation assessing employee productivity
Design	engineering analysis CAD - computer aided design	
Costing	job estimating/quoting job costing/cost analysis	analysis of production costs
Office Administration	invoicing etc purchase order processing wordprocessing payroll	
Marketing	mailshots to customers	sales analysis forecasting future sales
Financial	nominal ledger budgeting	debtors analysis forecasting cash flow monitoring profit forecasting profit

The FAA score varied between 1 and 6, reflecting the total number of functional areas covered. A firm had to have at least one application or use from the list to be considered as providing assistance in that functional area.

Appendix 6

SUMMARISED ANALYSIS OF RESPONSES BY QUESTION

SURVEY RESPONSES

PART A. All 289 Firms

1. Q.1 Awareness of MSC grants

No	65%
Yes	33%
Other	1%

2. Q.2 Using other equipment?

CNC	17%
Some automation	1%
Both above	1%
None	80%
Other	2%

3. Q.3 Use a computer?

No	59%
Yes	42%

4. Q.31 Developed any new products?

No	34%
Yes	62%

5. Q.32 Written business plan?

No	82%
Yes	14%

6. Q.33 Written monthly forecasts for?

Sales	46%
Bad debts	26%
Profit	36%
Cash flow	52%
Material requirements	28%
No forecasts	33%

7. Q.34 Type of firm?

Partnership	12%
Sole trader	15%
Limited company	73%

8. Q.36 Year established?

Before 1940	9%
1940s	7%
1950s	7%
1960s	21%
1970s	37%
1980s	17%

9. Q.37 Family employees only?

No	92%
Yes	7%

10. Q.39 Number of marketing and sales staff?

None	33%
1	27%
2	20%
3	8%
4	3%
more than 4	4%

11. Q.40 Number of employees?

1-5	26%
6-10	24%
11-19	25%
20-49	26%

12. Q.41 Sales revenue in 1985?

Under £50,000	8%
£50,000-99,999	14%
£100,000-199,999	16%
£00,000-299,999	15%
£300,000-399,999	13%
£400,000-499,999	9%
£500,000-749,999	10%
£750,000-999,999	5%
£1 million - 2 million	5%
£2 million - 5 million	1%

13. Q.42 Type of firm?

Mechanical engineering	64%
Electrical engineering	14%
Vehicle parts	9%
Other metal goods	13%

14. Q.43 Recent total market changes?

Decreased	25%
Same	36%
Increased	36%

15. Q.45 Net profit 1985 compared with 1984:

Decreased	19%
Same	19%
Increased	56%

PART B. <u>All 289 Owner Manager/Managing Directors</u>

16. Q.26 Worked mainly at?

Desk	66%
Machinery	20%
Both above	10%

17. Q.27 Employee or owner?

Employee	6%
Owner	92%

18. Q.28 Daily involvement?

No	3%
Yes	97%

19. Q.30 Wish to grow into a large firm?

Least important	68%
Medium importance	27%
Most important	5%

20. Q.30 Wish for job satisfaction?

Least important	4%
Medium importance	27%
Most important	69%

21. Q.30 Wish to earn as much money as possible?

Least important	8%
Medium importance	59%
Most important	33%

22. Q.29 Year of birth?

Before 1930	17%
1930s	30%
1940s	36%
1950s	10%
1960s	1%

PART C. All 120 Firms With A Computer

23. Q.4 Acquired for sole use?

Sole use	89%
Share	8%
Bureau	3%

24. Q.6 Number of terminals?

1	57%
2	16%
3	11%
4	6%
Over 4	8%

25. Q.7 Hardware and software cost?

Up to £1000	2%
£1000-£2000	6%
£2000-£3000	8%
£3000-£4000	9%
£4000-£5000	11%
£5000-£7500	17%
£7500-£10,000	11%
£10,000-£20,000	11%
£20,000-£30,000	9%

26. Q.8 Year of first computer?

During 1970s	3%
1980	14%
1981	8%
1982	8%
1983	12%
1984	20%
1985	18%
1986	10%

27. Q.9 Still with first computer?

First computer	63%
Considerably upgraded	20%
Totally replaced	16%

28. Q.10 Any prior computer experience in the company?

None	58%
Some	42%

29. Q.11a Was a written statement of requirements prepared?

No	66%
Yes	32%

30. Q.11b Who wrote it?

Within the firm	55%
Someone outside the firm	42%
Jointly	8%

31. Q.12 Applications planned at time of purchase?

Sales processing	75%
Payroll	57%
Nominal ledger	52%
Stock control	35%
Wordprocessing	32%
Costing	28%
Purchasing	22%
Production planning	13%
Mailshots	12%
NC programming	9%
Budgeting	6%
CAD	6%
Various others	

32. Q.13a Aims - to provide information?

Least important	16%
Medium importance	37%
Most important	38%

33. Q.13a Aims - to save time?

Least important	7%
Medium importance	28%
Most important	60%

34. Q.13b Aims - to provide a new product or service?

Least important	63%
Medium importance	7%
Most important	16%

35. Q.13b To support clerical tasks?

Least important	18%
Medium importance	26%
Most important	52%

36. Q.13b To support technical tasks?

Least important	46%
Medium importance	18%
Most important	23%

37. Q.13b support managerial tasks?

Least important	22%
Medium importance	33%
Most important	38%

38. Q.15 Current uses for a computer?

Sales processing	73%
Payroll	66%
Nominal ledger	61%
Wordprocessing	52%
Purchase processing	46%
Stock control	36%
Budgeting	34%
Costing	30%
Mailshots	28%
Estimating	23%
NC programming	17%
Production planning	15%
Controlling equipment	10%
Capacity planning	8%
CAD	8%
Engineering analysis	7%

39. Q.18 Number of managers using a terminal monthly?

0	33%
1	24%
2	18%
3	8%
4 or more	5%

40. Q.19 Computer used to support managers in?

Debtors analysis	66%
Sales analysis	59%
Monitoring profit	45%
Forecasting cash flow	36%
Analysis of production costs	30%
Stock control	25%
Forecasting profit	20%
Forecasting sales	14%
Monitoring production output	11%
Assessing employee productivity	8%
Monitoring machine utilisation	1%
No managerial use	15%

41. Q.20 It has improved decision making?

Disagree	25%
Undecided	18%
Agree	50%

42. Q.20 It has helped provide new services or products?

Disagree	49%
Undecided	13%
Agree	33%

43. Q.20 It has failed to meet some of our requirements?

Disagree	48%
Undecided	17%
Agree	31%

44. Q.20 It has been well worth its cost?

Disagree	6%
Undecided	13%
Agree	79%

45. Q.20 It has created many problems?

Disagree	58%
Undecided	18%
Agree	21%

46. Q.20 It has helped the firm increase sales?

Disagree	43%
Undecided	16%
Agree	35%

47. Q.20 It has been a failure?

Disagree	85%
Undecided	7%
Agree	5%

48. Q.20 We have achieved fewer benefits than expected?

Disagree	64%
Undecided	12%
Agree	20%

49. Q.20 It has significantly improved organisation effectiveness?

Disagree	23%
Undecided	15%
Agree	58%

50. Q.20 It has significantly improved customer service?

Disagree	29%
Undecided	26%
Agree	39%

PART D. All 120 MDs of firms with a computer

51. Q.14 MD's level of involvement when defining needs?

Not involved	5%
Overseeing role only	8%
Closely involved	28%
Highly involved	53%

52. Q.14 MD's level of involvement when selecting a system?

Not involved	8%
Overseeing role only	7%
Closely involved	28%
Highly involved	51%

53. Q.14 MD's level of involvement during implementation?

Not involved	8%
Overseeing role only	13%
Closely involved	28%
Highly involved	46%

54. Q.14 MD's involvement in solving problems?

Not involved	9%
Overseeing role only	17%
Closely involved	25%
Highly involved	43%

55. Q.14 MD's involvement in planning further developments?

Not involved	3%
Overseeing role only	10%
Closely involved	33%
Highly involved	49%

56. Q.16 MD's typical personal use of a terminal?

Never	22%
Monthly	8%
Weekly	32%
Daily	32%

57. Q.17 MD's used terminals to?

Assess financial performance	44%
Cost control	19%
Wordprocessing	18%
Sales order processing	18%
CAD and engineering analysis	16%
Programming	15%
Sales analysis	10%
Production planning and control	10%
Financial planning	8%
Payroll	7%
Purchasing	7%
NC programming	5%

PART E <u>All 169 Firms without a computer</u>

58. Q.21 Likelihood of acquiring a computer the next year?

Definitely not	21%
Unlikely	37%
Possibly	25%
Probably	7%
Definitely	2%
Don't know	5%

59. Q.22 Any prior personal experience with computers?

None	58%
Some	37%

60. Q.24 I can see a need for a computer in the firm?

Disagree	40%
undecided	30%
Agree	28%

61. Q.24 I know very little about computers?

Disagree	20%
Undecided	5%
Agree	73%

62. Q.24 My firm could afford a computer?

Disagree	27%
Undecided	18%
Agree	52%

63. Q.24 A computer could help me manage the firm?

Disagree	35%
Undecided	28%
Agree	35%

64. Q.24 I do not have time to learn about computers?

Disagree	33%
Undecided	21%
Agree	44%

65. Q.24 I like computers?

Disagree	18%
Undecided	36%
Agree	43%

66. Q.24 The firm is too small for a computer?

Disagree	31%
Undecided	23%
Agree	43%

67. Q.24 computer could probably save money for the firm?

Disagree	37%
Undecided	29%
Agree	32%

68. Q.24 firm's operations cannot be computerised?

Disagree	52%
Undecided	22%
Agree	24%

69. Q.24 Computers waste more time and effort than they save?

Disagree	37%
Undecided	39%
Agree	21%

Appendix 7

Organisational Characteristics and Financial Performance: Kendall Rank Correlation Coefficients - For All Mechanical Engineering Firms (n=184)[1]

Expected Direction of Relationship		Sales Change 1985/84	Net Profit Change 1985/84	Net Return 1985	Sales Change 1985/80
	Information Technology				
+	Presence of a computer	.03	-.02	-.04	.14*
+	Number of sophisticated applications (SOF)	-.02	-.10	-.12*	.08
+	IT success	.04	-.02	-.03	.14*
	Planning				
+	Written business plan	.00	-.11	-.12	-.07
+	Monthly sales forecasts	.04	-.11	-.05	.06
+	Monthly bad debts forecasts	-.08	-.02	-.05	-.06
+	Monthly profit forecasts	-.00	-.06	.02	-.04
+	Monthly cashflow forecasts	.04	-.05	-.10	.04
+	Monthly material requirement forecasts	-.06	-.00	-.08	-.05
-	No monthly forecasts	-.10	.04	.04	-.02
	Type of Firm				
	Limited company	-.11	-.02	-.28***	.06
	Year firm established[2]	.17***	.01	.15**	.23***
	Number of managers	-.01	-.02	-.22***	.04
+	Number of marketing/sales staff	-.17**	-.12*	-.09	-.06
	Number of employees	-.01	.01	-.18**	.05
	Sales Revenue (1985)	-.05	.06	-.16**	.10
+	New products	.04	-.12	-.05	-.00
	Owner/Manager Characteristics				
-	Works at desk or machinery	.06	-.02	.20**	-.10
+	Year of birth[2]	.17**	.08	.10	.31***
+	Wants firm to grow	.10	.06	-.05	.10
-	Seeks job satisfaction	-.11	-.06	.06	-.14*
+	Wants to earn money	-.03	-.07	.08	.06

* Significant at 5%
** Significant at 1%
*** Significant at .1%

Notes: (1) Sample sizes varied from 121 to 171 depending on missing data.
(2) For the "Year of birth" variable a high value (e.g. born 1965) is indicative of a young owner, hence the expected +ve correlation. Similarly, high values for the variable "Year firm established" indicate a young firm.

Appendix 8

Owner-Manager Characteristics used in studies of small firm financial performance

RESEARCH STUDY

Managerial Characteristics	Begley & Boyd (B & B)	Cragg (C)	Dollinger (D)	Foley (F)	Hand Sineath & Howle (HS&H)	Hornaday & Wheatley (H & W)	Ibrahim & Goodwin (I & G)	Miller & Toulouse (M & T)
Social								
Married	NS							
Experience								
Founder	G,P							
Years in position	P			P				NS
Years with firm	G			G	G			G,P
Education	P			G	NS			
Previous experience				P	G			
Product familiarity				P				
Psychological/Managerial								
Goals		G						
Need for achievement								G
Flexibility								G,P
Locus of control								G,P
Type A	G,P							
Speed and impatience	NS							
Job involvement	G,P							
Hard driving competitiveness	G							
Use of time		P			G			
Innovativeness			E					
Entrepreneurial values							PS	
Managerial skills							PS	
Interpersonal skills							PS	
Craft v Promotions v Administrative						G,P		
Teamwork			E					
Owner Authority			E					

Key:
- NS — No significant correlations found
- G growth — Significant relationship found at 5% level or stronger with at least one measure of firm growth
- P - profit — Significant relationship found at 5% level or stronger with at least one measure of profit
- E - effectiveness — Significant relationship found at 5% level or stronger with an overall measure of organisational effectiveness
- PS - perceived success — Significant relationship found at 5% level or stronger with perceived success.

Appendix 9

Behavioural Constructs used by researchers of small firm performance

Construct Name	Research Study	Key word descriptors	Based On
Goals	C	Relative objectives of job satisfaction, earn money, and company growth	Scase & Goffee (1982)
Need for achievement	M & T	High nAch set challenges to stretch themselves, prefer to work at a problem, spend time thinking about doing things better	Steers & Braunstein (1976)
Flexibility - Rigidity	M & T	Refers to adaptability of a person's thinking and social behaviour. F. are more likely to react and adapt to changing conditions	Gough (1960)
Locus of Control	M & T	Internal-external, with Internal more task oriented, function better under stress, favour innovation, lead competitors, take risks - measures felt ability to influence their circumstances	Rotter (1966)
Type A	B & B	Type As strive to achieve more and more, while Type B are relaxed, patient and satisfied	Jenkins Activity Survey (1979)
Speed and Impatience) Job Involvement) Hard driving competitiveness)	B & B	Separate dimensions within the Type A construct	
Use of Time	C	Work most at desk or machinery	Scase & Goffee (1982)
	H,S & H	Total hours spent at work, and priority given to time spent with customers, record keeping, mechanical work, supervision, absences and idle time	
Innovativeness	D		Maidique (1980)

Appendix 9 continued

Construct Name	Research Study	Key word descriptors	Based On
Entrepreneurial Values)	I & G	Intuition, extrovert, risk taking, creativity, flexibility, sense of independence, high value of time skills needed to manage a successful small business, including niche strategy, cash flow management, budgetary system, prior experience, education	
Managerial Skills)	I & G		
Interpersonal Skills	I & G	Good relationships with bank, customers and employees	
Teamwork	D		Mintzberg (1979)
Owner Authority	D		Mintzberg (1979)
Craft)		Craft type managers achieve a level of sales and revenue that satisfies their need for independence and resist further business growth	Filley & Alday (1975)
Promotion)	H & W (as one of 3 types)	Personal wealth is the motivation for promotion type managers. Can tolerate organisational confusion to achieve rapid growth. Less interested in the operation aspects of the firm that the other two types	
Administration)		Usually in large firms, often better education. They develop sound organisational structures and expect constant linear growth. Enjoy the trappings of success and recognition from leadership in civic affairs	

Appendix 10

MANN-WHITNEY AND KRUSKALL-WALLIS PROBABILITIES WHEN TESTING PROPOSITION 1 FOR EACH CLUSTER

Cluster 1 Owners that want growth not money

Table A10.1: Mean Ranking by Computer/No Computer

	1 year sales		Net Return		5 year Sales	
No computer	22	(n=24)	24	(n=22)	18	(n=18)
Computer	23	(n=20)	19	(n=19)	18	(n=17)
		(n=44)		(n=41)		(n=35)
Mann-Whitney Probability	.680		.307		.987	

No significant results, with a negative direction for net return.

Table A10.2 Mean Ranking for ITSOPH

	1 year sales		Net Return		5 year Sales	
No computer	22	(n=24)	23	(n=22)	18	(n=18)
Unsophisticated	24	(n=8)	19	(n=7)	21	(n=7)
Sophisticated	23	(n=12)	19	(n=12)	16	(n=10)
		(n=44)		(n=41)		(n=35)
Kruskall-Wallis Probability	.901		.593		.693	

No statistically significant results, with the no computer firms ranked highest on Net return.

Cluster 2 Younger Limited Companies

Table A10.3: Mean Ranking by Computer/No Computer

	1 year sales		Net Return		5 year Sales	
No computer	27	(n=32)	25	(n=26)	21	(n=27)
Computer	30	(n=23)	24	(n=22)	25	(n=18)
		(n=55)		(n=48)		(n=45)
Mann-Whitney Probability	.417		.649		.342	

Again, no significant results, but positive results for both sales growth variables.

Table A10.4: Mean Ranking for ITSOPH

	1 year sales		Net Return		5 year Sales	
No computer	26	(n=33)	26	(n=27)	22	(n=28)
Unsophisticated	31	(n=9)	28	(n=9)	22	(n=7)
Sophisticated	31	(n=13)	19	(n=12)	26	(n=10)
		(n=55)		(n=48)		(n=45)
Kruskall-Wallis Probability	.563		.325		.639	

No statistically significant results though the firms with sophisticated IT ranked high on both sales growth variables but worst on the net return.

Cluster 3 Larger, Older Firms

Table A10.5: Mean Ranking by Computer/No Computer

	1 year sales		Net Return		5 year Sales	
No computer	9	(n=16)	11	(n=14)	10	(n=14)
Computer	17	(n=6)	12	(n=8)	12	(n=7)
		(n=22)		(n=22)		(n=21)
Mann-Whitney Probability	.017*		.837		.456	

One significant result for one year sales growth.

With only a small number of firms, the analysis by ITSOPH was not deemed appropriate.

Cluster 4 Small Partnerships

Table A10.6: Mean Ranking by Computer/No Computer

	1 year sales		Net Return		5 year Sales	
No computer	27	(n=47)	20	(n=36)	18	(n=31)
Computer	26	(n=6)	24	(n=4)	20	(n=5)
		(n=53)		(n=40)		(n=36)
Mann-Whitney Probability	.877		.527		.749	

Again, no significant results, and the small number with a computer, made analysis by ITSOPH inappropriate.

Cluster 5 Larger, Limited Companies

Table A10.7: Mean Ranking by Computer/No Computer

	1 year sales		Net Return		5 year Sales	
No computer	18	(n=17)	16	(n=16)	16	(n=14)
Computer	15	(n=15)	17	(n=16)	14	(n=15)
		(n=32)		(n=32)		(n=29)
Mann-Whitney Probability	.520		.777		.541	

Again, no significant results, with negative results for both sales growth variables.

Table A10.8: Mean Ranking for ITSOPH

	1 year sales		Net Return		5 year Sales	
No computer	18	(n=17)	16	(n=16)	16	(n=14)
Unsophisticated	12	(n=6)	16	(n=8)	15	(n=7)
Sophisticated	18	(n=9)	18	(n=8)	14	(n=8)
		(n=32)		(n=32)		(n=29)
Kruskall-Wallis Probability	.453		.924		.805	

No statistically significant results.

Appendix 11

MANN-WHITNEY AND KRUSKALL-WALLIS PROBABILITIES WHEN TESTING PROPOSITION 1 FOR THE SIC GROUPS

SIC 31 Other Engineering Firms

Table A11.1: Mean Ranking by Computer/No Computer

	1 year sales		Net Return		5 year Sales	
No computer	12	(n=18)	13	(n=16)	14	(n=16)
Computer	15	(n=7)	10	(n=7)	7	(n=7)
		(n=25)		(n=23)		(n=23)
Mann-Whitney Probability	.412		.402		.041*	

One significant result but a negative one for five year sales growth.

SIC 32 Mechanical Engineering Firms

Table A11.2: Mean Ranking by Computer/No Computer

	1 year sales		Net Return		5 year Sales	
No computer	68	(n=94)	63	(n=81)	53	(n=74)
Computer	69	(n=42)	58	(n=41)	65	(n=39)
		(n=136)		(n=122)		(n=113)
Mann-Whitney Probability	.934		.401		.068	

One significant and positive result for five year sales growth.

Table A11.3: Mean Ranking for ITSOPH

	1 year sales		Net Return		5 year Sales	
No computer	68	(n=95)	64	(n=82)	54	(n=75)
Unsophisticated	74	(n=11)	59	(n=14)	64	(n=13)
Semi-Sophisticated	75	(n=18)	60	(n=15)	65	(n=15)
Sophisticated	59	(n=12)	51	(n=11)	62	(n=10)
		(n=136)		(n=122)		(n=113)
Kruskall-Wallis Probability	.711		.713		.471	

No statistically significant results, and the firms with sophisticated IT ranked lowest on one year sales growth and net return.

SIC 34 Electrical Engineering

Table A11.4: Mean Ranking by Computer/No Computer

	1 year sales		Net Return		5 year Sales	
No computer	16	(n=16)	17	(n=14)	10	(n=9)
Computer	17	(n=16)	14	(n=16)	11	(n=11)
		(n=32)		(n=30)		(n=20)
Mann-Whitney Probability	.597		.440		.703	

No significant results.

Table A11.5: Mean Ranking for ITSOPH

	1 year sales		Net Return		5 year Sales	
No computer	16	(n=16)	17	(n=14)	10	(n=9)
Unsophisticated	22	(n=6)	16	(n=7)	12	(n=5)
Sophisticated	15	(n=10)	13	(n=9)	10	(n=6)
		(n=32)		(n=30)		(n=20)
Kruskall-Wallis Probability	.269		.534		.806	

No statistically significant results, and the firms with sophisticated IT ranked poorly on all three variables.

SIC 35 Transport Parts

Table A11.6: Mean Ranking by Computer/No Computer

	1 year sales		Net Return		5 year Sales	
No computer	8	(n=12)	7	(n=7)	7	(n=9)
Computer	14	(n=7)	8	(n=7)	10	(n=7)
		(n=19)		(n=14)		(n=16)
Mann-Whitney Probability	.012*		.699		.223	

One positive, significant result for one year sales growth.

Appendix 12

KENDALL RANK CORRELATION COEFFICIENTS FOR IT SOPHISTICATION WITH FINPERF, FOR SUB-SAMPLES OF FIRMS WITH A COMPUTER

SIC 32

Table A12.1: Significant Kendall Rank Correlations for Components of IT Sophistication with FINPERF - All in SIC 32 (n=39+)

IT Variable	1 year sales growth	Net return	5 year Sales growth
Ownership (Q4)	.21*		
Number of terminals (Q6)	-.20*	-.22**	
Year of first computer (Q8)			
Use by owner (Q16)			
Number of sophisticated applications (SOF)		-.26**	
Number of functional areas (FAA)		-.17*	-.17*
Number of managerial applications (MST)		-.23**	
Number of unsophisticated applications (UNS)			
ITSOPH (aggregate measure)			

Seven significant results, all are negative as high values for ownership (Q4) indicate a shared system or use of a bureau.

Cluster 1

Table A12.2: Significant Kendall Rank Correlations for Components of IT Sophistication with FINPERF - Cluster 1 - Owners that want growth not money (c=17+)

IT Variable	1 year sales growth	Net return	5 year Sales growth
Ownership (Q4)	.33**		
Number of terminals (Q6)			
Year of first computer (Q8)		.24*	.40**
Use by owner (Q16)		.45**	
Number of sophisticated applications (SOF)			-.27*
Number of functional areas (FAA)			-.30*
Numbere of managerial applications (MST)			-.32**
Number of unsophisticated applications (UNS)			-.32**
ITSOPH (aggregate measure)			

Eight significant results, seven of which are negative, and only one positive.

Cluster 2

Table A12.3: Significant Kendall Rank Correlations for Components of IT Sophistication with FINPERF - Cluster 2 - Young, Limited Companies (n=18+)

IT Variable	1 year sales growth	Net return	5 year Sales growth
Ownership (Q4)			
Number of terminals (Q6)			
Year of first computer (Q8)	.31**	.27*	
Use by owner (Q16)			
Number of sophisticated applications (SOF)		-.28**	
Number of functional areas (FAA)			
Numbere of managerial applications (MST)		-.35**	
Number of unsophisticated applications (UNS)			.35**
ITSOPH (aggregate measure)			

Five significant results, and all are negative.

Cluster 5

Table A12.4: Significant Kendall Rank Correlations for Components of IT Sophistication with FINPERF - Cluster 5 - Larger, Limited Companies (n=15+)

IT Variable	1 year sales growth	Net return	5 year Sales growth
Ownership (Q4)			
Number of terminals (Q6)			
Year of first computer (Q8)			.42**
Use by owner (Q16)			
Number of sophisticated applications (SOF)		-.29*	-.27*
Number of functional areas (FAA)			
Numbere of managerial applications (MST)			
Number of unsophisticated applications (UNS)			
ITSOPH (aggregate measure)			

Three significant results, and all are negative.

Appendix 13

IT USER FIRMS COMPARED WITH NON-USER FIRMS

Table A13.1: Comparisons of Firms - No computer versus With Computer for large firms only (n=55)

	No Computer (n=20)	With Computer (n=35)	Difference Level of significance	Test Used	All firms (n=55)
Organisational variable					
Year established (median)	1948	1968	*	M-W	1961
New products	47/53%	17/80%	*	χ^2	28/70%
Written business plan	90/11%	74/23%	NS	χ^2	80/19%
No monthly forecasts	16%	11%	NS	χ^2	13%
Number of monthly forecasts[1]	3	3	NS	M-W	3
Number of employees	-	-	-	-	-
Number of managers[1]	3	3	**	M-W	3
Sales Revenue in 1985[2]	$300,000-$400,000	$300,000-$400,000	NS	K-S	$300,000-$400,000
Percentages in SIC2/SIC4	63/11%	60/20%	NS	χ^2	61/17%
Owner-Manager variables					
Year of birth[1]	1938	1939	NS	M-W	1939
Work at desk/machinery	90/5%	86/6%	NS	K-S	87/6%
Wish firm to grow	58%	51%	NS	K-S	54%
Gain job satisfaction	47%	63%	NS	K-S	57%
Earn money	42%	51%	NS	K-S	48%
Financial Performance					
One year's sales growth[1]	15%	20%	*	M-W	15%
Net return in 1985[1]	+6%	+7%	NS	M-W	+7%
Sales revenue 85/80[1]	+50%	+60%	NS	M-W	+60%

M-W	Mann-Whitney test for 2 groups and rankable scores
χ^2	Chi-squared test for 2x2 groups
K-S	Kolmogorov-Smirnov two sample test for 3 or more ordinal groups
NS	Not significant at the 5% level
*	Significant at the 5% level
**	Significant at the 1% level
***	Significant at the .1% level
1	Median
2	Mode

Table A13.2: Partial correlation coefficients between computer ownership and one year sales growth, controlling for other variables (n=55) (large firms only)

Controlled Variable	Partial Correlation Coefficient Value	Significance
No controlled variable	.2139	.031*
Organisational variables		
Year established	.1319	.173
New products	.2155	.068
Written business plan	.2098	.074
No monthly forecasts	.2216	.063
Number of monthly forecasts	.2099	.074
Number of employees	-	-
Number of managers	.2164	.068
Sales revenue in 1985	.2775	.027*
Owner-Manager variables		
ear of birth	.1969	.081
Work at desk/machiner	.2273	.053
Wish firm to grow	.2146	.063
Gain job satisfaction	.2223	.057
arn money	.2257	.054

The data above shows that the correlations between computer ownership and performance remain high, even when controlled for other variables. However, it should be noted that the calculated statistics are product moment rather than rank correlations. In addition, there would be many "tied" as few of the variables were measured over a long scale. Some of the variables given above were dichotomous (NO/YES): for example, New Products, Written Business Plan. Thus, the data above should be viewed with caution and considered as only possibly indicative of a correlation between computer ownership and performance.

Table A13.3: Extension to Table 12.6 showing Mann-Whitney probabilities when testing with versus without, controlling for possible explanatory variables (n=55)

Q29 = 1	+ .0959*	=2 + .587	=3 + .4812
Q39 = 0	+ .0325*	=1 + .4197	=2 + .1873
FST = 1	+ .1671	=2 + .2840	
REV = 1	+ .2379	=2 + .1604	=3 + .4893
Q26 = 1	+ .0351	(n=47)	
FS6 = 1	+ .0936*	(n=44)	
FS4 = 1	- .8411	=2 + .0459* (n=37)	
FS2 = 1	+ .0680*	(n=32)	=2 + .5352
OB1 = 1	+ .2604	=2 + .0270*	=3 + .4386
OB2 = 1	-	=2 + .0292*	=3 + .5711
OB3 = 1	+ .7237	=2 + .4696	=3 + .0502
Q32 = 1	+ .0187*	(n=43) =2 + 1.000	

Variable where no relationship when controlled:

FS1	monthly sales forecasts	)
FS3	monthly profit forecasts	) forecasting is important
FSS	monthly material requirements forecast	)
FST	total number of monthly forecasts	)

REV annual sales revenue 1985

Table A13.4: Oldest Large Firms - Comparison of the No Computer versus With Computer Firms

	No Computer (n=13)	With Computer (n=15)	Difference Level of significance	Test Used	All firms (n=28)
Organisational variable					
Year established (median)	1938	1948	*		1947
New products	46/54%	13/80%	**		29/68%
Written business plan	92/8%	73/20%	*		82/14%
No monthly forecasts	15/69%	13/80%	NS		14/75%
Number of monthly forecasts[1]	3.00	3.00	NS		3
" " " " [2]	2.46	2.71			2.6
Number of employees	-	-	-	-	-
Number of managers[1]	3.00	4.00	*		3
" " [2]	2.46	3.73			3.14
Sales Revenue in 1985	$400,000-$500,000	$500,000-$750,000	NS	K-S	$400,000-$500,000
Number of marketing/sales staff[1]	2.00	2.00	NS		2.00
" " " [2]	2.31	2.57			2.44
SICC					
Owner-Manager variables					
Year of birth	1933	1939	NS		1936
Work at desk/machinery	92/8%	73/20%	*		82/14%
Wish firm to grow	69%	53%	*		61%
Gain job satisfaction	46%	60%	NS	- -	54%
Earn money	46%	40%	NS		43%
Financial Performance					
One year's sales growth[1]	+10%	+20%	*	M-W	+15%
Net return in 1985[1]	+5%	+5%	NS		+5%
Sales revenue 85/80[1]	+25%	+44%	NS		+44%

M-W	Mann-Whitney test for 2 groups and rankable scores
χ^2	Chi-squared test for 2x2 groups
K-S	Kolmogorov-Smirnov two sample test for 3 or more ordinal groups
NS	Not significant at the 5% level
*	Significant at the 5% level
**	Significant at the 1% level
***	Significant at the .1% level
1	Median
2	Mode

Table A13.5: Extension to Table 12.7 - Comparing the 28 oldest large firms, computer versus no computer, for specific types of monthly forecasts

Monthly Forecasting Variable	No Computer (n=13)	Computer (n=15)	Difference	All 28 firms
Sales	46%	73%	*	61%
Bad debts	39%	20%	-ve	29%
Profit	23%	67%	**	46%
Cash flow	62%	60%	NS	61%
Material requirements	39%	33%	NS	36%
None	15%	13%	NS	15%

Appendix 14

PRODUCT MOMENT CORRELATIONS FOR ALL VARIABLES IN THE IT SUCCESS MODEL
(after standardisation of scores) (n=85)

Variable Name	EXP	OITPLAN	HELP	OITCONT	PLANTOT	MOD	YEARS	USE
Prior experience (Exp)	1.00							
Owner IT Planning (OITPLAN)	.04	1.00						
External assistance (HELP)	.00	-.00	1.00					
Owner IT control (OITCONT)	.02	.75	-.03	1.00				
IT Planning (PLANTOT)	.16	.05	.51	.09	1.00			
Modern equipment (MOD)	.50	.09	-.01	.12	.03	1.00		
Years of experience (YEARS)	.10	.11	-.08	.15	.13	-.29	1.00	
Use (USE)	.19	-.04	.12	.03	.43	.17	.23	1.00
IT Success	.06	.04	.01	.23	.19	.09	.08	.39

Appendix 15

THE SIX CASE STUDY FIRMS

Firm A

This firm was founded in 1970 by the current owner who had been a shareholder in a similar enterprise. The firm manufactures and imports specialised cutting tools for mineral prospecting and for the drilling of water wells. They have enjoyed steady sales growth during the 1980s. This has been restricted by a lack of skilled labour rather than the market. They currently employ fifteen staff including one manager, one office person and one sales representative. The owner has a degree in geology so provides expertise for product design and determining customer needs.

The firm acquired their computer in 1983 to speed up their invoicing system and to provide better information. The initial debtors system was a real success. However, they found it very difficult to expand their IT applications. Unfortunately, their vendor's local office was closed down and their accountant obstructed rather than encouraged further computerisation. As a result it took them 2½ years to implement their general ledger system; a system which still has many weaknesses, one being that data is transferred manually from the debtors and creditors system. The slow progress with IT has resulted in a reluctance to replace their system, even though they see the need and are operating profitably.

One of the major benefits from the debtors system was that the invoicing process was speeded up considerably. This resulted in earlier payment. The system paid for itself within a year through the reduction of interest on the bank overdraft.

The system also saved clerical time, which pleased the owner considerably as his wife had been the office person and had to take work home regularly. A further benefit has come from the general ledger system with a reduction of involvement from their accountant, and hence a reduction in fees.

A small number of customers were affected in the early days of computerisation. There were a small number of "foul-ups" when reminders were sent in error to those that had already paid. Such errors had been remedied quickly. In general, customer reactions had been favourable, and the smarter and more efficient invoicing system had improved the company's image.

Advantages had also been gained through the "better information" which their system provided. One simple example was the monitoring of customers. Any customer who had not placed an order in the last four months was automatically placed on a list for the sales representative to explore further.

Firm B

The firm was founded in 1975 by the current owner who previously served his apprenticeship and worked as a tradesman with a larger firm. He formed him own business because he was keen to "escape the prison-like environment" of the larger firm. The firm reconditions automotive engines. As the business has not prospered during the 1980s, survival has been a major concern during the last few years. They are still in business, partly because they have succeeded in broadening their customer base. Instead of working predominantly for garages, they now also deal direct with the public. The owner has no desire for the firm to grow beyond the current level of six workers in the workshop, in addition to the owner and his wife. The owner manages the business, including the important tasks of dealing with customers, determining their needs and costing jobs. Only rarely does he do any machining work. His wife runs the book-keeping side of the business from home. She used to work in the factory office, but moved home full-time when they acquired their computer prior to the arrival of their third child. Though the owner's wife produces the computer reports, they are predominantly for use by the owner.

Their microcomputer was acquired in 1982 for the major purpose of saving time. The computer was acquired in order that the wife of the owner could continue with the clerical tasks, despite having three children. The implementation was very successful; the wife was able to continue her role, and the owner received regular feedback on debtors, income and expenditure. Apart from adding an automatic cheque writing procedure, their system has seen no development since the early days. The owner has never used the computer and is unlikely to as it is located at home, and he likes to go home to relax, not work. If the economic climate had been healthier, they would probably have considered replacing their system. However, it is currently doing a good job so they see little incentive to change.

There is little doubt that the computer has achieved clerical efficiencies, and at the same time enabled the wife of the owner to remain active in the business.

The better information on expenditure has been used in some cases to reduce costs. For example, in a review of 1987 expenditure, large cost items were identified and steps taken to reduce these costs in 1988.

Customers, apart from receiving an earlier and smarter invoice, have not been affected.

Firm C

In the early 1980s, the firm was the largest local aluminium joinery firm with 120 employees. In 1984 the highly competitive aluminium joinery part of the business was sold to enable the

firm to concentrate on specialised glass products. They now employ 40, which includes an accountant, production and marketing managers and four office staff, one of which has the computer as a major responsibility. However, this person has received no IT training other than an initial half-day familiarisation course. The recent restructuring has worked well for the firm. The firm now has many established value-added products, and they have plans to set up a similar operation in Australia.

Their computer experience started in 1978 through the use of a computer bureau. Poor service from the bureau, and at an ever increasing cost, encouraged them to acquire their own mini-computer, using a custom-built accounting package. A few years later, their software suppliers encouraged the firm to change both their hardware and software on the grounds that a newer computer would provide a better environment for users, and that the old system was in need of replacement. Furthermore, the software house was switching to new hardware, and threatened to stop maintaining Firm C's system if it remained on the original hardware.

The basic accounting packages were implemented quickly. However, as the costing side has proven more difficult to design and implement, the firm continues to rely on their software suppliers for maintenance work. To ease the development process, the firm has a modem link in order for the software house to make changes from a distance.

Use of the computer system has grown. They have already upgraded the system to take ten ports from the original six. The CPU was also due for an upgrade. The system has been a success and both the Marketing and Production managers were pushing for terminals in their offices.

Recently, they have also acquired a microcomputer, primarily for word-processing but also with a view to acquiring LOTUS 1-2-3 for financial planning purposes. The mini system possessed a rather crude spreadsheet option which was used for job-costing only.

Computerisation has given the firm an efficient order processing system. The monthly reports are used by managers, predominantly for control rather than planning. Customers have not been affected, other than through a lower probability of receiving an incorrect price quotation.

Firm D

When visited in early 1984 this firm had a total staff of seven, engaged in the design, manufacture and marketing of computer controlled energy management systems. A few months later, the current owner was brought in by the receivers to take over as General Manager. By mid year the firm had been restructured, with the current owner acquiring the design and manufacturing side of the business. As a trained electronics engineer he has continued to run the business, but on a survival basis due to low

sales. In 1988 the firm was running at a loss. This lack of profitability meant it was unlikely that capital would be made available to allow for a new product to be designed which could ensure the viability of the firm. In 1988, the firm was down to being a one person firm, and the owner recognised that he would be better off working for someone else. He lived in the hope of designing and manufacturing a new product which would prove very profitable.

The firm originally acquired a computer in 1982 to help them produce instruction manuals for users of their product. With a background in electronics, the owner has no fear of IT. He uses the computers regularly and has designed spreadsheet models for stock control, sales quotes and cash flow projections. Also, he has written a programme which automates the testing of each finished item. None of the systems are integrated so any data is transferred manually. The owner would have liked to have replaced at least one of the computers but felt that the expenditure could not be justified to his bank manager. He would very much like to use a computer for the design of printed circuit boards. Overall, the computers are currently used to support clerical, managerial and manufacturing activities.

The computer has been used successfully to make life easier for the owner. However, such software development has been carried out by the owner, and has thus been an investment of his time in an effort to free up future time for the design of a new product. Meanwhile, the firm has failed to maintain a satisfactory profit, primarily due to low sales. The owner has made little effort to increase sales, but has spent time on IT developments.

Firm E

This flourishing precision engineering firm was established in 1969. The founder's son took over as managing director in 1985 after he had spent a period of five years with the firm since leaving school. The founder retains some interest in the firm but is primarily engaged in building his second boat.

They manufacture and market valves of various sizes and designs, and other precision products. All components are manufactured on site using five automated lathes and one automated cutting machine. The business has grown slowly, helped along by exporting to Australia. 1987 and 1988 have been particularly busy years leading to the acquisition of further equipment costing $250,000. Currently they have a staff of 40, including one in the office and a production manager.

Their first computer was acquired in 1981 to support the manufacturing side of the business through CNC (computer numerical control) machining. The computer made it easy to prepare, store and edit CNC programmes. It is still used for this purpose. However, due to programming errors, they no longer use their first computer for payroll. They are happy for a bureau to do payroll.

When the son took over as managing director, one of the first things he did was to bring their accounting systems "into the 80s, rather than the 50s". This required the purchase of a new microcomputer in 1986 with an integrated accounting package. This move was encouraged by poor service from their ageing accountant, and made easy through help from a knowledgeable friend, and the office lady who had had prior experience with a computer. Since then the MD has installed and used a CAD (computer aided design) package on this new purchase. He is finding it slow in operation so has thought of acquiring a faster, more modern microcomputer for CAD. They have also considered and rejected other applications; in particular, Bill of Materials and Costing. Though they see the need for improvement, they feel it would be hard to justify as such applications would require one person dedicated full-time to computer work.

They now have much better information on company performance, and are less reliant on their accountant. A good example of better information would be the debtors data. The MD chases late payers much sooner than would have been possible in the past.

The office lady and the MD are the only ones to touch the newer computer. However, as in the past, the earlier purchase is used by machine operators for CNC work.

The computers have not created problems with personnel or had much impact on customers.

Firm F

This electrical engineering firm was founded in 1966 by the current owner. Their product and customer bases have changed over the years and they now operate at three manufacturing sites with 35 employees in total, including managers at each site. The owner has a background in electronics and a masters degree in the social sciences. He is happiest as the "ideas" person in the firm, concerning himself mainly with market and product development activities.

Until recent years, the firm only made goods to order. Typically, they would be large items requiring design expertise. The firm has had to invest "huge amounts on buying the technology" for the firm to keep up with an ever changing market. They have had to be innovative and flexible. A recent development has been the move to manufacture point of sale terminals, under a licence agreement. A few years previously, the major product had been electrical switch gear for export to Fiji.

Originally, the office and accounting administrative functions were carried out internally. After a few years it was seen as more appropriate to use an accounting service. However, the fees rose, so an accounting machine was acquired in 1979. As it was

quite expensive at about $20,000, and because it did an adequate job, the firm was relatively slow to move into computers. Their first computer was acquired in 1983. This was never used for business applications but as a way of learning about computers, particularly their potential for product design and for incorporation into final products.

Since 1986, they have acquired two further computers; the first predominantly to replace the accounting machine, the second predominantly for computer aided design. The systems are viewed as a success. The owner has acquired a spreadsheet model to assist with cash-flow predictions. He also uses the debtors data to help rate and sift out poor payers.

Although the owner prefers to have no day to day managerial responsibilities, he has been keen for the firm to be flexible. He has viewed IT as a real aid to flexibility. His long term aim is for all employees to use computers in their work.

The computer has had no real impact on customers. It has helped them be more efficient administratively. Their investments in IT has been viewed as having longer term benefits. For example, the owner hopes to see the number of users increase, but recognises that this will be a slow, learning process with effectiveness benefits in the years ahead. He already feels that effectiveness benefits are showing. For example, he has encouraged the other managers to find their own data and to do their own word-processing. This has released his secretary from some menial tasks, enabling her to offer the owner much more support, particularly by way of printed reports. An example being their annual cash flow projections and updates.