

**EFFECTIVE APPLICATIONS OF MICROCOMPUTER-BASED
MANAGEMENT INFORMATION AND DECISION SUPPORT SYSTEMS
FOR SMALL AND MEDIUM SIZED ENTERPRISES**

A Thesis submitted for the degree of Doctor of Philosophy

by

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DECLARATION

I declare that all the work described in this thesis was produced by myself and that none of this work has been previously submitted for any academic degree. All sources of quoted information has been acknowledged by means of references.

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by Samuel K. M. Ho, September 1992

ABSTRACT

Firstly, this thesis reviews the literature on the application of microcomputer-based Management Information Systems (MISs) and Decision Support Systems (DSS) to Small and Medium sized Enterprises (SMEs). It is found that the hardware platform today is already sufficient for SMEs. However, information regarding successful implementation of MISs for SMEs is scarce and largely fragmented.

DSS requires more focused and dedicated use of information to support managerial decision making. Unfortunately, the development of DSSs for SMEs is even more backward. Yet, there is an emerging need for SMEs today because business operations have become more sophisticated under intensified competition.

With this scenario in mind, the author undertook intensive questionnaire and case surveys to find out the current development and trends for the effective applications of MISs and DSSs. In 1987, the author was awarded the Oshikawa Fellowship by Asian Productivity Organisation in Tokyo and started the present research. 446 completed questionnaire survey sheets from U.K. and Hong Kong have been received and analysed. 67 SMEs and related organisations in 6 developing/developed countries were also visited. This forms the knowledge for the development of expert systems (ES) for effective applications of MIS.

The approach for DSS is based on a carefully selected business game which has most of the common business decision parameters. Intensive experiment with over 100 subjects was conducted in running the game, with an average time contribution of about 20 hours/person. The findings are again consolidated and structured into an ES.

Longitudinal research was conducted in 5 representative SMEs. With the use of action learning and participation of the researcher, more in-depth firsthand information were obtained and analysed. These form part of the input to the ES as well.

Both ES have been validated and further improved. The experimenters find these as keys to develop MIS/DSS for SMEs. A marketing plan is suggested to launch these two products so that they can become more easily available. Finally, recommendations are made on the effective use of the ES and for further development.

ABBREVIATIONS

APO	Asian Productivity Organisation
AI	Artificial Intelligence
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CIM	Computer Integrated Manufacturing
CNC	Computer Numerical Control
CSF	Critical Success Factor
DOS	Disk Operating System
DP	Data Processing
DSS	Decision Support System
ES	Expert System
ESS	Executive Support System
FA	Factory Automation
HK	Hong Kong
IBM	International Business Machines
IS	Information System
IST	Information System Technology
IT	Information Technology
MB	Mega Byte
MIS	Management Information System
MINI	Minicomputer
OA	Office Automation
PC	Personal Computer
R&D	Research & Development
RAM	Random Access Memory
ROM	Read Only Memory
S&M	Small & Medium sized
SME	Small & Medium sized Enterprise
TPS	Transaction Processing System
UK	United Kingdom
UNIX	Operating System licenced by American Telephone Telecommunication Corporation

VAN **Value Added Network**
VLSI **Very Large Scale Integrated Circuit**
XENIX **A modified version of UNIX used on PC**

CHAPTER 1 INTRODUCTION

PROLOGUE

This Chapter introduces the basic concepts of information and its management which forms the basis of the research. Then the Aim and Objectives of the research are explored and defined. The structure of the dissertation is summarised at the end of the Chapter.

1.1 FUNDAMENTALS OF INFORMATION SYSTEMS

An information system is a special class of business system. The components are people, procedures, and equipment that work interdependently under some means of control to process data and provide information to users. One useful way to represent how an organisation can employ information systems technology is to think in terms of three basic kinds of information systems: Transaction Processing System, Management Information System, and Decision Support System. The data for these systems are organised into well-defined collections of data called files or databases. FIG. 1.1 shows a model of information systems and databases. The various terminology and major terms used in the present research are explained in the following sections.

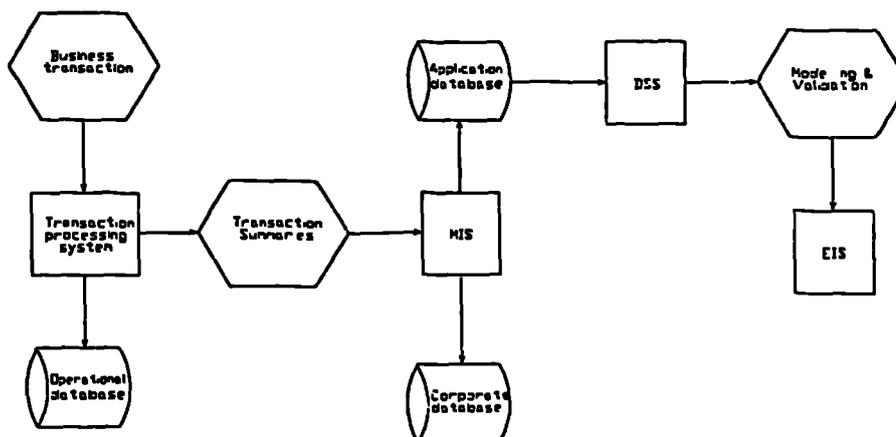


Fig 1.1: Model of Information Systems and Database

1.1.1 TRANSACTION PROCESSING SYSTEM (TPS)

A TPS captures the detail data necessary to update existing records whenever stored data about the fundamental business operations of the organisation must be changed. A transaction is a unit of work that is elemental from the organisation's point of view. The TPS edits all input to ensure that it is accurate and complete. For example, a customer-order transaction is rejected if it contains an invalid account number or if the product code of the item ordered is missing. The TPS will frequently access files of basic information to edit the input transactions.

1.1.2 MANAGEMENT INFORMATION SYSTEM (MIS)

MIS is a system capable of integrating data from many sources to provide data and information useful to support operations, management, and decision making in an organisation. MIS accepts transactions from the TPS to update the contents of the database. The MIS can draw data from the database and process it to provide management with information in a predetermined, routinely reported format. Printed reports (details, summary, or exception reports), visual displays on some video device, and graphic output are three of the most common ways of presenting reports. Such reports can be used to identify opportunities for improvement or to help finding alternative courses of action.

1.1.3 DECISION SUPPORT SYSTEM (DSS)

DSS is a comprehensive computer-based system used to help people reach decisions about semistructured problems. A DSS can be applied to support operational, tactical, or strategic decision making. A DSS can provide access to both corporate and externally generated data related to the problem being studied. The data can be input to a model that simulates the real world, displaying the results in a number of different ways including graphics. An ideal DSS requires minimal training for users.

People use DSS to access the application database to get the key facts needed to help in decision making. The DSS may be fairly simple and straightforward, merely producing some type of printed report containing information useful to managers. On the other hand, it may be a complex system that models some business situation and allows managers to simulate what will happen under different conditions and assumptions.

1.1.4 EXECUTIVE SUPPORT SYSTEM (ESS)

ESS is a DSS customised to meet the needs of upper management. Such a system can extract, filter, and compress a wide range of internal and external data to present information to the executive without creating a data overload situation. Top-level managers need data that will help them to assess their organisation's

success and the performance of individuals critical to that success. They also need data to judge if the management team is taking action on what is vital to the organisation's performance. To support long-term planning, executives are also keenly interested in data about the economic and competitive environment of the outside world. An ESS accumulates data from a variety of internal and external sources and delivers timely and pertinent information to the top level of management. The system must be customised to meet the specific needs of individuals whose needs and personal style may vary greatly.

1.1.5 CRITICAL SUCCESS FACTORS (CSF)

CSF are the few key areas of business activity in which favourable results are absolutely necessary for business to reach its goals. Because these areas of activity are critical, the manager should have the appropriate information to allow him to decide whether events are proceeding sufficiently well in each area. CSF are of so important that these key areas of activities should receive constant and careful attention from management. The current status of performance in each area should be continually measured and status information should be made accessible for management's use.

1.1.6 INFORMATION TECHNOLOGY (IT)

A well accepted definition of IT is by the British Advisory Council for Applied Research and Development [HMSO, 1980]:

"The scientific, technological and engineering disciplines and the management techniques used in information handling and processing; their applications; computers and their interaction with men and machines; and associated social, economic and cultural matters."

The integrated circuit, a combination of miniature transistors and circuits on a tiny silicon chip, has been instrumental in propelling the rapid growth of IT. This industry can be divided into three major segments: communications, data processing, and office automation (FIG. 1.2). Equipment manufacturers in all three segments incorporate integrated circuits to add value to their products. This is one reason for the blurring of the line distinguishing one segment's products from another's. Personal computers can communicate with other devices and perform office-related activities such as

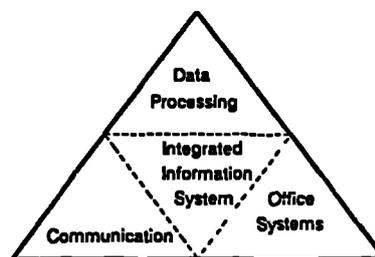


Fig 1.2 : Segmentation of IT Industry

word processing. Simple office copiers have been upgraded to serve as computer-output devices and to communicate with each other.

1.1.7 INFORMATION SYSTEMS TECHNOLOGY (IST)

This refers to the whole spectrum of ideas and applications based on information systems and information technologies. More important is the concerted application of both for the benefits of organisations.

1.1.8 SIX STAGES OF DATA PROCESSING GROWTH

NOLAN [1979] did extensive studies in the 70s and found out that there are 6 stages of DP growth. It ranges from the inception of the computer into the organisation to mature management of data resources. The findings are best to be summarised in the following chart:-

DP GROWTH STAGE	USER AWARENESS	DP PLANNING AND CONTROL	DP ORGANISATION	APPLICATIONS PORTFOLIO
I: INITIATION	"Hands off"	Lax	Specialisation for technology learning	Functional cost reduction applications
II: CONTAGION	Superficially enthusiastic	More Lax	User-oriented programmers	Proliferation
III: CONTROL	Arbitrarily held accountable	Formalised planning and control	Middle management	Upgrade document restructure applications
IV: INTEGRATION	Accountability learning	Taiored planning and control systems	Establish computer utility and user teams	Retrofit existing applications using database
V: DATA ADMINISTRATION	Effectively accountable	Shared data and common systems	Data administration	Organisation integration of applications
VI: MATURITY	Acceptance of joint user and data processing accountability	Data resource strategic planning	Data resource management	Application integration "mirroring" information flows

FIG.1.3: NOLAN'S Stage Theory

1.1.9 INFORMATION MANAGEMENT (IM)

IM is a difficult subject within management. This is because information is an intangible resource, yet it is increasingly important in our economy and at all levels of management of the SME. However, individual managers vary widely in their knowledge and experience of IT, and their enterprises vary widely in the extent to which they address, or need to address, the issues of corporate information management. The attempt here is to review the current development in the field and explore ways of doing it effectively.

1.1.9.1 Traditional Use of IST

In the past, companies acquired computers to automate highly repetitive functions. These early computer applications focused on the automation of "back-room" functions such as accounting and inventory control. The costs of such applications were easy to justify because savings were often clear and tangible. The goal was towards improving the efficiency of information processing. However, this was soon recognised as insufficient. When organisation develops, people are not just looking at "Doing the things right ", i.e., efficiency. Organisations today are more concern about "Doing the right things ", i.e., effectiveness.

1.1.9.2 Gaining Competitive Advantage

The information-oriented society of the 1990s will require that business not only continue to use IST wherever they can to reduce costs, but also that they package information processing into the products and services which they offer to their customers. This is an important aim of the effective use of information. Companies increasingly will differentiate themselves through superior information systems that enable them to deliver better customer services. Many managers and executives consider information system as integral and essential part of the business strategy. It is no longer a corporate expenditure, but a vital corporate asset, an important element of staying competitive. It is a "Strategic Advantage" to companies.

1.1.9.3 Added Responsibility for the Manager

The basic management functions have traditionally included planning, organising, staffing, influencing, controlling, and communication. Each of these managerial functions is vital to the success of the organisation. With the increased emphasis on the use of all forms of new technology, managers are expected to use the technology in their area of the business. Managers must lead their organisation in the positive use of IST.

1.1.10 SPECIAL PROBLEMS OF SMALL & MEDIUM ENTERPRISES(SME)

There are different definitions adopted by different countries. Broadly speaking, the number of employee is the main differentiator, though some countries, like

Singapore, also consider the capitalisation. For the sake of this research, the definition of SME adopted are:-

Small & Medium Manufacturing Firms --	Less/equal 300 employees.
Small & Medium Service Firms --	Less/equal 150 employees.

This definition is closest to the ones adopted by most countries surveyed.

The number of SME usually accounts for over 80% of all firms in most countries. Further, the number of people employed in SME are usually more than that of large organisations. This explains why every Trade and Industry Dept. of advanced countries are giving special care to SME. Examples of such special divisions can be found in UK, Singapore, HK, Taiwan, South Korea, and Japan. In Japan, for instance, there is one special division called SME Agency under the organisation of Ministry of International Trade and Industry (MITI). Every year they publish white paper on SME in Japan. The SME Agency [1985] recognised that 72% of SME admitted insufficient use of information (as compare with 14% for large enterprise). The reasons for this were mainly related to in-company information distribution, e.g., "unsystematic information flow" and "insufficient daily interaction among divisions".

As the importance of information activities, including information collection and utilisation, has grown, the spread of information equipment that supports SME from the hardware side has also progressed. SME are finding it important to use information equipment effectively and to aim at rationalisation, labour-saving, and sophistication of management.

1.2 AIM & OBJECTIVES

Today, in every aspect of our society, our daily lives and our industries, the spread of information has escalated in speed and diffusion. The industry is backed by a heightened need for information and technological innovation based mainly on the development and spread of computers. Hence, the collection, processing, communication, accumulation, and utilization of information by firms has become brisk. Thus, information-related activities have been expanding rapidly.

1.2.1 DEVELOPMENT OF IST

During the past decade, the development of personal computer (PC) hardware technology and application software has been astronomical. In 1987, IBM announced a launch of their new Personal System/2. If the high end of this system is used as the server of their PC Network system, it can serve up to 72/PC's. However, it has its limitation as PC-DOS supports relatively small RAM and does not support multi-user, multi-tasking operations. Although IBM has been trying

to overcome the last limitation with its release of OS/2 shell above the DOS operation, the problem of RAM size becomes more eminent.

In 1989, IBM launched the RS/6000 UNIX-based LAN server which has capacity and capability above many minicomputers. The idea of the Personal Workstation has grown out of the limitations that DOS has had in the office. The power of machines like the POWERstation (workstation of RS/6000) allows user to use spreadsheet, database, communications, scheduling, and project management software concurrently. Yet it is presented in a clear, simple, high-resolution graphics environment with the power, speed and convenience of each application far outstripping stand-alone, text-based DOS packages. However, the popularity of UNIX-based software has to be developed. [PCW, April 1990]

1990's brings with it a set of pressing technology and management issues. The challenge is to confront and understand these questions in order to make informed and intelligent decisions about how PC and LAN can best serve the needs of organisations. FIG.1.4 shown the technological forecasting during the past 3 decades [Scrvens, 1991].

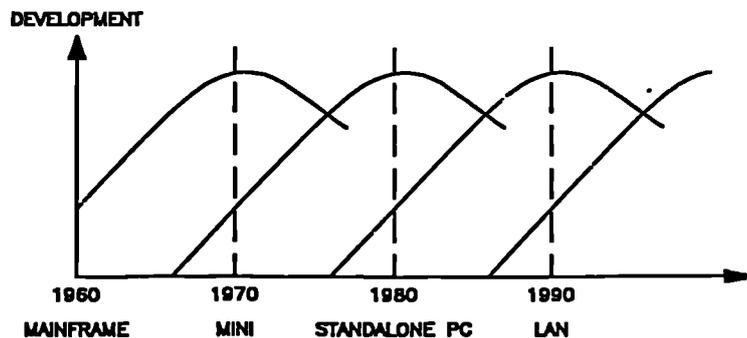


FIG. 1.4: Technological trend of Computer Systems

The hardware trend in the 90's will be increased reliance on PC-LAN and "Client-server Computing" [Gates, 1991]. The concept of the latter is illustrated in FIG.1.5. Basically, it builds upon the fact that the computing models have evolved from the time-sharing model to the new client-server model, which takes advantage of the intelligence of both client workstations and servers to deliver new benefits.

The LAN Manager developed by Microsoft claims to provide the "glue" that ties client workstations and servers together (FIG.1.6) by providing the "Window" graphic environment and the "SQL" Server for enterprise-wide connectivity for all network users. Assuming that this concept were successful, SME do not have to worry that their hardware platform will not be compatible to that of their larger customers or external database services.

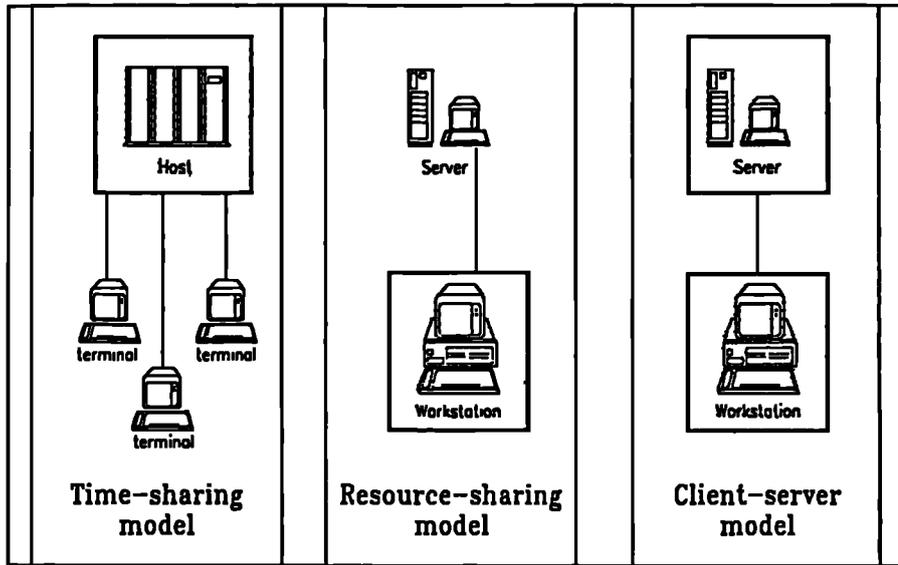


FIG. 1.5 : Client-Server Computing

 Shared areas show where processing occurs.

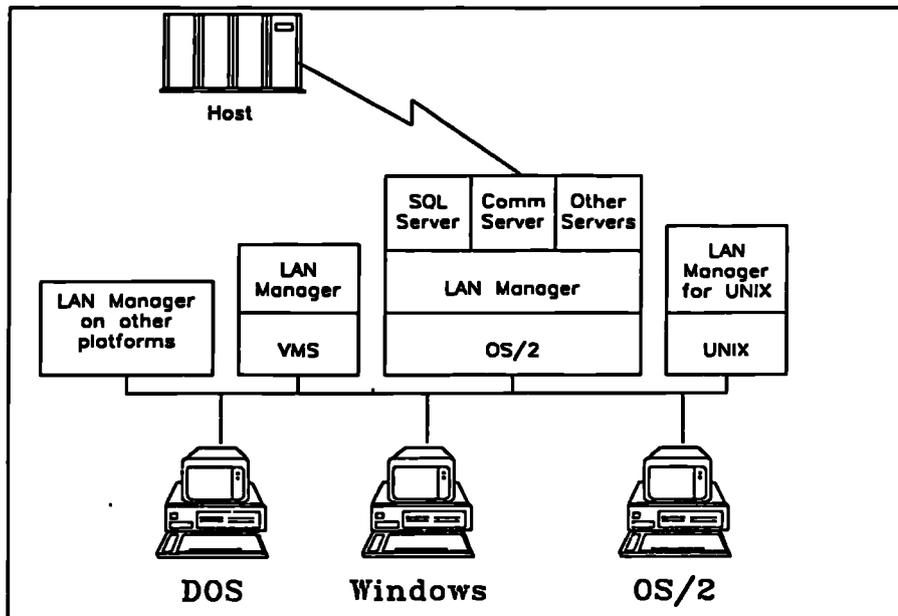


FIG. 1.6 : LAN Platform of the 90'S

On the side of application software, PC have a clear edge over minicomputer range. This is purely due to market force as every software house realizes the tremendous difference in the number of PC comparing with MINI in the market. Consequently, there are thousands of well-written, versatile, easy understood and turn-key type software written for micro. With this advent, application software is no longer entirely a programmer/analyst's job. It is often the case that software developed by users using packages are having higher efficiency and better utilization than those developed by software houses. On the other hand the software cost for mini is much higher than that for PC, largely due to economy of scale. Further, the very powerful colour graphic capabilities and file up-load down-load facilities offered by PC is an added advantage for MIS/DSS applications.

The importance of information collection is widely recognised. For SME, information collection usually lies with the top management. The need for information closely connected with everyday production and sales activities are widely expected to grow in the future. A survey comparing SME with large organisations has shown that SME has more problem in in-company information distribution. [MITI P.43, 1985]. The reasons for choosing SME for the study are:-

- [A] Large organisations have complicated business operations and are less suitable for comparison between companies.
- [B] SME are the organisations where use of microcomputers are more cost-effective.
- [C] If a general purpose MIS/DSS model can be set up basing on selected industries for SME, there are a lot more similar sites for their implementation.

In order to promote and educate the executives of SME to move towards MIS/DSS applications, there needs to be a well-based research on their applicability at micro (corporate) levels through case studies and analysis of relevant data and information. Therefore, the present research proposal fits well into the place as a motor for driving these executives towards using MIS/DSS to their advantages. Further, this can be carried out more effectively if the knowledge can be planted into an Expert System (ES). With the above scenario duly considered, the aim and objectives of the research are stated as follows.

1.2.2 AIM

To develop and validate a knowledge-based advisory service to enable SME to use modern microcomputer-based MIS/DSS technology to improve the quality and productivity of their business operations.

1.2.3 OBJECTIVES

1.2.3.1 Review the constituents of contemporary Management Information Systems (MIS) and Decision Support Systems (DSS) via literature search and questionnaire survey.

1.2.3.2 Identify factors critical to the success of computerisation of SME based on a study of enterprises in industrialised South-east Asian countries and the U.K.

1.2.3.3 Identify factors critical to the successful use of DSS based on the controlled experiment of playing a simulated business game.

1.2.3.4 Produce guidelines, in the form of ES, to enable user managers of SME to use effectively MIS and DSS to achieve better productivity for their work.

1.2.3.5 Evaluate the contribution of the ES to knowledge in the field of MIS/DSS for SME, and also to good management practice in general.

The above aim states the purpose of the research, whereas the objectives are targets of the research through which, if achieved successfully, will build up the aim.

1.3 SCOPE & STRUCTURE OF RESEARCH

The present research was based on the firms in UK, Japan, and the newly industrialised countries of Asia (i.e., South Korea, Taiwan, HK, and Singapore). This mix of countries enabled comparison of applications across cultural and geographical differences. Furthermore, the research objective could be extended to SME in various countries where social and economic conditions are similar.

The scope of study was focused on the functional areas of SME as and when feasible. These were :-

- **Business Planning & Marketing**
- **Finance**
- **Human Resources**
- **Purchasing**
- **Production/Operations**
- **Distribution**

The structure of the dissertation follows the objectives closely. It can be summarised in the FIG.1.7. Broadly speaking, the dissertation adopts a 3-tier approach, i.e., the development of ES-MIS, ES-CASE and ES-DSS via Questionnaire Survey, Field Survey, and Research Game. They corresponds to the Objectives 1.2.3.2 – 4.

STRUCTURE	CHAPTER	JUSTIFICATIONS
Introduction	1	S.1.2
Literature Survey	2	S.2.1.3
Questionnaire Survey	3	S.3.1.2
Field Survey	3	S.3.4 (Intro.)
Business Game	4	S.4.1.2 & S.4.2 (Intro.)
ES-MIS	5	S.5.1.3 & S.5.2 (Intro.)
ES-CASE	5	S.5.3 (Intro.)
ES-DSS	5	S.5.4.1
Longitudinal Research	6	S.6.3 (Intro.)
Validation of ES	6	S.6.1 (Intro.)
Conclusions	7	S.7.1 (Intro.)
Recommendations	7	S.7.2 (Intro.)

FIG.1.7: SUMMARY OF THE STRUCTURE OF DISSERTATION

After the introduction (Chapter 1) to why the present work is done, and hence the objectives and scope of the study, the subsequent chapters develop the work systematically as follows.

Chapter 2 describes a comprehensive literature survey based on the latest publications and on-line search facilities. Then the methodology of research is critically reviewed and the appropriate approach adopted. The scheduling of the project was in phase with the activities. Sufficient time was allowed for the survey, field work, business game experimentation, longitudinal survey, and validation.

Chapter 3 develops the principles of effective MIS based on questionnaire and field surveys. The questionnaire surveys were conducted in UK and HK. The field surveys were carried out in 6 countries. With this spread of experience across countries, experience amongst nations of different technological and cultural backgrounds were tapped and cross referenced. This entails the results of the research to be of value to SME from different countries of similar backgrounds. Further, successful experience from other countries can be shared.

Chapter 4 develops the principles of effective DSS based on controlled experiments using a business game. A game with marketing, production, and finance functional decisions was used. It was supported on a spreadsheet which has been recognised as a suitable tool for DSS. In order to compare results, the game was run both in HK and UK. Further, in HK, the game was played for second

round but with the use of expert system shell for decision making. The results of these experiments were analysed and positive evidence of effective DSS applications were sought and developed.

Chapter 5 describes the development of the advisory service based on the models in MIS and DSS established as above. An expert system shell was used for its development. Two ES were developed, one for effective applications of MIS, the other for effective applications of DSS. These two packages were supported with user manual and details of background preparation required before their use were also presented. The objective was to ensure the user-friendliness and user-effectiveness on their use.

Chapter 6 describes the validation of the advisory service by SME user-managers and individuals who were conversant on business and information management. The validation was further enhanced by longitudinal research carried out over a minimum period of one year in SME in UK and HK. The validity of the shells were evaluated and improvement sought. The final product was a package which had the essential features and expertise for commercialisation.

Finally, **Chapter 7** presents the conclusions and recommendations for further work. The conclusion revealed that SME could make the effective use of microcomputer-based MIS and DSS if they followed a set of well-defined procedures and exercise good managerial skill in its implementation.

EPILOGUE

This chapter sets the scene and defines the aim and objectives of the research. The scope and structure of the research are also discussed. This leads to the identification of the scope of literature survey in the next Chapter.

CHAPTER 2 OVERVIEW

PROLOGUE

This Chapter reviews the literatures on microcomputer-based MIS and DSS. Books are reviewed first, followed by published articles. Then relevant work on methodology of research for MIS and DSS are also explored, with the aim of establishing a valid set of research approaches. Finally, the research project is planned and organised so that research effectiveness and efficiency can be maintained.

2.1 BIBLIOGRAPHY & LITERATURE SURVEY

The difference between a bibliography and literature survey is that the former is a survey based on text and reference books, whereas the latter is based on published articles in journals and magazines. To be more precise, review of the literature for this dissertation consisted of reviewing books, articles, working papers, and technical journals and manuals from hardware and software vendors. Specifically, pertinent literature was identified from the following five main sources:

- Data Search Service using MIS, DSS, microcomputer, and other specific business functions as keywords.
- Bibliographies in related books, manuals, and dissertations.
- Trade and technical journals, e.g., Information & Management, PC World, Journal of IT, International Journal of Information Management, IT Quarterly, MIS Quarterly, Journal of MIS, etc.
- Transactions of conferences, e.g., International conference on DSS, Proceedings on ES and AI in DSS, Proceedings of Singapore Computer Society, etc.
- Attending conferences, e.g., IT Developments and Their Implications for ASAIHL Institutions, Taiwan Computer Society, HK Computer Society, Singapore Computer Society, Japan Office Automation Show, Conferences on MIS & DSS in National Exhibition Centre and Olympia Conference Centre of UK, etc.

2.1.1 BIBLIOGRAPHY

There are many new text and reference books in topics on MIS and DSS for SME. This is enhanced by the rapid development of the hardware and software technology. Although published books tend to become obsolete rapidly, this encourages writers to update their information frequently. The more relevant books are reviewed here in order to build up a picture of the latest development of microcomputer-based MIS and DSS which are related to the present research. The details of the books are quoted in the Bibliography Section at the end of this thesis.

2.1.1.1 Higgins [1985] describes and illustrates the principles of computer-based planning systems. He pays particular attention to the impact of the microcomputer on business systems. The book attempts to:

- emphasize the significance of models of the various systems,
- discuss planning at all levels (not just strategic or tactical/operational) and shows the interrelationships,
- use practical illustrations and many descriptions of actual computer-based systems and packages.

Relevance: Although the book is not entirely microcomputer based, it is a good reference for the understanding of the criteria for successful implementation of MIS.

2.1.1.2 Loebbecke and Vasarhelyi [1986] believe that today's modern manager should view the microcomputer as a tool for problem solving and task performance. In that light, the microcomputer and its related software should be viewed as a data processing system and a DSS. The manager can define the various types of problems and tasks routinely encountered and identify those to which the microcomputer is best suited. They can then develop micro-based systems to deal with them.

Relevance: The book is directed towards the usefulness of the microcomputer in solving a wide variety of business-related problems, through six specific learning objectives:

- (a) Problem recognition,
- (b) Structured approach,
- (c) The importance of software,
- (d) General software characteristics,
- (e) Comprehension of manager-microcomputer interface,
- (f) Type of management computer usage.

The concept is sound and will contribute to the questionnaire design and framework of the expert system of the present research.

2.1.1.3 Rogerson and Benyon [1986] puts emphasis in systems analysis on the use of case studies. Each case is based on a real situation and is thus relevant to the future work of aspiring systems analysts. Various categories of case study are included, ranging from those in which all the necessary information is provided and a clear-cut decision can be made, to those requiring assessment of what information is required and how it can be obtained.

Relevance: These cases have been tried and tested over a number of years and cover many areas of business, commerce and industry. They are designed to support a broad spectrum of knowledge in business systems analysis and design. Consequently, some of the cases can be used as comparative studies for the case studies in the present research.

2.1.1.4 Weidlein & Cross [1986] offer a practical perspective on the rapidly emerging area of personal computer networking. It provides an overview of the organisational considerations and concerns required for building productive networks and helps managers answer questions such as:

- How can networking benefit the organisation?
- What can be accomplished by networking?
- Which issues are important from the users' perspectives?
- What planning issues are important to the organisation?
- What are the drawbacks? the trends?

Relevance: The book gives an in-depth presentation of the management concerns and issues surrounding PC networks. Extensive surveys, charts, and graphics, are used to offer managers concrete guidelines for dealing with networking PCs. These results provide valuable and important resource for IT decision makers for the building up of the expert systems in Chapter 5.

2.1.1.5 Holspple and Whinston [1987] explore the potential of business expert systems and explain how to transform that potential into reality. It is designed to engender an in-depth understanding of business expert systems from the standpoints of what they are, how they can be developed, how they work, how they can be used, and what their significance is for modern organisations.

Relevance: The book explains that there are two keys to highly productive learning experiences concerning business expert systems:

- (a) selection of a real-world application problem that is sufficiently rich to illustrate all important aspects of business expert system construction and usage;
- (b) selection of a real-world AI software environment that is sufficiently versatile to illustrate the construction and usage of a business expert system for the chosen application, yet sufficiently easy to understand.

These two keys are used in the development of the ES for the present work. Thus, more efficient and effective instructional experience are expected.

2.1.1.6 Parkinson and Parkinson [1987] illustrate how the implementation of marketing within an organisation can be assisted using the microcomputer. It provides many specific examples of how the microcomputer can be used in marketing decision making. Topics cover includes marketing information systems, marketing research, forecasting, marketing strategy, product development applications, pricing applications, distribution applications, sales force applications, advertising applications, and marketing control.

Relevance: The book appeals to professional and marketing practitioners seeking to learn how the microcomputer can be applied to a range of marketing decisions. Since marketing is a very important for SME to be successful, the application of PC-based MIS and DSS in this function has to be forming part of the research and advisory services.

2.1.1.7 Ho [1988] reports on the applications of IT among the SME in HK, Singapore, Taiwan, South Korea, and Japan. Firstly, an intensive questionnaire survey was conducted in HK and 358 valid replies have been received and analysed. Then there are 38 case studies from the 5 countries covering various economic sectors including manufacturing, distribution, forwarding agencies, as well as business services such as accounting firms and software houses. The report also examines extensively the aggressive government policies adopted by these countries in promoting the technology with the specific objective of enhancing productivity and competitiveness of the SME. The latter part of the report stipulates various recommendations which are thought-provoking for policy-makers, businessmen, professional bodies, academics, technology and management institutes.

Relevance: The report sets the background work for the present research. However, because of the difference in orientation, and the lack of time, it is not sufficient in detail and validity to aid SME to develop MIS in their organisation. Further, the element of DSS is non-existing. This brings the need to do the present dissertation by the author.

2.1.1.8 West [1988] focuses on fundamental management issues and information system principles that do not change as rapidly over time as do software which is currently in vogue. It does, however, provide a valuable perspective on how tools like word processing, spreadsheet, database, and business graphics can be employed by the manager to meet business needs. There are many case studies which provide ample opportunity to develop one's skills in using these software packages to solve "real life" problems.

Relevance: The focus of the book is on identification of the fundamental management issues associated with the use of information systems technology and the trade-offs associated with dealing with the issues and approaches for resolving

them. Therefore, it is of direct relevance in developing the effective approach to MIS and DSS for SME.

2.1.1.9 Capron and Duffy [1989] provides a solid exposure to package applications such as Lotus 1-2-3, Dbase IV, Word Perfect, etc. Further, there are some very attractive features, including:

- Colour-coded Computer Screens
- Keystrokes Only Boxes
- Random Bits Boxes
- Real World Pages
- Buyer's Guide
- Ready Reference Guide
- Software Packages offered at student prices

Relevance: The book is very well illustrated text for beginners and business users. Therefore, it will be used as one major reference material in the advisory services.

2.1.1.10 Knight and Silk [1990] wrote the book with the objective to equip practising general managers to use information effectively in order to improve business performance. It is intended for practising managers who are not specialists in IT: its guidance is therefore practical and non-technical. The emphasis is on using information, not just the technology: so the descriptions of IT, although necessary, are from the viewpoint of the user. Further is aimed at improving business performance. The book uses real-life examples of how this can be done and suggests a practical plan for action.

Relevance: The book identifies the challenge that information presents to all managers and deals with the technology of information systems. Further it shows how such systems can be put to practical use in organisations. The coverage is very broad and includes the state-of-the-art development in the field of IT and MIS/DSS. Further, there are many practical applications from the world of business and management. Therefore, it will be used as a key reference to the development of advisory service in Chapter 5.

2.1.1.11 Bibliography: Overview

So far, the books most relevant to the present research are identified. Books are important for the present research in particular as they help to give SME overviews of the areas of focus in MIS and DSS. Although the field is fast developing, there is some "Science" behind these two which does not change frequently. The text book knowledge is most suitable for this kind of knowledge. It is therefore important for SME managers to grasp some of these books and have a conceptual understanding of the problems that they have to deal with in developing MIS and DSS for their organisation.

2.1.2 LITERATURE SURVEY

An on-line information search was done in March 87 via the DIALOG's "Management Contents" file. From records for the previous 3 years, there were 41 citations on DSS. However, there was only 11 on microcomputer applications. When using the "Microcomputer Index" file of DIALOG database for the past 5 years there were only 7 citations on DSS. Thus it was evident that research on the captioned topic had been very weak. A further manual search on the topic on DSS in "Computer & Control Abstracts" over 1986 indicated that although there were 87 DSS related citations, only 16 are related to microcomputers in particular. Further, all the above citations were on discrete topics and none had given a complete view of microcomputer-based DSS applications for the various functional aspects of business.

In October 89, a similar on-line search was done using DIALOG's Computer and Control Abstracts, and IT Focus: Update on Information Technology (INSPEC). The descriptors used were:

- Microcomputer Applications,
- Decision Support Systems.
- 1987:1989

There were 92 citations. After scanning through the abstracts about 30 of them were relevant to the present research.

In March 90, another search was done using ABI/INFORM database which is recorded on a CD-ROM. The diskette held 5 years of data dated back from Jan 90. The same descriptors were used. There were 61 citations. After scanning through the abstracts about 17 of them were relevant to the present research. It was noted that these 17 citations were different from those from INSPEC.

Since the later two searches gave more significant results and they were more updated, the literature survey were based on them.

For the purpose of this research, the literatures on MIS/DSS can be conveniently grouped under the following headings:-

2.1.2.1 Management Information Systems

2.1.2.2 Decision Support Systems

2.1.2.3 Manufacturing Industries

2.1.2.4 Service Industries

2.1.2.5 Financial Information Systems

In the following sections, the discussion starts off with an overview analysis of the focused topics, followed by the summary of abstracts. The abstracts have been studied and their corresponding articles reviewed as far as they are available.

2.1.2.1 Management Information Systems

Overview :

Developments in two distinct areas within the last decade offer us the potential to develop altogether new ways of supporting decision processes. First, there has been considerable technological progress. The evolution of remote access to computers with short turn around time and flexible user interfaces has been rapid. Powerful microcomputers are available at low cost and users can be linked to computer resources through inexpensive network systems. The second development has been a conceptual one. There is emerging an understanding of the potential role of MIS within organisations. We are adding to our knowledge of how human beings solve problems and of how to build models that capture aspects of the human decision-making processes.

The progress in these areas has been dramatic. Entirely new kinds of planning and control systems can now be built – ones that dynamically involve the manager's judgements and support him with analysis, models, and flexible access to relevant information. It is further believed that an understanding of managerial activity is a prerequisite for effective systems design and implementation. Most MIS groups become involved in system development and implementation without a prior analysis of the variety of managerial activities. This has prevented them from developing a sufficiently broad definition of their purpose and has resulted in a generally inefficient allocation of resources.

Abstracts :

2.1.2.1.1 Gurbaxani & Whang [1991] claims that a rational economic model exists that explains the relationships between key measures of organisational structure and the use of IS. They analyse the role of evolving IS and their effects on markets served in this context. Then they use both agency theory and transaction cost economics to develop relationships between information costs and the attributes of organisations. That is, firm size and placement of the organisation decision process among the management players are a direct result of the costs associated with acquiring, storing, processing, and disseminating information. In short, IT can and does have a direct impact on optimal firm size by affecting the organisation's underlying cost structure.

2.1.2.1.2 Silk [1989 & 1990] believes that practising managers are now expected to take a more active role in managing information and using IT. In 1988, he tried to identify the major information management issues by surveying 269 middle and senior managers in UK. 20 major areas of concern were voiced by them, with 5 major issues accounting for more than half of the responses. These are:-

- [1] The impact of information systems (IS) on users;
- [2] The need for an Information Strategy
- [3] Security of information; hackers; staff security
- [4] Managing the IS function, and IS development

[5] Justifying the cost of new systems

In 1989, the survey was repeated by another 401 subjects, with the view of increasing the sampling size. Further, the effect of change over time can be observed. The overall results show a stop of position between [2] & [3]; and [4] & [5]. Moreover, whereas the percentage response of [1] remains high, those of [2]--[5] are clustered to the same level.

2.1.2.1.3 Straub Wetherbe [1989] forecasts the dominant technological forces that will affect organisational change in the 1990s. The study uses a traditional approach to the forecast, aiming at technologies that will "enter the market place and assume a dominant position in the 1990s." The technique employed is "key informant interviews," and the process of selecting the 11 well-qualified experts and winnowing the candidate technologies was done with care. The reduced list of technologies involved 31 entries, ranging from CASE tools and calendaring/tickling software at the beginning to windowing software and word processing software at the end. In between were technologies like desktop publishing, hypertext/hypermedia, LANs, and ES. The results are surprising. The experts synthesize their selections into several groups. The winners called "critical IT", are two groups: human interface technologies and communication technologies. Human interface technologies like speech recognition, natural language processing, voice input, and high-end workstations are judged to be "key", and mice, touch screens, light pens, and EIS "important". In communications, the "key" technologies are voice mail, e-mail, fax, EDI, and high-end workstations with ISDN, desktop publishing, and LANs are "important".

2.1.2.1.4 Stair & Crittenden [1989] explores the use, operation, and control of the small business computer. Levels of satisfaction with the ability of computer systems to provide information and better products and services are revealed. For SME, the hope and promise information system is no longer a dream.

2.1.2.1.5 Holtham [1989] extrapolates some of the technological trends that could have significant impacts on commercial and public sector IT in the 1990s. He then reviews four major challenges. These are the need to develop IT strategies, both nationally and for individual organisations; the need to create alliances; the need to avoid misalliances; mechanisms for converting ideas into action. A considerable emphasis is placed on the need to understand the managerial environment within which IT is used, and to see IT as only one element within wider organisational systems.

2.1.2.1.6 Tavakolian [1989] deals with the relation of the organisation of MIS activities to the competitive strategy pursued by an enterprise. He defines 3 different strategies: "defenders", "prospectors", and "analysers". The study looked at 52 organisations in the computer component industry. Each organisation was independent with respect to organisation and decision making. The study indicates that indeed there is a relation between competitive strategy and IS organisation. Not surprisingly, the aggressive strategy pursued by "prospectors" leads toward decentralisation of IS activities, while the "defenders" tend toward centralisation

(with the "analysers" falling in between). This study thus lends credibility to the oft-cited maxim that the organisation of MIS activities should be consistent with the strategic approach taken by the organisation as a whole.

2.1.2.1.7 Moynihan [1989] details the results of a field study that he conducted among the top IT executives in 49 organisations in Ireland. Although the findings are divided into two categories, organisational and technical, this paper concentrates on the organisational findings. This category contains 11 "themes" or issues, and Moynihan lists and explains each of these issues, with a summary of the management comments. He concludes by comparing the perspectives of the three areas of management (CEOs, senior functional managers, and chief information officers) on these issues and comparing these findings with previous studies. The paper gives an overview of the important IT issues of today's organisations. Although the study was conducted in Ireland, the research comparison shows that the results are internationally applicable.

2.1.2.1.8 McAlister [1988] outlines the role of the PC; and the jobs it can do, e.g. writing, analysis, presentation, and administration. He then reviews the software needed, e.g. spreadsheet, word processor, graphics, and database. Through his research he finds out that a manager must understand the proper role of the PC in the management process, know which managerial jobs are most suitable for PC application, and familiarise himself with what the various types of software can do. PC are useful for preparing managerial spreadsheets, lengthy reports, and crystallizing thoughts. But they are not a substitute for rational analysis and intelligent decision making. He gives guidelines in how to go about buying software and even briefly evaluates six relevant software packages.

2.1.2.1.9 Wu [1988] provides a framework for understanding the types of software packages available in the marketplace and the use of the computer to obtain information for decision-making. Four types of software are examined: systems software, general purpose packages, specialised packages, and application packages. The potential of such software for decision-making by small businesses, is discussed, and the types of decisions, identified. Selection criteria and guidelines for buying decision-making software are also provided.

2.1.2.1.10 Beaumont [1987] examines the strategic positioning of MIS. MIS will not reach their potential in the near future because of the general inability of companies to generate, process, and interpret the available data. Further, there is a possibility that data overload will hinder management decision making. He then finds out the criteria for specifying suitable MIS. These include: (a) required data accuracy, (b) elapsed time of producing data, (c) time periods for which data can be generated, (d) data requirements, (e) ease of comprehension, and (f) cost of implementation and operation.

2.1.2.1.11 Jenster [1987] examines the relationships between business strategy, executive monitoring of CSF, and organisational performance. Its findings suggest that MIS planning and requirements analysis should reflect these relationships. Jenster begins by categorising business strategies, defining organisational

performance, and identifying specific CSF and their corresponding monitoring IS. He then examines several hypotheses based on a survey of organisations; the key hypothesis is that the relationship between CSF monitoring and organisational performance differs by business strategy. The research questions are important ones, particularly in contexts where other requirements analysis methods are unsatisfactory. Though more needs to be said about how the CSF were chosen and validated, the research methodology as a whole is appropriate and well documented. The findings are substantiated by the data.

2.1.2.2 Decision Support Systems

Overview :

The label "support system" is meaningful only in situations where the "final" system must emerge through an adaptive process of design and usage. This process is needed for a variety of reasons:

- [1] The designer or user cannot provide functional specifications or is unwilling to do so. A "semi-structured" task is such an instance.
- [2] Users do not know what they want and the designers do not understand what they need or can accept; an initial system must be built to give users something concrete to react to.
- [3] Users' concepts of the task or decision situation will be shaped by the DSS. The system stimulates learning and new insights, which in turn stimulate new uses and the need for new functions in the system.
- [4] Intended users of the system have sufficient autonomy to handle the task in a variety of ways, or differ in the way they think to a degree that prevent standardisation. In this situation, any computer support must allow personalised usage and be flexible.

While [3] states that the DSS shapes the user, [4] equally suggests that the user shapes the DSS. This conception makes DSS a necessary concept. For any given system development effort, it makes a great deal of difference whether or not the implementers view it as requiring a DSS as opposed to a marketing model, retrieval system, report generator, etc. It would be a severe mistake to rely on traditional development techniques if the final system will evolve only through the ongoing interaction of designer and user, learning, personalised use, or the evolution of new functions. Learning, adoption, and evolution are made feasible by building a "DSS" and not a "model". If these are not needed for effective development and use of a system, then one should build it as a "model" in the traditional way and the new label is not relevant.

Abstracts :

2.1.2.2.1 Tran [1990] claims that traditional tools and techniques have been considered inappropriate for the design and development of individualised DSS because these tools only apply to very simple situations and produce a basic model to support only one product. This is quite the opposite, however, with

organisational DSS, which support organisational decision making in complex environments. He presents a case study of the successful development of a complex organisational DSS using traditional IS tools, techniques, and personnel.

2.1.2.2.2 Silk [1990] firstly identifies the growing concern of managers about justifying IT investment, and the methods which they currently use in their organisations to do so. Then, he discusses the challenge facing managers by viewing IT/IS within the context of strategic business thinking. Finally, the response of managers and IT professionals are analysed. A benefit-level matrix is described at the end which can be used as a tool for both analysis and synthesis within the business context. The model developed can be used as a decision support tool for managing the IS benefits for the 1990s.

2.1.2.2.3 Gongla, et al [1989] identify that the use of Information and IT (IIT) as a strategic tool to gain competitive advantage has become increasingly significant in recent years. Although the potential competitive benefits of IIT are generally recognised by business and information system executives, there is a great gap between recongising such value and applying the technology effectively. To help bridge this gap, a group at the IBM Los Angeles Scientific Center has developed a knowledge-based system facilitator, called S*P*A*R*K. The system is designed to help business and Information System managers identify competitive applications of IIT which will help them be creative in generating a range of IIT alternatives. The paper provides an overview of S*P*A*R*K, including the conceptual frameworks used for knowledge sources, the design philosophy, functions, and implementation approaches.

2.1.2.2.4 Chuk & Liu [1989] believe that MIS does not provide flexible support for handling semi-structured decision problems. There is an urgent need for DSS which can provide information and analytical tools to deal with complex decision problems. In fact, there are many specific DSS built, but they aim at usage in particular application areas. They present a brief overview of DSS and a conceptual architecture of a generalised software system for DSS. A new idea for bridging the gap between the database and model-base is also presented.

2.1.2.2.5 Napier, Batsell & Guadango [1989] do an experiment comparing a natural language interface (Lotus HAL) with menu-oriented interface (Lotus 1-2-3). Two groups (about 20 for each group) of novice users were hired. One group learned Lotus HAL and the other learned Lotus 1-2-3. The experimental subjects completed a survey of personal information that enabled the researchers to ensure that the two groups were comparable in terms of demographics. After training, the two groups worked problems which were scored as to correctness. The results showed that nearly twice as many subjects completed a budget problem correctly using Lotus HAL as did using Lotus 1-2-3. Moreover, the average number of correct problems increased more rapidly across problem sets with Lotus HAL than with Lotus 1-2-3. This leads to the conclusion that Lotus HAL is easier to learn for novice users.

2.1.2.2.6 Braden, Kanter & Kopcsó [1989] give a good description of a practical application of ES technology (a diagnostic system for repairing a complex page printing system). They then explain the rationale used to select the application for the development of an ES, the process used to elicit expert knowledge about diagnosing repair problems, and the costs and payoff from the application. The process of assessing and assimilating new technologies is a monumental and never-ending task facing MIS management. This case gives a good example of how an organisation developed expertise in a new area of technology and then applied it successfully to an important problem.

2.1.2.2.7 Carlsson [1988] reports on the use of a spreadsheet program based on results from a longitudinal case study. This work focuses on spreadsheet program users' perceptions of their information environment. The data were transformed into a measure of integrative complexity and analysed. The study provides insight into the impact of end-user-developed computer-based DSS models.

2.1.2.2.8 Silver [1988] believes that when a manager relies on the functional capabilities of a particular DSS in solving a problem, he is actually restricted to some subset of the full range of possible decision-making processes. A key research question is whether all users will be restricted identically by a given DSS. He did an experiment which explores if different users of the same DSS differ in their perceptions of system restrictiveness and if they do so, how. Subjects used three DSS and ranked them from most to least restrictive. The results indicated that, while there was a significant similarity among ranking, there were also substantial differences. Several factors contributing to the perceptible differences were identified; these can serve as the basis for further research.

2.1.2.2.9 Welter [1988] finds that the computer industry has begun targeting executives with what is called an "Executive Information System" (EIS). These systems provide graphic, colourful displays of information normally obtained manually from reports, newspapers, or telephone and face-to-face conversations. According to the author, the EIS from Metapraxis Inc. begins by monitoring sales, costs, capital expenditures, working capital, and the bank balance. It is then tailored to track key indicators for an individual firm.

2.1.2.2.10 Kopcsó & Pipino [1988] address the treatment of uncertainty in expert system shells, starting with a review of the modelling of uncertainty by expert system shells. They did an experiment to replicate earlier work investigating the manner in which individuals manipulate certainty factors in comparison to commercial shells, both PC-based and mainframe-based, and individuals. A significant difference in manipulation between individuals and shells themselves is indicated.

2.1.2.2.11 Mahmoud [1988] has reviewed eight software packages on sales forecasting and DSS. They are evaluated in the light of criteria used by practitioners when selecting software for forecasting purposes. He then discusses on the choice criteria for forecasting software. The more important ones are, in descending order, accuracy, compatibility with other software, ease of data handling and output interpretation, and graphical capabilities.

2.1.2.2.12 Peters [1988] has developed a mapping technique to portray IS investment in a way which is meaningful to senior managers. The two axes of his map are the 'focus' and the 'benefit' of the IS investment. By taking a wide range of examples he has been able to quantify the axes more precisely than is usual for management matrices; hence the term 'map'. The Peters Map gives a good overview of current or proposed IS investment, and can be related to broad categories of business strategy to review whether the investment is appropriate.

2.1.2.2.13 Huff, Munro & Martin [1988] propose a stage theory to end user computing in organisations. Central to the theory is the idea that an organisation's end user computing activity can be classified by stages of "application maturity." Application maturity is defined as the extent of usage of applied end user computing skills and is measured in terms of the interconnectedness among end user and other applications. There are five stages: isolation, stand-alone, manual integration, automated integration, and distributed integration.

2.1.2.2.14 Reid [1987] has shown that the PC is the centre of an ESS. The author shows in one instance how a chain of retail stores used ESS software to perform decision support analysis to: (a) improve profitability, (b) challenge competitors, (c) examine demographic changes and customer buying preference, (d) cultivate consumer commitment, (e) survey customers and staff, (f) analyse salesforce performance, (g) model the multiple choices, (h) investigate the investments, and (i) develop a model to decompose profit and loss line items.

2.1.2.2.15 Dologite [1987] has developed a knowledge-based system, called the Strategic Planning Adviser. The system is designed to provide assistance or advice to a user who is doing strategic planning for an organisation. It helps a planner to determine the most likely overall strategic direction for an organisation to pursue. The Strategic Planning Adviser was developed with an expert system shell package for a PC.

2.1.2.2.16 Main [1987] notes the various types of DSS, i.e., database managers, statistical analysis programs, spreadsheets, project managers, chart packages; thought processors, and decision modelers. Five decision modelers are then described: Decision, Decision-Analyst, Decision Aide, Expert Choice, and Lightyear. The names and addresses of each manufacturer, the price, and the hardware requirements are also listed.

2.1.2.2.17 Gupta & Harris [1989] conduct a survey of 348 SME executives in central Indiana. Results indicate that more than 2/3 of the executives believe that computers can help them make better decisions. In addition, familiarity with such concepts as MIS and DSS increased significantly when the business owned a computer. Further effective DSS should have 3 functions, i.e., information management, data quantification, and model manipulation. In order to ensure selection of the most appropriate and beneficial DSS, the executive must determine whether the business needs a DSS, what functions are desired, and if a DSS is warranted.

2.1.2.2.18 Morris [1987] believes that DSS is uncontrolled in most institutions. As the move to expand DSS is driven by microcomputers and advances in LAN and network communication software, the need for control over direction, use, and acquisition is clear. Thus, a planning committee of users and information services is needed to provide guidelines for DSS.

2.1.2.2.19 Bobrow, Mittal & Stefik [1986] delineate three different approaches to ES development: the low road that involves direct symbolic programming, the high road that involves building a system that contains explicit representation of the knowledge of some matter, and a middle-road system such as Mycin that is between these two extremes. The development of ES at Digital Equipment Corporations, Xerox, and Schlumberger is discussed. Perhaps the most valuable portion of the paper is the discussion of the criteria for the selection of an appropriate problem for an ES. Also of value are the guidelines for managing the stages of development in an ES.

2.1.2.3 Manufacturing Industries

Overview :

Manufacturing Information Systems depend on the technical task and the manufacturing system involved. In general, the following activities are involved: production engineering; plant location and layout; work study and job design; production planning and control; quality control; stock control; maintenance and machine replacement. Manufacturing will also have at least a considerable say in if not responsibility for purchasing, product planning and various aspects of labour relations such as the introduction of new payment or incentive schemes.

Ideally a company should establish an integrated manufacturing data base including such record types/files as: (a) Part Master, (b) Bill of Material, (c) Master Schedule, based on customer orders and forecasts of future demand, (d) Routing, (e) Work Centre. It is also worth noting that although the application of systems concepts in many manufacturing companies is of comparatively recent origin, the process industries -- oil, petrochemicals, etc. -- have been designed on this basis, together with the appropriate mathematical models, for many years. Automation of the non-process industries though is now accelerating, particularly as a result of the microcomputer's advent.

Abstracts :

2.1.2.3.1 Ho [1991] has done surveys for small & medium sized manufacturing firms (SMM) with the purpose of identifying the better ways of making use of IT. Comparative study has been conducted at firm and Government levels in HK, UK and Japan. Whilst there is no significant difference between the practice of more successful firms in the three places, there are some difference in the government supports. The former confirms that the approaches in the management of IS for SMM is somewhat universal.

2.1.2.3.2 Rushinek [1989] has found out that the selection of appropriate features for inclusion in microcomputer systems can be very frustrating for both hardware and software manufacturer, as well as for end-users. He describes an interactive microcomputer based feature selection system (FSS). The feature price contribution margin measures to what degree a specific feature meets end-user needs. FSS produces a segmented income statement of possible future products lines.

2.1.2.3.3 Ho [1989] has identified that some computer systems are not very good at communicating with their users. They often fail to understand the nature of what the user is asking them to do and fail to communicate to the user the nature of their misunderstanding, instead responding "Syntax error" or some other unhelpful message. Through the development of a user-friendly CAD/CAM interface, the author identifies that the use of menu structure has proved capable of allowing application programmers to specify complex user dialogues. This has been effected by extra features such as branching within the menu structure and the display of a textual file on the screen.

2.1.2.3.4 Grzesik & Niklewicz [1988] characterise operative production planning as a controlled object, present drawbacks of the traditional production planning methods and describe the task of production planning optimization and functional structure of the Microcomputer Aided Decision Planning System described.

2.1.2.3.5 Chu [1988] declares that the emergence of DSS, AI, and microcomputers in the information systems arena provides managers with some new insights to the planning and control of a productive system. He illustrates how an intelligent microcomputer-based DSS was developed to support demand forecasting.

2.1.2.3.6 Chaudhry & Khidhathong [1988] identify that the influx of microcomputers in industry has created an environment in which industrial engineers have started to utilize them as a tool to justify various production decisions. They describe the development and implementation of a microcomputer based system for managing resources at a manufacturing firm. This system has been implemented on a microcomputer and has played an important role in decision making regarding resource utilization.

2.1.2.3.7 Veerakool [1988] finds out that with the advent of the inexpensive microcomputer, small manufacturers have been able to automate many applications in their day-to-day operations. Under the auspices of the State of Missouri 'Productivity Improvement Program' -- a program to aid small manufacturing businesses in improving their productivity, a DSS was developed to assist a small metals manufacturing company in production planning and bid preparation. He then discusses the development of the DSS, its implementation, and its utilisation.

2.1.2.3.8 Elfner [1988] describes the DSS approach to problem solving in an industrial engineering environment. The recent development of microcomputers and related software to aid the engineering problem solver is also presented. The

industrial engineer is ideally suited to implementing a DSS using the microcomputer hardware and modelling software now available. Finally, the author reviews a number of general and specific DSS software packages which can assist the industrial engineer when undertaking the complex analyses necessary to make good decisions.

2.1.2.3.9 Chu & Wang [1988] show that the emergence of DSS, AI, and microcomputers in the information systems area provides some new insights for the design and operations of productive system. They illustrate how an intelligent microcomputer-based DSS was developed to solve line balancing problems. The conceptual framework, technical issues, and minute details for effectively designing such a system are addressed. Directions for future research are also discussed.

2.1.2.3.10 Canada & Hodge [1988] summarise information on 28 commercial microcomputer software packages which facilitate various types of multi-attribute decision analysis, particularly for evaluating advanced manufacturing system alternatives. Programs which perform traditional economic analyses and which also include some unique features for decision makers are identified.

2.1.2.3.11 Ho [1988] reports on the experience of four representative cases of IT applications in manufacturing, one each from HK, Singapore, South Korea, and Japan. The purpose is to bring light to readers on how to harness and adopt the technology which is so vital as a competitive weapon. One observation is that the LAN technology is widely used for its cost-effectiveness. In Japan, the full extend application of computer integrated manufacturing is becoming popular. The comment is that the stage of computerisation has to be consistent with the resources available and the economy of using them.

2.1.2.3.12 Lefrancois & Cherkez [1987] report work on the development of a DSS to implement the adaptive control limits approach within a transaction-oriented PC-based inventory control system. The system developed offers ways for an automatic adjustment of the inventory control parameters when the sales forecasts are updated or management adjusts its expected customer service level. Technical aspects of the approach used to generate the adaptive limits are presented along with an illustrative case example of its application.

2.1.2.3.13 Pendegraft [1987] has developed a simple microcomputer-based decision aid that can support the manager, not by optimising schedules, but by quickly displaying finish times and lateness. The worksheet, built with LOTUS 1-2-3, incorporates a simple, user-written macro instruction to sort the data and display the graphs. This system takes advantage of the scheduler's experience and is simple to build and operate.

2.1.2.4 Service Industries

Overview :

Service Information Systems ties very much to their abilities to create and sustain "competitive advantage". However, the competitive advantage that results from enhanced service may or may not be reproducible. To the extent that a competitor has equivalent in-house expertise and can harness it in a comparable way, the initial competitive edge may not be fully sustainable. Nevertheless, the first entrant into the marketplace with this enhanced service may have created some entry barriers for competitors that consider following its lead.

Related to the idea of enhanced services is the notion of new services. An enhanced service is concerned with improved features, greater timeliness, greater thoroughness, and so on. A competitive strategy could also be aimed at furnishing a new service that draws customers to a company. It would not be surprising to see the emergence of a new industry concerned with the publication of computerised expertise. For instance, it is likely that there will be new businesses concerned with producing and distributing chunks of reasoning knowledge, each addressing one of a wide variety of problem areas from vehicle maintenance to marketing management.

Abstracts :

2.1.2.4.1 Madsen [1988] discusses the construction of a DSS assisting the planner in charge of routing and scheduling tasks at the operational level. The system is implemented on an IBM PC and should, therefore, be an economically feasible solution for companies of any size. The system will assist in solving both routing problems with one depot and one depot routing and scheduling problems where time constraints are imposed. The system is interactive, which makes it possible to incorporate usually unquantifiable factors on top of the solution process and to produce better solutions. The method is fast and may handle problems with several hundred customers.

2.1.2.4.2 Pacek & Radcliff [1988] provide an overview of the applicability of microcomputers to the practice of law. Three broad categories of usage are examined: office management, decision analysis and modelling, and instruction. The paper concludes with a discussion of the potential uses of expert systems in the simulation of legal reasoning.

2.1.2.4.3 Fletcher & Buttery [1988] record their experience in designing a marketing information system. An essential prerequisite is an analysis of the major duties of a marketing manager. For the initial MIS, information should be collected for short-term forecasting, modelling, planning, and controlling the areas that comprise the marketing mix. In the longer term, the company may wish to graduate to a dull DSS involving the storage and retrieval of data that are often qualitative in nature.

2.1.2.4.4 Lincoln & Warberg [1988] assess the extent to which small business owners use microcomputers to make marketing decisions. A questionnaire was developed that covered several categories of information, including: 1. customers, 2. sales, 3. inventory, and 4. marketing costs. The questionnaire was mailed to 3004 small businesses that had bought microcomputers within the last 2 years. The response rate was 10%. The study showed that most businesses (80.9%) kept customer names and addresses on their computers, and many of the respondents used the computer to tie sales records to customers and their locations. Some of the businesses said they used microcomputers for forecasting, but it appears that many small businesses are not using computers in a DSS manner.

2.1.2.4.5 Jacquet & Meziani [1988] declare that it is now possible to use very efficient microcomputer codes to solve linear programming models. If such a model is included in a more general DSS environment, the user may ask for an optimal solution, and may also progressively modify this solution by taking into account criteria difficult to formalise directly. They then illustrate this process on a manpower scheduling problem at AIR-FRANCE for which a microcomputer version of the CHEOPS model is presented.

2.1.2.4.6 Ho [1988] explores the VAN and Value Added Service (VAS) available in HK for the business community. Relevant case studies are used to explain their use. Further the role of system houses in the promotion of these services are researched. As such service is still at its infancy, system houses play an important role in bridging the gap from the SME users. Further, there is ample opportunities for firms to make use of such technologies to enhance their competitive position.

2.1.2.4.7 Ariano & Lehouillier [1987] implement individual expert system on a microcomputer and describes its possible uses as an aid to nursing care decision-making. A methodological approach is presented leading to an analytic matrix for eating and drinking needs related to body weight and water content, state of digestion, etc. The results of trials with students, junior nurses and experienced senior nurses are compared.

2.1.2.4.8 Huattinger [1987] studies the DSS for the management of distribution systems. The constraints that must be considered in planning the shortest and cheapest route are identified. The role of microcomputers in making decision support accessible to a greater number of potential users is examined. The requirements for a user-friendly system are outlined.

2.1.2.4.9 Carlisle & Nickerson [1987] describe a microcomputer-based DSS for logistics planning. The system uses efficient network algorithms to optimise the flow of freight from vendors, through processing centres, to retail store locations. It comprises three different models for determining inbound sourcing, outbound transshipment points, and the location of a set of market service centres. Despite the large size of some of the networks (over 20000 links) the package offered surprisingly fast execution times even when solving large facility location problems. Overall, the microcomputer environment (IBM PC-AT) offered significantly

greater speed (in terms of total turnaround time), flexibility, and ease of use over the corporate mainframe.

2.1.2.4.10 Ho [1986] investigates into the better approach in the teaching of IT to business students. First the rationale and methodology that have been used for the design of the IT content for a B.A. Business Studies course has been explored. The approach is to allow IT to thread through the course in the various business disciplines as far as possible, yet without over-stretching the students into the technical aspects of software engineering and sophisticated hardware architecture. This need is further confirmed by a comparative study of two groups of students, one from Business Studies Dept. and the other from Computer Studies Dept., doing the same module.

2.1.2.5 Financial Information Systems

Overview :

Many organisations have developed their own systems and programs for such obvious candidates for computerisation as order processing and invoicing, sales ledgers, payrolls and so on. Some organisations have used consultants or software houses to help in such work. However, the advent of the micro is considerably increasing the numbers of companies using in-house facilities. Broadly speaking, there are three levels of financial information systems:-

- [1] The first level which uses as input such data as invoices and produces as output financial ledgers, in particular those for purchase and sales respectively.
- [2] The second level which uses as input information from financial ledgers and produces as output balance sheets and profit and loss accounts.
- [3] The third level which deal with some aspect of reality in a context that is referred as a "problem". The reality can be simplified by constructing a DSS. The DSS model reduces the elements and relationships from many to a few, and it describes them in a fashion that we are comfortable with. Deriving the model provides us with further insight into the problem, which helps us reach a workable solution.

For instance, the retail bank may provide customised consumer loans. However, the bank would not be financially justified in hiring sufficient investment bankers to handle the relatively large number of relatively small applicants. But a DSS that embodies the sophisticated reasoning behaviour that an investment banker would display for consumers could be financially attractive, especially if it were shared by a consortium of banks. As in the case of enhanced services, reproducibility and entry barriers are important issues when considering new services implemented via DSS.

Abstracts :

2.1.2.5.1 Sounderpandian [1989] finds that decision analysis concerns situations where uncertainties exist, and additional information that can reduce the uncertainties cost money. The analysis calculates expected monetary value of any additional information so as to help decide whether or not to get that information. Although the calculations are tedious, the calculation logic is simple enough to be incorporated in a spreadsheet. Through a hypothetical case study, the author illustrates decision analysis using a spreadsheet, lists possible classroom exercises and points out many advantages of spreadsheets over commercial software packages.

2.1.2.5.2 Prekel [1988] thinks that SLAM, the Simulation Language for Alternate Modelling, is one of a growing number of popular simulation languages run on the PC. Most of the applications, however, are used to model physical processing type situations, such as production lines, inventory systems, vehicle scheduling, and mining operations. He analyses two entirely different types of problems with the help of SLAM in this paper. In the first, TOPCHEM, it is shown how SLAM can be used to compare two investment opportunities by generating distributions of possible internal rates of return for each of them, and analysing the results. The second, MANPOWER, shows how SLAM can be used to analyse the effects of various manpower planning policies on the long term staffing position of a company.

2.1.2.5.3 Baird & Kazamek [1988] establish that cost accounting information is needed for flexible budgeting, productivity management, contracting with third party payers, physician evaluation, and investment and divestment decisions. Based on the experience of Tucson Medical Centre, a 562-bed hospital in Tucson, Arizona and many other hospitals, they illustrate that decision support applications, of which cost accounting is the heart, can be effectively implemented using microcomputers. Their experience also demonstrates many of the advantages this approach has to offer. With cost containment a major issue facing healthcare financial managers, the decision support tools used to support strategic financial decisions should also be cost-effective.

2.1.2.5.4 O'Keefe & Belton [1987] find out that microcomputer based expert system shells promise those without an extensive background in AI the opportunity to develop relatively simple, yet practical and useful, expert systems. The main types of shells are reviewed. In particular Micro-expert, ES/P Adviser, and Expert-Ease are discussed as examples of three distinct classes of shells, respectively using network based Bayesian inference, rule based logic, and deterministic decision trees as the bases for knowledge representation. They then discussed an application in financial analysis. The weakness of the present range of microcomputer based shells is highlighted; it is concluded that flexibility, particularly access to a symbolic language, is an essential feature. Further, as spreadsheets have come to be used for a plethora of applications beyond those initially envisaged, declarative programming and knowledge based methods have

applications beyond expert systems. As embodied in shells, they combine to provide a convenient structure for implementing many DSS.

2.1.2.5.5 Garellick [1987] finds out that clever marketing and ingenuity in developing personalised microcomputer applications have opened new markets, of which executive information systems (EIS) is one -- a method for creating and delivering the information that managers can use for financial reporting, planning and decision making. After examination of current systems, he reveals that although they may be able to deliver information without requiring computer literacy, they have as yet several limiting gestures. The characteristics of an ideal EIS, and the shortfalls of many produced to date are summarised. Attempts to meet executive workstation requirements are discussed along with criteria for future technology.

2.1.2.5.6 Walvoord [1987] concludes that the latest generation of micro-based accounting packages can produce -- either directly or in conjunction with productivity software -- tightly focused financial reports for management decision needs. Accounting programs typically generate tabular reports; a spreadsheet can be used to turn these into meaningful graphs. The result is that increasingly, accounting software is being used by all of a company's top management, and not just the accounting department. The packages developed by him are not just helping managers to make decisions, but help them implement them too.

2.1.2.5.7 Major Michael [1989] finds out that despite reservations about using PC, bank executives are increasingly interested in using PCs to obtain information. He identifies four reasons why he believes there is a small but growing market for EIS: [1] The increased volatility of the banking industry, with the corresponding need for quicker access to the external political and economic environment; [2] The restructuring of corporate America; [3] The growing number of computer-literate middle managers and professionals who are moving into the senior-level ranks; and [4] The improvements in EIS software. Of the PCs now on top executives desks, about 40% are not very valuable and about 35% are only moderately valuable.

2.1.2.5.8 Porter [1988] identifies that Expert Systems for financial analysis can be categorised into 3 areas. First, insight-facilitating systems simply produce relevant analyses -- usually financial statement ratios and graphs. Decision-facilitating systems can access a financial knowledge base and retrieve insights about an entity. They also contain decision rules that trigger relevant insights about the data under analysis. He surveys and confirms the use of expert systems in a number of management areas.

2.1.2.6 Literature Survey: Overview

Current developing and case experience are best communicated in journals and magazines. Thus, they are good supplement to books. Furthermore, with the easy availability of on-line search facilities like the CD-ROM, finding relevant articles to the special problems of SME can now be done much more effectively.

2.1.3 RELEVANCE OF BIBLIOGRAPHY & LITERATURES TO SME

Much has been said about the microcomputer applications in MIS and DSS. However, many of them are focusing on large organisations rather than SME. Also there is a lack of knowledge in the discussion on how MIS and DSS can be effectively implemented, based on an in-depth understanding of the needs of SME.

On the bibliography, in this era of technological advancement, textbooks on current development in the field are soon out of date. Thus, the main uses of publications are on the concepts, hardware and software fundamentals, man-machine interface, and the management of information systems.

As for published papers, the main uses are on specific applications and research topics. However they are largely fragmented and do not constitute a solid approach to help SME to develop their microcomputer-based MIS and DSS. In other words, SME cannot rely on the knowledge of these papers to act as a guide to implement MIS and DSS. Instead, the knowledge can be used as reference for specific areas where applications are similar.

On the user side, SME are finding the need to rationalise their operation by effective implementation of the said system. This means competitive edges for them and is a key to survival and prosperity. Therefore, there is a pressing need for an effective and validated advisory service to guide SME towards the best use of information.

Thus, the current research is aiming at addressing these "gaps" of knowledge so that SME will find the results of direct relevance to them. Further, the work will release the SME managers of the burden to look for relevant information from the information explosion in the field of MIS and DSS due to their fast development.

2.2 RESEARCH METHODOLOGY

Regarding research methodology, it is essential that the direction should be set correctly at the outset. Various research methods applicable to information systems have been considered. The following are research methods that are useful to this particular context. Their relevance are also discussed.

2.2.1 OPINION RESEARCH

Buckley & Chiang [1976] identify that the objective of this methodology is to gather data on attitudes, opinions, impressions, and beliefs of human subjects. This is accompanied by asking the subjects (via questionnaires, interviews, etc.). This methodology allows testing of a priori hypotheses and offers an iterative approach to the generation of hypotheses.

Relevance: Since SME are always large in number, and there are sufficient similarities in their operations, it is useful to gather the basic information via questionnaire survey so that statistical analysis can be made, and conclusion drawn.

2.2.2 ACTION RESEARCH / CASE STUDIES

Wood-Harper T. [1985] declares that a major difficulty for researchers has been to understand the choice rationale and applicability of Information Systems Methodology in small organisation. One of the tentative conclusions from this research was that information systems design for small organisations comprises the information systems methodology, the problem situation, and the intentions and assumptions of the analyst. Lee A.S. [1989] explains that the classical research paradigm, drawn from the physical sciences, requires the proposal of a theory from which conclusions can be deduced and verified. The scientific method calls for control over experimental variables in order to measure their effects on outcomes. Lee argues persuasively that a case study can meet the requirements of rigorous research. Theories can be proposed that can then be tested against observed results. Although control cannot be exercised over important variables, advantage can be taken of the natural variation that occurs in the real world. The study can often be replicated in other organisations in order to subject a theory to further verification and add to its generality.

Relevance: This approach focuses on the specific environment under which SME use information systems. This is important as the practice of SME users may not be as rational as the large organisations. Thus, it is important that for the present research, one should study the real life implementation and successful use of information system by SME via intensive case studies so that practical problems can be investigated. These will then form basis for other similar set-ups.

2.2.3 CRITICAL THEORY

Klein H.K. [1985] suggests that information systems which are designed to increase organisational effectiveness must also increase human understanding and emancipate people from undesirable social and physical constraints, distorted communication and misapplied power. Hirschheim & Klein [1989] present the fundamental assumptions associated with four systems development approaches (functionalism, social relativism, radical structuralism, and neohumanism). They tell four stories which illustrate their point that not only do alternative conceptions of IS development exist, but it is specifically because of these fundamental differences (based on differences in assumptions) that the resultant systems will differ.

Relevance: Development of information system is, in itself, an educational process. Therefore, during MIS/DSS development for SME, it is important to treat the improvement of effectiveness and efficiency as the main objectives. Then, despite

the difference in initial assumptions, the resultant improvement will be directed towards.

2.2.4 PARADIGM

Galliers R.O. [1985] identifies some of the shortcomings of traditional research approaches in the field of information systems. He believes that at a time when technology advances are occurring in the information field at a rapid rate, it is essential that we improve our knowledge of the appropriate uses to which this technology can be put and of its impact on organisations and society as a whole.

Relevance: The social impact of IT on SME is equal, if not more important than the technological impact. This is particularly significant as IT is advancing so rapidly. Therefore, it is essential that the most appropriate, rather than the most advanced technology should be adopted by SME to develop their information system. This theme will be used in the expert system development.

2.2.5 USER DEVELOPMENT / INVOLVEMENT

Flensburg P. [1985] proposes two approaches, the first being a collection of experiences in case study form, the second being active participation in a user controlled project. The case study approach as a means of further defining DSS is certainly not a new idea. Many thorough case study analysis have been previously done. Sutton [1978] presents a case study of a specific division within IBM. He followed this soon after with a research report that covered his findings as they related to 22 separate DSS applications. Wagner [1981] conducts a survey of 24 users of his company's product IFPS and, although not presented as individual case studies, the findings certainly added to the knowledge base available on DSS users. Costanza [1985] prepares feasibility study for the use of microcomputer in long range planning model and the software was eventually implemented by a member staff of the company. Baroudi & Olson [1986] find out through survey that user involvement during system design could conceivably cause improved user satisfaction, system utilisation, or both. In addition, satisfaction could cause improved utilisation, or vice versa. Barki & Hartwick [1989] find out that a user becomes strongly involved when an issue carries deep psychological significance and has direct relevance on his life. By focusing on the psychological state, it may be possible to obtain better insights into how we can get more effective user involvement in systems development.

Relevance: Apart from the intensive use of case studies as stipulated in S.2.2.2 above, the current research will also be based heavily on active participation in a user controlled project. This is important so that the process and problem of implementation can be studied closely. Further, any results arrived at after such experiment are of immediate value to the expert system development.

2.2.6 GAME APPROACH

2.2.6.1 Duke R.D. [1974] comments that there are many examples of Game/Simulations which could satisfactorily be employed for hypothesis testing or theory generation.

2.2.6.2 Bowen K.C. [1978] states "Research games can be used to examine the interplay of information and decision in realistic simulations of situations which cannot easily, economically or safely, be observed directly." He also suggests ways in which gaming can be used as a research tool with success. The application of experimental gaming methodology enables the researcher to control the nature of the information system and detail utilized by the experimental subjects.

2.2.6.3 Cooper and Klein [1980] outline the following requirements for the design and use of an experimental game :

- Simple, easily learned rules.
- Speed of play to ensure continued interest in the game.
- Ease of recording, with a minimum of interference to the players.
- Strategic aspect.
- Interest must be maintained by a realistic game.
- Data must be gathered by the researcher in the natural course of the game.
- The player must believe he is an active Decision Maker.
- The game must have sufficient complexity and detail to be accepted by the player as "realistic".
- The experimenter must be able to control a game so that he can replicate it exactly with different subjects.

2.2.6.4 Fripp J.W. [1982] concludes that the methodology offers many advantages over others, and in particular, the scope conditions for allow the researcher to make a number of general conclusions and recommendations on the effectiveness of models for decision making.

Relevance: These research results have supported the use of Game Approach to information system development. In fact Game Approach is more suitable for SME as the decision criteria for SME are less and therefore more likely to be simulated by game environment. Thus part of the current research will be to establish DSS framework and decision criteria using results of simulated games. However, statistical significance is important for valid interpretation of results.

2.2.7 LONGITUDINAL RESEARCH

Pettigrew A.W. [1983] points out the dangers associated with the 'prejudice' of the moment in time that the research happens to be undertaken. Time itself sets a frame of reference for what changes are seen and how those changes are explained. The more we look at present day events the easier it is to identify change. The

longer we stay with an emergent process and the further back we go to disentangle its origins, the more likely we are to identify continuities. Without longitudinal data it is impossible to identify the process dynamics of changes and therefore the inextricable link between structure and process.

Relevance: One typical method for problem analysis is to look at "Changes". Through analysing changes, many strengths and weaknesses can be revealed. In studying information system development, it is important to understand the changes for the organisation during various stages of development. More important is that when results are not as desired, these records of "Changes" will be extremely useful to highlight problem areas. Thus, the present research will also make use of longitudinal research so that the behaviour of change can be interpreted.

2.2.8 EXPERIMENTAL DESIGN MODEL

Howard & Sharp [1983] regard the experimental design model as having considerable virtues as a conceptual model of research directed towards explanation and prediction. This is true even if no attempt is made to carry out a statistical analysis. It offers an explanatory framework which is capable of handling complex relationships between the respondent variables and factor levels along with predictions of the effect of any particular set of factor levels.

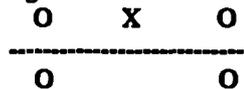
Relevance: The experimental design model assumes that the researcher can control the experiment to the extent of selecting the factors and factor levels whose effects are to be examined. This is not always the case in the social sciences type of research like the present one. However, it may still be possible to approximate to an experimental design by using the fact that particular variables vary between one organisation or country and another or over time. Such applications of the model, usually referred to as 'quasi-experiments', will form part of the research methodology.

2.2.9 QUASI-EXPERIMENTAL DESIGNS FOR MIS RESEARCH

Campbell and Stanley [1973] find out that there are many natural social settings in which the researcher can introduce something like an experimental design into his scheduling of data collection procedures (e.g., the WHEN and TO WHOM of measurement) although he may lack full control over the scheduling of experimental stimuli (the WHEN and TO WHOM of exposure and the ability to randomise exposures) which makes a true experiment possible.

One of the most widespread experimental designs in educational research involves an experimental group and a control group both given a pretest and a posttest, but in which the control group and the experimental group do not have pre-experimental sampling equivalence. Rather, the groups constitute naturally assembled collectives such as classrooms, as similar as availability permits but yet

not so similar that one can dispense with the pretest. The assignment of experiment "X" to one group or the other is assumed to be random and under the experimenter's control. "O" will refer to some process of observation or measurement. Such study might be diagrammed as follows:



Relevance: The quasi-experimental design for Non-equivalent Control Group Design can be used for comparing and interpreting the results of DSSs derived from the experimental business games played in HK and UK by the two respective non-equivalent control groups of subjects.

2.2.10 STATISTICAL POWER IN MIS RESEARCH

Baroudi & Orlikowski [1989] discuss some important issues in statistical analysis in MIS research. Statistical analysis aims at understanding complex relationships among variables described by a set of data. The "power" of a statistical test gives a measure of its ability to correctly detect significant effects among these variables (e.g., the influence of organisational level on a manager's intensity of use of PCs). In analysing 57 empirical studies in the MIS literature, they found that most of the statistical analyses used in the research provided relatively low power of discrimination. As a result, the studies often failed to identify statistically significant effects when, in fact, they may have existed. They discuss a number of ways to increase the power of a statistical test by such means as increasing the sample size and selecting a more efficient method of analysis, research, design, and sampling plan.

Relevance: The experiments in this research are designed in the upmost care so that the data collected enables relevant statistical analysis to be carried out. Potential statistical analysis employed include hypothesis testing, factor analysis, cluster analysis, discriminant analysis, and correspondence analysis. Ample data need to be collected across countries, industries, and other independent and relevant variables.

2.2.11 VALIDATING INSTRUMENT IN MIS RESEARCH

Strub & Carlson [1989] point out that in questionnaire design, questions will be misinterpreted by some of the respondents, no matter how carefully one crafts the document. Worse, responses may not really tell the researcher what the questionnaire is intended to reveal. They argue that too often insufficient attention is given to the validation of the research instrument. They discuss the issues involved and outline procedures to provide a higher degree of confidence in research results. The procedure consists of four phases: pretest, technical validation, pilot test, and full-scale survey.

Relevance: The present research relies heavily on survey "instruments" of various kinds to measure factors important to the understanding of the MIS/DSS disciplines. In order to have confidence in the conclusions stemming from such research, it needs to be assured that care is taken in designing and validating the research instruments.

2.2.12 OVERVIEW ON RESEARCH METHODOLOGY

The above nine selected research methods are highly relevant to the present work. They have included most of the effective research methodology that IS research should consider seriously. More important is that they are complementary to one another. Therefore, in the design of experimentation and software development for the present work, all these methodologies are reviewed to obtain the best feasible approach. In essence, they will form guidelines for the present research in order that its validity will be guaranteed.

2.3 RESEARCH PROJECT MANAGEMENT (APP.1)

Some background work was done prior to the commencement of the present research in January 1987. As a senior lecturer in Operations / Information Management of the Business and Management Dept. at the City Polytechnic of Hong Kong since 1984, the author had the access to undergraduate / postgraduate teaching and project supervision. In fact, the business game "STRATPLAN" was used for teaching by the author just before the research commenced. There were also a few student projects on ISs and MISs for SMEs in HK.

Also beginning from January 1987, the author was awarded as the Oshikawa Fellow of the Asian Productivity Organisation (APO) for one year duration. The fellowship was named after the first president of APO and had been awarded to one candidate per year out of the 16 membership countries in the South-East Asian region. The objective of the fellowship scheme was to research into productivity improvement activities of regional interest for SMEs. Since the commencement of the scheme in 1980, it was the first time that the research has been directed towards IT focus. Thus, APO had given very good support on the research activities.

The object of the research was on 5 technologically advanced countries in the region, i.e., Japan, South Korea, Taiwan, HK & Singapore. Some 68 organisations in the manufacturing, services, information, and public sectors had been interviewed. Many of them were case surveys. A book was published and many copies have been sold to all parts of the world through the distribution network of APO.

Since the above APO work was an original work from the author, the present research is a natural extension of the work done. The original focus was on the SMEs in the S.E. Asian regions. In July 1988, the author took up a lectureship at Warwick University. Consequently, the focus was changed from S.E. Asian countries to UK.

In order to extend the validity of the research to UK, it was assumed that MIS/DSS for SMEs were largely the same between technology advanced countries. However, a similar survey to the one did in HK was conducted in UK during early 1989. The finding was a basis for comparison, and has been on the positive side. Further comparison were based on conducting the same business game with several groups of UK students.

As part of the consultant work, the author had the opportunity of doing longitudinal research for some SMEs, both in HK and UK. This further enhanced the work done and enabled further comparison to be made.

ES using shells and presentation graphics were developed based on the results of the above work done. They were further validated by selected SMEs. They constitute to an important "end-product" of the research and is expected to be of commercial value.

The management of the research project can be identified into the following stages, with the duration and corresponding chapters in brackets:-

2.3.1 PREPARATION (1/87 -- 2/87; Chapter 1 & 2)

Concepts, research methodology, originalities, and contributions were established via literature survey, discussions, and personal experience.

2.3.2 QUESTIONNAIRE SURVEY (3/87--4/87 in HK; 12/88--3/89 in UK; Chapter 3)

Before the survey, some pilot tests were run in order to make sure that the questions were legitimate and meaningful for subsequent analysis. The basic sample addresses were obtained from the "Asian Computer Directory 1986". The survey was directed to about 1600 firms (inclusive of training institutes and software houses) that had computers installed. 358 valid replies were received, of which 166 were SMEs. The questionnaire was designed based on some established criteria. The results was then analysed by SPSSx.

The aims of the questionnaire survey were to:-

2.3.2.1 Identify disparity between SMEs and large enterprises in MIS requirement and development.

2.3.2.2 Identify key features of MIS development for SMEs.

2.3.2.3 Establish cost-benefit factors.

A similar questionnaire survey was conducted in UK in early 1988. For economic reason, the scale was cut down to about 1/3 of that in HK. However, they were directed towards SMEs only. The survey results were compared and any statistical difference were noted. Conclusions were drawn on the similarity and differences.

2.3.3 FIELD SURVEY

(5/87 – 7/87 in Asian NIC & Japan; 2/89 – 3/89 in UK; Chapter 3)

Field survey were conducted in Singapore, HK, Taiwan, South Korea, Japan, and UK with the aim to:-

2.3.3.1 Identify the factors for successful implementation as influenced by Government policies and economic environment.

2.3.3.2 Identify commonality and disparity in MIS development for SMEs amongst these countries.

2.3.4 EXPERIMENTATION USING BUSINESS GAME

(1/88 – 4/88 in HK; 10/89 – 12/89 in UK; Chapter 4)

A controlled experiment based on a business game was used to simulate the real life business environment. The objective was to study the applicability of DSSs in simulated business decision making. The game was a commercially available one which meets most of the requirement in Para. 2.4. The one selected was called "STRATPLAN" by Hinton [1985] which supports up to 6 firms, with 2 products and 3 markets. A reason for choosing the game was that it was run in the LOTUS 1-2-3 environment which enabled participants to make simple 'what-if' analysis readily. The decision parameters of each cycle were grouped under R&D, marketing, production, and finance.

Two classes of BA Business Studies final year students (about 30 FT and 30 PTE) were invited to enter into competition. For the first round the teams within each group competed in a single market for 6 periods. Then the teams entered into the second round which had 3 international markets.

A similar running of the same game was conducted in UK. The group of students (about 36) were part-time postgraduate in Manufacturing Systems Engineering. Although they were not as converse as the BA Business Studies in the understanding of business functions and finance, it was complemented by their maturity and working experience. Thus, the comparison can be somewhat in line.

2.3.5 EXPERT SYSTEM DEVELOPMENT FOR EFFECTIVE APPLICATIONS OF MIS FOR SMEs (4/89 -- 9/89; Chapter 5)

The main task was to build the knowledge of MIS developed in Para.3.2 & 3.3 above into an expert system shell. The aim of this was to structure the research findings and deductions in such a manner as to assist SMEs to search for the most likely successful course of implementation, with reasoning and case examples included.

This part was an important achievement of the research. An expert system model was developed based on the analysis of the questionnaire survey and fieldwork findings foregone. Statistical analysis and regression packages (e.g. SPSS/PC) were used wherever necessary to arrive at a set of statistically significant results for decision making. Having noted that both environmental factors and hardware/software availability would change over time, some forms of artificial intelligence was built into the model for suggestions. Further, the state-of-the-art presentation graphics were used as and when necessary.

2.3.6 EXPERT SYSTEM DEVELOPMENT FOR EFFECTIVE APPLICATIONS OF DSS FOR SMEs (1/90 -- 3/90; Chapter 5)

The main task was to build the knowledge of DSS developed in Para.2.3.4 & 2.3.5 above into an expert system shell. The aim of this was to structure the research findings and deductions in such a manner as to assist SMEs to search for the most likely successful course of implementation, with reasoning and case examples included.

This part was also an important achievement of the research. An expert system model was developed based on the analysis of the findings in business game and case studies foregone to arrive at a set of results for decision making. The approach was similar to that of MIS for SMEs.

2.3.7 CONSOLIDATE LONGITUDINAL RESEARCH FINDINGS IN UK & HK (4/90 -- 7/90; Chapter 6)

In the Section 2.2.6 of Research Methodology, the advantage of longitudinal research has been pointed out. Three cases in UK and two cases in HK were reviewed basing on this principle. The aim of this exercise was to assess critically the process dynamics of changes due to introduction of MIS and DSS. Further, these cases could enhance the validity of the ES developed.

2.3.8 VALIDATION OF THE EXPERT SYSTEMS (8/90 -- 10/90; Chapter 6)

It is important to validate the ES before it can be used competently. The validation serves two purposes. Firstly, it provides a testing ground to the validity of the model

and knowledge developed under real-life environment. Secondly, it enables the ES to be further improved and refined.

The questionnaire survey in Para.3.2 above was aimed at finding out the general hardware/software configurations, applications and achievement of various industries macroscopically. However, this needed to be supplemented by some in-depth case studies in order that the findings can be soundly based, and reference sites could be established. Based on the experience in Para.3.4 above, longitudinal research was conducted in about five SMEs to develop DSSs for their strategic/operational activities, aiming at:

- specifically relate the MIS/DSS applications using microcomputers and try to determine the suitability of these applications to micros.
- developing a better appreciation for the variation in MIS/DSS applications in terms of capability and complexity.
- testing the validity of using expert system shells to help management in decision making under a real life situation in business operation.

After the ES was verified, it was then presented using the latest available hardware/software technology. The objective was to enable the software to be appealing to SME users and hence it could be marketed better. Although this is not the main purpose of this research, it is considered as a by-product, an important one as a test for its successfulness.

2.3.9 DERIVE CONCLUSIONS & RECOMMENDATIONS (11/90 – 12/90; Chapter 7)

The last chapter is to conclude the findings of the research. It reflects the achievement of the aim and objectives set out at the end of Chapter 1. The useful feedbacks from the users were highlighted and results are summarised. Further recommendations were made to the use of the ES developed and further work that can generate new idea and new applications of the knowledge.

EPILOGUE

This Chapter has reviewed the bibliographies and literature relevant to the research. The general findings are that the development of both MISs and DSSs is very fast, both in terms of hardware and software technology and also new applications in business. The benefits are plentiful. However, it is important for managers of SMEs to develop the specific functional applications that are most suitable for their organisation. The review of the research methodology has established the direction for the present work. Examples are action research, user development, game approach, and longitudinal research. Finally, the project schedule has been planned in order to aim at getting the best results possible.

CHAPTER 3

DEVELOPMENT OF EFFECTIVE MIS

PROLOGUE

Research methods used to reveal the use of MISs by SMEs are identified. The first phase involved intensive questionnaire surveys. The second phase consisted of in-depth field survey. This is necessary in order to establish a set of valid models. Further, the questionnaire survey was repeated in HK and UK. The advantage is that difference can be explicitly shown. Field surveys were carried out in HK, Japan, Singapore, South Korea, Taiwan, and UK. This provides a good cross-sectional view of various applications for countries with differences in culture and level of technological development.

3.1 MIS AND QUESTIONNAIRE & FIELD SURVEY

From the literature reviews in Section 2.1.2.1, there are many applications of MISs for contemporary management support. However, these can be derived from vastly diversified disciplines of management activities. It is therefore necessary to revisit the important issues of MISs. Then evidence can be developed to support the use of questionnaire survey and case studies as vehicles to find out the practice of MISs for most SMEs. This will set the foundation for the work in the next section.

3.1.1 FUNDAMENTALS OF MIS

MIS has been generally defined in Section 1.1.2 as:

"A system capable of integrating data from many sources to provide data and information useful to support operations, management, and decision making in an organisation. Such reports can be used to identify opportunities for improvement or to help finding alternative courses of action."

Development in two distinct areas within the last decade has offered us the potential to develop altogether new ways of supporting decision processes. Firstly, there has been considerable technological progress. Secondly, there is emerging an understanding of the potential role of MIS within organisations.

The progress in these areas has been dramatic. Entirely new kinds of planning and control systems can now be built -- ones that dynamically involve the manager's

judgements and give him flexible access to relevant information. It is further believed that an understanding of managerial activity is a prerequisite for effective systems design and implementation. Many MIS groups become involved in system development and implementation without a prior analysis of the variety of managerial activities. This has prevented them from developing a sufficiently broad definition of their purpose and has resulted in a generally inefficient allocation of resources.

3.1.2 THE USE OF QUESTIONNAIRE AND FIELD SURVEY FOR MIS

As can be seen from the Research Methodology in Section 2.2 (S.2.2), there are several possible approaches for developing an effective MIS model for SMEs. It is worthwhile to go through them in order that the best alternative can be established for the research.

Opinion Research (S.2.2.1) is suitable as MISs are generally accepted concepts to SMEs. This can be obtained effectively and efficiently via questionnaire survey. Action Research / Case Studies (S.2.2.2) is a good approach, except that significant amount of case studies have to be conducted. Yet, this is made possible through the effort of the research activity. Critical Theory (S.2.2.3) can be employed by observation through field survey and successful approaches are reported. Paradigm (S.2.2.4) is appropriate for MIS and the solution is to do case studies basing on System Houses, as they are the pioneer in driving the technological advancement. User Development / Involvement (S.2.2.5) is good, and is adopted mostly in the longitudinal research cases. Game Approach (S.2.2.6) is not suitable as MIS is such a vast subject area and can hardly be represented by a simulated game. Further, only a small number of subjects can enter into a game. Longitudinal Research (S.2.2.7) is good for MIS research, and is again adopted whenever appropriate. Statistical techniques (S.2.2.8) are used to analyse the data in order to draw conclusions on hypotheses and correlations. Finally, the research results are validated (S.2.2.9) in Chapter 6.

After weighting out all the above alternatives, the only one which is not suitable and has been discarded is the Game Approach. For the other 8 approaches, they are incorporated into either the questionnaire or field (including longitudinal) surveys.

3.2 QUESTIONNAIRE SURVEY IN HK & UK

The approach adopted is based on Opinion Research (S.2.2.1). Here, questionnaire survey is used in order that hypotheses on the applications, hardware/software usage, achievement, etc. can be tested and improved. The design of the questionnaire survey is based upon Klein's aim in improving organisational effectiveness as the focus (See S.2.2.3).

3.2.1 METHODOLOGY

The questionnaire was designed based upon the following criteria:-

3.2.1.1 It should cover the major sectors of business and industries.

3.2.1.2 It should include the major applications modified from similar surveys conducted by the Japan Bureau of SMEs (1986).

3.2.1.3 It should consist of the major software used as ranked by the journal "PC World" (1986).

3.2.1.4 It should include objectives and achievement modified from similar survey conducted by the Japan Bureau of SMEs (1986).

The finalised questionnaire is shown in APP. 2.1.

3.2.2 QUESTIONNAIRE SURVEY IN HK

The author was awarded the Oshikawa Fellowship for one year by the Asian Productivity Organisation of Japan. As part of the research mission, a questionnaire survey was conducted in HK in 1987. The findings give a diagnosis of the approaches and expectations of the present users. Further, it provides detailed studies of successfully computerised companies.

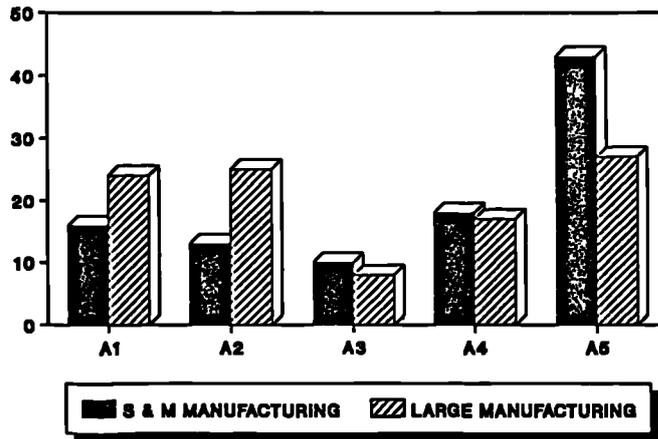
The mailing addresses were extracted from the Asian Computer Directory, 1986. It was used as the source for mailing list because it is the most comprehensive directory on computer installations in the south-east Asian region. Altogether, 1442 installations, 170 consultancies & software houses and 47 training institutes were sent with return stamped envelopes. 358 valid replies was received. The breakdown is as follows :-

- Small & Medium (S&M) manufacturing firms : 61
- Small & Medium (S&M) service firms : 155
- Large manufacturing firms : 48
- Large service firms : 94

Graph 1: This shows the types of manufacturing enterprises returned from the questionnaire survey classified according to large and SMEs.

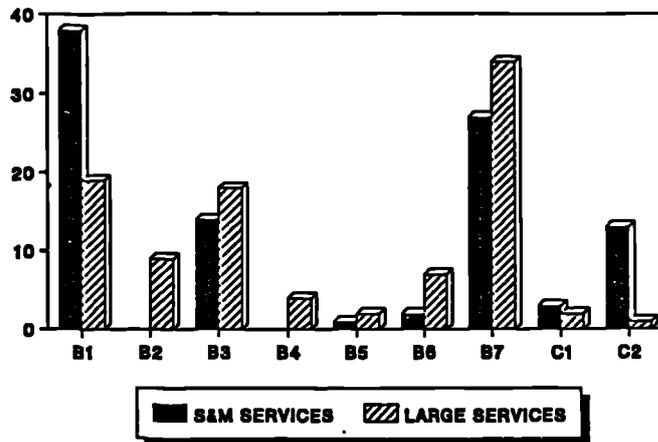
Graph 2: This shows the types of services enterprises returned from the questionnaire survey classified according to large and SMEs.

GRAPH 1: TYPE OF MANUFACTURING (Q.2)



KEY A1: Garment & Textile
 A2: Electrical & Electronic
 A3: Plastics & Toys
 A4: Building & Construction
 A5: Others

GRAPH 2: TYPE OF SERVICES (Q.2)



KEY B1: Trading & wholesales
 B2: Retail, Restaurant & Hotel
 B3: Finance & Insurance
 B4: Real Estate & Business Services
 B5: Community, Social & Personal Services
 B6: Transport & Distribution
 B7: Others
 C1:
 C2:

3.2.2.1 Analysis of Results

The data are analysed using the SPSS/PC statistical software. From the analysis, the following findings are deduced:-

Q.1.1: The mean employee numbers are:
S&M Manufacturing = 76
S&M Services = 41
Large Manufacturing = 530
Large Services = 280

Q.1.2: The mean year established are:
S&M Manufacturing = 1966
S&M Services = 1976
Large Manufacturing = 1956
Large Services = 1966

Comment: The average large firms are 10 years older than the corresponding SMEs.

Q.2: The sample distribution of the Manufacturing and Service sectors are shown in Graph 1 and Graph 2 respectively.

Q.3.1: The mean year for starting to use computers are:
S&M Manufacturing = 1978
S&M Services = 1981
Large Manufacturing = 1974
Large Services = 1977

Comment: The average SMEs start their computerisation 3-4 years later than their large counterparts.

Q.3.2: The mean number of programmers / system analysts are :
S&M Manufacturing = 3.1
S&M Services = 3.6
Large Manufacturing = 3.7
Large Services = 4.5

Comment: Although S&M and large firms differ greatly in employee numbers, when they go for computerisation, the number of computer staff are almost the same. However, the SMEs have more 'part-time' computer staff than the large firms.

Q.3.3: The mean number of computer end-users are:
S&M Manufacturing = 6
S&M Services = 12
Large Manufacturing = 45
Large Services = 33

Comment: The end-users in the average manufacturing firms is about 8% of all the employees, irrespective of the size of the firm. However for service sector, the figures are 52% and 14% for S&M and large firms respectively. This shows that

service sector employees use computer more than manufacturing. However, for small service firms, over half of the employees are using computer for their work.

Q.4: Hardware Configuration

Q.4.1: Microcomputers:

- [A]** The mean percentage of firms using IBM-PC or Compatibles are:
 S&M Manufacturing = 70%
 S&M Services = 67%
 Large Manufacturing = 79%
 Large Services = 69%

Comment: On average, about 70% of all firms are using IBM-PC/Compatibles. Slight more large firms are using them than SMEs.

- [B]** The mean number of IBM-PC or compatible (harddisk) are :
 S&M Manufacturing = 3.5 (3.4)
 S&M Services = 3.8 (3.4)
 Large Manufacturing = 5.2 (4.7)
 Large Services = 5.4 (4.4)

Comment: On average, the SMEs have only 1.6 IBM-PC/compatibles less than their large counterparts. Also, over 90% of these microcomputers have hard disk installed.

- [C]** The mean percentage of firms using non-IBM PC or Compatibles are:
 S&M Manufacturing = 52%
 S&M Services = 38%
 Large Manufacturing = 38%
 Large Services = 48%

Comment: On average, about 45% of all firms are using non-IBM PC/Compatibles. Slightly more SMEs are using them than large firms.

- [D]** The mean number of non-IBM PC or compatible (harddisk) are:
 S&M Manufacturing = 3.1 (2.8)
 S&M Services = 3.3 (3.2)
 Large Manufacturing = 5.0 (3.6)
 Large Services = 3.9 (3.8)

Comment: In average, the SMEs have only 1.3 non-IBM PC/compatibles less than their large counterparts. Also, over 90% of these microcomputers have hard disk installed.

- [E]** The mean percentage of networking installed are:
 S&M Manufacturing = 28.6%
 S&M Services = 36%
 Large Manufacturing = 22%
 Large Services = 27.8%

Comment: Networking is becoming popular in HK firms. However, SMEs use networking more than large firms, probably because they are, on average, computerised more recently and thus can use advanced technology more readily. Furthermore, services firms tend to use networking more than manufacturing ones.

- [F] The mean number of Chinese character card used are:
S&M Manufacturing = 26%
S&M Services = 30%
Large Manufacturing = 39%
Large Services = 28%

Comment: On average about 30% of all firms using microcomputers have installed Chinese character cards. Obviously, there are some who are just using Chinese character input software. Large manufacturing firms have more Chinese hardware, apparently because they need more Chinese for their workers, vendors and customers than other types of firms. Moreover, they can afford the expensive hardware more than the S&M counterpart.

Q.4.2: Minicomputers

- [A] The mean percentage of firms using Minicomputer systems are :
S&M Manufacturing = 70%
S&M Services = 67%
Large Manufacturing = 85%
Large Services = 84%

Comment: On average, about 85% of all large firms are using minicomputer systems. SMEs use somewhat less, particularly for the services firms. This agrees with the finding that they are using more networking of PCs instead.

- [B] The mean number of terminals are:
S&M Manufacturing = 6.5
S&M Services = 5.2
Large Manufacturing = 8.8
Large Services = 12

Comment: Although large firms use more terminals, the marginal increase is not significant compared with the increase in the population of their end-users.

- [C] The mean RAM capacity are:
S&M Manufacturing = 4.1 MByte
S&M Services = 4.9 MByte
Large Manufacturing = 3.9 MByte
Large Services = 4.4 MByte

Comment: On average, the SMEs have more RAM capacity than the large firms, mainly because they have undergone computerisation at a later stage and thus have benefitted from the advancement in hardware technology. By the same reasoning, the services firms have higher RAM capacity than the manufacturing firms.

- [D] The mean disk storage capacity are:
S&M Manufacturing = 100 MByte
S&M Services = 142 MByte
Large Manufacturing = 160 MByte
Large Services = 280 MByte

Comment: Large firms need more disk storage capacity than SMEs. However, the difference between large and S&M is much more significant in services than manufacturing because the customer and reporting databases are usually very big.

- [E] The mean percentage of firms using Chinese character system are:
S&M Manufacturing = 17%

S&M Services = 28%
Large Manufacturing = 29%
Large Services = 28%

Comment: The same reasoning for microcomputer Chinese character card applied here.

Q.5: Major Applications

Graph 3: This shows the comparison between S&M and large firms. For SMEs, the five most important applications in descending order are word processing, accounting, inventory control, sales control and finance. For large firms, the corresponding ones are accounting, word processing, inventory control, personnel data, and sales control. On average, the SMEs have about 10% less in terms of the number of applications.

Graph 4: This shows the comparison between S&M manufacturing and services firms in terms of major applications. The manufacturing firms have more applications in inventory control, finance and production/operations planning and control. Conversely, the services firms have more applications in Accounting, telex terminal, and database access to public informations.

Q.6: Major Software used

Q.6.1: Using high-level languages

Graph 5: This shows the comparison between S&M and large firms. For SMEs, the three most widely used languages in descending order of preference are: BASICO, COBOLO, and COBOLS. For large firms, the corresponding ones are: COBOLO, COBOLS, and BASICO. On average, SMEs use less COBOL and RPG than large firms.

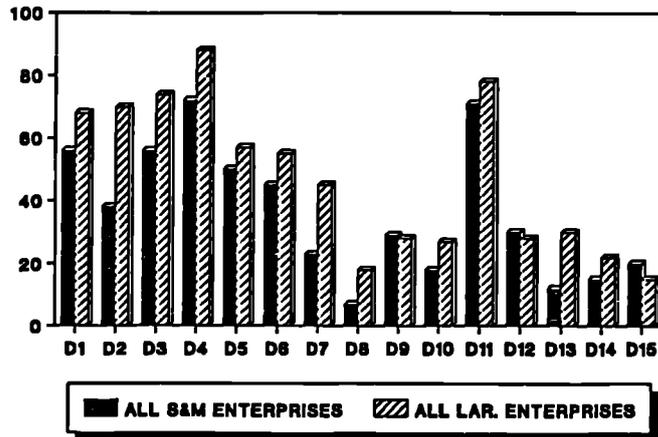
Graph 6: This shows the comparison between S&M manufacturing and services firms in terms of major languages used. The manufacturing firms use more BASICO, COBOLS, and BASICS and services firms. Conversely, the services firms use more PASCALO, RPGS, and COBOLO.

Q.6.2: Using development packages

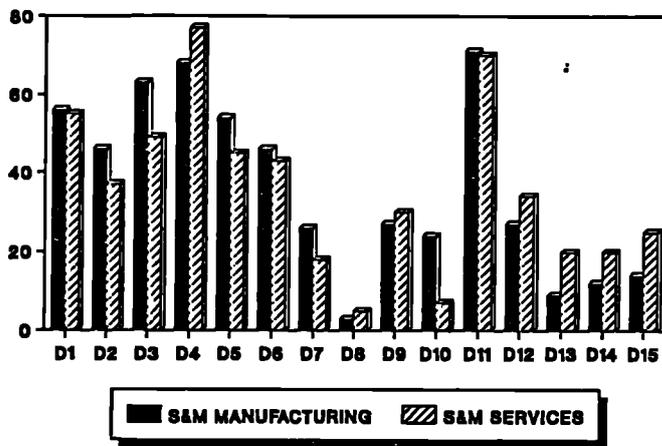
Graph 7: This shows the comparison between S&M and large firms. For both type of firms, they have the same preference in using packages, which in descending order are word processing, database, integrated, accounting systems, desktop manager, drawing, and inventory system.

Graph 8: This shows the comparison between S&M manufacturing and services firms in terms of major software packages used. The manufacturing firms use more integrated, drawing, and project planning. Conversely, the services firms use more database, accounting system, and 4-GL.

GRAPH 3: MAJOR APPLICATIONS I (0.5)

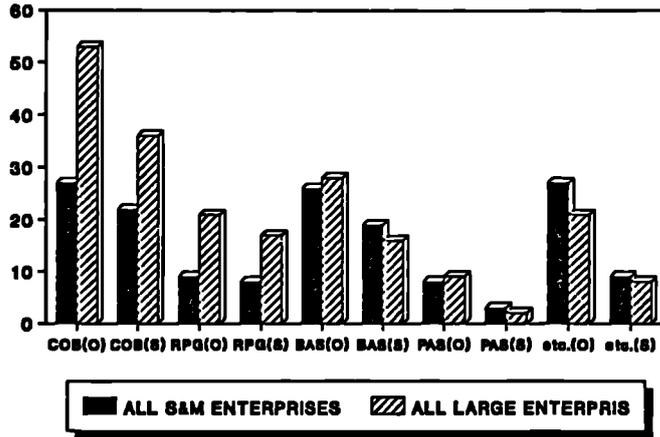


GRAPH 4: MAJOR APPLICATIONS II (0.5)

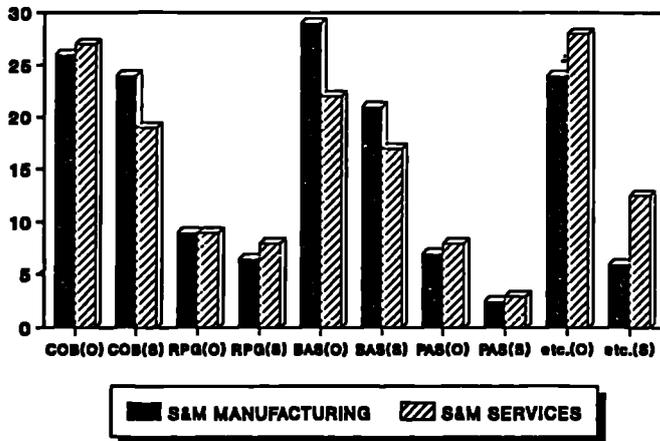


- KEY**
- D1: Sales Control (customer details, accounts receivable, etc)
 - D2: Personnel Data
 - D3: Inventory Control
 - D4: Accounting (general ledger, payroll, etc)
 - D5: Finance (budgetary control, financial analysis, etc)
 - D6: Purchasing (vendor detail, accounts payable, etc)
 - D7: Production/Operations Planning and Control
 - D8: Transport/Distribution
 - D9: Business Planning and Forecasting
 - D10: Computer Aided Design
 - D11: Word Processing
 - D12: Document Filing System
 - D13: Telex Terminal
 - D14: Database Access (VIEWDATA, DATAPAK, etc)
 - D15: Others

GRAPH 5: MAJOR LANGUAGE USED I (O.6.1)

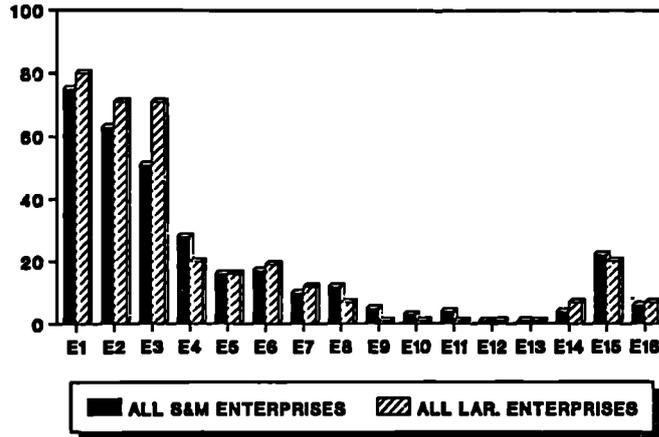


GRAPH 6: MAJOR LANGUAGE USED II (O.6.1)

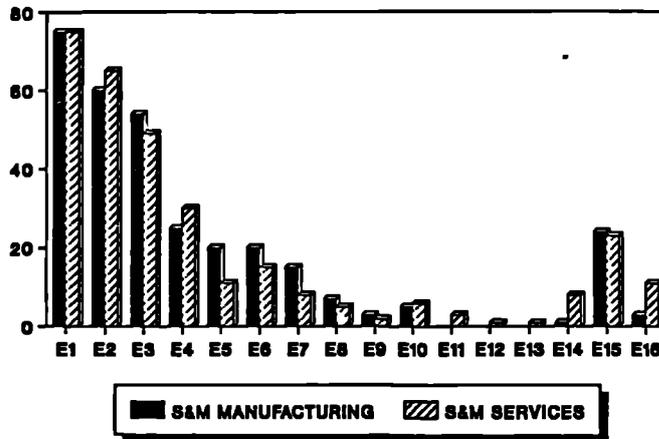


KEY O = OWN COBOL
 S = SOFT RPG BASIC
 PASCAL
 Others

GRAPH 7: MAJOR SOFTWARES USED I (O.6.2)



GRAPH 8: MAJOR SOFTWARE USED II (O.6.2)



- KEY:**
- E1: Word Processing (e.g. Wordstar/Multimate, etc)
 - E2: Database (e.g. Dbase/II/III+, etc)
 - E3: Integrated (e.g. Lotus 1-2-3/Framework, etc)
 - E4: Accounting System (e.g. PROMAS, BPI, INCOME, etc)
 - E5: Inventory System (e.g. INMASS, MRP, etc)
 - E6: Drawing (e.g. Autocad, etc)
 - E7: Project Planning (e.g. Milestone, HTPM, etc)
 - E8: Statistics (e.g. Abstat, SPSS, SAS, etc)
 - E9: Forecasting (e.g. PC-GIVE, ESP, LRP, etc)
 - E10: Financial Analysis (e.g. IFPS, etc)
 - E11: Decision Supporting I (e.g. Sales Edge, etc)
 - E12: Decision Supporting II (e.g. Don Jones, etc)
 - E13: Decision Supporting III (e.g. Operation Research, etc)
 - E14: Decision Supporting IV (e.g. 4-GL, AI, etc)
 - E15: Desktop Manager (e.g. Sidekick, Sideway, etc)
 - E16: Others

Q.6.3: Using Chinese character software

The mean percentages in using Chinese character input/output software are:

S&M Manufacturing = 26%

S&M Services = 26%

Large manufacturing = 36%

Large Services = 36%

Comment: The results indicate that SMEs tend to use less Chinese software than the large firms by some 10%. When comparing this question with Q.4.D, it is further found that when firms install Chinese hardware cards, they use Chinese software as well. However, about 8% of the large services firms have only installed a Chinese software system without the use of hardware card.

Q.7: Total Hardware Costs

The mean total costs of the above hardware are:

S&M Manufacturing = US\$54,000

S&M Services = US\$38,000

Large Manufacturing = US\$118,000

Large Services = US\$99,000

Comment: Although somewhat less than that of the large firms, investment on hardware by SMEs have been quite substantial when comparing with their turnovers. However, pictures are changing now as hardware costs are coming down rapidly.

Q.8: Total Software Costs

The mean total costs of the above software are:

S&M Manufacturing = US\$10,000

S&M Services = US\$9,000

Large Manufacturing = US\$22,000

Large Services = US\$37,000

Comment: For SMEs, software costs are about 20% of hardware. For large firms, it is about the same for manufacturing, but almost double for services. This is reasonable as the latter rely very much on the software development for their provision of services.

Q.9: Objectives and Achievement

Graph 9 & 10: These two graphs together show the comparison of objectives and achievement between S&M and large firms. The findings are tabulated as follows:-

		<u>SMEs</u>	<u>Large Firms</u>
<u>Objective:</u>	1st	F1	F1
	2nd	F4	F8
	3rd	F8	F2
	4th	F2	F6
	5th	F6	F3
<u>Achievement:</u>	1st	F1	F3
	2nd	F3	F1
	3rd	F4	F4
	4th	F5	F6
	5th	F14	F8

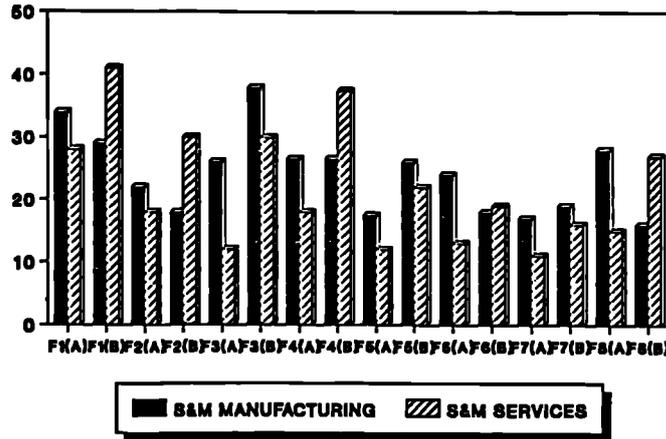
Comment: Generally speaking, both SMEs and large firms view F1 and F8 as important objectives. However when they come to achievement, it turns out to be F1, F3, and F4. Also, SMEs consider F4 and F5 more important than large firms.

Graph 11 & 12: These two graphs together show the comparison of objectives and achievement between S&M manufacturing and services firms. The findings are tabulated as follows:-

		<u>S&M Manufacturing</u>	<u>S&M Services</u>
<u>Objectives:</u>	1st	F1	F1
	2nd	F8	F4
	3rd	F3	F2
	4th	F4	F8
	5th	F6	F14
<u>Achievement:</u>	1st	F3	F1
	2nd	F1	F4
	3rd	F12	F2
	4th	F5	F3
	5th	F4	F12

Comment: Generally speaking, both S&M manufacturing and services firms view F1 and F8 as important objectives. When it comes to achievement both turn out to be F1, F3, and F4. Moreover, manufacturing firms consider F3 and F8 more important than services firms.

GRAPH 11 : OBJECTIVE & ACHIEVED (O.9)



GRAPH 12 : OBJECTIVE & ACHIEVED (O.9)



KEY

A = OBJECTIVE

B = ACHIEVED

- F1: Greater capability to meet future increase in business
- F2: Better control of source and use of funds
- F3: Better control of inventory
- F4: Better filing & reporting of marketing and operational informations
- F5: Reduce overtime requirement
- F6: Reduce cost of production/operations
- F7: More systematic flow of materials and goods
- F8: Improve human resources management efficiency
- F9: Standardising procedure from planning to implementation
- F10: Simplification of business forecasting
- F11: Saving of raw materials and fuel
- F12: Improve product/service quality
- F13: Security of information
- F14: Training of staffs in data processing
- F15: Others

Q.10: Cost-Benefit Comparison

The mean percentages of firms that think that computerisation is worthwhile are:

S&M Manufacturing = 97%

S&M Services = 91%

Large Manufacturing = 96%

Large Services = 94%

Comment: Most firms think that computerisation is a worthwhile investment.

3.2.2.2 OTHER FEEDBACK FROM THE QUESTIONNAIRE SURVEY

Other than the findings stipulated above, there are some interesting and useful feedback from the survey on the open-end questions. These are:-

D15: Other major applications

These include such applications as:-

- * Actuarial valuation, retirement scheme administration
- * Banking, securities trading, information service
- * Billing
- * Computer ticketing, library automation, licensing
- * Cost control
- * Credit card and fixed deposit
- * Customer trading account
- * Data communication
- * Data processing
- * Demonstration
- * Development
- * Distribution
- * Electronic banking and communication
- * Electronic mail
- * Engineering analysis
- * Engineering computation
- * Examination results processing
- * Front office operation
- * General calculation
- * General insurance
- * HEXAGON with Hong Kong Bank
- * Hotel information system
- * Hotel management system
- * Hotel system, membership

- Insurance administration
- Insurance and reinsurance applications
- Integrated database system on tax record
- Just-in-time system
- Marker making and plotting
- Marketing information system
- Members file, players registration, and match particulars
- Money market and foreign exchange dealing
- Newspaper production
- Office automation
- On-line banking, ATM, POS Bills
- On-line reservation
- Paging
- Patient services
- Produce timely management information
- Product data management, costing
- Project management
- Research analysis
- Reservation, seat control
- School administration
- Shares registration
- Software development
- Statistical analysis
- Structural analysis, E&M calculation
- Structural calculations, timesheet records
- Student reports
- System development
- Teaching, examination result processing
- Technical analysis
- Test program development
- Textile export licensing
- Training
- Transaction analysis on database
- Underwriting and claim administration systems
- Valuation system and property MIS
- VISA system

E16: Other development packages

- CAI, CAD/CAM
- Computer ticketing

- EECO
- FW, LION, DATACOM
- Graphic
- Hotel system
- MAPICS
- Pattern Grading and Marker Making
- PC Tools, Norton Utilities
- POWERHOUSE
- SAP, ETAB (Structural analysis software)
- STATUS, INTELLECT, HOGAN
- Utilities

F15: Other objectives and achievement

- Analysing research data
- Better accounting system
- Better filing and statistical compilations
- Easy and accurate access to information
- Education
- Investment analysis
- More business
- Research
- Software development
- Student record
- Training

Comment: Some of the above feedback are similar to the choices in the same question, as the respondents may not bother to select a choice which fits into his particular idea. However they do provide an unbiased view of the various useful applications and considerations.

3.2.3 QUESTIONNAIRE SURVEY IN UK

In early 1989, a similar questionnaire survey was conducted in UK. The objective was to see whether there was significant difference in MIS/DSS applications for SMEs as comparing with HK. The mailing addresses were extracted from the "Britain's Privately Owned Companies, Vol.2: The Second 2000". This directory was selected because it represented a good cross-section of the firms actively in business. However, the firm sizes fell within the definition of SMEs adopted in this research (this also explains why the "Vol.1" was not used). 98 (18%) valid replies were obtained from 550 letters sent out in Dec 1988. Some minor changes have been made on the questionnaire to make it more suitable to the UK scene (APP.2.2).

3.2.3.1 COMPARISON OF RESULTS OF SURVEY SAMPLED IN HK & UK

In analysing effective applications of microcomputer-based MISs & DSS for SMEs, it is often more informative to look into how firms operate in more than one country. The advantage is that environment and applications can be compared, thus highlighting the merits of one country's practice over the other. This will give light to further applications for both UK and HK firms.

As a result of the survey, the data set for HK and UK are:-

	<u>HK</u>	<u>UK</u>
S&M Manufacturing (= < 300 employees)	61	53
S&M Service (= < 150 employees)	<u>155</u>	<u>33</u>
	<u>216</u>	<u>86</u>

Although the survey sample size in HK is much greater than that in UK, the intention in the HK survey has included the comparison of SMEs with large enterprises. In UK, this is not intended and thus the above publication has been used to obtain the samples. By looking at the above table, it is apparent that the sample sizes are comparable for Manufacturing sector, but not Service sector. On the other hand, since the S&M Service sample size is greater than 30, this would allow the Z-statistic to be valid. Therefore, the above data set is sufficient for the comparison.

3.2.3.2 COMPARISON BETWEEN S&M MANUFACTURING

In comparison of survey results between firms in HK and UK, test procedures based on the "Z" value are used. For a two tailed test, the conclusion is drawn when comparing the "Z" value for 95% confidence level, i.e. 1.96. Thus, if the "Z" value is very much larger than 1.96, it shows that the difference is very significant, and vice versa. The following observations of difference are obtained based on the results in APP. 3.1:-

3.2.3.2.1 Firms surveyed in UK have longer history than those in HK (Z = 3.31).

3.2.3.2.2 UK firms tend to use more hard disk storage device for IBM-PC compatible microcomputers (Z = 2.84). On the other hand, HK firms have more access to minicomputer terminals (Z = 2.42).

3.2.3.2.3 UK firms use computer more on such applications as sales control (Z = 4.16), accounting (Z = 3.90), finance (Z = 2.44), purchasing (Z = 4.58), and production planning (Z = 2.33) than HK firms.

3.2.3.2.4 HK firms tend to use COBOL to develop own application programmes more than UK firms (Z = 3.32).

3.2.3.2.5 UK firms use more software package as accounting systems ($Z = 3.57$) but less desktop manager ($Z = 2.75$) than HK firms.

3.2.3.2.6 UK firms achieve greater capability for future ($Z = 4.05$) and closer cash flow control ($Z = 3.53$) than HK firms.

The following general features are observed as well:-

3.2.3.2.7 The type of business are statistically the same for both places.

3.2.3.2.8 In terms of year starting computerise and the programmer/user involvement, there is little difference.

3.2.3.2.9 Most HK & UK firms are using PCs, although some have minicomputers as well. It is understandable that those firms with mini are most likely to have micro as well.

3.2.3.3 COMPARISON BETWEEN S&M SERVICES

Likewise, the following observations of difference are obtained based on the results in APP. 3.2:-

3.2.3.3.1 Firms surveyed in UK have longer history than those in HK ($Z = 4.23$).

3.2.3.3.2 The type of business are statistically different ($Z = 3.25$).

3.2.3.3.3 UK firms tend to use more hard disk storage device for minicomputers ($Z = 4.27$).

3.2.3.3.4 UK firms use computer more on such applications as sales control ($Z = 2.58$), accounting ($Z = 2.50$), finance ($Z = 4.19$), document filing ($Z = 2.86$), and telex terminal ($Z = 2.22$).

3.2.3.3.5 HK firms tend to use COBOL to develop own application programmes than UK firms ($Z = 3.04$).

3.2.3.3.6 HK firms use more software package as database systems ($Z = 2.12$) and desktop manager ($Z = 2.45$) than UK firms.

3.2.3.3.7 UK firms spend more on hardware ($Z = 2.75$) and software ($Z = 2.30$) than HK firms.

3.2.3.3.8 HK firms achieve greater reduction in overtime than UK firms ($Z = 2.59$).

The following general features are observed as well:-

3.2.3.3.9 In terms of year starting computerise and the programmer/user involvement, there is little difference.

3.2.3.3.10 Most UK & HK firms are using PCs, although some have minicomputers as well. It is understandable that those firms with mini are most likely to have micro as well.

3.2.3.4 COMMENT ON DIFFERENCES

Using the Normal Approximation to Binomial Distribution, and at 95% confidence level, the interval attributable to "chance" for the Manufacturing Sector is between 1.20 and 4.50 (See APP. 3.1). Since this is much less than the "DIFFERENT" conclusions which are valid (13), it implied that there is a difference in response between UK & HK firms.

Likewise, in the Services Sector, the interval is between 0.99 and 4.11 (See APP. 3.2). Again, compared with the number of "DIFFERENT" conclusions (15), it implied that there is a difference in response between UK & HK firms.

One major reason for such difference can be explained by the way the questionnaires are set. For question sets Q.5, Q.6 & Q.9, the firms are not asked to choose a fixed number of answers. UK firms have a tendency to choose more answers than HK firms. Also, most of the "DIFFERENT" responses are on the less frequently answered parts of these question sets. As the frequencies are very low, significant differences are expected.

3.2.3.5 EXPERIENCE FOR SMEs

Although the above analysis highlights the difference in approach in computerisation, there are other information that can be derived from looking at the practice of UK firms. This is now summarised in the following table. (The numbers represent the priority.)

	<u>S&M Manufacturing</u>		<u>S&M Services</u>	
	HK	UK	HK	UK
Major Applications: (Top 4 out of 14)				
Accounting	2	1	1	3
Sales control	4	2	3	1
Purchasing	-	3	-	2
Word processing	1	4	2	4
Inventory Control	3	-	4	-
Language used: (Top 3 out of 8)				
BASICS	-	1	-	2
BASICO	1	2	3	3
COBOLS	2	3	2	1
COBOLO	3	-	1	-
Use of Packages: (Top 4 out of 14)				

Word processing	1	1	1	1
Integrated	3	2	2	2
Accounting	4	3	3	4
Databases	2	4	4	3
Achievement: (Top 4 out of 14)				
Greater capability	2	1	1	1
Control cash flow	-	2	-	2
Control inventory	1	3	4	3
Information retrieval	4	4	2	-
Improve quality	2	-	3	-
Effective use of HRM	-	-	-	4

One remark is that there is little difference between manufacturing and services firms in the uses and achievement of the above points both in UK and HK, notwithstanding there is a slight difference in priority.

3.3 KNOWLEDGE CONTRIBUTIONS FROM QUESTIONNAIRE SURVEY

Using the results of the questionnaire survey, it is possible to establish a set of valid approaches towards effective implementation of MIS. The approach is to use statistical analysis to find out the practice and tendency of more successful users. This knowledge is then structured so that it can form decision rules for the development of ES-MIS.

3.3.1 PRINCIPLES OF MIS KNOWLEDGE BASE DEVELOPMENT

Based on the above analysis, firms wishing to use information effectively can learn from the experience of other firms (Q.1, Q.2 & Q.10) by looking into the priority of application (Q.5), and achievement (Q.9). This is an important step before any implementation. Efforts should be concentrated on the areas with high priorities so that effectiveness can be achieved.

Efficiency is then maximised by using the appropriate languages and software packages (Q.6 & Q.8). This is particularly relevant for new users and systems as there are so many software packages available in the market, and their functionalities are improving all the time.

Finally, guidelines can be obtained for the investment requirement in MIS personnel (Q.3), and hardware configurations (Q.4 & Q.7). Further, one has to recognise that both items depend on the stage of development. Also the costs of most hardware are decreasing all the time.

3.3.2 MIS MODEL BASED ON QUESTIONNAIRE SURVEY

In developing the MIS Model for the ES-MIS, it is important first to look at the ways the questions can be effectively structured. The original sets of questionnaires used in the HK and UK survey would form the basis for the Model. This is because the results of the questionnaire survey have indicated the focuses of SMEs in their MIS requirement. Moreover, the results are adopted to provide a more suitable model.

One major improvement is that question sets Q.5, Q.6 & Q.9 need to be restructured in the ES-MIS. The argument here is that, although each question set is designed to be as comprehensive as possible, the results show that most SMEs are interested in a subset of these answers. Therefore, the questions in the ES-MIS should be narrowed down to the choice of a number of answers equal to the average number (N) found in the survey. Then these choices are matched against the first set of answers up to the number N. The score is then assigned accordingly.

Another refinement is that some less relevant questions are dropped from the consultation. This helps to make the questions more concise and relevant for the users.

Questions dropped from the ES-MIS are:-

- Q.1.2
- Q.2
- Q.4.2
- Q.4.4
- Q.4.6
- Q.4.7
- (Q.4.1 combine with Q.4.3)
- Other Choices: D15, D16, F15

Taking the above improvement into account in developing the Model, the revised Table of Comparison between HK and UK firms for the Manufacturing and Services Industries are shown in APP.3.3 & APP.3.4 respectively.

From APP.3.3, the conclusion for S&M Manufacturing between HK & UK firms is that "There is no significant difference in response between them". Similar conclusion is drawn from APP.3.4 for S&M Services Industries. Therefore, the data can be combined together thus giving a larger database for statistical comparison and analysis. Further, the same ES-MIS can be used by both HK and UK firms.

3.3.3 SUMMARY OF DECISION RULES FOR THE ES-MIS

FIG.3.1 is a summary of the decision rules used in the ES-MIS. The "knowledge" will be developed using an ES shell in Chapter 5.

QUESTION	DESCRIPTION	MANUFACTURING	SERVICES
1.1	Number of Employees (N)	300	150
3.1	Mean No. of years' experience	10	8
3.2	Mean no. of Programmer/SA (/N)	.015	.04
3.3	Mean no. of End-users (/N)	.06	.10
4.1	Mean no. of PCs (/N)	.08	.12
4.2	Use of LAN	29%	36%
5.	Major applications	D1 D3 D4 D5 D6 D11	D1 D3 D4 D5 D6 D11
6.1	Major languages used for development of applications	BASICO BASICS	COBOL COBOLS
6.2	Major packages used for development of applications	E1 E2 E3 E4	E1 E2 E3 E4
7.	Av. cost of hardware (/N)	£500	£650
8.	Av. cost of software (/N)	£170	£270
9.	Achievements	F1 F2 F3 F4	F1 F3 F4 F12
10.	Computerisation is worthwhile	97%	91%

FIG.3.1: SUMMARY OF DECISION RULES FOR ES-MIS

3.3.4 STATISTICAL ANALYSIS

At this point, it is necessary to do a proper statistical analysis of the questionnaire to determine a reasonable knowledge base for ES-MIS. Factor Analysis, Cluster Analysis, Discriminant Analysis and Correspondence Analysis are selected for consideration because they are among the most useful approaches for establishing the nature of relationships among sets of interrelated variables [SPSS, 1989].

FACTOR ANALYSIS is a statistical technique that attempts to represent relationships among sets of interrelated variables by a smaller set of independent and interpretable, but not directly observable, factors. For example a factor analysis of scores on a battery of aptitude tests may result in describing aptitude in terms of factors such as verbal skills, mathematical aptitude, and perceptual speed. These factors would be linear combinations of the original battery variables. Likewise factor analysis of a consumer attitude survey could result in consumer preference being expressed as a function of product quality, value for money, and status. Thus factor analysis helps identify key underlying, not directly observable (i.e. latent), constructs.

CLUSTER ANALYSIS is a statistical technique that attempts to identify similar groups of objects or cases based on a variety of attributes. In biology, cluster analysis is used to classify animals and plants. This is called numerical taxonomy. In medicine, cluster analysis is used to identify diseases and their stages. For example, by examining patients who are diagnosed as "depressed" one finds that there are several distinct subgroups of patients, corresponding to different types of depression. In marketing, cluster analysis is used to identify persons with similar buying habits. By examining their characteristics one may be able to target future marketing strategies more efficiently [Everitt, 1980].

Although both cluster analysis and discriminant analysis deal with the classification of objects or cases into categories, **DISCRIMINANT ANALYSIS** requires the knowledge of group membership for the cases used to derive the classification rule. For example, if one is interested in distinguishing among several disease groups, cases with known diagnoses must be available. Then, based on the cases whose group membership is known, discriminant analysis derives a rule for allocating undiagnosed patients. In cluster analysis, group membership for all cases is unknown. In fact, even the number of groups is often unknown. The goal of cluster analysis is to identify homogeneous groups of clusters.

CORRESPONDENCE ANALYSIS [Greenacre, 1984] starts off with the correspondence table which is any two-way table whose cells contain some

measurement of correspondence between the rows and the columns. The measure of correspondence can be any indication of the similarity, affinity, confusion, association, or interaction between the row and column variables. The most common type of correspondence table is a crosstabulation table, where the cells contain frequency counts. It enables the examination of the relationship between two nominal variables graphically in a multidimensional space. It computes row and column scores and produces plots based on the scores. Categories that are similar to each other appear close to each other in the plots. In this way, it is easy to see which categories of a variable are similar to each other or which categories of the two variables are related.

In this study the Factor, Cluster and Correspondence Analysis procedures are applied in an attempt to arrive at:

- (a) meaningful grouping of applications, of software and of achievements; and
- (b) to establish how the grouping in (a) relate to the industries included in the study.

Discriminant analysis was not used because the pool of potential discriminant variables was of the nominal type.

For the factor and cluster analysis, the binary nature of the data was taken into consideration by use of an appropriate similarity measure. The similarity measure used in this study was the Jaccard measure [SPSSX, 1988]. This measure was used in preference to the Pearson correlation coefficient which is the more appropriate association measure when data are ratio or interval scaled [CHURCHILL, 1983].

3.3.4.1 FACTOR ANALYSIS

The HK and UK aggregated manufacturing (114 cases) and services sector (188 cases) are used for the analysis. The process involves two steps. Firstly, the proximity matrix of the set of variables is computed. (This is achieved by using the PROXIMITIES procedure of the SPSSX package.) The proximities matrix is then factored by means of the Principal Components method within SPSSX. The output from these routines is given in App.3.5. The procedure is repeated for the three major sets of common variables (Question 5, 6.2 & 9) and for both manufacturing and services sectors. The results are summarised in FIG.3.2 and matched against the corresponding parts of FIG.3.1. It is observed that the factor analysis suggests that the original groups of factor based on priority ranking are, to a large extent, homogeneous groups and therefore can be used effectively for the decision rules of ES-MIS.

<u>QUESTION</u>	<u>DESCRIPTION</u>	<u>MANUFACTURING</u>		<u>SERVICES</u>	
		<u>Priority</u>	<u>F.A. *</u>	<u>Priority</u>	<u>F.A.</u>
5.	Major applications	D1	D1	D1	D1
		D3	D3	D3	D3
		D4	D4	D4	D4
		D5	D5	D5	D5
		D6	D6	D6	D6
		D11	D11	D11	D11
6.2	Major packages used for development of applications	E1	E1	E1	E1
		E2	E2	E2	E2
		E3	E3	E3	E3
		E4	X	E4	X
9.	Achievements	F1	F1	F1	F1
		F2	F2	F3	F3
		F3	F3	F4	F4
		F4	F4	F12	F12

* Factor Analysis grouping based on Rotated Factor Matrix.

Most of the rules are found to be within the same group of factor, with the exception of E4 in both the manufacturing and services sectors.

FIG.3.2: MAJOR ES-MIS RULES TESTED BY FACTOR ANALYSIS

The results of FIG.3.2 will be used in Chapter 5 for the ES-MIS.

3.3.4.2 CLUSTER ANALYSIS

As in other statistical procedures, a number of decisions must be made before one embarks on the actual analysis. Which variables will serve as the basis for cluster formation? Is distance or similarity between cases to be measured? How will the distance or similarity between cases be measured? What criteria will be used for combining the cases into clusters? For the present research, since the focus is on the three sets of questions, namely, applications, software and achievement, it is natural to have them as the basis for cluster formation. When working with qualitative data, it is customary to work with similarities rather than distance measures. In this study similarity is measured by the Jaccard matching coefficient. Regarding criteria for combining cases, one of the simplest methods for joining cases is that of single linkage, sometimes called "nearest neighbour".

The cluster analysis statistics are generated in App.3.6 for the manufacturing and services industries separately. The aggregate data for HK and UK are used. The cluster memberships are summarised as follows:-

QUESTION	DESCRIPTION	MANUFACTURING		SERVICES	
		Priority	C.A. *	Priority	C.A.
5.	Major applications	D1	D1	D1	D1
		D3	D3	D3	D3
		D4	D4	D4	D4
		D5	D5	D5	D5
		D6	D6	D6	D6
		D11	D11	D11	D11
6.2	Major packages used for development of applications	E1	E1	E1	E1
		E2	E2	E2	E2
		E3	E3	E3	E3
		E4	X	E4	X
9.	Achievements	F1	F1	F1	F1
		F2	F2	F3	F3
		F3	F3	F4	F4
		F4	F4	F12	X

* Cluster Membership of Cases using Complete Linkage.

Most of the rules are found to be within the same group of cluster, with a few minor difference as follows:-

1. In the manufacturing sector, E4 does not belong to the same cluster group.
2. In the services sector, F4 & F12 do not belong to the same cluster group.

FIG.3.3: MAJOR ES-MIS RULES TESTED BY CLUSTER ANALYSIS

The results of FIG.3.3 is almost the same as that of FIG.3.2. Thus, there is an agreement between Factor Analysis and Cluster Analysis. The common results will be used in Chapter 5 for the ES-MIS.

3.3.4.3 CORRESPONDENCE ANALYSIS

The correspondence analysis statistics are shown in App.3.7 for the manufacturing and services industries combined. The aggregate data for HK and UK are used. A study of the correspondence analysis computer outputs, both statistical and graphical, suggests five distinct industry-application groupings. These are summarised as follows:-

3.3.4.3.1 Correspondence Analysis - All SMEs "D" (See FIG.3.4 for graphical description)

INDUSTRY < = = = = > APPLICATION "D"

(Many to many relationship)

Group I:

M1: Garment or Textile	D1: Sales Control
M3: Plastic or Metal	D2: Personal Data
M5: Other Manufacturing	D3: Inventory Control
S1: Trading or Wholesale	D4: Accounting
S2: Retail, Restaurant or Hotel	D5: Finance
S3: Finance or Insurance	D6: Purchasing
S8: Training Institute	D9: Business Planning
	D11: Word Processing
	D12: Document Filing System

This is the biggest group of affiliation and are very closely packed together. Amongst them are the Manufacturing Group M1, M3, M5 and Services Group S1, S2, S3. The major applications include those found in Factor and Cluster Analysis (i.e. D1, D3, D4, D5, D6, D11) plus D2, D9 & D12.

Group II:

S6: Transport or Distribution	D8: Transport/Distribution
-------------------------------	----------------------------

It is evident that the Transport and Distribution Industry (S6) is akin to the Transport/Distribution Applications (D8).

Group III:

M2: Electrical or Electronic	D7: Production Plan and Control
------------------------------	---------------------------------

The Electrical and Electronic Industry uses more Production/Operation Planning and Control than other industries.

Group IV:

M4: Building or Construction	D10: Computer Aided Design
------------------------------	----------------------------

The Building and Construction Industry uses more Computer Aided Design than other industries.

Group V:

S4: Real Estate or Business Services	D15: Other Applications
S5: Community, Social or Personal Services	

The Real Estate & Business Services and Community, Social & Personal Services Sectors use more of other special application software than average.

Group VI:

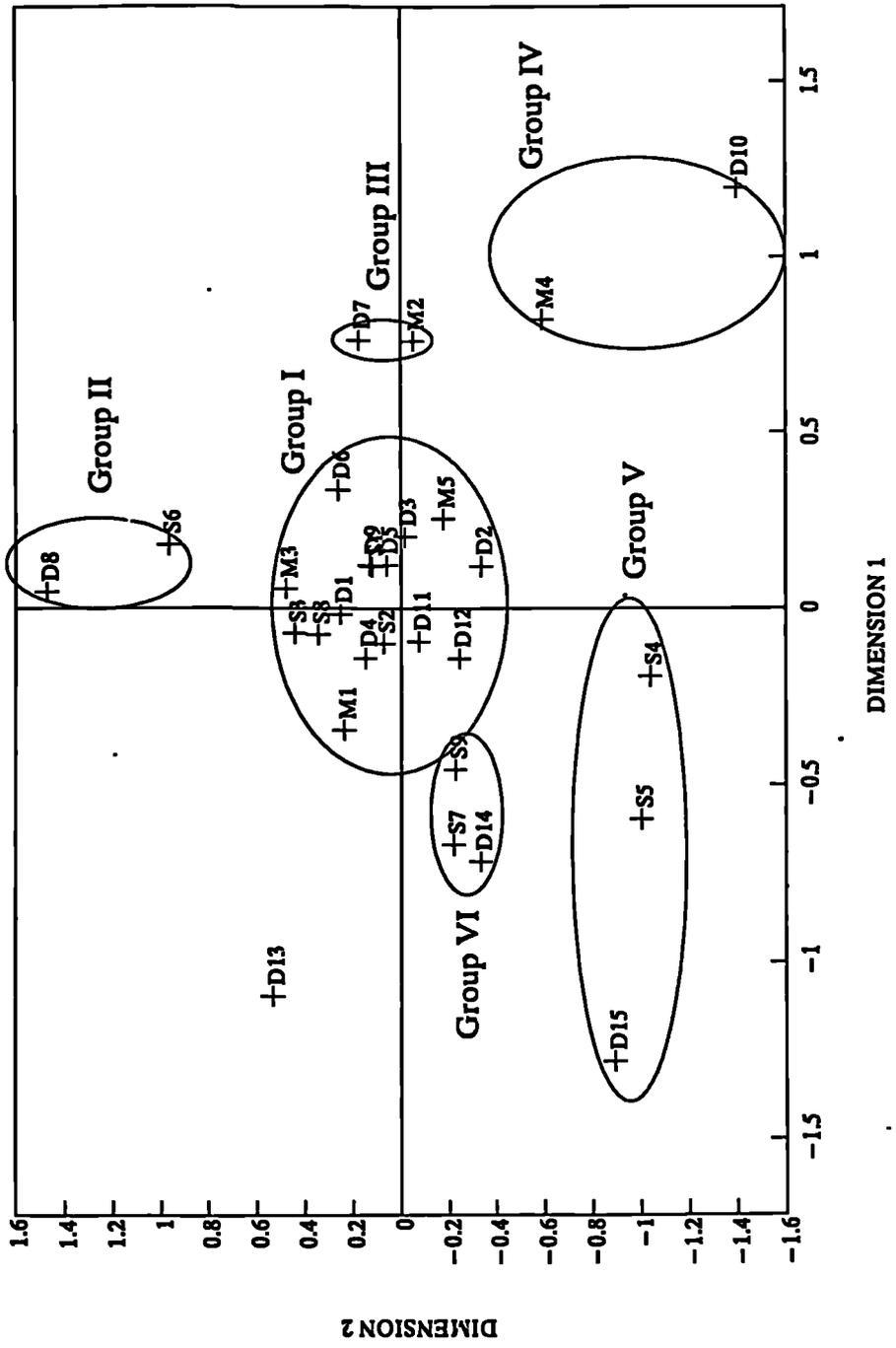
S7: Other Services	D14: External On-line Database
S9: Software Houses	

The Other Services and Software Houses use more of On-line Database facilities than average.

Single Child:

D13: Telex/Fax Terminal

FIG.3.4: CORRESPONDENCE ANALYSIS - ALL SME APPLICATIONS "D"



ax communication does not akin to any specific industry. One may argue that every industry requires such facility.

Regarding the axes, the "DIMENSION 1" seems to differentiate between Manufacturing (towards right) and Services (towards left). "DIMENSION 2" favours tactical use of information system (towards top) and strategic use of information system (towards bottom).

3.3.4.3.2 Correspondence Analysis - All SMEs "E" (See FIG.3.5 for graphical description)

Since the frequency for Questions E11-E14 (Decision Support Softwares Type I to IV) are very low, it is necessary to combine them otherwise they will distort the results of the map. In the analysis, the combined Questions (E11-E14) are represented by E11.

INDUSTRY < < = = = = = > > PACKAGES "E"

(Many to many relationship)

Group I:

M3: Plastic or Metal	E1: Word Processing
M5: Other Manufacturing	E2: Database
S1: Trading or Wholesale	E3: Integrated
S3: Finance or Insurance	E4: Accounting System
S4: Real Estate or Business Services	E10: Financial Analysis
S6: Transport or Distribution	E15: Desktop Manager
S7: Other Services	
S8: Training Institute	

This is the biggest group of affiliation and are very closely packed together. Amongst them are the Manufacturing Group M3, M5 and Services Group S1, S3, S4, S6, S7, S8. The major softwares include those found in Factor and Cluster Analysis (i.e. E1, E2, E3, E4) plus E10 & E15.

Group II:

M1: Garment or Textile	E5: Inventory System
M2: Electrical or Electronic	E8: Statistics
	E9: Forecasting

It is evident that the Garment & Textile and Electrical & Electronic (M1 & M2) is akin to the use of Inventory Control, statistics, and Forecasting softwares (E5, E8 & E9) respectively.

Group III:

M4: Building or Construction	E6: Drawing
------------------------------	-------------

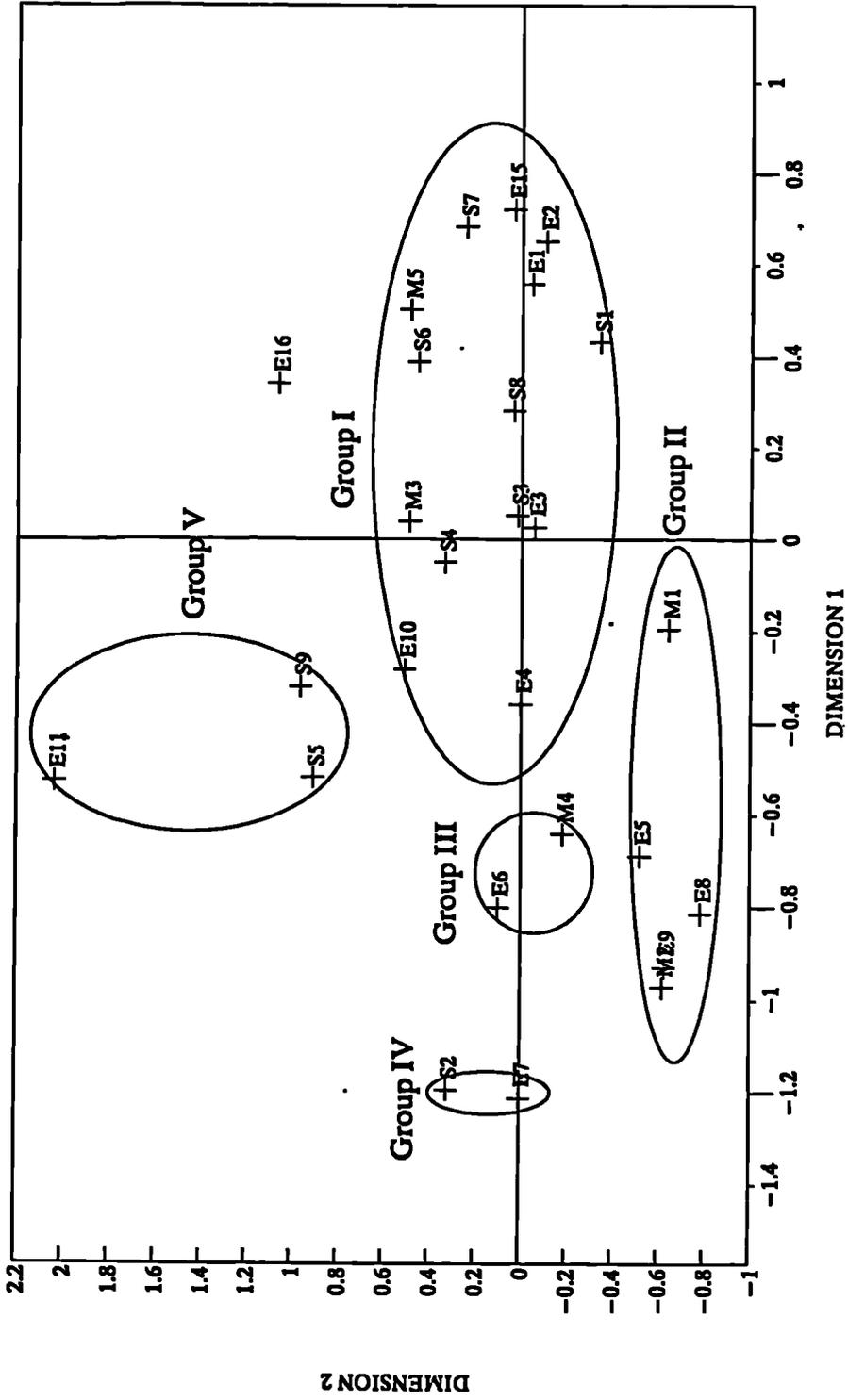
The Electrical and Electronic Industry uses more Computer Aided Design software than other industries.

Group IV:

S2: Retail, Restaurant or Hotel	E7: Project Planning
---------------------------------	----------------------

The Retail, Restaurant and Hotel Industry tends to use more Project Planning software than other industries.

FIG.3.5: CORRESPONDENCE ANALYSIS – ALL SME SOFTWARE PACKAGES "E"



Group V:

S5: Community, Social or Personal Serv. E11: Decision Supporting
S9: Software House

The Community, Social & Personal Services and Software Houses use more Decision Support Tools than other industries.

Single Child:

E16: Other Software Packages

Since the software can be any other type, it does not akin to any specific industry.

Regarding the axes, the "DIMENSION 1" does not seem to differentiate between Manufacturing and Services. "DIMENSION 2" favours strategic use of information system (towards top) and operational use of information system (towards bottom). One interesting observation is that the high frequency choices (E1, E2, E3 & E4) are all very near to the horizontal axis and except for E4 to the right of the centroid.

3.3.4.3.3 Correspondence Analysis - All SMEs "F" (See FIG.3.6 for graphical description)

Since the frequency for Questions F15 (Other Achievements) is very low (average = 3), it is necessary to neglect it otherwise it will distort the results of the map.

INDUSTRY < < = = = = = > > ACHIEVEMENT "F"

(Many to many relationship)

Group I:

M3: Plastic or Metal

M4: Building or Construction

S1: Trading or Wholesale

S3: Finance or Insurance

S7: Other Services

F1: Greater capability to expand

F2: Better control of funds

F3: Better control of inventory

F4: Better retrieval of information

F5: Reduce overtime requirement

F6: Reduce cost of production

F10: Simplification of forecasting

F13: Security of information

F14: Training of staffs in DP

This is the biggest group of affiliation and are very closely packed together. Amongst them are the Manufacturing Group M3, M4 and Services Group S1, S3, S7. The major softwares include those found in Factor and Cluster Analysis (i.e. F1, F2, F3, F4) plus F5, F6, F10, F13 & F14.

Group II:

S2: Retail, Restaurant or Hotel

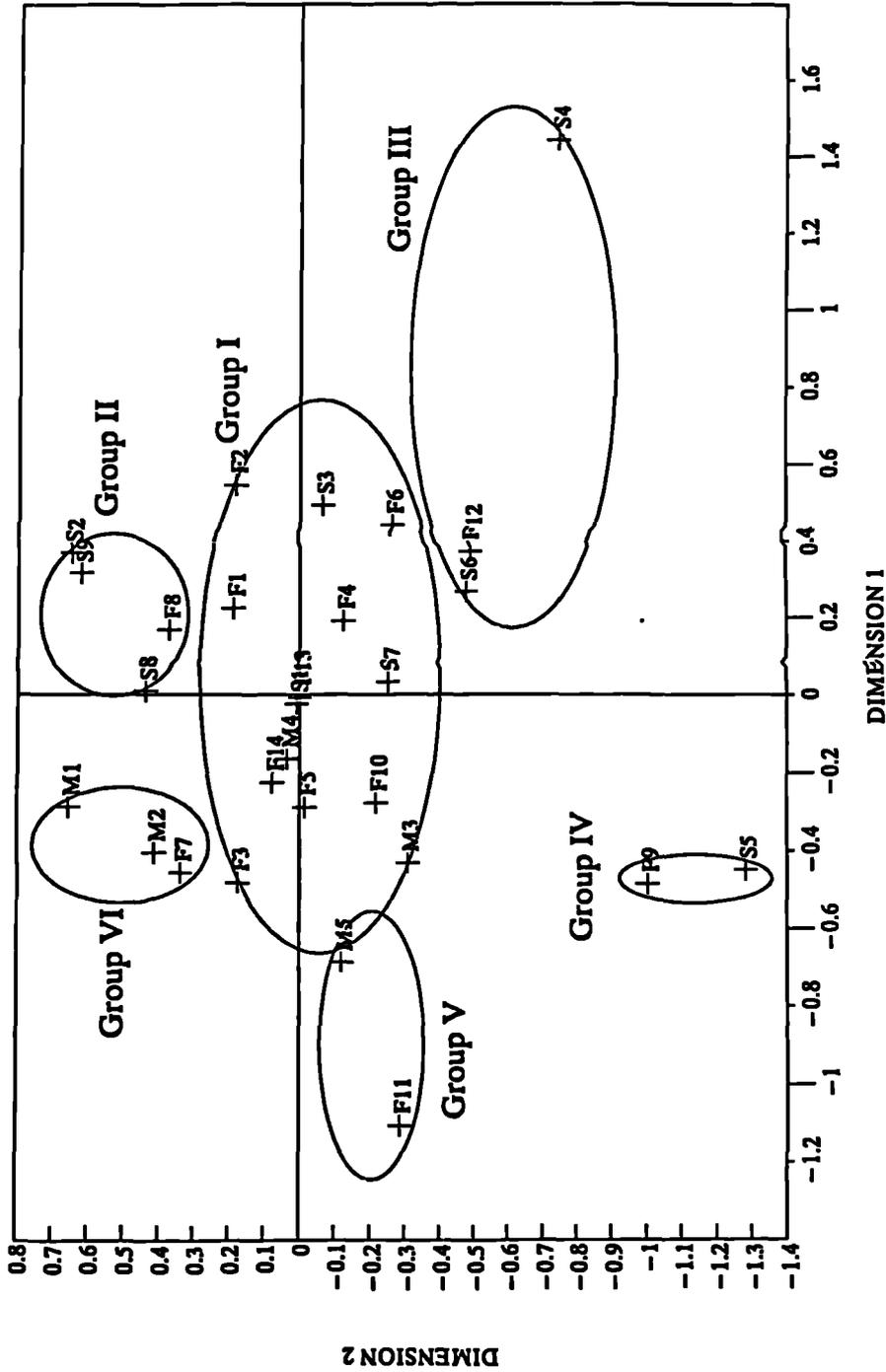
S8: Training Institute

S9: Software House

F8: Improve personnel management

It is evident that the Retail, Restaurant & Hotel, Training Institute, and Software House Sectors (S2, S8 & S9) are akin to the improvement of Human Resources Management Efficiency (F8).

FIG.3.6: CORRESPONDENCE ANALYSIS -- ALL SME ACHIEVEMENTS "F"



Group III:

S4: Real Estate or Business Services F12: Improve quality
S6: Transport or Distribution

The Real Estate & Business Services, and Transport & Distribution Sectors seek Improve Product/Service Quality as more important than other sectors.

Group IV:

S5: Community, Social or Personal Serv. F9: Standardising procedures

The Community, Social & Personal Services Sector tends to Standardise Procedures from Planning to Implementation more than other industries.

Group V:

M5: Other Manufacturing F11: Saving of raw materials

The Other Manufacturing considers to more important to Save Materials and Fuel as their objectives in using information systems.

Group VI:

M1: Garment or Textile F7: Systematic flow of materials
M2: Electrical or Electronic

The Garment & Textile and Electrical & Electronic Industries consider it more important to have Systematic Flow of Materials and Goods as their objectives in using information systems.

Regarding the axes, the "DIMENSION 1" seems to differentiate between Manufacturing (towards right) and Services (towards left). "DIMENSION 2" favours operational use of information system (towards top) and strategic use of information system (towards bottom). One interesting observation is that the high frequency choices (F1, F2, F3 & F4) are all very near to the horizontal axis and skewed towards the top.

The results of this Correspondence Analysis and the foregone analysis will be used in Chapter 5 for the ES-MIS wherever applicable.

3.4 FIELD SURVEY IN 6 COUNTRIES

The field survey was conducted in line with the thought under "METHODOLOGY" (Section 2.2). Based on Wood-Harper [1985] and Flensburg [1985], case studies have been conducted in order to have deeper understanding of the choice rationale and applicability of MISs. Further Galliers [1985] also supports the view that case studies are useful as a mechanism to update the knowledge of the appropriate uses to which IT can be used by organisations. It has also been established in S.2.2.2 that Action Research and Case Studies are proven methods to understand how MISs can be used effectively in organisations.

The venues selected for the study were Singapore, HK, Taiwan, South Korea, Japan, and UK. This sequence fell roughly into the chronological order of the surveys being done. The SMEs visited in these countries contribute to case studies, and their experience can be shared by SMEs of similar operation. Further, this approach provides some understanding on any cultural / environmental differences for effective applications of IT by firms from different countries.

In the four Asian countries visited (Singapore, Taiwan, South Korea and Japan), the APO has organised visits to relevant organisations as far as possible through their regional offices. Usually, either the chief executives or the chief information officers of the organisations are interviewed. The interview last for about 2 hours, including site visit if necessary. Firstly the questionnaire is completed by the interviewee. Then a list of standard questions based on key words like "what", "why", "how", "when", "who", and "whom" were used. These questions led to specific answers about the effective use of the IS. The dialogue was recorded on tape to facilitate subsequent analysis.

At this point, only the background information on each of the five countries visited is discussed. The field survey of SMEs Computerisation and Software Houses in these countries are detailed in APP. 4 & APP. 5 respectively.

3.4.1 SINGAPORE

The Singapore Government has entered wholeheartedly into the Information Age by publicly declaring the computer services industry as a key pillar of growth. No less public is the declaration of support by committing the Government's Ministries and various agencies as the impetus to computerise Singapore. Their intention is to ultimately gain the expertise to take advantage of this exciting new technology.

IT is recognised as being of great importance to Singapore as international competitiveness is a matter of survival. Companies in both manufacturing and services need to exploit fully the advances in IT. The service sector is primarily knowledge-based. The average investment per service worker in Singapore is small. Use of IT will result in improved service levels and higher productivity. In the manufacturing sector, Singapore is no longer competing with countries with low labour cost. Increasingly, it will be competing with advanced countries that are using IT and other advanced technologies, enabling them to be low unit-cost manufacturers, despite their high wage levels. Singapore manufacturers similarly exploited IT to reduce the labour content of their manufactured goods to remain competitive.

While the major impact of IT will be to raise efficiency and productivity, IT should itself be a growth industry. New IT products, such as optical disc drives and customised chips, are constantly being developed. These are high value-added products which Singapore can manufacture, especially early in the product life cycle, when prices are high, and volumes are low. Manufacturers look for production bases which offer quick start-ups, a work-force that can be trained up quickly, and good infrastructure for the use of sophisticated technologies.

Advances in IT have also generated a tremendous demand for application and system software and associated services, e.g. consultancy, turnkey systems, and training. In addition, developments in communications are bringing about new telecommunications services such as VAN. Singaporeans has been exploiting these opportunities.

3.4.2 HONG KONG

HK has enjoyed fast economic growth during the past decade. Economic policy in HK is to a large extent dictated, and constrained, by the special circumstances of its economy. Owing to its small and open nature, the economy is vulnerable to external factors. Government action to offset unfavourable external factors is often of limited effectiveness. The government is of the view that, except where social considerations are overriding, the allocation of resources in the economy based on market forces will normally be most efficient. Government intervention in the private sector is kept to a minimum.

This free-enterprise, market-disciplined system has contributed to HK's economic success. The narrowly based tax structure with low tax rates provides incentives for workers to work and for entrepreneurs to invest. Both workers and entrepreneurs are highly motivated, given that all people have equal opportunity to pursue the goal of individual betterment and accumulation of wealth. The primary role of the government is to provide the necessary infrastructure and a stable legal and administrative framework conducive to economic growth and prosperity.

Overall, the major factors that have contributed to HK's success as a leading manufacturing and commercial centre are continuing to work well. These include the government's consistent commitment to free enterprise and free trade and a simple tax structure. Among other factors are the flexible and industrious work-force, a modern and efficient seaport with the world's busiest container port, a centrally located airport with a computerised cargo terminal, and an excellent worldwide communications.

The "positive nonintervention" attitude of the government applies equally well towards the promotion of IT for SMEs. There are no such schemes as guidance, special grants, and assistance, etc., but a framework is provided whereby people can develop their talents. Graduates from tertiary institutes, hardware vendors, and software houses are pulled-in by the market force.

Although HK has pioneered in computer applications amongst South-east Asian countries, its major development is in the financial sector. In the manufacturing and other services sectors, the development is lacking behind countries like Singapore, ROC, particularly for the SMEs. The main reasons are lack of support by public bodies, and that most SMEs are looking for short term profit rather than longer term growth. However, situation is fast changing now. As the prices of hardware come down so rapidly, and software becoming standardised, a lot more firms are seriously considering for computerisation and automation. Nevertheless,

the stage of computerisation for SMEs are generally speaking within the data processing and MIS boundary. Information networking is still very scarce.

3.4.3 TAIWAN

In the early years, Taiwan oriented its industrial development towards the production of substitutes for imported consumer goods. Three principal types of industry are given development priority: food, textiles, and building materials. Beginning in the early 1960s, industrial development efforts are centred on export expansion. Key products in the export drive included electronic goods and home appliances. Meanwhile, the country's fledgling petrochemical industry has begun to produce a wide range of products both for domestic use and for export.

The 1970s saw the beginning of backward integration and the development of petrochemical intermediates. There was also a shift toward the production of heavy industrial products and more sophisticated items, such as machine tools and motor vehicles. In the 1980s, two broad categories of industry were given high priority: machinery manufacturing and information. The Government considered these strategic industries by virtue of their greater linkage effects, high technology intensiveness, high market potential, and low rate of pollution. Efforts to upgrade Taiwan's infrastructure have, over the years, achieved marked success. By 1985, for example, the share of food and textiles in total manufacturing output has fallen to only 25% (far below 50% in 1952), while that of electronics, machinery, and metal products have risen to 34% (compared to only 6.5% in 1952). Such restructuring is essential to the long-term growth of Taiwan's economy.

Government policies in guiding SMEs aim to create a suitable environment wherein such enterprises can engage in fair competition under the free-economic system. With this objective in mind, the following services are offered:

- Assistance in introducing updated knowledge of improved production processes, equipment and quality.
- The promotion of modernised managerial systems which will allow them to improve their business operations.
- Assistance in obtaining financing and the establishment of sound financial systems.

During the past three decades, Taiwan has experienced a tremendous economic boom which has so impressed the rest of the world that Taiwan is now regarded as the model for accomplishment to other developing countries. During this economic development, SMEs have played a very important role. There are three characteristics of SMEs in the Taiwan:-

- They are generally organised and run by families.
- They are generally managed by highly educated entrepreneurs with a strong idea of modern administrative and managerial skills.

- Most such enterprises have been established by a generation of internationally oriented youths possessing far-reaching perspectives and a strong sense of dedication.

SMEs often encountered difficulties which larger enterprises are generally able to avoid, due mostly to a lack of working capital and a lower level of technological know-how and experience. The presence of family influence tended to limit such business in terms of managerial capacity. Accounting practices are frequently unsound, and they also lack the experience of advisors as well as the efficiency of computerised equipment. Those SMEs which have been established by former workers or mechanics usually have difficulty in upgrading their level of technology. They seldom conduct their own R&D, and lack the necessary experience launch into joint ventures. Financially speaking, SMEs possessed limited working capital and, while private loans pose too great a burden, often have difficulty obtaining bank loans. Moreover, these enterprises must confront a disorganised and highly competitive market with a limited capacity for marketing their products, especially in terms of foreign markets, consequently, their potential export business is chiefly dominated by the larger trading companies.

3.4.4 SOUTH KOREA

South Korea is a fast developing country. Products made in South Korea are now penetrating into the various markets of the world, in competition with Japan, US and European countries. Her civil and construction industries are of a reputable standard. The shipbuilding industry is now the world's leader. Steel, electronic and automobile manufacturing industries are also fast developing. The whole country is progressing at a quick pace. One can observe this from the activities planned by the Korean Government within three months. Commencing end-September 1986, the Government has planned to invest US\$1.5 billion in developing three industrial zones within the next four years. Up till 1990, the Government has invested US\$120 million in strengthening 24 harbour facilities. Within the shortest time, it has established seven high-technology parks in the southwestern part of the country. In field of industrial development, 837 categories of products are selected for self-production. By 1990, the Government has help five enterprises to invest US\$800 million in VLSI fabrication. In the shortest time, South Korea has organised industries to develop 14 kinds of key computer-based industries, and established seven Value Added Networks for the whole country. Before end-1986, they improved policies to attract foreign investors and immigrants, and so on.....

The recent success of the South Korea products in the world market based very much on their cheap prices and good quality, particularly for the matured products. In 1987, the "Goldstar" video cassette player was selling at US\$200 in USA, 20% cheaper than the cheapest Japanese brand. In the same year, Hyundai's Excel car hammered a shock to the USA market by pricing at US\$5200, whilst her "Blue Chip" IBM PC compatible was dumping at \$700. It is not surprising at these prices that Hyundai has improved from selling nothing two years previously to being the best seller in the US market for these two product lines. Nowadays, South Korean

large enterprises are well known to the world to be highly efficient in turning matured products out in an incredibly good and cheap way.

In 1986, South Korea has for the first time in history recorded a trade surplus which helped greatly to release her deficit of payment which has been accrued to US\$40 billion level. Altogether, ten large enterprises in South Korea have made their way to the Fortune 500 companies. (Japan has 147, whilst Taiwan has only two.) However, the success of large enterprises has not propagated down the line to the SMEs. For instance 40% of her electronic components and automobile parts still have to be imported from Japan. This has significant impact, especially during the recent appreciation of the Japanese Yen. Therefore, one thing the Government has been showing concern over is how to help SMEs to grow and support the large enterprises. Moreover in the longer term, in order to survive and remain competitive, SMEs in South Korea should now start thinking about the use of IT for office and factory automation in order to maximise their productivity.

3.4.5 JAPAN

All countries are amazed at the development of the enterprises in Japan. The focus of other countries are on the competitiveness of the Japanese products, the capital investment strategy and the industrial relationships. In the global manufactured product market, Japanese cars, commercial vehicles, machine-tools, and robots are the world's number one. Steel, plastics, computers are the second. Nowadays, people are still surprised by her very success in combating the two oil crisis. In 1985, Japan's overseas investment had surpassed UK and Saudi Arabia to become the world's first. Together with her immense foreign currency reserves, Japan has become the world's richest nation.

On the contrary, the Japanese are restless about the future. Their main concern is about trade conflicts. In 1985, her export amounted to US\$176 billion, which is 29% above her import. The trade surplus was US\$40 billion to the US and US\$11 billion to the EEC. This has caused the two regions to impose import restrictions from Japan and force Japan to open wider her import market. Faced with such changes, Japanese enterprises had to change their strategies. Moreover, the appreciation of the Japanese Yen has brought further unrest to them. On the other hand, there is rapid development pushed by new technologies, particularly in the areas of office automation, factory automation, factory and home electronic technology.

SMEs make up a large share of Japan's national economy, in terms of output, employment, and number. They have played an important economic and social role. By exercising their creativity and vitality, they will continue to contribute significantly to promoting national economic growth and improving the quality of life. In order to maintain their performance and continue to play their role in the national economy in the future, SMEs are making positive efforts to improve all aspects of their business activities. Further they continue to show the superior adaptability they have acquired during past difficulties. At the same time, the government is taking various measures to support their self-help efforts.

3.4.6 U.K.

The UK Government's stated aim is to encourage enterprise through the working of a competitive market economy. Measures towards this end include the planned reduction in State ownership, the strengthening of competition policy and the promotion of measures to improve efficiency and competitiveness. Schemes of financial and other aid continue for areas and industries with special problems. Examples are:

- Generous allowances given for expenditure on scientific research and enterprise zone developments.
- Regional development grants do not reduce the expenditure on which tax depreciation allowances are given.
- Under business expansion scheme, qualifying investment in unquote UK companies deductible from taxable income of ordinarily resident individual.
- Attractive grants available for investment in Assisted Areas.
- Emphasis on new and high technology investment, together with generous assistance from a wide variety of training schemes.
- New towns, freeports, enterprise zones, science parks, urban development corporations provide suitable locations for certain investment.

The support of UK Government for SMEs has traditionally been good. In 1988, the Department of Trade & Industry (DTI) launched the Enterprise Initiative and has since then received very good response (DTI, 1988). The Enterprise Initiative is quite simply the biggest and most comprehensive self-help package ever offered to British business. It has offered businesses both a valuable source of information and expert resources. Its aim is a simple one. To put British business in general in the position it deserves, at the top.

It helped SMEs in many ways. It can, for example, put SMEs in touch with experts in the fields of business planning, financial, and information system. It helped to forge links between local universities and polytechnics and SMEs. In Assisted Areas or Urban Programme Areas, SMEs can even get special assistance.

The key assistance to SMEs in the IT area is through the Consultancy Initiative in the Information Systems. This is an area where many businesses need independent, professional advice. Under the scheme, assistance will be available using proven technology across a range of areas including office automation, systems growth, decision support systems, and the use of external data services. The DTI consultants offer expert advice on improving existing systems or planning, designing, introducing and operating new facilities. DTI pay up to 2/3 the cost of between 5 and 15 man-days of consultancy.

The UK Government has provided a very good infrastructure for SMEs to develop their business. This is particularly true for office automation, and improvement of MISs/DSSs. Thus, SMEs should make the best use of these resources and gear themselves up for competition and growth.

3.5 KNOWLEDGE CONTRIBUTIONS FROM FIELD SURVEY

The field survey was conducted in six countries (HK, Japan, Korea, Singapore, Taiwan, and U.K.) during 1987 to 1989. Altogether there are 67 cases. 35 SMEs are contacted. Apart from these, there are 6 large organisations. They are included because the nature of their business has a direct link with SMEs. A further 26 software houses and related organisations are included in the survey. This is because they have direct impact on the knowledge of computerisation for SMEs.

The list of companies with a description of their activities and number of employees are detailed in FIG.3.7. FIG.3.8 gives an analysis of the cross references for cases matching against various industries. Thus, when a firm input its type of industry, the related cases are extracted and printed if necessary. This "knowledge" is developed using an ES shell in Chapter 5.

EPILOGUE

In this Chapter, both the questionnaire and field survey have been explored and reviewed. The results of the findings are useful for cross-reference by SMEs. This forms the basis for the subsequent development of the ESs for MIS and Case Studies in Chapter 5.

FIG.3.7: SUMMARY OF CASE STUDIES**KEY:** () Approximate number of employees

- C** – Case
- S** – Software Houses
- H** – Hong Kong
- J** – Japan
- K** – South Korea
- S** – Singapore
- T** – Taiwan
- U** – U.K.

- CH1** A Toy Manufacturer (280)
- CH2** A Battery Manufacturer (180)
- CH3** A Manufacturer of Electrical Appliances (250)
- CH4** A Construction Firm (35)
- CH5** A Medium Size Department Store (180)
- CH6** The Management Office of a Private Housing Estate (20)
- CH7** A Paging Service Firm (20)
- CH8** A Freight Forwarder (25)
- CH9** A Life Insurance Firm (80)
- CH10** A Publisher of Product Magazines (140)

- CI1** Precision Plastic Components Manufacturer (120)
- CI2** Precision Metallic Components Manufacturer (100)
- CI3** Manufacturer of Metal Panels for Computers (80)
- CI4** Distribution of Fresh Food and Household Consumable (200)
- CI5** Distribution of Processed Food and Household Consumable (30)
- CI6** Distribution of Wire Ropes for Lifts and Cranes (6)
- CI7** Manufacturing and Distribution of Toiletries and Hygiene Consumable (300)
- CI8** Manufacturing and Distribution of Garments and Related Accessories (280)
- CI9** Manufacturing and Distribution of Bakery Products (260)
- CI10** Manufacturing and Distribution of Spectacles and Related Accessories (250)
- CI11** Human Resources Recruitment and Development (8)

-
- CK1** A Construction Firm (300)
CK2 An Electronic Product Manufacturer (150)
CK3 A Shipping Company (300)
CK4 A Garment Manufacturer (300)
- CS1** A Manufacturer of Electrical Switches (150)
CS2 A Trading Firm (45)
CS3 A Distribution Services Organisation (100)
CS4 A Country Club Management Office (45)
CS5 A Mould and Die Maker (80)
CS6 An Architectural Firm (45)
- CT1** A Multiple-product Sales and Distribution Corporation (300)
CT2 A Manufacturer of Electronic Sub-assemblies (150)
CT3 A Manufacturer of Electrical Switches (80)
- CU1** A Manufacturer of Industrial Fasteners (160)
CU2 A Manufacturer of Office Furniture (90)
CU3 A Manufacturer of Electrical Water Heater (280)
CU4 A Manufacturer of Precision Ballscrews (140)
CU5 A Chartered Accountant and Solicitor Firm (15)
CU6 A Computer Training School (5)
CU7 A Nursing Home (4)
- SH1** A System House Specialising in LAN (10)
SH2 A System House Specialising in LAN and Manufacturing Control Software (15)
SH3 A System House Specialising in LAN based on Work-stations (15)
SH4 A System House Specialising in low-cost LAN (5)
- SJ1** A System House Center (50)
SJ2 An Information System House (145)
SJ3 A System House Specialising in Financial Services (55)
SJ4 VAN for Pharmacies (15)
SJ5 VAN for General Retails (20)
SJ6 VAN for Electronic Bulletin Board (15)

-
- SK1** An Accounting Firm with Management Services Division (80)
 - SK2** A System House with Experience in Hotel, Small Bank, and School Systems(15)
 - SK3** A System House with Experience in Manufacturing Information Systems (20)
 - SS1** Management Consultant Department of an Accounting Firm (25)
 - SS2** Management Consultant Group of an Accounting Firm (9)
 - SS3** A System House Specialising in Accounting Packages (4)
 - SS4** A System House with a Subsidiary Computer Training Centre (6)
 - SS5** An Independent Consultant and Supplier of CAD/CAM Equipment (12)
 - SS6** Commonly Used Software Encountered during Field Survey
 - SS7** THE "SINGAPORE DEVELOPED SOFTWARE DIRECTORY"

 - ST1** A Major Hardware/Software Production Firm (30)
 - ST2** An Experienced Software House Specialised in Application Software (20)
 - ST3** A System House Specialising in Chinese software for OA (15)
 - ST4** Information Industry Institute (300)

 - SU1** A Software House specialised in Accounting Software (10)
 - SU2** A Software House specialised in Manufacturing Information System (30)

NO	CODE	E/N	MANUFACTURING					SERVICES							
			M1	M2	M3	M4	M5	S1	S2	S3	S4	S5	S6	S7	
51	SL6	15													R
52	SK1	80								R					R
53	SK2	18									R	R			R
54	SK3	20	R	R	R	R									R
55	SS1	25								R					R
56	SS2	9								R					R
57	SS3	4								R					R
58	SS4	6										R			R
59	SS5	12	R	R	R	R	R								R
60	SS6	N.A.	R	R	R	R	R	R	R	R	R	R	R	R	R
61	SS7	N.A.	R	R	R	R	R	R	R	R	R	R	R	R	R
62	ST1	30									R	R			R
63	ST2	20									R	R			R
64	ST3	15													
65	ST4	>150	R	R	R	R	R	R	R	R	R	R	R	R	R
66	SL1	10								R					R
67	SL2	30	R	R	R	R									R
TOTAL CASES			9	14	16	10	7	10	11	10	10	17	18	26	

KEY: E/N Number of Employees (Approximate)

M1 - Garment or Textile
M2 - Electrical or Electronic
M3 - Plastic or Metal
M4 - Food or Household Consumable
M5 - Construction or Civil Engineering
S1 - Trading or Wholesale
S2 - Retail or Restaurant
S3 - Finance or Insurance
S4 - Real Estate or Business Services
S5 - Community, Social or Personal Services
S6 - Transport of Distribution
S7 - Software Houses
R - Relevant case

CODE

1st Character: C -- Case
S -- Software House

2nd Character: H -- Hong Kong
J -- Japan
K -- South Korea
S -- Singapore
T -- Taiwan
U -- U.K.

CHAPTER 4

DEVELOPMENT OF EFFECTIVE DSS

PROLOGUE

Business decisions are, in general, complex. Yet, there is a need to generalise business decisions, otherwise it is difficult for one firm to learn from the other. The vehicle chosen is a carefully selected business game, called "STRATPLAN". The rationale behind its choice is explained first, followed by the design of a controlled experiment with the objective of acquiring knowledge of the participants. The game was played in HK and UK, to enable comparisons to be made. This knowledge is then structured for subsequent ES development.

4.1 DSS & THE BUSINESS GAME

From the literature reviews in Section 2.1.2.2, there are many applications of DSS for contemporary management support. These can be derived from vastly diversified disciplines of management activities. It is therefore necessary to revisit the important issues of DSS. Then evidence is developed to support the use of the business game as a vehicle to simulate the DSS for most SMEs. This will set the foundation for the experimentation in the next section.

4.1.1 FUNDAMENTALS OF DSS

DSS has been generally defined in Section 1.1.3 as follows:

"DSS is a comprehensive computer-based system used to help people reach decisions about semi-structured problems. A DSS can be applied to support operational, tactical, or strategic decision making."

Holsapple and Whinston [1985] state:

"A DSS must possess application-specific knowledge about the decision making system's problem domain. The generic architectural framework incorporates three elements, a language system, a problem-processing system, and a knowledge system."

The above two definitions are complementary to one another. The former one focuses on the function of DSS, whereas the latter one defines its architecture.

The Language System provides the means by which the user can enter data or define parameters. The Problem-processing System is the kernel of the DSS. It receives input from the user via the language system and draws upon knowledge resident in its knowledge system. These inputs are then processed and the results presented to the user. The Knowledge System contains the information about the problem domain. Holsapple and Whinston suggest that there are at least seven distinct kinds of application-specific knowledge:-

- [A] Empirical or Environmental Knowledge – Drawn by observation or other means from the problem domain.
- [B] Modelling Knowledge – Take the form of computations which need to be performed to derive new knowledge from empirical knowledge.
- [C] Derived Knowledge – The product of the computation in [B].
- [D] Reasoning – The knowledge about how knowledge might be applied.
- [E] Assimilative Knowledge – The knowledge of learning and of knowing what new knowledge needs to be retained.
- [F] Linguistic Knowledge -- A knowledge of the rules of language that will govern the operation of the language system referred to above.
- [G] Presentation Knowledge – A knowledge of how interaction with the user might best be controlled, implicit within which is a knowledge of the user.

4.1.2 THE USE OF BUSINESS GAME FOR DSS

As can be seen from the Research Methodology in Section 2.2 (S.2.2), there are several possible approaches for developing an effective DSS model for SMEs. It is worthwhile to go through them in order that the best alternative can be established for the research.

Opinion Research (S.2.2.1) is unsuitable as DSS are generally new concepts to SMEs. Action Research / Case Studies (S.2.2.2) is a possibility, except that large sample size is required. Critical Theory (S.2.2.3) can be applied more suitably under game situation. This is because feedback is much faster, and any communication problems can be observed immediately. Paradigm (S.2.2.4) is not very appropriate for DSS as the technology required for DSS do not evolve as quickly as MISs, else the effect of technological impact is not as significant. User Development / Involvement (S.2.2.5) is good, provided the user has the fundamental knowledge in DSS. However, this will be the further work of the DSS development. Longitudinal Research (S.2.2.7) is good, except that it has two pre-requisite. Firstly, the organisation must be willing to cooperate over a lengthy period of time. Secondly, there should be little significant external changes which could distort the results of the research.

After weighing out all the above alternatives, the most suitable choice for the purpose of the present research into DSS is the Game Approach. Apart from the advantages suggested by Duke, Bowen, and Fripp in S.2.2.6, the spreadsheet has made the simulation of DSS a reality. Thus, if a game chosen can satisfy Cooper

& Klein's criteria (S.2.2.6.3), this will be a good combination for the experimentation.

4.2 EXPERIMENTATION OF DSS USING BUSINESS GAMES

The idea for using Business Games as one of the approaches for this research springs from a statement by Bowen [1978] as presented in S.2.2.6.2. Because of its importance, it is repeated here *"Research games can be used to examine the interplay of information and decision in realistic simulations of situations which cannot easily, economically or safely, be observed directly."*

Simulation is more effective than traditional forms of learning because it allows the user to learn by doing rather than by reading, viewing, or listening. Simulation presents the user with situations that require action. When action is taken, simulation reflects the new conditions created and presents the user with resulting choices. The lessons learned are vivid and lasting because simulation demands and receives complete user involvement.

A good simulation is an abstraction of reality that contains the same key variables and cause/effect relationships existing in the real world. In a computer-based simulation, however, unnecessary detail and distractions are removed, creating an ideal learning environment. The participants can plan strategies and clearly observe results without the downside risks of running a real-world business. In addition, time is compressed so years of activity can be simulated in only hours.

As quoted in Section 2.2, Duke [1974], and Fripp [1982] are all in support of Game/Simulation as a research tool. Cooper and Klein [1980] outline the requirements for the design and use of an experimental game. These requirements form the criteria for the search of the most suitable game for the present research.

A controlled experiment based on a business game is used to simulate the real life business environment. There are many PC-based games available in the market. It is therefore impossible to compare all of them for the purpose of this research. The more popular ones are selected for comparison and the best overall one is chosen for the experiment.

4.2.1 PAINTCO II

The game was developed by Evans & Berman [1988] at the Business School of Hofstra University in USA. This is a simulation game for the learning of marketing. It allows a maximum of 6 companies to enter into the game. There are 2 products, one consumer, the other industrial.

The team objective is to maximise cumulative profits.

The decision for each period are:

- Product quality level,
- Distribution level,
- Advertising level,
- Personal selling expenses level,
- Price,
- Seasonal index,
- Material price adjustment index.

The decision levels are quoted in the range from 1-9. The programme converts these levels into money terms. Profit & Loss (P&L) accounts and market share figures are provided after each period of simulation.

Comment: This is a simple simulation game for the marketing function only. Inputting is not user-friendly and the flickering screen is a pain to the eye. Graphic capability are somewhat limited.

4.2.2 THE MARKETING GAME

The game was developed by Mason & Perreault [1985] at University of North Carolina School of Business in USA. The simulation is a model on software marketing in the USA. A maximum of 4 teams can enter into the game. Participants have responsibility for the marketing of an existing product, a word processing package, and they have the option of launching a new product, desktop software. Strategic marketing issues are well-covered at the level of segmentation and positioning. Most of the elements of marketing tactics are included. Effective use of marketing information is required in what is a highly competitive market place.

The team objective is to maximise cumulative profits.

The decision for each period are:-

For Channel 1 (Retail Outlets), and Channel 2 (Mail-order):

- Number of sales representatives
- Exposure goal
- Percent non-selling time
- Sales commission

For Product 1 (Word Processing S/W), and Product 2 (Desktop S/W):

- Brand features (3)
- Production order quantity

- Advertising budget
- Type of advertising
- Wholesale prices for Channel 1 & 2
- Sales promotion for Channel 1 & 2
- Marketing research reports (6)

There is decision support tool which is a dedicated spreadsheet to assist the calculation of budgets so that what-if analysis can be performed. Alternatively, a budget form is provided for the same purpose, although what-if analysis is bound to be more tedious and subject to calculation mistake.

Reports feedback to teams at the end of each "year" include:-

- Financial summary (P&L account)
- Production summary
- Industry sales report
- Product features and prices report
- Marketing activity report

Marketing research reports available at a surcharge are:-

- Market share by segment
- Market share by channel
- Average customer preferences
- Marketing effectiveness report
- Detailed sales analysis
- Customer shopping habits

The game objective is to maximise cumulative profits.

Comment: The game provides scope for marketing decisions in a clearly defined fashion. The participants have a choice of purchasing additional marketing reports, as is the case in real-life. The logic of the game is sound. For example, over spending will suffer cutbacks in advertising. Further product positioning is clearly visible through the product feature definitions. Four firms entering into a market with 6 segments is about right, and this makes competition much more realistic. Apart from the above merits, the obvious one over PAINTCO II is that the products are well-defined, and easily understood by the players. This is possibly the best marketing game available running on a PC.

4.2.3 BUSINESS STRATEGIST

The game was developed by Reality Technologies [1986] in USA. It is a sophisticated business simulation derived from over 3500 equations. Business

Strategist offers a realistic simulation of how a business operates strategically at different phases in its development.

The player is thrust into the role of the President of a shipping company on the verge of bankruptcy. The company, being 150 years old, has recently moved away from its mainstream business of shipbuilding and has begun to focus exclusively on its Brewing operations and its super premium lite beer.

To produce its product, the company initially forged a short-term relationship with another brewer and eventually built its own brewery to brew its super premium lite beer. Soon afterwards, the company has high market share and high sales revenue in the new super premium lite beer market.

The game objective is to successfully return the company to profitability and maintain market leadership within five years.

The Simulation contains four independent models: The Underlying Economy and Marketplace, Competitors, Company Finance, and an Independent Group of Financial Analysts. By including the Customize feature, Business Strategist allows player to build in actual business environment or any other of his choice into the simulation. Competitors, the *Economy*, *Markets*, *Product Lines* and *Market Sensitivities* can be selected for each products.

Business Strategist comes with 3 tools, namely:

Consulting to get valuable expert advice when making decisions;

Tutorial to review key business terminology and concepts when viewing reports;

Analysis to help to evaluate competitive status when viewing reports; The decisions for each period are:

- Price
- Advertising premium
- Production quantity
- Capacity change
- Bond issue or repurchase
- Common stock issue or repurchase

Reports feedback to teams at the end of each "year" include:-

- Sales & inventory report
- Income statement
- Balance sheet
- Performance summary

Comment: The game is based on the key business disciplines, i.e., marketing, operation, and finance. There are a lot of interesting industry reports, economic journals, and memos available for decision making and these make the simulation

very real-life. Further, the Customize feature is very useful for tailoring one's business scenario into the game.

The drawback of the game is that it only allows for a single player. The competitive element from the other 4 predetermined companies vanishes quickly as the player can do a mock up game on his own before actually competing. On the other hand, although much information has been given, the number of decisions is only 6, which is over-simplifying the scene.

4.2.4 STRATEGIC MANAGEMENT GAME

The game was developed by Spero & Aronson [1987] at the Wharton School of Business in USA. The product simulated is a household robot which is expected to be the next great opportunity in the growing consumer electronics industry. A maximum of 2 teams can enter into competition with four predetermined competitors.

It is a model that provides the underlying economic fabric of the business world. Growth, inflation, interest rates, and the strength of the stock market are determined. It also provides competitors (Tandy Corp., Texas Instruments, Hewlett-Packard, and Apple Computer) who examine the economy, the marketplace, and other competitors. Lastly, it provides an objective group of Wall Street analysts who evaluate the attractiveness of industry stocks and establish credit ratings.

The team objective is to maximise net worth of the firm.

It comes with a very comprehensive decision support spreadsheet with the following options:-

- Make decisions
- Process decisions
- Read annual reports
- Read the journal
- Read memos

The decisions for each period are in the areas of marketing, operations, and finance. However, it is not necessary to enter into every levels of decision:-

- Level 1 - Price
 - Advertising budget
 - Units subcontracted
- Level 2 - Factory expansion
 - Factory production quantity (Cost of production includes material, depreciation, fixed overhead, and labour)
- Level 3 - Long-term debt (bonds) issue or repurchase
 - Common stock issued or repurchase

- Sales force size
 - Commission on sales
 - % sales on credit
 - R&D on new products (2)
 - One year loan
 - Supplier payment period
 - Common dividend per share
- Level 4 - Price for new products
- Advertising new products
- Level 5 - Expansion in market place

Comprehensive financial statements and competitors' analysis are available after each run of the game.

Comment: Similar to the last one, the game is based on the key business disciplines, i.e., marketing, operation, and finance. The interaction of these 3 areas are effectively presented in the decision spreadsheet. There are a lot of interesting industry reports, economic journals, and memos available for decision making and these make the simulation very real-life.

The drawback of the game is that it only allows a maximum of 2 teams to play. The competitive element from the other 4 predetermined companies vanishes quickly as the player can do a mock up game on his own before actually competing. Further, the amount of information and decision required is quite intensive and hence demands a lot of business knowledge from the player.

4.2.5 STRATPLAN

The game was developed by Hinton and Smith [1985] at Kellogg Graduate School of Management, Northwestern University in USA. It supports up to 6 firms, with 2 products and 3 markets. There is no hidden players from the package. Although there are sample scenarios, the instructor can set one which is more suitable for the players. The most complicated scenario can be 6 firms competing in one product, then move to 2. The market can also be expanded from local to 2 additional overseas markets. Each product and market has its own parameters.

It simulates the business environment by building in the law of diminishing returns on various parameters like advertising weight, salesforce weight, R&D weight, and branch weight FIG.4.1 & FIG.4.2. Further the carry-on effect are established, e.g., quality decay rate, advertising decay rate, market share decay rate, payback R&D cost period, and payback technological investment period. Automatic adjustment like learning curve, production adjustment, advertising adjustment are also explained. Further it has a reasonable realistic cash flow cycle (FIG.4.3).

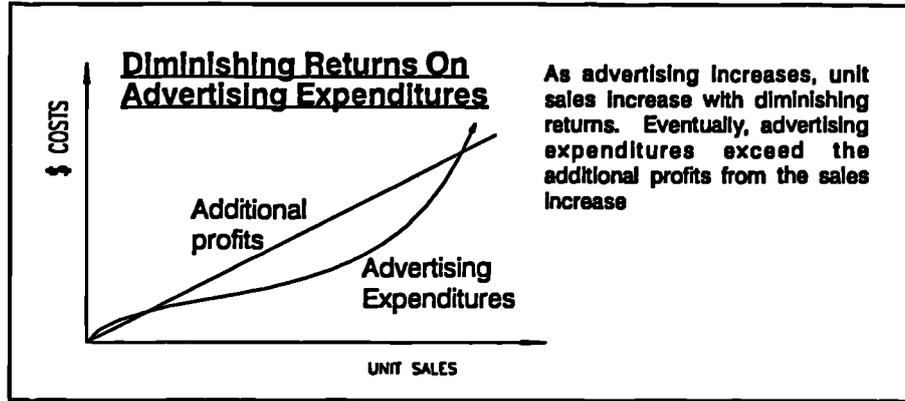


FIG. 4.1 : Law of Diminishing Returns

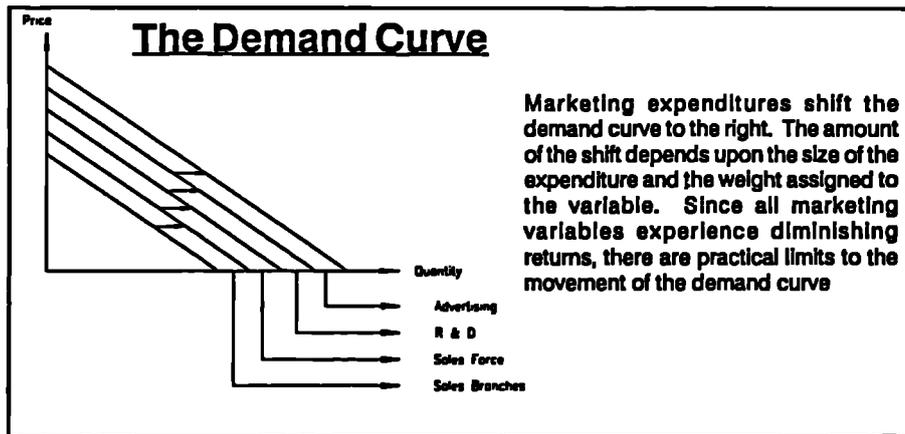


FIG. 4.2 : The Demand Curve

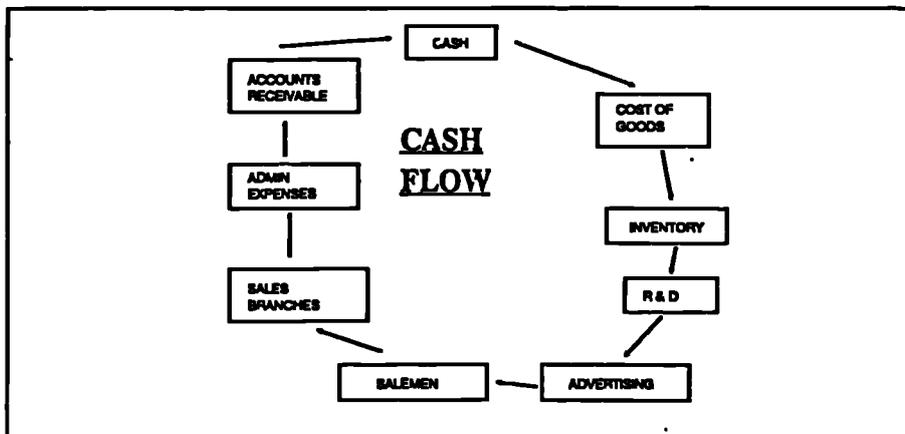


FIG. 4.3 : Cash Flow Cycle

4.2.6 JUSTIFICATION OF USING STRATPLAN FOR THE RESEARCH

The validity of using business game as one of the most appropriate research methodology for DSS has been established in S.4.1.2. Further in the introduction of S.4.2, many researchers in the field have been highly supportive in using game/simulation as a research tool. After investigating into some of the more commonly available business games, STRATPLAN is chosen for the current research. The reason for choosing this game against the ones discussed above are:-

[A] The game meets most of the requirement in S.2.2.6.3.

[B] The game focuses on major business functions including marketing, production, R&D, capital, and finance issues. PAINTCO II and The Marketing Game only look at marketing issues.

[C] Unlike the Business Strategist and the Strategic Management Game, the game has no hidden player.

[D] It is run in the LOTUS 1-2-3 environment which enables participants to make simple 'what-if' analysis readily. Further, this means that the source code is given and hence the ES-DSS can be developed easily using the Worksheet interface features. For instance, Carlsson (See S.2.1.2.2.5) has supported the value of end-user developed computer-based DSS models using spreadsheet through his longitudinal case study.

[E] Spreadsheet as a Language System can support almost all 7 types of Knowledge Systems as suggested by Holsapple and Whinston in S.4.1.1 above. Further, the ingenious computational capability of spreadsheet can provide a very powerful Problem-processing System. Consequently, a good spreadsheet, like the LOTUS 1-2-3 is obviously a very suitable DSS tool.

4.2.7 THE STRATPLAN STRAND OF RESEARCH

It is now recognised that STRATPLAN can be used for development of the DSS model. However, in order to warrant its effectiveness, the following rigorous procedures are adopted to arrive at a valid model:

4.2.7.1 Develop a scenario which is real-life and compatible to the experience of the subjects.

4.2.7.2 Structure the experiment in two stages run by about 60 Business Study undergraduate students from Hong Kong. The first stage is a simple scenario, so that the participants can gain some experience. The second stage has a more complex scenario and requires the use of Expert System approach to decision making.

4.2.7.3 Conduct a similar experiment with about 40 MSc engineering students from UK. The objective is to compare the similarity and differences of decision making process from subjects of different cultural background.

4.2.7.4 Analyse the reports from the above two groups of students. Identify the game criteria of their choice and their respective course of action. Highlight the CSFs of each team and extract the common ground of success.

4.2.7.5 The knowledge-base used by the winning teams is used to develop the ES-DSS model for the STRATPLAN. The model developed is validated with another group of MSc students using "Blind Play" by the experimenter. The result of the round of game is analysed for further improvement of the model. Further, the other game players are request to comment on the model if they were allowed to use it for competition.

4.2.7.6 The results of the entire STRATPLAN experiment is analysed in order to establish whether an ES can be developed effectively to help managers in their business decision.

More details about STRATPLAN are discussed in the following sections.

4.3 SCENARIO DEVELOPMENT of STRATPLAN

There is a Worksheet called "SCENARIO" which should be used to set the scenario of the game. A sample is shown in APP.6.1. This Scenario is given to the participants before the game starts. The Annual Report for the base year is also given. For a firm with two products and in one market, 24 parameters are required. STRATPLAN produces a total of six reports, namely, decisions, balance sheet, income statement, market index, operations, and competitive analysis (APP.6.2). Clearly, every team is receiving the same set of data at the beginning. Basing on the given data, the participants have to make the following strategic and tactic decisions:-

4.3.1 MARKET GROWTH

- Are all markets growing? Shrinking?
- At what rates do you expect each market to grow or shrink?
- Are markets mature?
- What are the relative strengths/weaknesses of each market?
- What evidence supports these assumptions?

4.3.2 TECHNOLOGY DEVELOPMENTS

- What can happen in terms of technology investments?
- What are the benefits/risks of investing?

4.3.3 PRODUCT QUALITY IMPROVEMENTS

- What type of product will be offered by competitors?
- How will it impact demand?
- What is an optimistic product quality scenario for your firm? A pessimistic scenario?

4.3.4 COST AND SUPPLY OF CAPITAL

- Will capital be cheap and available?
- What are advantages/disadvantages of different sources of capital in different business environments?
- What can happen with currency fluctuations?

The decision parameters of each cycle can be grouped under R&D, marketing, production, and finance. Under a worksheet called "FIRM", the various decision parameters can be experimented. Typical examples are shown in APP.6.3.

The broad perspective of STRATPLAN includes the following sets of activities:

- Establish objectives (team and individual).
- Develop preliminary strategies.
- Organise team to support strategies.
- Enter the decision making cycle.
- Reformulate strategies if necessary.
- Debrief the simulation and experience gained.

The learning objectives of the game are:-

- Increased understanding of cross functional relationships.
- Better understanding of the relationships between a balance sheet and income statement.
- Improved understanding and application of a strategy formulation process.
- Improved understanding and application of strategy implementation tactics.

On the other hand, the game objectives are:-

- [A] Stock price
- [B] R.O.I.
- [C] Shareholder Value
- [D] Market Share
- [E] Total Assets

[F] Profits

Given these objectives, teams then should set specific goals such as "Increase market share by 8% for Product 1 in Market A over the duration of the simulation." "Have a 25% ROI by year 4." Of course, strategies must be formulated and implemented to support objectives and goals.

Before each team started, they had to decide on the weighting given to each of these six objectives, within the range of 0 to 0.3. The total must be equal to one. After playing the game, they were given a "Debrief" spreadsheet which gave them the overall results, and also other teams' decisions and results throughout the game (APP.6.4). Each team of HK students was asked to write a report to explain their strategies, decision process, one example of results meeting objectives, and one example of results departing from objective. Likewise, the UK students were asked to do a presentation of based on the same set of guidelines immediately after the game. The "knowledge" developed in this Chapter is based on the analysis of these reports and presentations.

4.3.5 RELEVANCE OF STRATPLAN TO SMEs

As it can be seen, STRATPLAN is based on a scenario which consists of the typical business parameters for an SME. The information and decisions are just about right for a decision maker (usually the director of the company). On the contrary, it is not suitable for use as a model for large enterprises as their decision variables are usually far more complicated, with a multi-product, multi-market environment. The other merits of STRATPLAN for SMEs are already described in S.4.2.6 above.

Another obvious advantage of STRATPLAN is that it allows the SMEs to enter their own industrial data and Company scenario into the game. This would make the game much more realistic, and provides a good foundation for real-life DSS to be developed.

4.4 THE "STRATPLAN" EXPERIMENT

STRATPLAN has been selected as the tool for SMEs to understand DSS in a simulated environment. However, before it can be used effectively, it is necessary for the participants to acquire the knowledge of how to make successful decisions based on the given scenario. In order to achieve this, a 2-hour induction session was conducted before the first run. During the running of the game, there were opportunities to ask the instructor questions. Further, the scenario was set to simulate the real business environment as far as possible. The two products chosen, one consumer and the other industrial, have familiar names like Hoover and Pump. Their parameters are also set to reflect the nature of consumer and industrial marketing respectively.

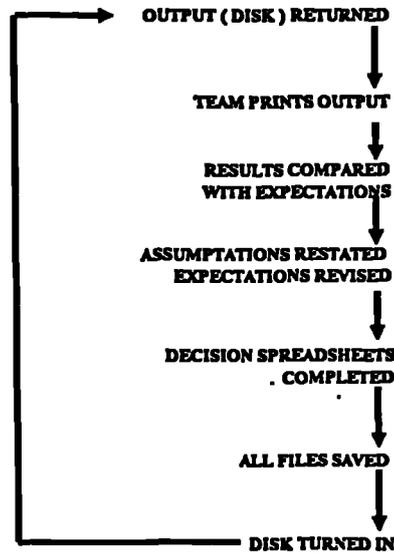


FIG. 4.4 The STRATPLAN Process

In order to obtain a representative sample, almost 100 subjects were invited to play the game over a period of time. The purpose is to understand the decision mechanism of to-be or practicing managers. Then the knowledge can be developed into an ES which can act as tool for SME managers to understand how successful managerial decisions can be made. The STRATPLAN process is shown in FIG.4.4.

4.4.1 HONG KONG STUDENTS

Two classes of BA Business Studies final year students (about 30 Full-time and 30 Part-time) from City Polytechnic of Hong Kong were invited to enter into competition during Nov 87 to May 88. They were chosen because they had studied the functional disciplines of business, including marketing, production, finance, and business policy. The game was run for two rounds as follows:-

ROUND 1 : 6 groups of 5 teams each: 2 products and 1 market

The population were divided into 6 groups of 10 students each. Two students formed a team each looking after one product and jointly decide on other common parameters. One product was consumer type (named "DOLLY") and the other industrial (named "POWER"). Altogether, there were 30 teams. For the first round the 5 teams within each group competed in a single market for 6 periods. The decision parameters required is shown in [D1] to [D37] of APP.6.3.

ROUND 2 : 5 groups of 6 teams each: 1 product and 3 markets

The winners of the 6 groups then entered into the second round, with 1 product and 3 international markets. The product was a consumer product named "Talkie". The decision parameters required is similar to that shown in APP.6.3, except that now there are 3 markets but 1 product. For the first 3 periods, they used the same decision aid as for the first round. Then before the 4th period, each team developed an expert system using a commercial system shell known as "MICRO-EXPERT". For the remaining 3 periods, they had to make use of the ES developed instead of mental decision. The ultimate winner was the team who gained the highest weighted score according to the preset objectives.

The remaining 24 teams were re-grouped irrespective of their ranking in the first round. They formed 4 additional groups and did the same competition as the winners of round one as described above. Thus, there were 5 groups in the second round altogether.

The reason for running Round 2 is that, apart from using the LOTUS spreadsheet as a decision support tool, the MICRO-EXPERT provided a chance to model the decision making. This is a more advanced step towards DSS. Since the students should have gained experience by then, this part of the experiment could test out the effectiveness of the decision modelling as a tool for DSS.

4.4.2 UK STUDENTS

Four classes of part-time MSc Manufacturing Systems Engineering final year students from Warwick University were invited to enter into competition during June 89 to December 89. They were chosen because they had studied the functional disciplines of business, including marketing, production, finance, and business policy. There were about 18 students in a class. The game was run for one round with each class of students entering into a group with 6 teams. It was run with two products and one market scenario. One product was consumer type and the other industrial. Each team competed for 5 periods within the home market.

The results of the UK experiment were then compared with the Round 1 of the HK students. Thus similarity and differences between these two groups of students could be identified. However, it was stressed that although Round 2 was not compared, Round 1 itself had already got some degree of DSS built into the LOTUS decision spreadsheet. Thus, comparison between effective applications of DSS using the business game could still be made.

4.4.3 RESULTS OF THE GAME

As the game was played in three distinct time periods, Round 1 & 2 from HK students, and Round 1 from UK students, the results are summarised accordingly.

Apart from reporting on the game, the observations on success and failure, particularly relating to the use of the decision support spreadsheet are noted. Then overall comments are drawn from each round and comparison are made between the three rounds of results.

4.4.3.1 Results from HK Students: ROUND 1

The decision spreadsheet of STRATPLAN was built with considerable "What-if" analysis for decision making. Thus, by comparing the winning team with the losing team, one can draw conclusions about whether the winning teams had, in general, been more effective users of the spreadsheet.

GROUP 1: Winning Team (0.20, 0.15, 0.15, 0.15, 0.15, 0.20)

{The Criteria follows the sequence of [A] to [F] of S.4.3.}

The team put emphasis on the performance and actions taken by the other competitors. They saw all business objectives as somewhat equal important. The tactics they adopted were "contingency approach", "high pricing strategy", "fair market share", "close monitor of the company performance", and "average increase of total assets". They monitored the results closely using the DSS (i.e. the LOTUS Spreadsheet) and reported the following successes:-

- Higher profit than the market average at all periods.
- Increasing asset at a constant rate, and ranked first against competitors.
- Prefer internal financing by retained earnings and share issue.
- Constantly high dividend policy was maintained.
- Increasing return on investment over time.
- Constant increase in market share.

GROUP 1: Losing Team (0.15, 0.15, 0.15, 0.30, 0.10, 0.15)

The team put great emphasis on market share (30% of total weighting). In order to achieve this objective, the firm invested a lot in R&D so as to lower the product unit cost. However, the firm failed to make use of the DSS to forecast its sales and profit contribution. In particular during one year, the price was much higher than the competitor, resulting in a serious loss of sales.

GROUP 2: Winning Team (0.20, 0.25, 0.20, 0.15, 0.10, 0.10)

The team used marketing variables to increase demand and sales. Through the use of DSS, they found that the optimal level of advertising expenditures was 50% of the unit sales. Quality was also important and was improved by R&D expenditure. The elasticity of sales via increase of commission was found faster for Dolly than Power. Further, the firm was aggressive in investing in technology in all markets.

An analysis using the decision spreadsheet revealed that the optimum level of investment to cost of capital was 0.5. Further, with the use of finance spreadsheet, the cheapest source of fund were used.

GROUP 2: Losing Team (0.15, 0.20, 0.10, 0.20, 0.15, 0.20)

The firm set tactics such as "considerable sum of money be invested in both technological investment and in R&D"; "establish an average price policy with the product price never higher than the industry average"; "steady expansion of

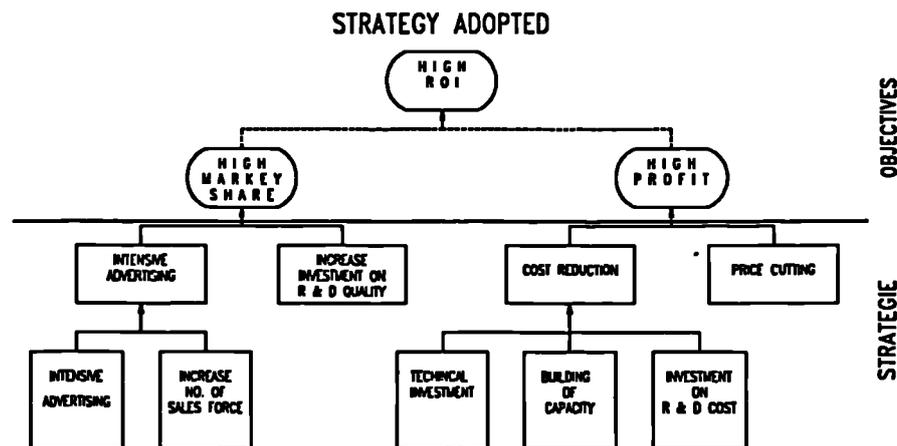


FIG. 4.5 : Strategic Decision of a Winning Team

production capacity over the five years"; and "no further debt be incurred so as not to decrease the shareholder value". However, these tactics did not reflect the actions taken by competitors. Further they did not make use of the DSS to optimise the contribution, and were over-rigid.

GROUP 3: Winning Team (0.10, 0.20, 0.15, 0.25, 0.10, 0.20)

The team had a well thought out strategy as shown in FIG.4.5. The decision tree for the tactic decisions is shown in APP.6.5. With the use of the DSS, the team drew the difference of effectiveness in increasing sales forces and R&D on quality improvement for the two products. The price was set marginally below market averages. In order to maintain the profitability, the company engaged in cost reduction programs by building up capacity, investment on R&D Cost, and increase

technical investment; to a level that the company could finance without going to a high debt/asset ratio.

GROUP 3: Losing Team (0.05, 0.15, 0.05, 0.30, 0.15, 0.30)

The team put the blame on the fluctuating market conditions such as price and commission. Actually, the deviation was caused by poor forecast of the industrial trends. They also admitted that the company failed to maintain an overall company objective that was consistent throughout the game periods. Yet, had they used the DSS effectively, they would not have ended up in a "fire-fighting" situation.

GROUP 4: Winning Team (0.10, 0.30, 0.10, 0.10, 0.15, 0.25)

The team ranked ROI and Profit as highest. They justified this as $ROI = \text{Profit}/(\text{Retained Earnings} + \text{Capital Invested})$. Thus, the higher the Net Profit, the higher the ROI. They controlled the net profit figure by closely monitoring the effect of different variables on profit using the DSS. On the other hand, the firm observed the high price elasticity of the products. They cleverly avoided putting too much weight on market share. Thus, they could clear themselves from cut-throat competition actions by competitors. Further, they also observed that the price of capacity increase was very high. Therefore, they affirmed that they should not cut price to gain high market share. On the other hand, they found cost reduction more justified and had gone for it via investment in R&D Cost.

GROUP 4: Losing Team (0.10, 0.25, 0.10, 0.20, 0.15, 0.20)

The team admitted that the effort in advertising and promotion was not enough. Further, they had been too dependent on sales force and neglect that there were other ways to improve sales. Had they been experimenting the variables with DSS, they would have found out the opportunities.

GROUP 5: Winning Team (0.25, 0.15, 0.15, 0.05, 0.10, 0.30)

The team had been making use of the DSS effectively. For instance, they put more emphasis on sales persons as the return rate was higher than that from the number of distribution outlets. Likewise, they found it worthwhile to spend on advertising to a level above the industrial average. Further, the stock price was improved by buying back issued shares, and paying stable amount of dividend throughout the periods. The DSS was used to decide the optimum level of borrowing from the bank, by adjustment various investments.

GROUP 5: Losing Team (0.10, 0.30, 0.10, 0.10, 0.15, 0.25)

In one year, the team suffered a great loss because of over-spending and sales were stagnant. They failed to justify their expenditure by looking at the profit contribution figures from the DSS. Further, their forecast of the industrial growth was quite wrong.

GROUP 6: Winning Team (0.10, 0.20, 0.20, 0.10, 0.25, 0.15)

Through the DSS, the firm saw advertising as most effective in shifting demand curve. They went for this initially until the law of diminishing return came in. Then they shifted to the next effective move, i.e., increase sales force and their commission. As the cost of opening up another branch was high, they did not go for it. Regarding production, they kept technical investment high to achieve low costs, and also increase assets. However, the production capacity was increased moderately every year so as to keep the cash flow healthy.

GROUP 6: Losing Team (0.10, 0.30, 0.00, 0.30, 0.00, 0.30)

The firm attributed its failure to the inaccurate forecast on industrial trends in various parameters such as advertising, pricing, R&D, etc. The fact was that industrial averages did not change that much and a reasonable forecasting was not difficult to achieve. Another major problem was a serious mistake in data entry. The production capacity for Power for one year was entered as 730,000 units instead of 73,000 units. Had the firm been studying the finance DSS carefully, they should have discovered the mistake as the firm could simply not be able to finance the huge expenditure arose.

4.4.3.2 Results from HK Students: ROUND 2

There are 5 groups in round 2, each having 6 teams. Each team was asked to develop an ES by the mid-period of the game. Then they used the ES developed to continue with the game. Thus, by comparing the winning team with the loser, one could draw conclusion whether the winning teams has, in general, developed a more effective ES. Group 1 composed of all the winning teams in Round 1.

GROUP 1: Winning Team (0.20, 0.30, 0.20, 0.00, 0.00, 0.30)

The decision tree of the team is shown in APP. 6.6. The decision nodes were very rational. Multiple decision layers were used for more complex decisions. Examples were found in shipment, production capacity, technological investment, and cash transfer. The decision tree was particularly effective in controlling the capital and operating budgets so that there would not be excessive loan. Through the decision process guided by the ES and supported by the DSS, strategy could be implemented with little possibility of major mistakes.

GROUP 1: Losing Team (0.20, 0.20, 0.10, 0.15, 0.10, 0.25)

The team's decision tree were mostly 1 - 2 levels. This had the defect that it could not effectively cope with all possible changes. For instance, for decision on production capacity, it was simply equated to the production requirement. A better strategy would be to look at the product life cycle, and make use of the relative cost/benefit of using overtime to meet peak and short term demands. Thus although the information is readily available in the DSS, they are not used to the full extend.

GROUP 2: Winning Team (0.15, 0.15, 0.15, 0.30, 0.00, 0.25)

The team used the goal-seeking approach in its development of ES. Examples were found in stock transaction and cash transaction. The amount of branching was compatible to the decision requirement. For instance, there were 7 branching for estimation of average price. This demonstrated the degree of details that had been considered. Again, the ES requires the proper use of the DSS for decision making.

GROUP 2: Losing Team (0.12, 0.10, 0.10, 0.30, 0.20, 0.18)

The team used descriptor "Is there possibility to rise / fall?" as a leading question to making a decision on changing the marketing variables like advertising and R&D Quality. What this actually did was pass back the decision criteria to the user, without giving guidance on the use of the information in the DSS. A better scheme would be based on past trends and observation of competitors' actions to forecast the rise and fall of marketing variables. Another weakness was in the level of decision making. For instance, in deciding on the level of R&D Cost, no reference was made to the position of the product life cycle.

GROUP 3: Winning Team (0.10, 0.00, 0.00, 0.30, 0.30, 0.30)

The team succeeded in analysing the factors contributing to the decision of parameters. In one example, technological investment, there were 14 decision nodes. Almost all possible outcomes had been exhausted. In another instance, for the cash transfer, the team related the cash transfer decision not only to difference in interest rate of the 3 countries, but also to the debt/asset ratios of the 3 operations. This can be decided effectively by the use of the DSS.

GROUP 3: Losing Team (0.14, 0.14, 0.08, 0.25, 0.09, 0.30)

The team took a simplistic approach to decision making. Most of the decisions were 1 - 2 levels. Unfortunately, there were multiple cause-effects of the determinants. There were obvious difference in technological investment, stock trading, dividend and cash transfer compared with the winning team above. The comparison reveals the fact that a well thought-out set of decision rules making use of the DSS tends to give better results.

GROUP 4: Winning Team (0.10, 0.20, 0.10, 0.27, 0.06, 0.27)

The team tried to emulate real-life decision process by prompting thought-provoking statement as and when necessary. One typical example for salesmen commission was:-

"During last year operation, some firms may increase commission while others may decrease it. However, it is the net percentage change that matters. Therefore you only have to consider the net change in commission when answering the following questions....."

In another instance for unit cost, the prompt was:-

"Before the consultation, you should be clear about the following facts:

- (a) Has there been any technological investment undertaken in this market before?
 (b) And is there going to be any technological investment this year in this market?"

With these guidance, the DSS can be used to its optimum.

GROUP 4: Losing Team (0.13, 0.18, 0.13, 0.27, 0.09, 0.20)

Just like the other losing team, the team's drawback was that they tended to over-simplify the decision routes. Obviously, not much thought had been given to multi-level decisions such as technological investment, cash transfer, and loan. This supported the hypothesis that the level of decision, and hence the use of DSS, had to be compatible with the environmental constraints imposing on the parameter.

GROUP 5: Winning Team (0.20, 0.20, 0.10, 0.30, 0.00, 0.20)

The team built into its decision tree, dynamic decision making over time. This was applied to such decisions which had a payback period of several years. Examples are R&D quality, technological investment, and R&D cost. Further, the decision criteria helped them to search for the lowest production cost per unit while fully utilising the capacities of the plants. Regarding cash flow, the objective of the decision tree was to maintain sufficient liquidity and avoid borrowing emergency loans. All these can be effected by the proper use of the DSS.

GROUP 5: Losing Team (0.20, 0.30, 0.05, 0.20, 0.10, 0.15)

As with the above losing teams, this team took a simplistic view on decision making. In fact the rule to parameter ratio was almost 1:1, comparing with the average of the winning teams of about 2.5:1. Once again, it confirmed that fact that there need to be an optimum level of decision nodes for successful use of the DSS.

4.4.3.3 Results from UK Students

GROUP 1: Winning Team (0.10, 0.20, 0.05, 0.30, 0.05, 0.30)

The strategies adopted were:

- steady growth for both products,
- compete on cost via R&D and low overtime,
- retain market share
- consistency

The first three strategies had been effected by the proper use of the DSS.

GROUP 1: Losing Team (0.00, 0.30, 0.10, 0.30, 0.00, 0.30)

The mistakes admitted by the team were:

- expenses through roof,
- not enough investment in production process
- not enough capital to invest

They admitted that these mistakes were avoidable with the proper use of the DSS.

GROUP 2: Winning Team (0.10, 0.15, 0.10, 0.30, 0.15, 0.20)

The strategies adopted were:

- minimise internal manufacturing costs by investment in facility improvement,
- continual investment in product quality improvement,
- steady growth in market share to ensure company growth while generating increasing profits and liquidity.

These strategies had been effected by the proper use of the DSS.

GROUP 2: Losing Team (0.10, 0.25, 0.05, 0.30, 0.10, 0.20)

The mistakes admitted by the team were:

- not realise time lag for capacity addition,
- not enough capacity,
- low profit due to expense on loan interest,
- low profit due to low market share.

They admitted that the last three mistakes could be avoided by the proper use of the DSS.

GROUP 3: Winning Team (0.15, 0.20, 0.15, 0.20, 0.10, 0.20)

The strategies adopted were:

- product differentiation by entering into the high quality segment,
- monitor competitor activity,
- premium prices and avoid price war,
- zero inventory,
- maximise contribution,
- match capacity and demand.

Most of the above strategies had been effected with the help of the DSS.

GROUP 3: Losing Team (0.10, 0.10, 0.10, 0.30, 0.10, 0.30)

The mistakes admitted by the team were:

- wrong R&D and advertising,
- used too much overtime,
- lack of investment in capacity,

The first two mistakes could be avoided by the proper use of the DSS.

GROUP 4: Winning Team (0.15, 0.20, 0.10, 0.25, 0.05, 0.25)

The strategies adopted were:

- high volume to achieve good market share,
- low cost to be competitive,
- low quality to reduce investment,
- medium R&D to help reduce costs,
- advertising to improve market share.

All the above strategies were effected via the DSS.

GROUP 4: Losing Team (0.15, 0.15, 0.15, 0.25, 0.10, 0.20)

The mistakes admitted by the team were:

- too great a price drop in Period 2,
- not sufficient capacity to cope with increased demand,
- suffers viscous circle between cash flow and investment.

They admitted that they could have avoid all these had they use the DSS during their decision making process.

4.5 KNOWLEDGE CONTRIBUTIONS FROM "STRATPLAN" EXPERIMENT

The STRATPLAN, being a simulation of the real business environment, is by its nature, complex. Thus, it is difficult to draw very strong quantitative or statistical comparison on various aspects of its usage by various groups of students. However, the attempt here is focused on the effectiveness of using STRATPLAN as a vehicle to understand DSS. Thus, results and comparisons are focused on such effectiveness only as perceived by the subjects of the experiment.

4.5.1 FROM HK STUDENTS: 1ST ROUND

For Round 1, it was found that the success of the game depended very much on the effectiveness of using the DSS. This was apparent from the reports of all winning teams. Before one made the best use of the spreadsheet, the CSFs must be identified. Then the spreadsheet was used to do "what-if" analysis so that the values for the optimum results of the CSFs can be identified. A combination of these two steps would ensure the game to be successful.

On the contrary, the failure teams admitted that they failed because of major mistakes in decision making. Had they been able to use the DSS effectively, the failure would not have occurred. This evidence supports the relevance and usefulness of the DSS in the business decision making process.

4.5.2 FROM HK STUDENTS: 2ND ROUND

For Round 2, it called for more structured analysis, especially towards the latter part of the game when ESs were used. Here, the CSFs were planted into the ESs. Thus the decision making process was reduced to doing the "what-if" analysis. However, the ability in identifying the more important CSFs were important.

From the experience of the winning teams, the greater the details of the ESs, the better it helps the decision process. This is because the use of DSS will then be highly focused and easy to follow. Hence the chance of playing a more successful game increased accordingly. On the contrary, the losing teams tend to make loose and simplistic decisions. This leads to mis-use of the DSS. Thus the chance of making mistakes will increase, leading to intensified failure.

4.5.3 FROM UK STUDENTS

Only one round of the game was played by each group of students in UK. As with Round 1 of the HK game, it was found that the success of the game depended very much on the effectiveness of using the DSS. Before one made the best use of the spreadsheet, the CSFs must be identified. Then the DSS was used to do "what-if" analysis so that the values for the optimum results of the CSFs can be identified. A combination of these two steps would give a better chance for the game to be successful.

4.5.4 OVERALL CONTRIBUTIONS

One very important conclusion from all the students in both HK & UK is that the winning teams are always able to make the best use of the DSS for their decision making. The reverse is true for the losing teams. This proves that the STRATPLAN can be used as a DSS training tool for SMEs.

The difference between HK and UK students are that, UK students tend to spend more time in developing the strategy and revising the tactics during the course of the game. On the other hand, HK students tend to spend more time in doing "what-if" analysis with the use of the spreadsheet. In fact for the game to be played successfully, both aspects are equally important. Further, it is necessary to fine tune the decisions by taking into account of the actions of the competitors. This is what the winning teams have done.

There is an insignificant difference in claiming that the decision process are

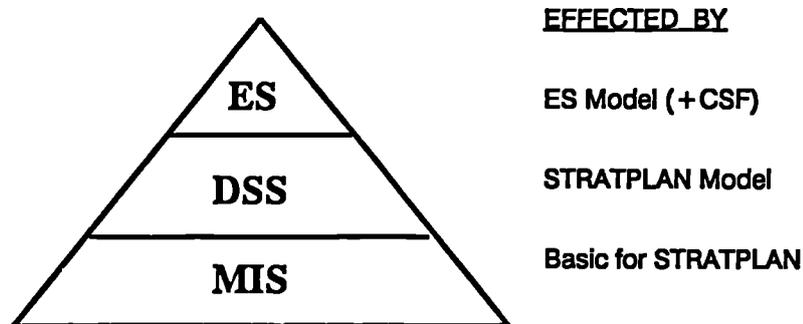


FIG. 4.6 : Model of STRATPLAN as DSS

different for the two groups of students. One explanation is that the game is well structured. Thus decision factors are fairly logical and there is little scope for deviation. However, the fundamental difference between winning and losing teams for both groups of students lies in the ability to make the best use of the DSS to arrive at a set of rational decisions.

To summarise the conclusions, firstly, the decision support spreadsheet is an important tool for DSS in business. Secondly, under the condition of similar background knowledge and experience, there is little fundamental difference between participants of HK and UK. Finally, ES-DSS can be used as an enhancement of the decision making process, particularly when the CSFs are planted into the ES. Thus the decision making process is reduced to doing the "what-if" analysis. Consequently, the decision is more consistent and less dependent on the ad-hoc decision of the decision makers. The conceptual model for these conclusions can be expressed in FIG.4.6

EPILOGUE

The experimental game for effective applications of DSS has been planned, organised and implemented. Valuable findings have been identified. These form the knowledge-base for the development of the ES-DSS in the next chapter.

CHAPTER 5

ADVISORY SERVICE DEVELOPMENT

PROLOGUE

In Chapters 3 & 4, the models for MIS and DSS have been developed based on surveys and experimentation using a business game. This Chapter extends this knowledge one step further, with the aim of developing ESs which can deliver the knowledge in the most effective manner to the users. The method of development is explained, followed by pilot testing before delivery.

5.1 FUNDAMENTALS OF EXPERT SYSTEMS (ES)

Expert system is a promising technology for solving some of the decision making problems. Fisher E.L. [1985] defines ES as:-

"A computer program that achieves high levels of performance on problems that normally requires years of special education and training for human beings to solve."

Edward & Connell [1989] adopted a similar definition:-

"A computer-based system in which representations of expertise are stored and which allows a user to access this expertise in a way similar to that in which he might consult a human expert, with a similar result."

As the technology progresses, however, these definitions will surely demand not only expert performance but additional expert qualities as well. In an ES, the private knowledge of a human expert, including factual, judgmental and procedural knowledge, is developed into a "knowledge base" for the particular domain in which the human is considered an expert – hence the system is "knowledge-based".

The knowledge base could contain expert knowledge for scheduling, process planning or facilities design. In this research, the expert knowledge is in helping SMEs to develop effective applications of MISs and DSS.

At the beginning of the 1980s, the Japanese MITI announced their ambitious 10-year plan to develop the next generation of computer systems. This 'fifth'

generation would have at its heart knowledge-based systems. In 1982, the first stage was marked by the establishment of the Institute for New Generation Computer Technology (ICOT). A key element of the development programme was to be the close cooperation between academics and industrialists.

The UK response to the Japanese initiative was the announcement, in 1982, of its own initiative. The Alvey Committee outlined plans for a five-year programme of government-supported collaboration between academe and industry under four broad research areas: software engineering, VLSI, man-machine interface, and intelligent knowledge based systems (IKBS).

The worldwide activity in ESs fuelled by such government funding and simulated by articles and books such as "The Fifth Generation" Feigenbaum and McCorduck [1983] led to a flurry of activity in ESs. Hewett [1986] confirmed that the sales of ESs in 1985 was at £40 million, and Friscia [1985] projected a market size of £1 billion by 1993. The range of applications in the mid-1980s was wide but with a firm emphasis on problem domains which were well structured. A review of working ESs carried out by Buchanan [1986] listed about 60 systems which had progressed beyond the development laboratories into field test or live environments. The systems were classified within 12 broad applications domains, such as agriculture, medicine, etc. Not surprisingly, the computer and electronic sub-domain had the most applications (22) followed by manufacturing and engineering (14). However, there are only 3 systems cited in the financial sub-domain, and only one in what the review described as 'information management'. Thus, there is a pressing need for the present work.

5.1.1 THE STRUCTURE OF ES

An ES can be broken down into four components (besides the Input and Output phases). These are:-

- Knowledge Representation
- Inference Engine
- Control Mechanism
- User Interface

There relationship can be illustrated in FIG.5.1.

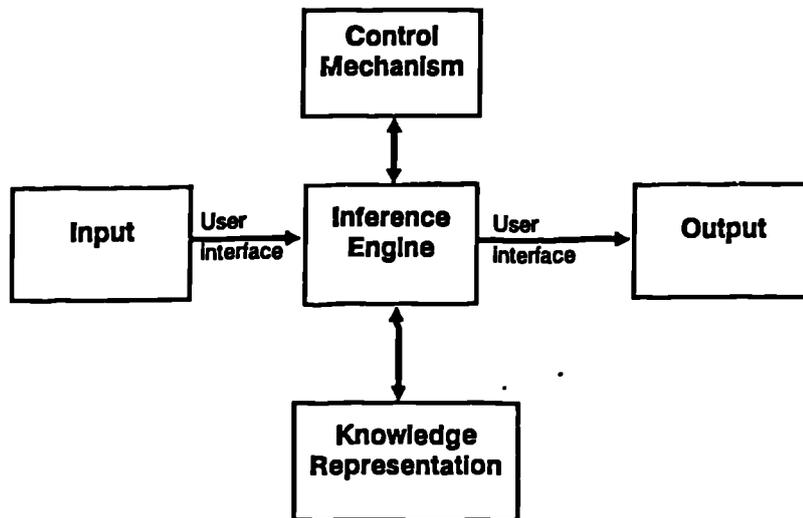


FIG. 5.1 : The Structure of an ES

5.1.1.1 Knowledge Representation

The first thing to do is to put the "knowledge" into the system. There are several ways of representing the knowledge depending on the level of sophistication of the ES. More popular ones are "Rule-based", "Frames", "Semantic Networks", "Hierarchies and Inheritance", "Object-Attribute-Value Triple", and "Certainty Factors".

[A] "Rule-based" Knowledge -- The knowledge can be entered as a set of rules. Such rules contain premises or conditions in the "if" clauses and conclusions in the "then" clauses. If-then rules in knowledge-based systems differ from similar ones in conventional computer systems. They are more flexible since they can be modified much more easily to meet changing needs. A more complex variation of "Rule-based" is the "Rule Inducing". With this, the rules can be evaluated from existing data.

For example:-

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IF      the firm has used computers for over 3 years
      AND there is at least one programmer/analyst
      AND the investment in IT is growing continuously
THEN   the firm is committed to IT
  
```

[B] "Frame-based" Knowledge -- It is based on "Frames" which are a kind of template for holding related clusters of data, facts, rules, hypotheses, or any other knowledge in a single conceptual unit. They therefore require conceptual

reorganisation of situation data around key controlling concepts. For this and other reasons frame systems appear to have many potential applications to strategic corporate planning. Frame-based, also called "Object-oriented", systems enable more complex decision situations to be dealt with than can be dealt with in systems that contain just rules and questions. Since people generally think in clusters, especially in decision situations such as strategic planning, frames can sometimes come closer to mimicking the way human beings reason and remember. Frames can be linked to other frames, to form a hierarchy. Then they can even be manipulated by the inference engine to draw new information from other frames.

[C] "Semantic Networks" Knowledge -- It is similar to frame hierarchies. They differ primarily in the way the knowledge is represented. Semantic networks use groups of nodes and arcs instead of groups of text and pointers, which are used in frame hierarchies. Their advantage is that the total picture of knowledge can be visualised more easily.

[D] "Hierarchies and Inheritance" Knowledge -- The inheritance relationships can be designated by inheritance indicators or pointers in a frame. For example, If Company X is in the consumer food products industry, everything generally true about that industry is also true about Company X. Inheritance relationships are important in these systems as when new companies are added to an industry model, they automatically inherit general industry characteristics without a system developer having to write them for each new company. At the same time, new information can be added to the data describing any company in the industry without disturbing the rest of the system's knowledge base.

[E] "Object-Attribute-Value Triple" Knowledge -- It determines outcome according to the rule set by the Triple. For example:-

Object = Product, specialty cookies

Attribute = Factors affecting success

Values = Familiarity with local markets and specific market segment tastes, flexible manufacturing operations, and the like

This representation can be used in conjunction with other forms of knowledge representation.



[F] Knowledge with "Certainty Factors" -- The confidence that one has in a statement or piece of evidence can be identified. There are many different ways to represent certainty factors. For example, MYCIN, a medical diagnosis knowledge-based system, uses numbers ranging from -1 (definitely false) to +1 (definitely true). Others use numbers 1 to 10, 0 to 1, or some other range. Certainty factors are not probabilities. They are informal measures of confidence or

certainty. They represent the degree to which one believes that the knowledge represented is, in fact, true.

Because the inference engine is separate from the knowledge base, it is possible to modify the knowledge base without disturbing the inference mechanism or control program. It is in this sense that it is easier to modify knowledge-based systems than conventional computer programs. Entering knowledge is not as easy as it would first appear. The system needs a coherent, comprehensive set of rules which cover all contingencies.

Finally, all the above are tools that are mixed and matched in different combinations in the creation of a knowledge base. The exact combination used will depend on the situation under study, and on the hardware and software used.

5.1.1.2 The Inference Engine

The inference engine is a computer program that guides the manipulation of knowledge contained in a knowledge base. The inferential reasoning mechanism is distinct from the knowledge base. There are several ways of inferring reasons. The more popular ones are "Backward Chaining", "Forward Chaining", "Depth Search", and "Breadth Search".

[A] "Backward Chaining" involves starting with one or more possible goals. In a rule-based system, for example, the inference engine tests each goal to see whether or not the "if" clauses in the rule containing each possible goal are all true. It tests each rule in turn until an answer is found or until all possible rules are examined and no answer can be found.

[B] "Forward Chaining" involves working from the other direction. It starts with the data, examines the "if" clauses, and searches for a solution by working from the data toward a goal. Using this reasoning process, the system builds its case working from the data toward a solution from the data. When an answer is found to all of the "if" clauses in a rule containing a goal word in its "then" clause, the system gives the user its recommended solution. It will report that no solution is possible, if after an exhaustive search no answer is found.

Forward chaining searches can expand very rapidly, since a virtually unlimited number of rules may be examined. For this reason controls are needed to set limits on the search process. In today's systems, therefore, forward chaining usually is combined with backward chaining, which sets limits on the number of goals examined, in order to reduce the time and computer capacity required for processing. For example a strategic planner may move from the data to several hypotheses, and then back from the hypotheses to the data to re-test initial thoughts.

[C] In "Depth Search", the search mechanism first explores a line of reasoning up or down through the knowledge base. The backward chaining discussed above is one kind of depth search.

[D] In "Breadth Search", on the other hand, it would first move across the knowledge base before moving up or down a rule or frame hierarchy structure.

Inference engines can present solutions that are uncertain by combining certainty factors when searching a knowledge base. For example, they can make recommendations such as "A selective product investment strategy has a 75% certainty factor of working". In this way they can provide guidance in estimating risk.

5.1.1.3 Control Mechanisms

Like other computer systems, knowledge-based systems also have operators and control programs. For example, rule-based systems have an executor (operating program) that determines which rules are appropriate (matches), chooses one to execute (select), and executes (or fires) the chosen rule. Object or frame-based systems have executors that can determine inheritance, traverse networks, and query and modify data given in frames. In addition, procedures can be written into frames to print, edit, handle messages, trigger default values, check restrictions, and manipulate values. A variety of controls can also be included to handle the variables contained in many knowledge based systems.

Some knowledge-based systems developers consider such control mechanisms to be part of the inference engine. Others treat control mechanisms as separate components of the programme.

5.1.1.4 User Interface

An inference engine may also provide an explanation facility (User Interface). This enables it to explain to a user why a question was asked or how a conclusion was reached. In this way, during a consultation, a user can study the search processes the system followed to make a recommendation. It helps a user to understand the logic used and the assumptions upon which a decision was based. For example, it can show users the rules used to reach a conclusion or an explanation of why certain questions were asked. This feature is a powerful one, and is extremely useful in dealing with strategic company planning decisions where certain assumptions have such a significant impact on decisions. With the explanation facility, a user can identify the root assumptions and re-examine their validity.

A good user interface should be able to emulate the real consultant. Kidd [1985] showed that the latter need to answer a range of question types, i.e.,

- (a) What constitutes a fault?
- (b) What constitutes the remedy?
- (c) Why did the fault occur?
- (d) Why did the remedy work?
- (e) Why didn't the remedy work?
- (f) Will another (specific) remedy work?

Overall, the consultant's explanations have to be fluent and are a function of the expert's view of the user. The construction of the user interface is often reported as being the single most costly element in the development of an ES.

5.1.2 KNOWLEDGE-BASED SYSTEM PROGRAMMING LANGUAGES AND SHELLS

Just as conventional programming is usually written in a high level language such as PASCAL, FORTRAN, BASIC, COBOL, C, so are expert systems. However, they use different high level languages, typically LISP or PROLOG. LISP stands for "LISt Processing language", and its function is to facilitate the creation of programs to manipulate lists. LISP represents data and programs as a series of linked list data structures in the machine and as multilevel lists externally. Unlike conventional high level languages which use a series of sequential statements along with subroutines, LISP uses a series of modules specialising in a particular task. This makes programming of large systems well structured, powerful and hence its popularity follows.

PROLOG stands for "PROgramming language for LOGic". PROLOG's structure is such that it makes it easy to manipulate logical expressions. Like LISP, it is designed for symbolic rather than numeric expressions and is also excellent at list processing. Programming in PROLOG takes the form of specifying facts about objects and relationships, simple logic deduction or logical inference. Unlike LISP, PROLOG does not require the programmer to specify how the tasks are to be performed, though it requires a description of the tasks as a series of constraints to be satisfied. In short, it is task rather than algorithm orientated. Consequently, PROLOG has found favour with the Japanese Fifth Generation Computer System project.

The alternative to high level languages such as PROLOG or LISP are special packages of pre-written code in a high level language such as LISP that are used for a particular task or set of tasks. This is analogous to conventional high level programming languages such as FORTRAN where libraries of subroutines are available and can be linked to form programs for specific applications. These knowledge engineering tools have fewer applications than the languages they are written in. However, they aid in the rapid development of knowledge systems that address a specific range of problems by providing functions that would normally require a large amount of programming. Tools also provide techniques for handling knowledge, inference and control simplifying the knowledge engineers' task. When a knowledge based tool is combined with knowledge then the result is an ES. Examples of these tools are OPSS, INTERLISP, and EMYCIN.

During the 1980s, a variety of pre-programmed ES shells were developed. They contain such components as inference engine programmes, programmed control mechanisms, programmed external software interface routines, and capabilities for storing knowledge bases. A user of a shell is expected to create only the knowledge base. This allows people to create knowledge-based systems without knowing

programming languages. Shells therefore offer a means of building ESs relatively quickly and easily. The main disadvantage of the shell approach is that the knowledge engineer is restricted to the knowledge representation formalism and the inference mechanism adopted by those who developed the shell. However, this should not be a major limitation if the shell is a good one. A general ES development shell architecture is shown in FIG.5.2.

Over the decade, ES shells have triggered the current surge of work in

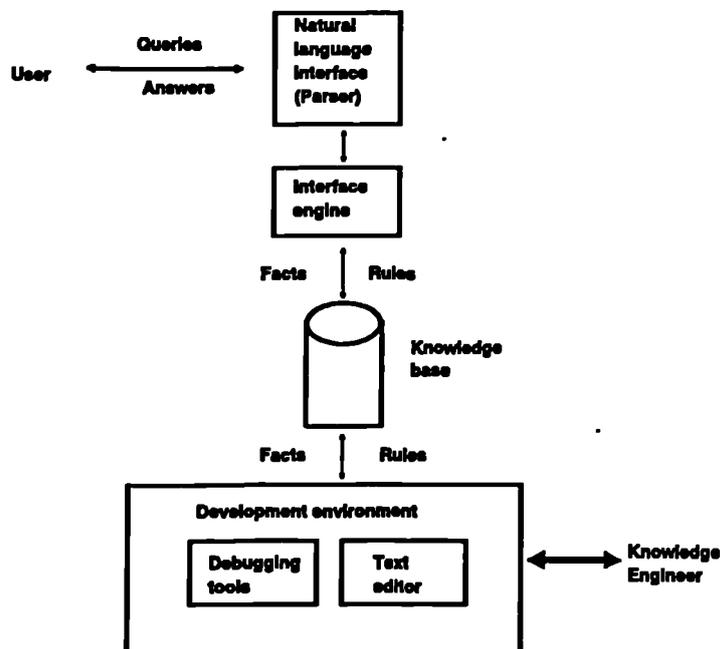


FIG. 5.2 : ES Development Shell Architecture

knowledge-based systems. Some shells developed require the use of a mainframe computer. Examples are ART, ESE and KEE. Many shells have been developed for PCs which are of most interest to this research. This is because they are the ones that will stimulate widespread development of knowledge-based systems for various applications.

Advanced microcomputer shells have been and are being developed. Teknowledge, for example, has such a microcomputer ES shell called M.1. It uses backward chaining, but also has some limited forward chaining capabilities. Its Version 2 can handle up to 2,000 rules in its knowledge base. Texas Instruments' shell PERSONAL CONSULTANT PLUS has backward and forward chaining capabilities and expanded rule capacity. Micro Data Base Systems' GURU is one of the more advanced and versatile ES shells available for PCs. Among its features are spreadsheet and relational data base systems' integration capability, math and certainty factor capabilities, and on-line knowledge base editing facilities.

The choice of tool for the development of an ES must be a compromise which takes into account factors such as performance, maintenance, cost, and development time and effort. For the purpose of this project, a good shell should be able to serve the requirement of the ES. Thus effort can be directed towards improving the ES rather than in its development.

5.1.3 THE CHOICE OF ES SHELL FOR THE RESEARCH

VP-Expert is a rule based ES shell with an inductive front end. The first release (Ver.2) is in 1987 by Paperback Software International. Since then it has been revised in 1988 (Ver.2.01) and 1989 (Ver.2.1). Williamson M. [1987] stated "VP-Expert offers the best price/performance ratio of any ES development software available today. It has my highest recommendation."

This commentary does not indicate that VP-Expert is the best all around, but it presents value for money and is a good starting point for any ES venture. It is written in C and it is fast. It can readily access or write to DBase IV, Lotus 1-2-3, VP-INFO, and VP-Planner, and has easy access to the whole of the MS-DOS environment. It has an internal editor, similar to that of WordStar, to aid easy creation and editing of knowledge bases. It uses menus and colour to provide one of the best interfaces available on a PC-based tool.

Once a rule base is built, VP-Expert is immediately available for consultation. the system displays three windows to the developer. The top window is what the user would see in a normal consultation. The bottom two windows display which rules are being tested and what conclusions have been reached.

In developing an ES, VP-Expert provides the developer with full trace facilities in the form of textual and graphic trees to explain how rules relate to each other. It supports explanations and lets the user ask What-If questions after the consultation. This allows the user to see how the results would have changed if different responses had been given. In effect it is a simulator. Backward chaining is the primary control strategy used although it is possible by manipulating the rules to force forward chaining.

The reason for choosing VP-Expert is that it is simple to use and a highly recommended development tool for ESs. It has good interfaces for both the developer and the user, and is reasonably powerful. Its features are sufficient for the type of consultation required. More important is that it is cheap, considering its price of £99 for Ver.2 and £199 for Ver.2.1 (with graphic enhancement) which is less than most of the other ES shells. Further, it has a Run-time version. Thus, any applications developed can be sold to the public together with the Run-time version which costs about 10% of the original version. Of course, the limitation is that the ES cannot be edited and re-compiled by the owner of the Run-time version.

5.2 ES DEVELOPMENT FOR EFFECTIVE APPLICATIONS OF MIS (ES-MIS)

After acquiring the knowledge through questionnaire surveys and field surveys in the 6 countries, it is imperative that this knowledge should be built into an ES so that it can be accessed by SMEs effectively. In order to achieve this objective, the ES-MIS has to be developed to be meaningful and valid. Eventually, it is hoped to produce a computer program that achieves high levels of performance on problems that normally require years of special education and training for SME managers.

5.2.1 DEVELOPING METHOD OF ASSESSMENT FOR ES-MIS

As explained in S.5.1.1.4, a good user interface should be able to emulate the real consultant. With this in mind, after using the ES-MIS the user should be able to answer the following questions:-

- [A] How successful is the degree of MIS implementation so far?
- [B] What constitutes a fault in its implementation?
- [C] What constitutes the remedy?
- [D] Why did the fault occur?
- [E] Why did the remedy work?
- [F] Why didn't the remedy work?
- [G] Will another (specific) remedy work?
- [H] The steps [B] to [G] will repeat for all suspect faults.

The knowledge of ES-MIS has already been acquired in Section 3.3. The task here is to convert that knowledge into an ES. The first step is to structure the knowledge so that it can be of value to SMEs. This is set based on the mean values of findings from the questionnaire survey (Fig.3.1). In order to have a quantitative measure of the degree of MIS achievement by SMEs, some subjective measurements have

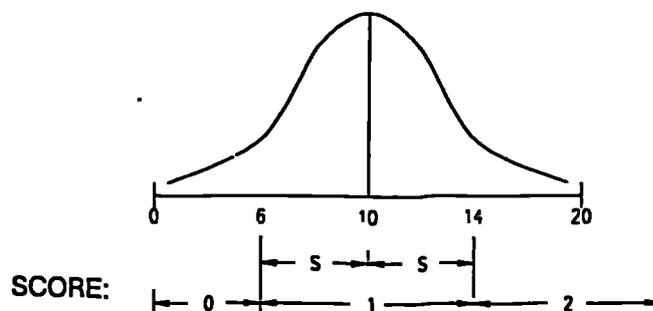


FIG. 5.3 : Scoring System Explained

to be devised. The scoring system used in the consultation is based on the spread of the mean according to the following diagram:-

For example, the mean no. of years' experience for Manufacturing Firms is 10. Then assuming normal distribution about the mean line of 10, the standard deviation 'S' = 4 (calculated from the raw data). The scoring system is such that score of 1 point will be assigned for firms within the +/- (standard deviation). In this case, firms which has experience between 6 – 14 years will be awarded a score of 1. Consequently, those with less than 6 years' experience will score 0, and more than 14 years' experience will score 2 points. This forms the basis of the scoring system. The priority established in Fig.3.1 is then weighted against the results of Factor Analysis (Fig.3.2) and Cluster Analysis (Fig.3.3). Since the discrepancy is very small, the results of Fig.3.1 is used as the representative picture based on the questionnaire survey. Finally, the following table is derived:-

FIG. 5.4 : DECISION RULES & SCORING FOR MIS-ES

Q/N	DESCRIPTION	MANUFACTURING	SERVICE
1.1	Number of Employees (N)	300	150
3.1	Mean No. of years' experience	5-14 *	5-11 *
3.2	Mean no. of Programmer/SA (N)	.01-.04 *	.02-.06 *
3.3	Mean no. of End-users (N)	.04-.12 *	.08-.24 *
4.1	Mean no. of PCs (N)	.03-.09 *	.04-.16 *
4.2	Use of LAN	NO (0) PLANNED (1) YES (2)	NO (0) PLANNED (1) YES (2)
5.	Major applications	D1 (1) D3 (1) D4 (1) D5 (1) D6 (1) D11 (1)	D1 (1) D3 (1) D4 (1) D5 (1) D6 (1) D11 (1)
6.1	Major languages used for development of applications	BASICO (1) BASICS (1)	COBOLO (1) COBOLS (1)
6.2	Major packages used for development of applications	E1 (1) E2 (1) E3 (1) E4 (1)	E1 (1) E2 (1) E3 (1) E4 (1)
7.	Av. cost of hardware (N)	£250-750 *	£350-950 *
8.	Av. cost of software (N)	£80-260 *	£120-420 *
9.	Achievements	F1 (1) F2 (1) F3 (1) F4 (1)	F1 (1) F3 (1) F4 (1) F12 (1)
10.	Computerisation is worthwhile	NO (0) YES (1)	NO (0) YES (1)
	MAXIMUM SCORE - - -	<u>31</u>	<u>31</u>

- * SMEs having less than these values score 0.
- SMEs within these values (both limits inclusive) score 1 point.
- SMEs having greater values than these score 2 points.

5.2.2 DEVELOPMENT OF KNOWLEDGE-BASE FOR ES-MIS

This is the most important part of the ES-MIS development. Here the rules are determined and the knowledge-base established. Since the ultimate objective of the ES is to include Case Studies and ES-DSS, the main menu is designated as follows:-

EXPERT SYSTEM FOR EFFECTIVE APPLICATIONS OF MICROCOMPUTER-BASED MIS	
	Copyright (C) 1991: Samuel K. M. HO, MSc MIPE MIEE MBCS MMS MIQA
[1]	Manufacturing Industry (Up to 300 Employees)
[2]	Manufacturing Industry (Up to 300 Employees) MUST switch on Printer. Prefer this to [1].
[3]	Services Industry (Up to 150 Employees)
[4]	Services Industry (Up to 150 Employees) MUST switch on Printer. Prefer this to [3].
[D]	Display this Menu again
[M]	Manufacturing Sector Case Studies
[S]	Services Sector Case Studies
[E]	Expert System for "STRATPLAN" D.S.S.
[Q]	Quit this Consultation
	Please Enter your Choice - - - >

It should be known that only Options [1] -- [4] are of direct relevance to ES-MIS. The difference between these four ESs are self-explanatory from the titles. The next step is to develop the ES itself. The ES for S&M Manufacturing with Printout (Option [2]) is illustrated in APP.7.

The overall design can be grouped under the following two phases:-

5.2.2.1 USER INPUT PHASE :-

- Q1: What is the number of employees in your firm ?
NOTE: You cannot use this consultation if your firm has over 300 people.
FIND EMPNO
- Q3A: For how many years has your firm been using computers ?
FIND YEAR
FIND SCORE3A
- Q3B: What is the number of (programmers + system analysts) ?
FIND PROSA
PROSAR = (PROSA / EMPNO)
FIND SCORE3B
- Q3C: How many End-Users are using the system ?
FIND ENDUSER
ENDR = (ENDUSER / EMPNO)
FIND SCORE3C
- Q4A: How many Personal Computers are there in your firm ?
FIND PC

PCR = (PC / EMPNO)
FIND SCORE4A

Q4B: Is networking being used ?
CHOICES NETWORK: YES,PLANNED,NO
FIND SCORE4B

*** MAJOR APPLICATIONS ***

- D1 Sales Control (customer details, accounts receivable, etc.)
- D2 Personnel Data
- D3 Inventory Control
- D4 Accounting (general ledger, payroll, etc.)
- D5 Finance (budgetary control, financial analysis, etc.)
- D6 Purchasing (vendor details, accounts payable, etc.)
- D7 Production/Operations Planning and Control
- D8 Transport/Distribution
- D9 Business Planning and Forecasting
- D10 Computer Aided Design
- D11 Word Processing
- D12 Document Filing System
- D13 Telex (Fax) Terminal
- D14 External On-line Database Access (VIEWDATA, DIALOG, etc.)

Q.5: From the above list, what are your top 6 choices ?

FIND SCORE5A
FIND SCORE5B
FIND SCORE5C
FIND SCORE5D
FIND SCORE5E
FIND SCORE5F

SCORE5 = (SCORE5A + SCORE5B + SCORE5C + SCORE5D
+ SCORE5E + SCORE5F)

Q6A: What is the CHOICE OF HIGH LEVEL LANGUAGE FOR YOUR OWN PROGRAM DEVELOPMENT ?

CHOICES Q6A: COBOL,RPG,BASIC,PASCAL,FORTRAN,NIL
FIND SCORE6A

Q6B: What is the CHOICE OF HIGH LEVEL LANGUAGE BY YOUR SOFTWARE CONSULTANT ?

CHOICES Q6B: COBOL,RPG,BASIC,PASCAL,FORTRAN,NIL
FIND SCORE6B

SCORE6 = (SCORE6A + SCORE6B)

*** DEVELOPMENT PACKAGES ***

- E1 Word Processing (e.g. Wordstar, Multimate, Word, etc.)
- E2 Database (e.g. Dbase III + / IV, Dataflex, etc.)
- E3 Integrated (e.g. LOTUS 1-2-3, Framework, Excel, etc.)
- E4 Accounting System (e.g. PROMAS, BPI, SAGE, PERGASUS, etc.)
- E5 Inventory System (e.g. INMASS, MRP, MICROSS, DACEASY, etc.)
- E6 Drawing (e.g. AUTOCAD, COREL DRAW, Harvard Graphic, etc.)
- E7 Project Planning (e.g. Milestone, HTPM, etc.)

- E8 Statistics (e.g. Minitab, SPSS, SAS, Minitab, etc.)
- E9 Forecasting (e.g. PC-GIVE, ESP, LRP, etc.)
- E10 Financial Analysis (e.g., IFPS, Ultra-plan, etc.)
- E11 Decision Supporting I (e.g. Sales Edge, Negotiate Edge, etc.)
- E12 Decision Supporting II (e.g. Don Jones, etc.)
- E13 Decision Supporting III (e.g. Operation Research, etc.)
- E14 Decision Supporting IV (e.g. 4-GL, AI, etc.)
- E15 Desktop Manager (e.g., Sidekick, Window, etc.)

Q6C: From the above list, what are your top 4 choices ?

FIND SCORE6C

FIND SCORE6D

FIND SCORE6E

FIND SCORE6F

SCORE6T = (SCORE6C + SCORE6D + SCORE6E + SCORE6F)

Q7: What is the total Hardware Investment in Pound Sterling so far ?

FIND HARD

HARDR = (HARD / EMPNO)

FIND SCORE7

Q8: What is the total Software Investment in Pound Sterling so far ?

FIND SOFT

SOFTTR = (SOFT / EMPNO)

FIND SCORE8

*** MAJOR ACHIEVEMENTS ***

- F1 Greater capability to meet future increase in business
- F2 Better control of source and use of funds
- F3 Better control of inventory
- F4 Better filing & reporting of marketing and operation information
- F5 Reduce overtime requirement
- F6 Reduce cost of production/operation
- F7 More systematic flow of materials and goods
- F8 Improve human resources management efficiency
- F9 Standardising procedures from planning to implementation
- F10 Simplification of business forecasting
- F11 Saving of raw materials and fuel
- F12 Improve product/service quality
- F13 Security of information
- F14 Training of staff in data processing

Q.9: From the above list, what are your top 4 choices ?

FIND SCORE9A

FIND SCORE9B

FIND SCORE9C

FIND SCORE9D

SCORE9 = (SCORE9A + SCORE9B + SCORE9C + SCORE9D)

Q10: Do you think that computerisation in your firm is worthwhile (i.e. benefit cost) ?

CHOICES WORTH: YES,NO

FIND SCORE10
 SCORET = (SCORE3A + SCORE3B + SCORE3C + SCORE4A + SCORE4B +
 SCORE5 + SCORE6 + SCORE6T + SCORE7 + SCORE8 + SCORE9
 + SCORE10)
 - - - > Your Total Score for the Consultation is : {SCORET},

5.2.2.2 DECISION RULE DESIGN PHASE :-

RULE 1	:	IF	YEAR > 6
		THEN	SCORE3A = 0
RULE 1A	:	IF	YEAR < = 14
		THEN	SCORE3A = 1,
		ELSE	SCORE3A = 2
RULE 2	:	IF	PROSAR < .01
		THEN	SCORE3B = 0
RULE 2A	:	IF	PROSAR < = .04,
		THEN	SCORE3B = 1
		ELSE	SCORE3B = 2
RULE 3	:	IF	ENDR < .04
		THEN	SCORE3C = 0
RULE 3A	:	IF	ENDR < = .12
		THEN	SCORE3C = 1
		ELSE	SCORE3C = 2
RULE 4A	:	IF	PCR < .03
		THEN	SCORE4A = 0
RULE 4A1	:	IF	PCR < = .09
		THEN	SCORE4A = 1
		ELSE	SCORE4A = 2
RULE 4B	:	IF	NETWORK = NO
		THEN	SCORE4B = 0
RULE 4B1	:	IF	NETWORK = PLANNED
		THEN	SCORE4B = 1
		ELSE	SCORE4B = 2
RULE 5A	:	IF	Q5A = D1 OR Q5A = D3 OR Q5A = D4 OR Q5A = D5 OR Q5A = D6 OR Q5A = D11 AND Q5A UNKNOWN
		THEN	SCORE5A = 1
RULE 5B	:	IF	Q5B = D1 OR Q5B = D3 OR Q5B = D4 OR Q5B = D5 OR Q5B = D6 OR Q5B = D11 AND Q5B UNKNOWN
		THEN	SCORE5B = 1
RULE 5C	:	IF	Q5C = D1 OR Q5C = D3 OR Q5C = D4 OR Q5C = D5 OR Q5C = D6 OR Q5C = D11 AND Q5C UNKNOWN
		THEN	SCORE5C = 1
RULE 5D	:	IF	Q5D = D1 OR Q5D = D3 OR Q5D = D4 OR Q5D = D5 OR Q5D = D6 OR Q5D = D11 AND Q5D UNKNOWN
		THEN	SCORE5D = 1
RULE 5E	:	IF	Q5E = D1 OR Q5E = D3 OR Q5E = D4 OR Q5E = D5 OR Q5E = D6 OR Q5E = D11 AND Q5E UNKNOWN
		THEN	SCORE5E = 1
RULE 5F	:	IF	Q5F = D1 OR Q5F = D3 OR Q5F = D4 OR Q5F = D5 OR Q5F = D6 OR Q5F = D11 AND Q5F UNKNOWN
		THEN	SCORE5F = 1
RULE 6A	:	IF	Q6A = BASIC AND Q6A UNKNOWN

```

      THEN          SCORE6A = 1
RULE 6B  :          IF Q6B = BASIC AND Q6B UNKNOWN
      THEN          SCORE6B = 1
RULE 6C  :          IF Q6C = E1 OR Q6C = E2 OR Q6C = E3 OR Q6C = E4 AND
      Q6C UNKNOWN
      THEN          SCORE6C = 1
RULE 6D  :          IF Q6D = E1 OR Q6D = E2 OR Q6D = E3 OR Q6D = E4 AND
      Q6D UNKNOWN
      THEN          SCORE6D = 1
RULE 6E  :          IF Q6E = E1 OR Q6E = E2 OR Q6E = E3 OR Q6E = E4 AND
      Q6E UNKNOWN
      THEN          SCORE6E = 1
RULE 6F  :          IF Q6F = E1 OR Q6F = E2 OR Q6F = E3 OR Q6F = E4 AND
      Q6F UNKNOWN
      THEN          SCORE6F = 1
RULE 7   :          IF          HARDR < 250
      THEN          SCORE7 = 0
RULE 7A  :          IF          HARDR <= 750
      THEN          SCORE7 = 1
      ELSE          SCORE7 = 2
RULE 8   :          IF          SOFTR < 80
      THEN          SCORE8 = 0
RULE 8A  :          IF          SOFTR <= 260
      THEN          SCORE8 = 1
      ELSE          SCORE8 = 2
RULE 9A  :          IF Q9A = F1 OR Q9A = F2 OR Q9A = F3 OR Q9A = F4 AND
      Q9A UNKNOWN
      THEN          SCORE9A = 1
RULE 9B  :          IF Q9B = F1 OR Q9B = F2 OR Q9B = F3 OR Q9B = F4 AND
      Q9B UNKNOWN
      THEN          SCORE9B = 1
RULE 9C  :          IF Q9C = F1 OR Q9C = F2 OR Q9C = F3 OR Q9C = F4 AND
      Q9C UNKNOWN
      THEN          SCORE9C = 1
RULE 9D  :          IF Q9D = F1 OR Q9D = F2 OR Q9D = F3 OR Q9D = F4 AND
      Q9D UNKNOWN
      THEN          SCORE9D = 1
RULE 10  :          IF          WORTH = NO AND WORTH UNKNOWN
      THEN          SCORE10 = 0
      ELSE          SCORE10 = 1
RULE 11  :          IF          EMPNO > 300
      THEN          COMMENT_EMPNO = UNQUALIFY
RULE 12  :          IF          EMPNO <= 300
      THEN          COMMENT_EMPNO = QUALIFY
```

5.2.2.3 ADDITIONAL ADVISORY PHASE :-

Based on the Correspondence Analysis in S.3.3.4.4, it is worthwhile to give additional advice to users for more industrial-specific applications, softwares, and achievements. The following decision table is employed:-

FIG.5.5: DECISION RULES FOR ADDITIONAL ADVISORY PHASE

<u>INDUSTRY</u>	<u>APPLICATIONS</u>	<u>SOFTWARES</u>	<u>ACHIEVED</u>
M1		E5,E8,E9	F7
M2	D7	E5,E8,E9	F7
M4	D10	E6	
S2		E7	F8
S4	D15		F12
S5	D15	E11	F11
S6	D8		F12
S7	D14		
S8			F8
S9	D14	E11	F8

The above mapping will form additional guideline for SMEs to make more rational choices, if they fall within one of the above industrial sectors.

5.2.3 PILOT TESTING of ES-MIS

In order to ascertain the validity of the ES-MIS developed before field testing, it is worthwhile to run a pilot test first. The questionnaire survey data from the UK samples (53 S&M Manufacturing and 33 S&M Services) are used for this purpose. The ES-MISM (Option 1) & ES-MISS (Option 2) for the Manufacturing and Services sectors are used respectively. The results are summarised as follows:-

	<u>UK SME</u>	
	<u>MANUFACTURING</u>	<u>SERVICES</u>
SAMPLE	53	33
MEAN SCORE	17.3	17.2
STD. DEVIATION	4.1	4.2

Thus the mean score for both can be treated as 17 with the 95% confidence limit set at +/-8. However, if the argument in S.5.2.1 were extended to the results of the total score, one can justify that the average firm would have a score of +/- (std. deviation), i.e. +/-4. Therefore, if a firm scores below 13, it should be considered as lower than average (at the lower quartile). On the other hand, if a firm scores

above 21, it should be considered as higher than average (at the upper quartile). This criteria now becomes the basis for comparison within the ES-MIS.

5.2.4 RECOMMENDATIONS FROM ES-MIS

Based on the findings in the above pilot test, the following recommendations are added to the ES-MIS:-

The MEAN SCORE for a successfully computerised firm is 17 with 95% confidence limit between 9 and 25. However, for sake of comparison:-

Score below 13 is LOW as it is within the Lower Quartile.

Score above 21 is HIGH as it is within the Upper Quartile.

SMEs with scores below 13 will need to consider ways in which their scores can be improved. This can be achieved by asking themselves the question "What is the ideal MIS that I want to have in my firm?" With this picture in their mind they should then repeat the consultation again. By this means, the SEMs are free from the constraint of their present state of MIS development. Those answers which give a higher score than before should be highlighted and considered as a clue for further improvement.

5.2.5 SCOPE OF GUIDANCE PROVIDED BY ES-MIS FOR SMEs

The recommendations from ES-MIS are based on the statistical results of surveys of 302 SMEs in HK & UK. The questionnaire design is based on an improvement of the similar questionnaire used by the Japan Bureau of SMEs and other PC software survey findings. They have been modified to suit the industrial environment of HK & UK respectively. It is also noted that, although hardware and software have been upgraded every year, the categories of hardware and software have remained more or less stagnant throughout the past few years. The major improvement is in the cost-effectiveness of their applications. Regarding managerial utilities, they can largely be assumed the same, except that the pace of business has been improved as a result of OA and FA. Thus, it is sufficient enough to conclude that the ES-MIS developed is and will be suitable for SMEs to assess their MIS development for the next few years or so.

5.3 DEVELOPMENT OF EFFECTIVE CASE BANK (ES-CASE)

It has been established in S.2.2.2 that Action Research and Case Studies are proven methods to understand how MISs can be used effectively in organisations. More important is that the study can often be replicated in other organisations in order to generalise the CSFs. Thus, the ES-MIS is useful as an "Acid Test" of the

effectiveness of computerisation by SMEs. However, it would not be sufficient to advise SMEs how good (or bad) they are just based on a set of parameters and a single overall measurement. This is because the computerisation process could depend on the types of business operation.

In many cases, an SME learns about computerisation through the experience of other similar organisations. However, finding a good match to the operations of a particular SME could be tedious and sometimes difficult. As discussed in Section 3.4, some 67 cases have been studied by the author in six countries (HK, Japan, Korea, Singapore, Taiwan, and U.K.) during 1987 to 1989. It is therefore useful to structure these cases so that they can be accessed readily and easily by an SME for a particular type of business operation.

The suggestion is to build up ES around the case studies, both from SMEs and Software Houses. The ES will be able to guide SME users to search for the most likely cases that would match their own requirements. They are hereby named as ES-CASE and the User-Menus are as follows:-

CASE STUDIES OF EFFECTIVE APPLICATIONS OF MICROCOMPUTER-BASED MIS

(For Manufacturing Industries of up to 300 Employees)

- [M1] Garment, Textile, or Footwear (9 cases)
 - [M2] Electrical or Electronic Products (14 cases)
 - [M3] Plastic or Metal Products (16 cases)
 - [M4] Food or Household Consumable (10 cases)
 - [M5] Building or Construction (7 cases)
 - [MA] Abbreviation List
 - [M] Display this Menu again
 - [D] Display the Main Menu
- Please Enter your Choice = = = >

CASE STUDIES OF EFFECTIVE APPLICATIONS OF MICROCOMPUTER-BASED MIS

(For Services Industries of up to 150 Employees)

- [S1] Trading or Wholesale (10 cases)
 - [S2] Retail or Restaurant (11 cases)
 - [S3] Finance or Insurance (10 cases)
 - [S4] Real Estate or Business Services (10 cases)
 - [S5] Community, Social or Personal Services (17 cases)
 - [S6] Transport or Distribution (18 cases)
 - [S7] Training Institute or Software House (26 cases)
 - [SA] Abbreviation List
 - [S] Display this Menu again
 - [D] Display the Main Menu
- Please Enter your Choice = = = >

The list of companies with a description of their activities and number of employees has been detailed in FIG.3.2. An analysis of the cross references for cases matching against various industries has also been provided in FIG.3.3. Thus, when a user inputs his type of industry, the related cases are extracted and printed if necessary. The programme listing of the ES-CASE [M1] for Garment, Textile, or Footwear is exhibited in APP.8.

5.3.1 ANALYSIS OF CASES USING CRITICAL SUCCESS FACTOR

It is important to analyse the 67 cases within a single non-trivial framework that attempts to utilise data on success factors to serve as a basis for the ES-CASE knowledge base. The approach adopted is based on the research finding of Hall [1980] which suggests that successful strategies come from purposeful moves toward a leadership position. From an investigation into 16 successful companies, Hall found that there are three main approaches:-

- [C] Achieved low delivered Cost position.
- [D] Achieved "Meaningful" Differentiation.
- [B] Both [C] & [D].

The CSF of each case is first explored and summarised in a statement. Then, the Factor Group [C], [D] or [B] is defined. These provide a framework for observing the similarity and difference in computerisation effort adopted by successful companies during the field survey. SME managers can then apply the CSFs to their company's particular operating environment.

<u>CASE</u>	<u>DESCRIPTION</u>(Critical Success Factor)	<u>EMPLOYEE</u> (Approx.)	<u>FACTOR</u> <u>GROUP</u>
<u>CH1</u>	<u>A Toy Manufacturer</u> Effective Process in installing MIS.	280	[C]
<u>CH2</u>	<u>A Battery Manufacturer</u> Improvement in sales control and factory automation.	180	[C]
<u>CH3</u>	<u>A Manufacturer of Electrical Appliance</u> Effective use of LAN and integrated database.	250	[C]
<u>CH4</u>	<u>A Construction Firm</u>	35	[B]

	Office automation and DSS system for tendering.		
CH5	<u>A Medium Size Department Store</u>	180	[C]
	Real-time inventory and accounting system.		
CH6	<u>The Management Office of a Private Housing Estate</u>	20	[D]
	Tailor-made management database.		
CH7	<u>A Paging Service Firm</u>	20	[D]
	Tailor-made customer service database as competitive edge.		
CH8	<u>A Freight Forwarder</u>	25	[B]
	Real-time logistic management.		
CH9	<u>A Life Insurance Firm</u>	80	[D]
	Tailor-made customer database to provide human touch.		
CH10A	<u>Publisher of Product Magazines</u>	140	[B]
	Improve quality and efficiency via desk-top publishing.		
CJ1	<u>Precision Plastic Components Manufacturer</u>	120	[C]
	Office automation, mould management system,		
CJ2	<u>Precision Metallic Components Manufacturer</u>	100	[B]
	CIM and "Quality, Cost, Delivery, and Service".		
CJ3	<u>Manufacturer of Metal Panels for Computers</u>	80	[C]
	OA & FA directed towards productivity and quality improvement.		
CJ4	<u>Distribution of Fresh Food and Household Consumable</u>	200	[B]
	JIT home-delivery service through VAN.		
CJ5	<u>Distribution of Processed Food and Household Consumable</u>	30	[D]
	JIT distribution service to retailers.		
CJ6	<u>Distribution of Wire Ropes for Lifts and Cranes</u>	6	[C]
	Customer database and CAD presentation.		
CJ7	<u>Manufacturing and Distribution of Toiletries & Consumable</u>	> 300	[B]
	Automated offices, VAN and marketing information system.		
CJ8	<u>Manufacturing and Distribution of Garments & Accessories</u>	> 300	[B]
	Computer-aid customised tailoring, VAN, and FA.		
CJ9	<u>Manufacturing and Distribution of Bakery Products</u>	260	[C]
	JIT bakery service and VAN.		
CJ10	<u>Manufacturing and Distribution of Spectacles/Accessories</u>	250	[D]

JIT customised services and VAN.

<u>CJ11 Human Resources Recruitment and Development</u>	8	[D]
On-line human resources services and VAN.		
<u>CK1 A Construction Firm</u>	300	[B]
Tendering DSS and on-line site control system.		
<u>CK2 An Electronic Product Manufacturer</u>	150	[C]
Distributed computing.		
<u>CK3 A Shipping Company</u>	300	[B]
Modem communication with agencies.		
<u>CK4 A Garment Manufacturer</u>	300	[C]
Turn-key material requirement planning software package.		
<u>CS1 A Manufacturer of Electrical Switches</u>	150	[C]
People commitment, software flexibility, and hardware performance.		
<u>CS2 A Trading Firm</u>	45	[C]
Continuous improvement in OA.		
<u>CS3 A Distribution Services Organisation</u>	100	[C]
Corporate software system and user participation.		
<u>CS4 A Country Club Management Office</u>	45	[D]
LAN, POS and member-oriented services.		
<u>CS5 A Mould and Die Maker</u>	80	[C]
Use of CAD/CAM for mould making.		
<u>CS6 An Architectural Firm</u>	45	[B]
Use of CAD for architectural design and OA.		
<u>CT1 Multiple-product Sales and Distribution Corporation</u>	300	[C]
Development of company-wide computerisation.		
<u>CT2 A Manufacturer of Electronic Subassemblies</u>	150	[C]
Management commitment and "Total Business System".		
<u>CT3 A Manufacturer of Electrical Switches</u>	80	[C]
Commitment and choice of software house and packages.		
<u>CU1 A Manufacturer of Industrial Fasteners</u>	160	[C]
Automation of production control system.		
<u>CU2 A Manufacturer of Office Furniture</u>	90	[C]
Development of production information system.		

<u>CU3</u>	<u>A Manufacturer of Electrical Water Heater</u>	280	[C]
	Continuous computerisation in various business applications.		
<u>CU4</u>	<u>A Manufacturer of Precision Ballscrews</u>	140	[C]
	LAN implementation of production control, OA and FA.		
<u>CU5</u>	<u>A Chartered Accountant and Solicitor Firm</u>	15	[B]
	LAN implementation of OA and computerisation of accounting.		
<u>CU6</u>	<u>A Computer Training School</u>	5	[D]
	Training on OA for the young generation.		
<u>CU7</u>	<u>A Nursing Home</u>	4	[C]
	Effective residents database.		
<u>SH1</u>	<u>A System House Specialising In LAN</u>	10	[D]
	Commitment in LAN hardware and software development.		
<u>SH2</u>	<u>A System House Specialising in LAN and Production Control</u>	15	[D]
	Specialisation in LAN and integrated business software.		
<u>SH3</u>	<u>A System House Specialising in LAN based on Work-stations</u>	15	[D]
	Customised software development based on 4-GL tool.		
<u>SH4</u>	<u>A System House Specialising In low-cost LAN</u>	5	[D]
	Low-cost LAN and bulletin board.		
<u>SJ1</u>	<u>A System House Centre</u>	50	[D]
	Software application sharing via "System House Association".		
<u>SJ2</u>	<u>An Information System House</u>	145	[C]
	Application software development for various industries.		
<u>SJ3</u>	<u>A System House Specialising in Financial Services</u>	55	[D]
	Specialisation in financial services.		
<u>SJ4</u>	<u>VAN for Pharmacies</u>	15	[B]
	Use VAN for stock minimisation and as competitive edge.		
<u>SJ5</u>	<u>VAN for General Retails</u>	20	[D]
	VAN for order processing and distribution.		
<u>SJ6</u>	<u>VAN for Electronic Bulletin Board</u>	15	[D]
	Information services to the public.		
<u>SK1</u>	<u>A Large Accounting Firm with Management Services Dept.</u>	80	[D]
	Focus on accounting and management services applications.		
<u>SK2</u>	<u>Experience in Hotel, Small Bank, and School Systems</u>	15	[D]

Market segmentation in software development.

SK3	<u>A System House with Experience in Manufacturing Systems</u>	20	[D]
	Database management systems.		
SS1	<u>Management Consultant Department of an Accounting Firm</u>	25	[B]
	Carefully selected range of LAN/OA products with own experience.		
SS2	<u>Management Consultant Group of an Accounting Firm</u>	9	[B]
	Understanding of the real need of users.		
SS3	<u>A System House Specialising in Accounting Packages</u>	4	[D]
	Customised business applications based on in-house package.		
SS4	<u>A System House with a Computer Training Centre</u>	6	[D]
	Emphasis on user training.		
SS5	<u>A Consultant and Supplier of CAD/CAM Equipment</u>	12	[D]
	Specialised in CAD/CAM and engineering applications.		
SS6	<u>Commonly Used Software met during Field Survey</u>	N.A.	[C]
	Recommend package solution first.		
SS7	<u>The "Singapore Developed Software Directory"</u>	N.A.	[D]
	Comprehensive source of software information.		
ST1	<u>A Major Hardware / Software Production Firm</u>	30	[D]
	Have faith and committed to IT development.		
ST2	<u>An Experienced Software House Specialised in Application</u>	20	[B]
	Trust in software package solution for SMEs.		
ST3	<u>A System House Specialising in Chinese software for OA</u>	15	[D]
	Belief in market niche in software development.		
ST4	<u>Information Industry Institute</u>	150	[C]
	Devoted to improvement of the software industry.		
SU1	<u>A Software House specialised in Accounting Software</u>	10	[C]
	Meeting the surging need of OA.		
SU2	<u>A Software House specialised in Manufacturing Systems</u>	30	[B]
	Specialised in manufacturing industry software support and EDI.		

The above grouping can be summarised as follows:-

GROUP	C	D	B	TOTAL
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CASE STUDIES	22	8	11	41
SOFTWARE HOUSES	4	17	5	<u>26</u>
				67
				--

It is observed that most SMEs tend to use "Cost Reduction" derived from IT as their competitive strategy. On the other hand, software houses tend to use "Differentiation" derived from IT as their competitive edge.

5.3.2 SCOPE OF GUIDANCE PROVIDED BY ES-CASE FOR SMEs

The recommendations from ES-CASE are based on the results of surveys of 67 SMEs in HK & UK. Case studies are proven methods to understand how MISs can be used effectively in organisations. The use of CSFs has been based on recognised research findings. It is generally accepted in business that the two most important competitive edges are Cost Reduction and Differentiation. These are the aspects that SME managers should be searching for when studying successful case studies. On the other hand, the cases need to be compatible with their operations. With the use of ES-CASE, they can search for the related cases easily. Then, they should be looking at the CSFs and try to emulate them for their own operations. Regarding managerial utilities, SMEs applications can largely be assumed the same, except that the pace of business has been improved as a result of OA and FA. Thus, it is good enough to conclude that the ES-CASE developed is and will be suitable for SMEs to assess their MIS development for the next few years or so.

5.4 EXPERT SYSTEM DEVELOPMENT FOR EFFECTIVE APPLICATIONS OF DSS (ES-DSS)

Before explaining how the ES-DSS was developed, it is worthwhile at this point to identify the distinction between the two "Systems". We have seen from the discussions in S.4.1 and S.5.1 that there is already a fundamental difference in the architectures of the systems. To recap, the two architectures are exhibited:-

DSS

Knowledge System
Problem Processing System
Language System

ES

Knowledge Representation
Inference Engine
Control Mechanism
User Interface

Using Bonczek's [1980] criteria, ES should be considered as a subset of DSS. Reference to architectural differences to distinguish between DSS and ES seems far from straightforward. A contrasting approach is to compare their functionality, describing the features of each. A classification approach which takes a functional perspective is that proposed by Connell and Powell [1987]. It acknowledges

architectural differences but does not focus upon them. It compares the decision maker's contribution to the decision process with the contribution made by the system, and uses this balance as a means of classifying the system. This emphasis on the extent of user input to the decision process is termed the value-added model.

The most comprehensive comparison is that of Turban and Watkins [1988], who suggest 11 attributes that may be used to contrast DSS and ES. These attributes centre around the following elements:-

- The nature of the problem (its uniqueness and complexity)
- The deciding agent (whether human or machine)
- The nature of the support given by the system (its reasoning characteristics and explanation capability, the direction of dialogue initiation)
- The nature of the system itself (its objectives and function, its method of knowledge manipulation)

After acquiring the knowledge through STRATPLAN Experiments, it is imperative that this knowledge should be built into an ES so that it can be accessed by SMEs effectively. In order to achieve this objective, the ES has to be developed to be meaningful and valid. Eventually, it is hoped that a computer program that achieves high levels of performance on problems that normally requires years of special education and training for SME managers to acquire can be produced.

5.4.1 DEVELOPMENT OF KNOWLEDGE-BASE FOR ES-DSS [E1]

The knowledge of ES-DSS has already been acquired in Section 3.4. The task here is to convert that knowledge into an ES. The first step is to structure the knowledge so that it could be of value to SMEs. This is the most important part of the ES-DSS development. Here the rules are determined and the knowledge-base established. The menu for the ES-DSS is designated as follows:-

EXPERT SYSTEM FOR EFFECTIVE APPLICATIONS OF DSS FOR "STRATPLAN"

- [E1] Decision for all rounds except last TWO
 - [E2] Decision for all rounds except last TWO (with Printout)
MUST Switch on Printer. Hardcopy will be printed.
 - [E3] Decision for last TWO rounds only
 - [E4] Decision for last TWO rounds only (with Printout)
MUST Switch on Printer. Hardcopy will be printed.
 - [H] Help Message explaining ES-DSS for STRATPLAN
 - [E] Display this Menu again
 - [D] Display the Main Menu
- Please Enter your Choice = = = >

The difference between these four ESs are self-explanatory from the titles. The reason for separating [E1] from [E3] is that the end-game strategy is quite different from the start of the game. This will be explained further in Section 5.3.2. The next step is to develop the ES itself. The ES-DSS for STRATPLAN for all except last 2 rounds and without Printout (Option [E1]) is illustrated in APP.9. Once this is developed, the Option [E3], for the last 2 rounds of the game can be derived fairly quickly.

The overall design of [E1] can be grouped under three phases, i.e., Data Capture, User Interface, and Decision Rules:-

5.4.1.1 Data Capture

The read/write of data from LOTUS 1-2-3 worksheet can be performed within VP-Expert by executing the commands called "WKS" and "PWK" respectively.

"Capture Last Year's Data from your Worksheet FIRM1.WK1"

*** LAST YEAR'S DECISIONS ***

Dividends (000)	=	{A[1]}
Stock Trade (000)	=	{A[2]}
Sales Branch	=	{A[3]}
Sales Force	=	{A[4]}
Notes Payable (000)	=	{A[5]}

	<u>PRODUCT 1</u>	<u>PRODUCT 2</u>
Price	{A[7]}	{A[16]}
Production (000)	{A[8]}	{A[17]}
Plant Capacity (000)	{A[10]}	{A[19]}
Technological Investment (000)	{A[11]}	{A[20]}
R&D Quality Investment (000)	{A[12]}	{A[21]}
R&D Cost Investment (000)	{A[13]}	{A[22]}
Advertising (000)	{A[14]}	{A[23]}
Salesmen Commission	{A[15]}	{A[24]}

*** BALANCE SHEET ***

	<u>TOTAL</u>	<u>PRODUCT 1</u>	<u>PRODUCT 2</u>
<u>ASSETS</u>			
Cash (000)	{A[25]}		
Accounts Receivable(000)		{A[26]}	{A[27]}
Inventory (000)		{A[28]}	{A[29]}
Plant Value (000)		{A[30]}	{A[31]}
Total Assets (000)	{A[32]}		
<u>LIABILITIES & EQUITIES</u>			
LIAB:	Notes Payable	{A[33]} (000)	
	Emergency Loan	{A[34]} (000)	
EQUI:	Capital Invested	{A[35]} (000)	

Advertising Weight		{A[110]}	{A[111]}
Average R&D Quality (000)		{A[112]}	{A[113]}
R&D Quality Weight		{A[114]}	{A[115]}
Average No. of Branch	{A[116]}		
Branch Weight		{A[117]}	{A[118]}
Average Salesmen	{A[119]}		
Salesmen Weight		{A[120]}	{A[121]}
Average Commission		{A[122]}	{A[123]}

5.4.1.2 User Interface

- D[1]: Estimate of New Industrial Price = $(A[106]*0.95)$
- D[2]: Estimate of New Industrial Advertising = $(A[108]*1.1) \times 1000$
- D[3]: Estimate of New Industrial R&D Quality = $(A[112]*1.1) \times 1000$
- D[4]: Estimate of New Industrial No. of Branches = $(A[116])$
- D[5]: Estimate of New Industrial No. of Salesmen = $(A[119])$
- D[6]: Estimate of New Industrial Commission Rate = $(A[122] + 0.001)$
- FACT: Your Last Year's PRICE for HOOVER = {A[7]}
- FIND: Rule 7
- ASK: C7 = What is the CHANGE of your new PRICE from last year ?
CHOICES : 10%,5%,0,-5%,-10%
- D[7]: Your Decision of NEW PRICE for HOOVER = $(A[7]*(1 + C7/100))$
- FACT: Your Last Year's UNIT COST for HOOVER = {A[79]}
- LET: E8 = $(A[13]/A[38])$
- FIND: Rule 8
- ASK: C8 = What is the CHANGE of your new UNIT COST from last year ?
CHOICES : 0,-5%,-10%,-15%,-20%
- D[8]: Your Decision of NEW UNIT COST for HOOVER = $(A[79]*(1 + C8/100))$
- FACT: Your Last Year's ADVERTISING for HOOVER = {A[14]} (000)
The ADVERTISING WEIGHT for HOOVER = {A[110]}
- HINT: If this is 0.5, you should ALWAYS choose the LOWER value of the following RECOMMENDED Advertising.
- FIND: Rule 9
- ASK: C9 = What is the CHANGE of new ADVERTISING from last year ?
CHOICES : 40%,30%,20%,10%,0
- D[9]: Your Decision of ADVERTISING for HOOVER = $A[14]*(1 + C9/100)*1000$
- FACT: Your Last Year's R&D QUALITY for HOOVER = {A[12]} (000)
The R&D QUALITY WEIGHT for HOOVER = {A[114]}
- HINT: If this is 0.5, you should ALWAYS choose the LOWER value of the following RECOMMENDED R&D Quality.
- FIND: Rule 10
- ASK: C10 = What is the CHANGE of new R&D QUALITY from last year ?
CHOICES : 40%,30%,20%,10%,0
- D[10]: Your Decision of NEW R&D COST for HOOVER = $A[12]*(1 + C10/100)*1000$
- FACT: Your Last Year's BRANCHES NO. for HOOVER = {A[3]}
The BRANCH WEIGHT for HOOVER = {A[117]}
- HINT: If this is 0.4, you should ALWAYS choose the LOWER value of the following RECOMMENDED BRANCH NO.

- FIND:** Rule 11
ASK: C11 = What is the CHANGE of new BRANCH NO. from last year ?
CHOICES : 1,0,-1
- D[11]:** Your Decision of NEW BRANCH NO. for HOOVER = $(A[3] + C11)$
- FACT:** Your Last Year's SALESMEN NO. for HOOVER = $\{A[4]\}$
 The SALESMEN WEIGHT for HOOVER = $\{A[120]\}$
- HINT:** If this is 0.5, you should ALWAYS choose the LOWER value of the following RECOMMENDED SALESMEN NO.
- FIND:** Rule 12
ASK: C12 = What is the CHANGE of new SALESMEN NO. from last year ?
CHOICES : 4,3,2,1,0
- D[12]:** Your Decision of NEW SALESMEN NO. for HOOVER = $(A[4] + C12)$
- FACT:** Your Last Year's COMMISSION for HOOVER = $\{A[15]\}$
- FIND:** Rule 13
ASK: C13 = What is the CHANGE of new COMMISSION from last year ?
CHOICES : 20%,10%,0,-10%,-20%
- D[13]:** Your Decision of NEW COMMISSION for HOOVER = $(A[15]*(1 + C13/100))$
- D[14]:** Estimate of New Industrial Price = $(A[107]*0.95)$
- D[15]:** Estimate of New Industrial Advertising = $(A[109]*1.1) \times 1000$
- D[16]:** Estimate of New Industrial R&D Quality = $(A[113]*1.1) \times 1000$
- D[17]:** Estimate of New Industrial No. of Branches = $(A[116])$
- D[18]:** Estimate of New Industrial No. of Salesmen = $(A[119])$
- D[19]:** Estimate of New Industrial Commission Rate = $(A[123] + 0.001)$
- FACT:** Your Last Year's PRICE for PUMP = $\{A[16]\}$
- FIND:** Rule 20
ASK: C20 = What is the CHANGE of your new PRICE from last year ?
CHOICES : 10%,5%,0,-5%,-10%
- D[20]:** Your Decision of NEW PRICE for PUMP = $(A[16]*(1 + C20/100))$
- FACT:** Your Last Year's UNIT COST for PUMP = $\{A[85]\}$
- LET:** E21 = $(A[22]/A[39])$
- FIND:** Rule 21
ASK: C21 = What is the CHANGE of new UNIT COST from last year ?
CHOICES : 0,-5%,-10%,-15%,-20%
- D[21]:** Your Decision of NEW UNIT COST for PUMP = $(A[85]*(1 + C21/100))$
- FACT:** Your Last Year's ADVERTISING for PUMP = $\{A[23]\}$ (000)
 The ADVERTISING WEIGHT for PUMP = $\{A[111]\}$
- HINT:** If this is 0.5, you should ALWAYS choose the LOWER value of the following RECOMMENDED Advertising.
- FIND:** Rule 22
ASK: C22 = What is the CHANGE of new ADVERTISING from last year ?
CHOICES : 40%,30%,20%,10%,0
- D[22]:** Your Decision of NEW ADVERTISING for PUMP = $A[23]*(1 + C22/100)*1000$
- FACT:** Your Last Year's R&D QUALITY for PUMP = $\{A[21]\}$ (000)
 The R&D QUALITY WEIGHT for PUMP = $\{A[115]\}$
- HINT:** If this is 0.5, you should ALWAYS choose the LOWER value of the following RECOMMENDED R&D Quality.

- FIND:** Rule 23
ASK: C23 = What is the CHANGE of new R&D QUALITY from last year ?
 CHOICES : 40%,30%,20%,10%,0
- D[23]:** Your Decision of NEW R&D COST for PUMP = $A[21]*(1 + C23/100)*1000$
- FACT:** Your Last Year's BRANCHES NO. for PUMP = {A[3]}
 The BRANCH WEIGHT for PUMP = {A[118]}
- HINT:** If this is 0.4, you should ALWAYS choose the LOWER value of the following RECOMMENDED BRANCH NO.
- FIND:** Rule 24
ASK: C24 = What is the CHANGE of new BRANCH NO. from last year ?
 CHOICES : 1,0,-1
- D[24]:** Your Decision of NEW BRANCH NO. for PUMP = $(A[3] + C24)$
- FACT:** Your Last Year's SALESMEN NO. for PUMP = {A[4]}
 The SALESMEN WEIGHT for PUMP = {A[121]}
- HINT:** If this is 0.5, you should ALWAYS choose the LOWER value of the following RECOMMENDED SALESMEN NO.
- FIND:** Rule 25
ASK: C25 = What is the CHANGE of new SALESMEN NO. from last year ?
 CHOICES : 4,3,2,1,0
- D[25]:** Your Decision of NEW SALESMEN NO. for PUMP = $(A[4] + C25)$
- FACT:** Your Last Year's COMMISSION for PUMP = {A[24]}
- FIND:** Rule 26
ASK: C26 = What is the CHANGE of new COMMISSION from last year ?
 CHOICES : 20%,10%,0,-10%,-20%
- D[26]:** Your Decision of NEW COMMISSION for PUMP = $(A[24]*(1 + C26/100))$
- FACT:** Your Last Year's CAPACITY for HOOVER = {A[10]}
- FIND:** Rule 27
ASK: C27 = What is the CHANGE of your new CAPACITY from last year ?
 CHOICES : 20%,10%,0,-10%,-20%
- D[27]:** Your Decision of NEW CAPACITY for HOOVER = $A[10]*(1 + C27/100)*1000$
- FACT:** Your Last Year's PRODUCTION for HOOVER = {A[8]}
 Your Last Year's EXCESS INVENTORY for HOOVER = {F[28]}
- LET:** $F[28] = (A[28]/A[7])$
- FIND:** Rule 28
ASK: C28 = What is the CHANGE of new PRODUCTION from last year ?
 CHOICES : 40%,30%,20%,10%,0
- D[28]:** Your Decision of NEW PRODUCTION UNITS for HOOVER = $(A[8]*(1 + C28/100)-A[28])*1000$
- FACT:** Your Last Year's CAPACITY for PUMP = {A[19]}
- FIND:** Rule 29
ASK: C29 = What is the CHANGE of your new CAPACITY from last year ?
 CHOICES : 20%,10%,0,-10%,-20%
- D[29]:** Your Decision of NEW CAPACITY for PUMP = $A[19]*(1 + C29/100)*1000$
- FACT:** Your Last Year's PRODUCTION for PUMP = {A[17]}
 Your Last Year's EXCESS INVENTORY for PUMP = {F[29]}
- LET:** $F[29] = (A[29]/A[16])$
- FIND:** Rule 30

- ASK:** C30 = What is the CHANGE of new PRODUCTION from last year ?
CHOICES : 40%,30%,20%,10%,0
- D[30]:** Your Decision of NEW PRODUCTION UNITS for PUMP =
 $(A[17]*(1 + C30/100) - A[29])*1000$
- FACT:** Your Last Year's TECH. INVESTMENT for HOOVER = {A[11]}
Your Last Year's DEBT/ASSET RATIO = {A[89]}
- HINT:** If this is 0.5, you should ALWAYS choose the LOWER value of the following RECOMMENDED TECH. INVESTMENT.
- FIND:** Rule 31
- ASK:** C31 = What is the new TECH. INVESTMENT as % of Last Year's Revenue ?
CHOICES : 8%,6%,4%,2%,0
- D[31]:** Your Decision of TECH. INVESTMENT for HOOVER =
 $(A[11]*(1 + C31/100))*1000$
- FACT:** Your Last Year's TECH. INVESTMENT for PUMP = {A[20]}
Your Last Year's DEBT/ASSET RATIO = {A[89]}
- HINT:** If this is 0.5, you should ALWAYS choose the LOWER value of the following RECOMMENDED TECH. INVESTMENT.
- FIND:** Rule 32
- ASK:** C32 = What is the new TECH. INVESTMENT as % of Last Year's Revenue ?
CHOICES : 8%,6%,4%,2%,0
- D[32]:** Your Decision of TECH. INVESTMENT for PUMP =
 $(A[11]*(1 + C32/100))*1000$
(You should ALWAYS choose the 2nd Choice of the following RECOMMENDED STOCK TRADE.
- FIND:** Rule 33
- ASK:** C33 = What is the CHANGE of your new STOCK TRADED ?
CHOICES : 20%,10%,0
- D[33]:** Your Decision of STOCK TRADE for Firm =
 $((A[35] + A[36])*C33/100)*1000$
- FACT:** Your Last Year's DIVIDENDS = {A[1]}
Your Last Year's DEBT/ASSET RATIO = {A[89]}
- HINT:** If this is 0.5, you should ALWAYS choose the LOWER value of the following RECOMMENDED DIVIDENDS.
- FIND:** Rule 34
- ASK:** C34 = What is the new DIVIDENDS as % of Last Year's Profit ?
CHOICES : 40%,30%,20%,10%,0
- D[34]:** Your Decision of DIVIDENDS for Firm = $(A[57]*C34/100)*1000$
- FACT:** Your Last Year's R&D COST for HOOVER = {A[13]}
Your Last Year's DEBT/ASSET RATIO = {A[89]}
- HINT:** If this is 0.5, you should ALWAYS choose the LOWER value of the following RECOMMENDED R&D COST.
- FIND:** Rule 35
- ASK:** C35 = What is the new R&D COST as % of Last Year's Revenue ?
CHOICES : 4%,3%,2%,1%,0
- D[35]:** Your Decision of R&D COST for HOOVER = $(A[38]*C35/100)*1000$
- FACT:** Your Last Year's R&D COST for PUMP = {A[22]}
Your Last Year's DEBT/ASSET RATIO = {A[89]}

HINT: If this is 0.5, you should ALWAYS choose the LOWER value of the following RECOMMENDED R&D COST.

FIND: Rule 36

ASK: C36 = What is the new R&D COST as % of Last Year's Revenue ?
CHOICES : 4%,3%,2%,1%,0

D[36]: Your Decision of R&D COST for PUMP = $(A[39]*C36/100)*1000$

FACT: Your Last Year's Outstanding Loan = $\{A[33]\}$

HINT: If you decided to Sell Stock at 1st round, ask NO Loan.
However, you should raise 1,000,000 at 2nd round;
and 500,000 at 3rd round for investment.

FIND: Rule 37

ASK: C37 = What is the LOAN (X1000) you want to borrow from Bank ?
CHOICES : 1500,1000,500,0

D[37]: Your Decision of Additional Loan = $C37*1000$

"Write Results back to FIRM1.WK1"

5.4.1.3 Decision Rules

RULE 7

IF $A[7] <= (A[106])$
THEN **DISPLAY***
LAST YEAR: Your firm had LOWER PRICE than the average firm.
RECOMMEND: Make no change."
ELSE **DISPLAY***
LAST YEAR: Your firm had HIGHER PRICE than the average firm.
RECOMMEND: Reduce by 5% if at 1st/2nd round ELSE No change."

RULE 8

IF $E8 <= 0.05$
THEN **DISPLAY***
LAST YEAR: Your firm had R&D COST less than 5% of your turnover.
RECOMMEND: Reduce UNIT COST by 5% if 1st/2nd round ELSE by 10%."
ELSE **DISPLAY***
LAST YEAR: Your firm had R&D COST more than 5% of your turnover.
RECOMMEND: Reduce UNIT COST by 10% if 1st/2nd round ELSE by 15%"

RULE 9

IF $A[14] <= A[108])$
THEN **DISPLAY***
LAST YEAR: Your firm had LOWER ADVERTISING than the average firm.
RECOMMEND: Increase figure by 30% if at 1st/2nd round ELSE by 20%."
ELSE **B9 = VALUE**
LAST YEAR: Your firm had HIGHER ADVERTISING than the average firm.
RECOMMEND: Increase by 20% if at 1st/2nd round ELSE by 10%."

RULE 10

IF $A[12] <= (A[112])$
THEN **DISPLAY***
LAST YEAR: Your firm had LOWER R&D QUALITY than the average firm.
RECOMMEND: Increase figure by 30% if at 1st/2nd round ELSE by 20%."
ELSE **DISPLAY***
LAST YEAR: Your firm had HIGHER R&D QUALITY than the average firm.

RECOMMEND: Increase by 10% if at 1st/2nd round ELSE No change."

RULE 11

IF A[3] <= (A[116])

THEN DISPLAY"

LAST YEAR: Your firm had LESS BRANCHES than the average firm.

RECOMMEND: Increase figure by 1 if at 1st/2nd round ELSE No change."

ELSE DISPLAY"

LAST YEAR: Your firm had MORE BRANCHES than the average firm.

RECOMMEND: Make no change."

RULE 12

IF A[4] <= (A[119])

THEN DISPLAY"

LAST YEAR: Your firm had LESS SALESMEN than the average firm.

RECOMMEND: Increase figure by 3 if at 1st/2nd round ELSE by 2."

ELSE DISPLAY"

LAST YEAR: Your firm had MORE SALESMEN than the average firm.

RECOMMEND: Increase figure by 2 if at 1st/2nd round ELSE by 1."

RULE 13

IF A[15] <= A[122])

THEN DISPLAY"

LAST YEAR: Your firm had LOWER COMMISSION than the average firm.

RECOMMEND: Increase figure by 20% if at 1st/2nd round ELSE by 10%."

ELSE DISPLAY"

LAST YEAR: Your firm had HIGHER COMMISSION than the average firm.

RECOMMEND: Increase figure by 10% if 1st/2nd round ELSE No change."

RULE 20

IF A[16] <= (A[107])

THEN DISPLAY"

LAST YEAR: Your firm had LOWER PRICE than the average firm.

RECOMMEND: Make no change."

ELSE DISPLAY"

LAST YEAR: Your firm had HIGHER PRICE than the average firm.

RECOMMEND: Reduce figure by 5% if at 1st/2nd round ELSE no change."

RULE 21

IF E21 <= 0.05

THEN DISPLAY"

LAST YEAR: Your firm had R&D COST less than 5% of your turnover.

RECOMMEND: Reduce UNIT COST by 5% if at 1st/2nd round ELSE by 10%."

ELSE DISPLAY"

LAST YEAR: Your firm had R&D COST more than 5% of your turnover.

RECOMMEND: Reduce UNIT COST by 10% if at 1st/2nd round ELSE by 15%."

RULE 22

IF A[23] <= (A[109])

THEN DISPLAY"

LAST YEAR: Your firm had LOWER ADVERTISING than the average firm.

RECOMMEND: Increase figure by 30% if at 1st/2nd round ELSE by 20%."

ELSE DISPLAY"

LAST YEAR: Your firm had HIGHER ADVERTISING than the average firm.

RECOMMEND: Increase by 20% if at 1st/2nd round ELSE by 10%."

RULE 23

IF A[21] <= (A[113])
 THEN DISPLAY"
 LAST YEAR: Your firm had LOWER R&D QUALITY than the average firm.
 RECOMMEND: Increase figure by 30% if at 1st/2nd round ELSE by 20%."
 ELSE DISPLAY"
 LAST YEAR: Your firm had HIGHER R&D QUALITY than the average firm.
 RECOMMEND: Increase by 10% if at 1st/2nd round ELSE No change."

RULE 24

IF A[3] <= (A[116])
 THEN DISPLAY"
 LAST YEAR: Your firm had LESS BRANCHES than the average firm.
 RECOMMEND: Increase figure by 1 if 1st/2nd round ELSE No change."
 ELSE DISPLAY"
 LAST YEAR: Your firm had MORE BRANCHES than the average firm.
 RECOMMEND: Make no change."

RULE 25

IF A[4] <= (A[119])
 THEN DISPLAY"
 LAST YEAR: Your firm had LESS SALESMEN than the average firm.
 RECOMMEND: Increase figure by 3 if at 1st/2nd round ELSE by 2."
 ELSE DISPLAY"
 LAST YEAR: Your firm had MORE SALESMEN than the average firm.
 RECOMMEND: Increase figure by 2 if at 1st/2nd round ELSE by 1."

RULE 26

IF A[24] <= (A[123])
 THEN DISPLAY"
 LAST YEAR: Your firm had LOWER COMMISSION than the average firm.
 RECOMMEND: Increase figure by 20% if at 1st/2nd round ELSE by 10%."
 ELSE DISPLAY"
 LAST YEAR: Your firm had HIGHER COMMISSION than the average firm.
 RECOMMEND: Increase by 10% if at 1st/2nd round ELSE No change."

RULE 27

IF A[10] <= (A[8]*0.8)
 THEN DISPLAY"
 LAST YEAR: Your firm had CAPACITY LESS than 80% of Production.
 RECOMMEND: Increase figure by 20% if at 1st/2nd round ELSE by 10%."
 ELSE DISPLAY"
 LAST YEAR: Your firm had CAPACITY MORE than 80% of Production.
 RECOMMEND: Increase by 10% if at 1st/2nd round ELSE No change."

RULE 28

IF C7 <= (-5)
 THEN DISPLAY"
 THIS YEAR: Your firm decided to drop Price by more than 5%.
 RECOMMEND: Increase Production by 30% if 1st/2nd round ELSE by 20%.
 NOTE: Stock carried over from last year will then be deducted."
 ELSE DISPLAY"
 THIS YEAR: Your firm decided to have little change in Price."

RECOMMEND: Increase Production by 20% if 1st/2nd round ELSE by 10%.
 NOTE: Stock carried over from last year will then be deducted."

RULE 29

IF $A[19] <= (A[17]*0.8)$

THEN DISPLAY"

LAST YEAR: Your firm had CAPACITY LESS than 80% of Production.

RECOMMEND: Increase by 20% if at 1st/2nd round ELSE by 10%."

ELSE DISPLAY"

LAST YEAR: Your firm had CAPACITY MORE than 80% of Production.

RECOMMEND: Increase by 10% if at 1st/2nd round ELSE No change."

RULE 30

IF $C20 <= (-5)$

THEN DISPLAY"

THIS YEAR: Your firm decided to drop Price by more than 5%.

RECOMMEND: Increase Production by 30% if 1st/2nd round ELSE by 20%.

NOTE: Stock carried over from last year will then be deducted."

ELSE DISPLAY"

THIS YEAR: Your firm decided to have little change in Price.

RECOMMEND: Increase Production by 10% if 1st/2nd round ELSE 0%.

NOTE: Stock carried over from last year will then be deducted."

RULE 31

IF $A[102] <= (0.2)$

THEN DISPLAY"

LAST YEAR: Your firm had LESS than 20% R.O.I.

RECOMMEND: Increase figure by 30% if at 1st/2nd round ELSE by 20%."

ELSE DISPLAY"

LAST YEAR: Your firm had MORE than 20% R.O.I.

RECOMMEND: Increase figure by 10% if at 1st/2nd round ELSE 0%."

RULE 32

IF $A[102] <= (0.2)$

THEN DISPLAY"

LAST YEAR: Your firm had LESS than 20% R.O.I.

RECOMMEND: Increase figure by 30% if at 1st/2nd round ELSE by 20%."

ELSE DISPLAY"

LAST YEAR: Your firm had MORE than 20% R.O.I.

RECOMMEND: Increase figure by 10% if at 1st/2nd round ELSE 0%."

RULE 33

IF $A[103] = (1990)$

THEN DISPLAY"

This is the 1st round, you need to raise fund to finance your
 Investments.

RECOMMEND: Sell 10% (+ 10%) more of your existing shares

ELSE DISPLAY"

This is not the 1st round, you should not do trading unnecessarily.

RECOMMEND: No trading."

RULE 34

IF $A[1] (0)$

THEN DISPLAY"

LAST YEAR: Your firm had PAID OUT Dividends.

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RECOMMEND: Pay 20% Profit as Dividends if 1st/2nd round ELSE 30%."
ELSE DISPLAY"
LAST YEAR: Your firm had NOT PAID Dividends.
RECOMMEND: Pay 10% Profit as Dividends if 1st/2nd round ELSE 20%."

RULE 35
IF A[102] <= (0.2)
THEN DISPLAY"
LAST YEAR: Your firm had LESS than 20% R.O.I.
RECOMMEND: Invest 4% of Last Year's Revenue if 1st/2nd round ELSE 3%"
ELSE DISPLAY"
LAST YEAR: Your firm had MORE than 20% R.O.I.
RECOMMEND: Invest 3% of Last Year's Revenue if 1st/2nd round ELSE 2%"

RULE 36
IF A[102] <= (0.2)
THEN DISPLAY"
LAST YEAR: Your firm had LESS than 20% R.O.I.
RECOMMEND: Invest 4% of Last Year's Revenue if 1st/2nd round ELSE 3%"
ELSE DISPLAY"
LAST YEAR: Your firm had MORE than 20% R.O.I.
RECOMMEND: Invest 3% of Last Year's Revenue if 1st/2nd round ELSE 2%"

RULE 37
IF A[103] (1990)
THEN DISPLAY"
T his is the 2nd/3rd Round. You need Loan to finance your investment.
RECOMMEND: Raise 1000K if 2nd round ELSE 500K if 3rd round."
ELSE DISPLAY"
This is the 1st Round.
You should not need any Loan unless you decided not to sell shares."

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5.4.2 DEVELOPMENT OF KNOWLEDGE-BASE FOR ES-DSS [E3]

There is a need to develop a separate ES for the last TWO round of the game. This is because tactics have to be modified as both product life cycles moves through the stages of maturity and decline stages. The major difference from [E1] are to:-

- [A] Keep above average prices to plough back profits.
- [B] Invest more in advertising to increase sales in order to increase the market share further.
- [C] Have zero investment in technological investment and R&D costs as the payback period are more than 3 years.
- [D] Minimise investment in capacity and R&D quality.
- [E] Pay back loan to reduce the debt/asset ratio, and buy back shares to strengthen stock price and shareholder values at the last round.

The corresponding expert system (ES-DSS Option [E3]) is shown in APP.10.

5.4.3 PILOT TESTING of ES-DSS

In order to monitor the validity of the models [E1] & [E3] developed, it is useful to do a "dry-run". This is done by keeping Firm 2-6 decision unchanged for the full period, and then using models to make decisions for Firm 1 only. The result of such simulation is summarised as follows. It is noted here that when the game was played, it was entirely driven by the decisions recommended by the ES-DSS models. The reports of Firm 1 are explained as follows:-

5.4.3.1 Decisions

The decisions for every period are summarised in the following table. Altogether, 21 decisions have to be made for every period. They are made according to the recommendations of the ES-DSS. For 1991-1993, [E1] was used. For 1994-1995, [E3] was used.

For year ending 31 Dec == >	1990	1991	1992	1993	1994	1995
Dividends Paid (000)	529	523	518	473	668	1,071
Stock Traded (000)	0	738	816	0	0	(1250)
Sales Branches	3	4	4	4	4	4
Sales Force	14	16	17	17	17	17
Notes Payable (000)	0	0	0	500	0	(500)
Capital moved (000) *	0	0	0	0	0	0
HOOVER Price	30.0	29.0	28.0	28.0	28.0	28.0
Production (000)	136	167	195	193	208	225
Shipments +- (000) *	0	0	0	0	0	0
Capacity (000)	129	142	156	172	172	172
Tech. Inv. (000)	120	156	225	172	172	0
R&D: Qual. (000)	120	156	172	172	172	0
R&D: Costs (000)	120	246	286	212	219	0
Advertising (000)	258	335	369	369	369	369
Commission Rate	1.00%	1.20%	1.30%	1.30%	1.30%	1.30%
PUMP Price	75.0	71.0	67.0	67.0	67.0	70.0
Production (000)	78	106	134	143	148	147
Shipments +- (000) *	0	0	0	0	0	0
Capacity (000)	73	80	95	105	116	116
Tech. Inv. (000)	160	208	0	229	229	0
R&D: Qual. (000)	160	208	229	229	229	0
R&D: Costs (000)	160	351	453	360	382	0
Advertising (000)	367	477	525	525	525	525
Commission Rate	1.00%	1.20%	1.30%	1.30%	1.30%	1.40%

* Not required for single market.

5.4.3.2 Balance Sheet (000)

These are the printouts available at the end of every period to show the account position at the year end. They provide valuable information to the ES-DSS for advising decisions for the next period.

For year ending 31 Dec == >	1990	1991	1992	1993	1994	1995
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Assets:Cash		1,269	1,523	1,611	2,933	4,437	4,895
Acct Rec.	: HOOVER	673	784	869	900	958	926
	: PUMP	962	1,240	1,479	1,572	1,627	1,533
Inventory	: HOOVER	0	0	40	0	0	265
	: PUMP	0	0	0	0	0	526
Plant Val	: HOOVER	3,545	3,960	4,315	4,940	4,856	4,614
	: PUMP	2,593	2,968	3,293	4,250	4,813	4,572
Total Assets		9,042	10,475	11,606	14,594	16,692	17,330
Liab. : Notes Payable		1,653	1,653	1,653	2,153	2,153	1,653
Emergency loan		0	0	0	0	0	0
Equity: Captl Invested		1,983	2,647	2,717	3,382	3,382	2,132
Retnd Earnings		5,406	6,176	7,236	8,060	11,158	13,546
Total Liab. & O.E.		9,042	10,475	11,606	14,594	16,692	17,330

5.4.3.3 Income Statement (000)

These are the printouts available at the end of every period to show the profit & loss during the year. They provide valuable information to the ES-DSS for advising decisions for the next period.

For year ending 31 Dec == >	1990	1991	1992	1993	1994	1995
Sales income : HOOVER	4,094	4,766	5,288	5,475	5,829	5,632
: PUMP	5,850	7,546	8,999	9,561	9,900	9,328
Cost of Goods :HOOVER	1,963	2,302	2,521	2,286	2,336	2,232
: PUMP	3,650	4,950	5,974	5,914	5,703	4,978
Gross profit	4,331	5,060	5,792	6,835	7,690	7,750
Expenses:						
Administration	66	68	70	75	77	77
Inven.Carry :HOOVER	0	0	6	0	0	48
: PUMP	0	0	0	0	0	28
Advertising :HOOVER	258	335	369	369	369	369
: PUMP	367	477	525	525	525	525
R&D Quality :HOOVER	120	156	172	172	172	0
: PUMP	160	208	229	229	229	0
R&D Cost :HOOVER	120	246	286	212	219	0
: PUMP	160	351	453	360	382	0
Depreciation:HOOVER	187	208	227	260	256	243
: PUMP	136	156	173	224	253	241
Sales Force :Salary	175	205	215	213	213	213
Commission : HOOVER	41	57	70	71	76	73
Commission : PUMP	58	91	119	124	129	133
Branch Ops : Base	113	180	150	150	150	150
: HOOVER	51	60	66	68	73	70
: PUMP	58	75	90	96	99	93
Shipping : HOOVER	0	0	0	0	0	0
: PUMP	0	0	0	0	0	0
Consulting Fees	0	0	0	0	0	0
Total Expenses	2,071	2,874	3,221	3,147	3,220	2,263
EBIT	2,261	2,186	2,571	3,688	4,470	5,488
Interest	248	198	149	215	215	165
Taxes Due	704	696	848	1,215	1,489	1,863

Net Profit	1,308	1,292	1,575	2,257	2,765	3,460
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5.4.3.4 Operation Summary

These are the printouts available at the end of every period to show the operational results of the year. They provide valuable information to the ES-DSS for advising decisions for the next period.

For year ending 31 Dec == >	1990	1991	1992	1993	1994	1995
—Market Index—	Actual	Actual	Actual	Actual	Actual	Actual
U.K. :HOOVER	2.00%	4.00%	6.00%	8.00%	6.00%	5.00%
: PUMP	2.00%	4.00%	6.00%	8.00%	6.00%	5.00%
—OPERATIONS—						
HOOVER						
: unit sales	136,467	167,242	192,278	195,522	208,170	201,130
: unit Inventory	0	0	3,022	0	0	23,870
: mkt. share (%)	17.0%	19.0%	21.0%	22.0%	23.0%	22.0%
: unit cost	14.08	12.98	12.13	11.20	10.49	10.14
: capac. price	35.93	37.03	37.38	39.13	40.13	40.13
: capac. sell	15.40	15.87	16.02	16.77	17.20	17.20
PUMP: unit sales	77,997	105,833	133,518	142,698	147,765	132,686
: unit Inventory	0	0	0	0	0	14,014
: mkt. share (%)	17.00%	21.00%	25.00%	26.00%	27.00%	25.00%
: unit cost	45.62	42.61	40.12	37.48	35.54	34.62
: capac. price	46.19	48.79	46.19	53.38	55.36	55.36
: capac. sell	21.00	22.18	21.00	24.27	25.16	25.16
Interest Rate on Debt	15.00%	12.00%	9.00%	10.00%	10.00%	10.00%
Debt/Assets Ratio	0.18	0.16	0.14	0.15	0.13	0.10
Debt/Equity Ratio	0.22	0.19	0.17	0.17	0.15	0.11
Inventory Turnover	24.00	24.00	24.00	24.00	24.00	18.24
HOOVER	0.00	0.00	24.00	24.00	0.00	4.21
PUMP	0.00	0.00	0.00	0.00	0.00	4.73
Gross Profit Margin	44.0%	41.0%	41.0%	45.0%	49.0%	52.0%
HOOVER	52.0%	52.0%	52.0%	58.0%	60.0%	60.0%
PUMP	38.0%	34.0%	34.0%	38.0%	42.0%	47.0%
Net Operating Margin	23.0%	18.0%	18.0%	25.0%	28.0%	37.0%
HOOVER	33.0%	29.0%	30.0%	38.0%	40.0%	46.0%
PUMP	21.0%	15.0%	15.0%	22.0%	26.0%	36.0%
Profit Margin on Sales	13.0%	10.0%	11.0%	15.0%	18.0%	23.0%
Return on Assets	17.0%	14.0%	15.0%	17.0%	18.0%	21.0%
Return on Investment	18.0%	15.0%	16.0%	18.0%	19.0%	22.0%
Year	1990	1991	1992	1993	1994	1995
Team No.	1	1	1	1	1	1
No. of Teams	6	6	6	6	6	6
Price: HOOVER	30.00	29.75	29.58	29.67	29.67	29.67
Price: PUMP	75.00	74.38	73.73	73.67	73.67	74.22
Advertising: HOOVER	258	271	277	277	277	277
Advertising: PUMP	367	385	393	393	393	393
Advertising Wt.: HOOVER	0.90	0.90	0.90	0.90	0.90	0.90
Advertising Weight: PUMP	0.90	0.90	0.90	0.90	0.90	0.90
R&D Quality: HOOVER	120	126	129	129	129	100
R&D Quality: PUMP	160	168	172	172	172	133

R&D Weight: HOOVER	0.50	0.50	0.50	0.50	0.50	0.50
R&D Weight: PUMP	0.10	0.10	0.10	0.10	0.10	0.10
Branches	3	3	3	3	3	3
Branch Weight: HOOVER	0.40	0.40	0.40	0.40	0.40	0.40
Branch Weight: PUMP	0.20	0.20	0.20	0.20	0.20	0.20
Salesmen	14	14	15	15	15	15
Salesmen Weight: HOOVER	0.80	0.80	0.80	0.80	0.80	0.80
Salesmen Weight: PUMP	0.20	0.20	0.20	0.20	0.20	0.20
Commission: HOOVER	0.010	0.010	0.011	0.011	0.011	0.011
Commission: PUMP	0.010	0.010	0.011	0.011	0.011	0.011

5.4.3.5 Decisions by ES-DSS

These are the printouts available at the end of every period to show the operational results of the year. They are based on the decisions advised by the ES-DSS.

For year beginning 1 Jan:-	1990	1991	1992	1993	1994	1995
D1: Ind.Av. Price	28.50	28.18	28.10	28.18	28.18	28.18
D2: Ind.Av. Advertising	283.80	304.15	304.15	304.15	304.15	304.15
D3: Ind.Av. R&D Quality	132.00	110.00	141.53	110.00	110.00	141.53
D4: Ind.Av. Branches	3.00	3.17	3.17	3.17	3.17	3.17
D5: Ind.Av. Salesmen No.	14.00	14.50	14.50	14.50	14.50	14.50
D6: Ind.Av. Commission	0.01	0.01	0.01	0.01	0.01	0.01
D7: Price	28.50	30.80	28.00	30.80	30.80	28.00
D8: Est. Unit Cost	13.38	10.14	10.31	10.14	10.14	10.16
D9: Advertising (000)	335.40	442.80	369.00	442.80	442.80	369.00
D10: R&D Quality (000)	156.00	1126.40	172.00	1126.40	1126.40	0.00
D11: Branches	4.00	6.00	4.00	6.00	6.00	4.00
D12: Salesmen	16.00	19.00	17.00	19.00	19.00	17.00
D13: Commission	0.01	0.02	0.01	0.02	0.02	0.01
D14: Ind.Av. Price	71.25	70.51	70.05	70.51	70.51	69.98
D15: Ind.Av. Advertising	403.70	432.67	432.67	432.67	432.67	432.67
D16: Ind.Av. R&D Quality	176.00	146.67	188.65	146.67	146.67	188.65
D17: Ind.Av. Branches	3.00	3.17	3.17	3.17	3.17	3.17
D18: Ind.Av. Salesmen No.	14.00	14.50	14.50	14.50	14.50	14.50
D19: Ind.Av. Commission	0.01	0.01	0.01	0.01	0.01	0.01
D20: Price	71.25	77.00	67.00	77.00	77.00	70.35
D21: Est. Unit Cost	43.34	34.62	34.10	34.62	34.62	33.00
D22: Advertising (000)	477.10	630.00	525.00	630.00	630.00	525.00
D23: R&D Quality (000)	208.00	1865.60	229.00	1865.60	1865.60	0.00
D24: Branches	3.00	6.00	4.00	6.00	6.00	4.00
D25: Salesmen	15.00	19.00	17.00	19.00	19.00	17.00
D26: Commission	0.01	0.02	0.01	0.02	0.02	0.01
D27: P1 Capacity (000)	141.90	206.40	171.60	206.40	206.40	172.00
D28: P1 Production (000)	176.80	50.00	174.50	50.00	50.00	249.60
D29: P2 Capacity (000)	80.30	139.20	104.50	139.20	139.20	116.00
D30: P2 Production (000)	101.40	-320.20	134.00	-320.20	-320.20	162.80

D31: P1 Tech. Investment	245.64	450.56	211.52	450.56	450.56	0.00
D32: P2 Tech. Investment	351.00	746.24	359.96	746.24	746.24	0.00
D33: Stock Traded (000)	0.00	3135.60	-995.30	3135.60	3135.60	-1371.30
D34: Dividends (000)	523.20	1384.00	472.50	1384.00	1384.00	1070.80
D35: P1 R&D Cost (000)	245.64	450.56	211.52	450.56	450.56	0.00
D36: P2 R&D Cost (000)	351.00	746.24	359.96	746.24	746.24	0.00
D37: Loan Increase (000)	0.00	0.00	0.00	500.00	0.00	-500.00

5.4.3.6 Summary of Results

These are the summary of results after each period. Only the more relevant ones are extracted here for analysis and comparison. The following notations are used for the first column:-

F1	=	Firm 1					
FX	=	Firm (2 - 6)					
F1PA	=	Firm 1 Product A (HOOVER)					
F1PB	=	Firm 1 Product B (PUMP)					
FXPA	=	Firm (2 - 6) Product A (HOOVER)					
FXPB	=	Firm (2 - 6) Product B (PUMP)					
For year ending 31 Dec == >		1990	1991	1992	1993	1994	1995
F1PA Tech Inv. (000)		120	156	172	172	172	0
FXPA Tech Inv. (000)		120	120	120	120	120	120
F1PA Capacity (000)		129	142	156	172	172	172
FXPA Capacity (000)		129	129	129	129	129	129
F1PA Unit Cost		14.1	13.0	12.0	11.2	10.5	10.1
FXPA Unit Cost		14.1	13.2	12.5	11.9	11.3	10.8
F1PA Price		30.0	28.5	27.5	28.0	28.0	28.0
FXPA Price		30.0	30.0	30.0	30.0	30.0	30.0
F1PA Unit Sales		136000	167000	192000	196000	208000	201000
FXPA Unit Sales		136000	140000	142000	142000	142000	142000
F1PA Mkt. Share		0.17	0.19	0.21	0.22	0.23	0.22
FXPA Mkt. Share		0.17	0.16	0.16	0.16	0.16	0.16
F1PB Tech Inv. (000)		160	208	229	229	229	0
FXPB Tech Inv. (000)		160	160	160	160	160	160
F1PB Capacity (000)		73	80	95	105	116	116
FXPB Capacity (000)		73	73	73	73	73	73
F1PB Unit Cost		45.6	42.6	39.7	37.5	35.5	34.6
FXPB Unit Cost		45.6	43.4	41.6	39.9	38.4	36.9
F1PB Price		75.0	71.3	67.4	67.0	67.0	70.3
FXPB Price		75.0	75.0	75.0	75.0	75.0	75.0
F1PB Unit Sales		78000	106000	134000	143000	148000	133000
FXPB Unit Sales		78000	79200	80300	80300	80300	80300
F1PB Mkt. Share		0.17	0.21	0.25	0.26	0.27	0.25
FXPB Mkt. Share		0.17	0.16	0.15	0.15	0.15	0.15
F1 Turnover (000)		9930	12317	14312	15069	15740	14978
FX Turnover (000)		9930	10140	10283	10283	10283	10283
F1 R&D (000)		560	961	1140	973	1000	0
FX R&D (000)		560	560	560	560	560	560

F1 Advertising (000)	625	812	894	894	894	894
FX Advertising (000)	625	625	625	625	625	625
F1 Sales Force	274	353	404	408	417	419
FX Sales Force	274	276	278	278	278	278
F1 Branches	222	315	306	314	322	314
FX Branches	222	224	226	226	226	226
F1 Profits (000)	1310	1290	1620	2300	2770	3440
FX Profits (000)	1310	1290	1620	2260	2770	3460
F1 Total Asset (000)	9040	10500	12300	14600	16700	17300
FX Total Asset (000)	9040	10100	11300	12700	14300	16000
F1 Debt (000)	1650	1650	1650	2150	2150	1650
FX Debt (000)	1650	1650	1650	1650	1650	1650
F1 Emergency Loans	0	0	0	0	0	0
FX Emergency Loans	0	0	0	0	0	0
F1 Equity + Retain 000	7390	8820	10700	12400	14500	15700
FX Equity + Retain 000	7390	8420	9690	11100	12600	14300
F1 Shares Issued 000	1000	1100	1200	1200	1200	1100
FX Shares Issued 000	1000	1000	1000	1000	1000	1000
F1 Dividends (000)	529	523	518	473	668	1070
FX Dividends (000)	529	529	529	529	529	529
F1 Stock Price	7.39	8.02	8.87	10.40	12.10	14.30
FX Stock Price	7.39	8.42	9.69	11.10	12.60	14.30
F1 R.O.I.	0.18	0.15	0.15	0.18	0.19	0.22
FX R.O.I.	0.18	0.19	0.19	0.17	0.16	0.15
F1 Shareholder Val.000	0	-1460	1810	5800	4540	6450
FX Shareholder Val.000	0	1870	2180	0	0	0
F1 Industry Mkt Share	16.70%	20.20%	23.15%	23.90%	24.80%	23.45%
FX Industry Mkt Share	16.70%	15.95%	15.35%	15.25%	15.05%	15.30%

5.4.3.7 Competitive Debrief (as at 31 Dec 1995)

[A] METHOD TABLE:-

In the following table, "1" represents the chosen method of evaluation.

	NPV	AVE.	ENDING	CUM.
Stock Price	0	0	1	0
R.O.I.	0	1	0	0
Shareholder Val.	1	0	0	0
Market Share	0	1	0	0
Total Assets	0	0	1	0
Profits	0	0	0	1

Ending year 1995
Rate of return 12.00%

[B] FIRM WEIGHTS

FIRM	Stock	R.O.I.	ShrHldVa.	Mkt.Shr	Assets	Profits	Total
1	0.17	0.17	0.17	0.17	0.17	0.17	1.00
2	0.10	0.30	0.20	0.10	0.10	0.20	1.00

3	0.20	0.15	0.10	0.20	0.10	0.25	1.00
4	0.20	0.10	0.20	0.10	0.20	0.20	1.00
5	0.15	0.20	0.15	0.05	0.15	0.30	1.00
6	0.10	0.20	0.10	0.30	0.10	0.20	1.00

[C] COMPETITIVE ANALYSIS

FIRM	DESCRIPTION	NPV	AVE.	ENDING	CUM.	SELECT	SCORE
1	Stock Price	32.64	10.18	14.30	61.08	14.30	1
2 - 6	Stock Price	34.27	10.58	14.30	63.50	14.30	1
1	R.O.I.	54.04%	17.78%	22.10%	106.70%	17.78%	1
2 - 6	R.O.I.	54.27%	17.33%	15.40%	104.00%	17.33%	0
1	Shareholder Val.	9554	2857	6450	17140	9554	1
2 - 6	Shareholder Val.	3042	675	0	4050	3042	0
1	Industry Mkt Shr	71.93%	22.03%	23.45%	132.20%	22.03%	1
2-6	Industry Mkt Shr	47.83%	15.60%	15.30%	93.60%	15.60%	0
1	Total Assets	43676	13407	17300	80440	17300	1
2 - 6	Total Assets	39418	12240	16000	73440	16000	0
1	Profits	6817	2122	3440	12730	12730	1
2 - 6	Profits	6802	2118	3460	12710	12710	0
1	TOTAL SCORE						6
2 - 6	TOTAL SCORE						1

5.4.3.8 Overall Ranking (as at 31 Dec 1995)

The way STRATPLAN calculates results is purely based on ranking for each of the 6 criteria. Thus, the difference in magnitude is immaterial. For any criterion, the formula used is:-

BANKING :	1st	2nd	3rd	4th	5th	6th
SCORE :	6	5	4	3	2	1

Consequently, based on the overall results at the end of the game {Column [SELECT] in S.5.3.3.7[C]} above, the score of the firms are:-

Firm	Stock	R.O.I.	ShrHldVal	Mkt.Shr.	Assets	Profits	Total
1	6.00	6.00	6.00	6.00	6.00	6.00	36.00
2	6.00	5.00	5.00	5.00	5.00	5.00	31.00
3	6.00	5.00	5.00	5.00	5.00	5.00	31.00
4	6.00	5.00	5.00	5.00	5.00	5.00	31.00
5	6.00	5.00	5.00	5.00	5.00	5.00	31.00
6	6.00	5.00	5.00	5.00	5.00	5.00	31.00

Each firm has its own criteria. For sake of comparison, assuming that every firm is following Firm 1's criteria, then the total score for each firm is in the last column of the following table. However, only the underlined figure is valid and it is for Firm 1 only.

FIRM 1 CRITERIA

Wts:	0.17	0.17	0.17	0.17	0.17	0.17	
1	1.00	1.00	1.00	1.00	1.00	1.00	<u>6.00</u>
2	1.00	0.83	0.83	0.83	0.83	0.83	5.17
3	1.00	0.83	0.83	0.83	0.83	0.83	5.17
4	1.00	0.83	0.83	0.83	0.83	0.83	5.17
5	1.00	0.83	0.83	0.83	0.83	0.83	5.17
6	1.00	0.83	0.83	0.83	0.83	0.83	5.17

By the same reasoning, Firms 2–6 results are shown underlined in the following tables respectively. It is worth-noting here that for this pilot test, although Firms 2–6 are making the same decisions every period, their results are not all the same. This is because they have assumed different criteria weighting (See S.5.3.3.7[B] above).

FIRM 2 CRITERIA

Wts:	0.10	0.30	0.20	0.10	0.10	0.20	
1	0.60	1.80	1.20	0.60	0.60	1.20	6.00
2	0.60	1.50	1.00	0.50	0.50	1.00	<u>5.10</u>
3	0.60	1.50	1.00	0.50	0.50	1.00	5.10
4	0.60	1.50	1.00	0.50	0.50	1.00	5.10
5	0.60	1.50	1.00	0.50	0.50	1.00	5.10
6	0.60	1.50	1.00	0.50	0.50	1.00	5.10

FIRM 3 CRITERIA

Wts:	0.20	0.15	0.10	0.20	0.10	0.25	
1	1.20	0.90	0.60	1.20	0.60	1.50	6.00
2	1.20	0.75	0.50	1.00	0.50	1.25	5.20
3	1.20	0.75	0.50	1.00	0.50	1.25	<u>5.20</u>
4	1.20	0.75	0.50	1.00	0.50	1.25	5.20
5	1.20	0.75	0.50	1.00	0.50	1.25	5.20
6	1.20	0.75	0.50	1.00	0.50	1.25	5.20

FIRM 4 CRITERIA

Wts:	0.20	0.10	0.20	0.10	0.20	0.20	
1	1.20	0.60	1.20	0.60	1.20	1.20	6.00
2	1.20	0.50	1.00	0.50	1.00	1.00	5.20
3	1.20	0.50	1.00	0.50	1.00	1.00	5.20
4	1.20	0.50	1.00	0.50	1.00	1.00	<u>5.20</u>
5	1.20	0.50	1.00	0.50	1.00	1.00	5.20
6	1.20	0.50	1.00	0.50	1.00	1.00	5.20

FIRM 5 CRITERIA

Wts:	0.15	0.20	0.15	0.05	0.15	0.30	
1	0.90	1.20	0.90	0.30	0.90	1.80	6.00
2	0.90	1.00	0.75	0.25	0.75	1.50	5.15

3	0.90	1.00	0.75	0.25	0.75	1.50	5.15
4	0.90	1.00	0.75	0.25	0.75	1.50	5.15
5	0.90	1.00	0.75	0.25	0.75	1.50	5.15
6	0.90	1.00	0.75	0.25	0.75	1.50	5.15

FIRM 6 CRITERIA

Wts:	0.10	0.20	0.10	0.30	0.10	0.20	
1	0.60	1.20	0.60	1.80	0.60	1.20	6.00
2	0.60	1.00	0.50	1.50	0.50	1.00	5.10
3	0.60	1.00	0.50	1.50	0.50	1.00	5.10
4	0.60	1.00	0.50	1.50	0.50	1.00	5.10
5	0.60	1.00	0.50	1.50	0.50	1.00	5.10
6	0.60	1.00	0.50	1.50	0.50	1.00	5.10

5.4.3.9 Game Review

The above pilot test has indicated that the ES models developed [E1] & [E3] can successfully help decision makers to win the STRATPLAN strategic management game. Nevertheless, the assumption that all other firms do not change their decisions is of course unrealistic in practice. Consequently, the models are used again in Chapter 6 to compete with a group of subjects who are invited to enter the game. The results will then be validated further.

5.4.4 SCOPE OF GUIDANCE PROVIDED BY ES-DSS FOR SMEs

The recommendations from ES-DSS are based on the results of experimental game by some 60 undergraduate final year business students in HK and 70 post-graduate part-time manufacturing management students in UK. The design of experiment is similar to the model proposed by Campbell & Stanley (See S.2.2.8). Since the control group and the experimental group do not have pre-experimental sampling equivalence (i.e., one group in HK and the other in UK), the non-equivalent control group design was adopted as follows:-

HK:	O1	X	O2
UK:	O3		O4

where O1 is the Observed Round 1 result in HK,
 X is the eXperiment in teaching the HK students about DSS and ES,
 O2 is the Observed Round 2 result in HK,
 O3 & O4 are the Observed results in UK,

From S.4.5.4, it was observed that the difference between HK and UK students lies in the extent the DSS tools provided by LOTUS was used. The HK students tend to use them more. This observation supports the fact that the experimental teaching of DSS and ES helps the students to use the DSS tools more in their business decision making.

Thus, in order to make sure that managers of SMEs can benefit from DSSs, it is important to provide some sort of ES and DSS training for them. The combination of STRATPLAN and ES-DSS developed can serve this purpose effectively. Moreover, if the scenario can be tailor-made to that of the SME, the ES-DSS can provide greater learning and experimental value.

Regarding managerial utilities, they can largely be assumed the same, except that the pace of business has been improved as a result of OA and FA. Thus, it is good enough to conclude that the ES-DSS developed is and will be suitable for SMEs to assess their DSS development for the next few years or so.

EPILOGUE

In this Chapter, the ES-MIS and ES-DSS have been developed based on the findings in Chapters 3 & 4, and using VP-Expert as the tool. The development process has demonstrated that knowledge can be efficiently built into ESs which can be used by a third party. The effectiveness of these models will be tested in Chapter 6.

CHAPTER 6 VALIDATION

PROLOGUE

The ES-MIS and ES-DSS developed in Chapter 5 have to be validated first before they can be released for use by SMEs. Further, the models were tested against longitudinal cases studies. After refinement, they were packaged for commercialisation and a marketing plan was suggested.

6.1 VALIDATION OF ES-MIS

As discussed in S.2.2.9, validation of the results of research is important, otherwise the research results may not be useable. The purpose of validation is to test the models under appropriate working conditions so that bugs can be disclosed and improvements can be made. A more important objective is to test the value of the models as tools for SMEs in developing their own MISs & DSSs. The validation process consists of two phases. The first one is the validation by a group of MSc students who have had some working experience. Their opinions are then taken up to further improve the ES. The second phase is the validation via SME directors/MIS managers. They represent a more demanding and practical group whose comments are, generally speaking, more precise.

6.1.1 VALIDATION BY MSc STUDENTS

The subjects chosen were from a group of 10 MSc students in IT for Manufacturing at Warwick University in the year 90/91. They were chosen because they represents a good cross-section of experimenters with reasonable IT background and some with industrial experience. Further, they come from various countries like HK, Malaysia, Singapore, and UK. This matches reasonably well with the background countries of the ES-MIS and ES-CASE.

Each student was given the ES-MIS together with the ES-CASE and sufficient time was allowed for them to go through the exercise and do an evaluation. A form is designed to help them to give critical comments (APP.11). The 7-point Likert scale was used for a set of standard questions, followed by some open-ended questions. The findings are summarised as follows:-

6.1.1.1 Background of Subjects

Undergraduate Disciplines: 4 in Manufacturing Engineering
 3 in Economic/Accountancy
 2 in Electronic Engineering
 1 in Engineering Management

Working Experience: 1 year -- 4
 1-3 years -- 3
 4-6 years -- 3

Worked in Manufacturing Sector: 7

Worked in Services Sector: 3

6.1.1.2 ES-MIS**QUESTION**

Q1.0 Choose Manufacturing [ES-MISM] = 7

Choose Services [ES-MISS] = 3

Q1.1 Scores: 9, 10, 12, 13, 15, 15, 16, 17, 19, 21

		FREQUENCY OF:						
		-3	-2	-1	0	1	2	3
Q1.2	Ease of Use	0	0	0	0	0	3	7
Q1.3	Adequacy of Information	0	0	1	0	1	5	3
Q1.4	Value as aid for installing MIS	0	0	0	1	0	7	2
Q1.5	Value as a learning tool	0	0	0	0	0	3	7

Response from Author:

- The sample is slightly biased towards manufacturing. However, since manufacturing industry would consist of most of the functions from the services sectors, it is still a good representation. The scores are skewed towards the lower end, comparing with the mid-range of 13–21. This means that the lower tail of the respondents are less successful in the use of MISs. When the students who gained the lower tail results were consulted, they admitted that the firms they tested were in fact poor in the use of computer-based MISs.
- The response of Q1.2 – Q1.5 indicate that the ES-MIS has been designed quite successfully to meet the needs of the users and as a learning tool as well.

Q1.6 Major Merits (as quoted):

- It asks very straight forward questions and has a very good guide to answer these questions.
- The result of consultation is very simple and direct by just giving the mean score and comparing with the survey results.
- Shows a comparison of using PC-based MISs

- Sufficient information for comparison / reference by any individual company.
- Menu-driven with help and related message is quite user-friendly.
- The user can have a brief idea about the possibility of whether the MIS can be implemented or not through this ES.
- Only numerical values are inputted. This helps to reduce ambiguity from the usual natural language.
- Can promptly give out a figure of score for the extent of computerisation of the company.
- Covers the major areas for companies to consider MISs development.
- Easy to use.

Response from Author:

- When summarising the above major merits, most users like the simplicity of the ES, yet it provides a single indicator on the success of a firm in using MIS. Further, the questions asked are leading questions which can help SMEs to further develop their MISs.

Q1.7 Major Drawbacks (as quoted):

- Not enough detailed information for the answers. It could give user more confidence if it tells how the score is estimated and by what kind of survey.
- no recommendation given.
- In terms of acting as a learning tool, the explanation behind the questions may not be enough.
- There is no suggestion about what the user can do if the score he gets cannot reach the required value. It will be much better if the ES can give the user an idea which he can follow to achieve the suggested requirement.
- Only a few questions are asked, not enough detail.
- Scoring system should be depicted at the beginning.
- Insufficient information provided for a first time user.
- Do not see the application/use for an non-expert user.

Response from Author:

- Most of the above drawbacks quoted focus on the need to explain the scores, and the need for recommendation. The former one has been included in the revised version of the ES-MIS. The latter problem is much reduced if the user chooses the option of printing the consultation. Nevertheless, more recommendations have been included in the revised version as well.
- Regarding the last drawback, it is believed that although an expert user has an obvious advantage in using the consultation, non-expert users can

also benefit as it helps to set direction as to areas of improvement which can be taken up with experts within his organisation or outside.

Q1.8 Other Comments (as quoted):

- It is not specific in the type of manufacturing environment. It is possible that in different manufacturing environments, the usage or implementation of MISs could differ. It might reflect the result of consultation.
- If the score is less than average, it is good to have some recommendations about where and what needs to be improved.
- The limits for the number of employees can be broadened.
- It would be much better if the knowledge-base of the ES is enlarged so that it can cover more question areas.
- The ES can be further developed so that it can be a mature consultant.
- An explanation test can be designed. At each score, an explanation of the average selection can be shown. This helps the user to learn more easily about the required conditions of computers in a manufacturing company.

Response from Author:

- The ES-MIS is designed not to be specific to sectors within industry, though there is a distinction between manufacturing and services industries. The rationale for this approach is that the survey data can be shared amongst more industrial sectors, and hence more accurate results can be achieved. Nevertheless, the ES-CASE be designed to be specific for different industrial sectors.
- Some of the above comments are similar to the "Drawbacks" and hence are not further discussed here.
- Other comments on the user-interface are incorporated into the revised ES-MIS as and when appropriate.

6.1.1.3 ES-CASE

QUESTION

Q2.1	Industry Code:	M2	-	5							
		M3	-	2							
		S1	-	1							
		S3	-	2							
					FREQUENCY OF:						
					-3	-2	-1	0	1	2	3
Q2.2	Ease of Use	0	0	0	0	0	0	0	2	8	
Q2.3	Adequacy of Information	0	0	0	0	0	1	5	4		
Q2.4	Value as aid for installing MIS	0	0	0	0	0	1	6	3		
Q2.5	Value as a learning tool	0	0	0	0	0	0	3	7		

Response from Author:

- Most of the subjects have working experience/knowledge from the electronic industry.
- The response of Q2.2 – Q2.5 indicates that the ES-CASE has been designed quite successfully to meet the needs of the users and as a learning tool as well.

Q2.6 Major Merits (as quoted):

- Very adequate information.
- Can see variation of MIS implementation amongst different countries.
- Good examples to show the pros and cons of implementing MISs.
- Good for new organisations to decide on the advantages before investing in MISs.
- Sufficient information in area of applications plus general idea of hardware or software packages used by these companies. This can be used as a reference in purchasing or installing MISs for companies.
- Cases acting as a study or learning tool is valuable. Information may also be useful for management.
- There is a selection menu about the industry type and place in the ES.
- Required information is extracted and consolidated.
- Can be reviewed at any time.
- Easy to use.

Response from Author:

- When summarising the above major merits, most users like the idea of using case studies as a tool to understand better the various ways to implement MISs. Further, the cross nation comparison of cases is another merit and interesting point.
- The ES-CASE is also considered as easy to use, and can be used as a reference data bank which can be referred to readily.

Q2.7 Major Drawbacks (as quoted):

- Page can only be scrolled upward.
- Cannot skip pages or cases after choice is made.
- A master index for the headings of the cases is not available.
- There is no information about the number of cases that will be shown in the menu. Consequently, the user cannot estimate how long will it take to examine the cases.

- There is no help menu on the screen to tell the user how to escape if he does not want to examine all the cases.
- The user becomes very tired after continuous viewing at the terminal.
- Can not provide search to a specific company.
- Did not answer how MISs can be installed. It did not outline drawbacks faced in installing MISs.
- It did not suggest which system to purchase.

Response from Author:

- Most of the above drawbacks quoted focus on the man-machine interface. Some of the drawbacks, like indexing can be solved easily. However, some are due to the limitation of the VP-Expert. Examples of such limitation are unidirectional scrolling, user-interrupt message. Those drawbacks which can be improved are incorporated into the revised version of the ES-CASE.
- The ES-CASE does not recommend Hardware/Software as it is outside the objective. The users have to consult software houses, or other experienced users for such detail and rapidly changing information.
- There is no critical comment on the contents of the cases. This agrees with the Merit section that the cases are all valuable information for SMEs to refer to whenever appropriate.

Q2.8 Other Comments (as quoted):

- I prefer ES to display using windows, especially in providing dialogue form. I think it would be more attractive for users.
- It is the best ES I have ever seen.
- Very good.
- Index for some highlight terms can be provided to give more details.
- Help menu may be provided on the screen throughout the whole consultation.
- Should include more detail index.
- The use is more information oriented.

Response from Author:

- The ES-CASE has been well received by students, as can be seen in some of the above comments.
- Some of the above comments are similar to the "Drawbacks" and hence are not further discussed here.
- Other comments on the user-interface are incorporated into the revised ES-MIS as and when appropriate.

6.1.1.4 STRATPLAN

QUESTION

Q3.1 Team's Ranking: 2nd to 6th

		FREQUENCY OF:						
		-3	-2	-1	0	1	2	3
Q3.2	Ease of Use	0	0	1	0	1	3	5
Q3.3	Adequacy of information	0	0	0	1	2	5	3
Q3.4	Value of spreadsheet as aid	0	0	0	0	1	5	4
Q3.5	Value of game as learning tool	0	0	0	1	0	5	4

Response from Author:

- These is no significant relationship between ranking in the game and the choice on the 7-point scale.
- The response of Q3.2 – Q3.5 indicate that the choice of STRATPLAN as a model of DSS has been quite successfully in meeting the needs of the users and as a learning tool as well.

Q3.6 Major Merits (as quoted):

- Easy to use.
- Very good value as a learning tool.
- Competitive analysis as an aid for marketing strategy planning is a very good tool.
- Understand competitors' performance by comparison. Most of the financial ratios are available as guide for production forecasting and evaluating the strengths of the company.
- Menu-driven is easy to use.
- Each sub-menu can be traced clearly.
- Learning the marketing or business aspects as well as a typical application of the spreadsheet.
- The outcome of any changes in input data can be examined immediately so that a clear comparison can be obtained using the spreadsheet.
- Easy and quick to recalculate.
- Manual inaccuracy is avoided.
- Excellent learning tool, exciting, and motivating.

Response from Author:

- When summarising the above major merits, most users like the idea of using a spreadsheet as a tool to understand better the relationship of decision variables via the what-if analysis.

- Another advantage of using a spreadsheet is that it gives accurate results instantaneously hence minimising error in decision making.
- The STRATPLAN is also considered as easy to use, and a good learning tool as well.

Q3.7 Major Drawbacks (as quoted):

- Not fully simulates the actual business situation.
- Some variables are not clearly defined.
- Not friendly enough, no "help" for users.
- There are so many special terms making it difficult for a participant to understand all these in the software if he is not knowledgeable about finance. This may reduce the effective use of the "STRATPLAN" because of the lack of professional background about finance, etc.
- Not sufficient message displayed while moving from one entity to another.
- No general guidance to help in deciding the entries. This may only be good for those who are professional rather than those who do not have any experience.
- Does not provide results using ratio analysis and graphic display.
- Not very successful in representing a real world model.

Response from Author:

- Most of the above drawbacks quoted focus on the difficulties in interpreting all the decision parameters, unless one is very strong in finance, and marketing. Further, the sheer number of decisions required can be confusing at times. This is a very good evidence for the need to develop of ES-DSS to supplement STRATPLAN.
- Other drawbacks refer to man-machine interface. Some of the drawbacks, like ratio analysis and graphic display can be solved, though they tend to make the model even more complicated. However, some are due to the limitation of LOTUS. Examples of such limitation are pull-down menu, and sufficient activity prompts. Although some of these drawbacks can be improved, the author do not intend to change of source code for copyright reason.

Q3.8 Other Comments (as quoted):

- It will be better if pull down menu is used.
- Need to include some information as a guide before entering decisions.
- It is a good tool for experienced user but not for beginner. It is better to have some information or guide line to use the spreadsheet.
- More easy to do the comparison of the results if graphic display and ratio analysis are given.

Response from Author:

- Some of the above comments are similar to the "Drawbacks" and hence are not further discussed here.
- Other comments on the user-interface are incorporated into the revised ES-DSS as and when appropriate.

6.2 VALIDATION OF THE ES-DSS

As stated at the end of Section 5.3.3, the pilot test has indicated that the ES models developed [E1] & [E3] can successfully help decision makers to win the strategic management game. Nevertheless, the assumption that all other firms cannot change their decisions is of course unrealistic in practice. Consequently, the models have to be validated. The subjects for validation was the same group of students as those validating the ES-MIS & ES-CASE. 10 of them form 5 teams of 2 persons each. After briefing to the game, they were invited to compete with the ES-DSS played by the author.

For Firm 1, the decisions were entirely driven by the decisions recommended by the ES-DSS models. Altogether, 21 decisions have to be made for every period. They were made according to the recommendations of the ES-DSS. For 1991–1993, [E1] was used. For 1994–1995, [E3] was used. The decisions made by all teams and the results of the game are summarised in the following sections.

6.2.1 SUMMARY OF RESULTS

This is the summary of results after each period. Only the more relevant ones are extracted here for analysis and comparison. The following notations are used for the first column:-

F = Firm

PA = Hoover

PB = Pump

C = Combining Hoover & Pump

For year end 31 Dec == >	1990	1991	1992	1993	1994	1995
F1PA Tech Inv.	120	326	358	381	0	0
F2PA Tech Inv.	120	400	100	18	30	0
F3PA Tech Inv.	120	300	314	470	0	0
F4PA Tech Inv.	120	200	300	400	200	50
F5PA Tech Inv.	120	40	60	80	100	30
F6PA Tech Inv.	120	400	400	500	500	500
F1PA Capacity	129	142	156	156	166	172
F2PA Capacity	129	135	140	189	187	207
F3PA Capacity	129	135	150	250	230	200
F4PA Capacity	129	140	160	170	180	180

F5PA Capacity	129	145	151	151	151	170
F6PA Capacity	129	130	140	150	160	170
F1PA Unit Cost	14.1	13.1	12.2	11.3	10.6	10.4
F2PA Unit Cost	14.1	13.2	12.2	11.7	11.5	11.3
F3PA Unit Cost	14.1	13.3	12.2	11.2	10.6	10.5
F4PA Unit Cost	14.1	13.2	12.3	11.3	10.5	10.1
F5PA Unit Cost	14.1	13.3	12.8	12.2	11.7	11.3
F6PA Unit Cost	14.1	13.2	12.2	11.3	10.4	9.7
F1PA Price	30.0	28.5	28.5	28.5	27.0	27.0
F2PA Price	30.0	27.0	26.0	25.5	26.0	25.0
F3PA Price	30.0	28.0	26.0	25.5	25.5	25.5
F4PA Price	30.0	29.0	27.0	26.5	26.0	26.0
F5PA Price	30.0	28.5	30.5	31.0	29.0	27.0
F6PA Price	30.0	28.5	28.0	27.0	26.0	25.0
F1PA Unit Sales	136000	157000	167000	179000	202000	212000
F2PA Unit Sales	136000	165000	179000	181000	174000	182000
F3PA Unit Sales	136000	156000	194000	226000	224000	237000
F4PA Unit Sales	136000	145000	175000	191000	200000	191000
F5PA Unit Sales	136000	148000	136000	145000	165000	197000
F6PA Unit Sales	136000	152000	163000	178000	201000	233000
F1PA Mkt. Share	0.17	0.17	0.17	0.16	0.17	0.17
F2PA Mkt. Share	0.17	0.18	0.18	0.16	0.15	0.15
F3PA Mkt. Share	0.17	0.17	0.19	0.21	0.19	0.19
F4PA Mkt. Share	0.17	0.16	0.17	0.17	0.17	0.15
F5PA Mkt. Share	0.17	0.16	0.13	0.13	0.14	0.16
F6PA Mkt. Share	0.17	0.17	0.16	0.16	0.17	0.19
F1PB Tech Inv.	160	468	560	563	0	0
F2PB Tech Inv.	160	450	100	0	30	0
F3PB Tech Inv.	160	75	0	0	300	0
F4PB Tech Inv.	160	100	180	250	100	30
F5PB Tech Inv.	160	40	50	80	100	30
F6PB Tech Inv.	160	600	498	600	600	700
F1PB Capacity	73	80	88	97	97	97
F2PB Capacity	73	76	90	101	115	119
F3PB Capacity	73	76	80	150	130	100
F4PB Capacity	73	75	85	96	100	100
F5PB Capacity	73	87	95	105	115	115
F6PB Capacity	73	74	78	80	90	100
F1PB Unit Cost	45.6	43.1	39.4	36.0	34.4	33.9
F2PB Unit Cost	45.6	43.4	40.1	39.0	38.2	37.6
F3PB Unit Cost	45.6	43.4	41.4	39.7	38.9	38.0
F4PB Unit Cost	45.6	43.6	41.9	40.2	38.8	37.9
F5PB Unit Cost	45.6	43.4	41.8	40.5	39.2	38.4
F6PB Unit Cost	45.6	43.3	39.5	36.3	32.9	31.2
F1PB Price	75.0	71.3	71.3	71.3	70.0	70.0
F2PB Price	75.0	74.5	70.0	69.0	67.0	65.0
F3PB Price	75.0	73.0	66.0	65.0	63.0	64.0
F4PB Price	75.0	74.0	71.0	67.5	67.5	66.0
F5PB Price	75.0	67.0	67.0	67.0	67.0	67.0
F6PB Price	75.0	72.0	70.0	69.0	66.5	66.0
F1PB Unit Sales	78000	98200	98700	103000	116000	122000
F2PB Unit Sales	78000	75400	91700	97600	105000	112000

F3PB Unit Sales	78000	86600	117000	129000	137000	142000
F4PB Unit Sales	78000	80100	95300	115000	116000	117000
F5PB Unit Sales	78000	113000	110000	114000	117000	123000
F6PB Unit Sales	78000	94400	103000	110000	124000	132000
F1PB Mkt. Share	0.17	0.18	0.16	0.16	0.16	0.16
F2PB Mkt. Share	0.17	0.14	0.15	0.15	0.15	0.15
F3PB Mkt. Share	0.17	0.16	0.19	0.19	0.19	0.19
F4PB Mkt. Share	0.17	0.15	0.16	0.17	0.16	0.16
F5PB Mkt. Share	0.17	0.21	0.18	0.17	0.16	0.16
F6PB Mkt. Share	0.17	0.17	0.17	0.16	0.17	0.18
F1C R&D	560	762	729	744	414	414
F2C R&D	560	670	460	300	230	120
F3C R&D	560	600	830	1100	400	400
F4C R&D	560	525	710	710	610	260
F5C R&D	560	495	540	690	780	290
F6C R&D	560	630	405	510	810	804
F1C Advertising	625	812	894	894	1190	1190
F2C Advertising	625	700	600	540	500	470
F3C Advertising	625	690	851	1050	800	1400
F4C Advertising	625	720	780	850	800	500
F5C Advertising	625	638	658	700	720	1000
F6C Advertising	625	810	780	760	880	1000
F1C Sales Force	274	343	392	422	432	441
F2C Sales Force	274	287	286	288	291	298
F3C Sales Force	274	348	393	482	477	522
F4C Sales Force	274	295	361	373	375	371
F5C Sales Force	274	331	345	374	395	408
F6C Sales Force	274	343	338	353	361	418
F1C Branches	222	306	280	287	299	307
F2C Branches	222	292	272	275	277	279
F3C Branches	222	298	290	306	307	316
F4C Branches	222	224	307	291	293	289
F5C Branches	222	241	305	283	288	299
F6C Branches	222	235	309	286	298	310
F1C Profits	1310	1240	1550	1990	2560	2910
F2C Profits	1310	1220	1790	2120	2270	2330
F3C Profits	1310	1280	1200	1270	2050	2090
F4C Profits	1310	1450	1500	1750	2180	2640
F5C Profits	1310	1320	1580	1930	2160	2490
F6C Profits	1310	1250	1780	2080	2300	2660
F1 Total Assets	9040	10600	12900	15000	15700	17100
F2 Total Assets	9040	10300	12100	14200	16400	18700
F3 Total Assets	9040	9780	10700	18500	19700	20300
F4 Total Assets	9040	10400	11600	13200	14700	16400
F5 Total Assets	9040	10400	11400	11900	12600	14500
F6 Total Assets	9040	10300	12000	13800	15800	18500
F1 Debt	1650	1650	2650	3150	1650	1650
F2 Debt	1650	1650	1650	1650	1650	1650
F3 Debt	1650	1650	1380	3880	3960	3960
F4 Debt	1650	1650	1650	1650	1050	53
F5 Debt	1650	2250	2150	1250	353	353
F6 Debt	1650	1650	1650	1650	1650	1650

F1	Emergency Loans	0	0	0	0	0	0
F2	Emergency Loans	0	0	0	0	0	0
F3	Emergency Loans	0	0	0	71	0	0
F4	Emergency Loans	0	0	0	0	0	0
F5	Emergency Loans	0	0	0	0	0	0
F6	Emergency Loans	0	0	0	0	0	0
F1	Equity + Retained	7390	9000	10200	11900	14100	15400
F2	Equity + Retained	7390	8610	10400	12500	14800	17100
F3	Equity + Retained	7390	8130	9330	14500	15700	16300
F4	Equity + Retained	7390	8740	9940	11600	13700	16300
F5	Equity + Retained	7390	8190	9230	10600	12200	14200
F6	Equity + Retained	7390	8640	10300	12200	14200	16900
F1	Shares Issued	1000	1100	1100	1100	1100	1000
F2	Shares Issued	1000	1000	1000	1000	1000	1000
F3	Shares Issued	1000	1000	1000	1540	1590	1590
F4	Shares Issued	1000	1000	1000	1000	1000	1000
F5	Shares Issued	1000	1000	1000	1000	1000	1000
F6	Shares Issued	1000	1000	1000	1000	1000	1000
F1	Dividends	529	294	294	350	387	516
F2	Dividends	529	0	0	0	0	0
F3	Dividends	529	540	0	600	600	600
F4	Dividends	529	100	300	100	100	0
F5	Dividends	529	529	539	540	540	540
F6	Dividends	529	0	100	200	300	0
F1	Stock Price	7.39	8.18	9.32	10.80	12.80	15.10
F2	Stock Price	7.39	8.61	10.40	12.50	14.80	17.10
F3	Stock Price	7.39	8.13	9.33	9.44	9.91	10.30
F4	Stock Price	7.39	8.74	9.94	11.60	13.70	16.30
F5	Stock Price	7.39	8.19	9.23	10.60	12.20	14.20
F6	Stock Price	7.39	8.64	10.30	12.20	14.20	16.90
F1	R.O.I.	0.18	0.14	0.15	0.17	0.18	0.19
F2	R.O.I.	0.18	0.14	0.17	0.17	0.15	0.14
F3	R.O.I.	0.18	0.16	0.13	0.09	0.13	0.13
F4	R.O.I.	0.18	0.17	0.15	0.15	0.16	0.16
F5	R.O.I.	0.18	0.16	0.17	0.18	0.18	0.18
F6	R.O.I.	0.18	0.15	0.17	0.17	0.16	0.16
F1	Shareholder Val.	0	-2200	1810	3710	4920	4100
F2	Shareholder Val.	0	-1740	5150	1480	1250	171
F3	Shareholder Val.	0	-1090	-2250	-5880	9600	3720
F4	Shareholder Val.	0	476	-1130	1390	3790	4860
F5	Shareholder Val.	0	-838	2030	2720	1570	3240
F6	Shareholder Val.	0	-1540	4350	1970	506	1900
F1	Industry Mkt Shr	16.70%	17.45%	16.25%	15.90%	16.75%	16.65%
F2	Industry Mkt Shr	16.70%	15.85%	16.25%	15.50%	14.80%	14.70%
F3	Industry Mkt Shr	16.70%	16.35%	19.10%	19.90%	19.15%	18.90%
F4	Industry Mkt Shr	16.70%	15.15%	16.40%	17.30%	16.65%	15.50%
F5	Industry Mkt Shr	16.70%	18.30%	15.60%	15.10%	15.30%	16.05%
F6	Industry Mkt Shr	16.70%	16.85%	16.40%	16.30%	17.25%	18.15%

6.2.2 COMPETITIVE DEBRIEF (as at 31 Dec 1995)**[A] METHOD TABLE:-**

In the following table, "1" represents the chosen method of evaluation.

	<u>NPV</u>	<u>Average</u>	<u>Ending</u>	<u>Cumulative</u>
Stock Price	0	0	1	0
R.O.I.	0	1	0	0
Shareholder Val.	1	0	0	0
Market Share	0	1	0	0
Total Assets	0	0	1	0
Profits	0	0	0	1
Ending year	1995			
Rate of return	12.00%			

[B] FIRM WEIGHTS

<u>Firm</u>	<u>Stock</u>	<u>R.O.I.</u>	<u>ShrHldVa</u>	<u>Mkt.Shr</u>	<u>Assets</u>	<u>Profits</u>
1	0.17	0.17	0.17	0.17	0.17	0.17
2	0.15	0.20	0.10	0.15	0.15	0.25
3	0.15	0.20	0.15	0.15	0.20	0.15
4	0.10	0.20	0.15	0.25	0.10	0.20
5	0.10	0.10	0.15	0.15	0.20	0.30
6	0.10	0.20	0.15	0.15	0.15	0.25

[C] COMPETITIVE ANALYSIS

<u>FIRM</u>	<u>DESCRIPTION</u>	<u>NPV</u>	<u>AVE.</u>	<u>ENDING</u>	<u>CUM.</u>	<u>SELECT</u>	<u>SCORE</u>
1	Combine Profits	6143	1927	2910	11560	11560	6.00
2	Combine Profits	5922	1840	2330	11040	11040	4.00
3	Combine Profits	4763	1533	2090	9200	9200	1.00
4	Combine Profits	5770	1805	2640	10830	10830	3.00
5	Combine Profits	5750	1798	2490	10790	10790	2.00
6	Combine Profits	6098	1897	2660	11380	11380	5.00
1	Total Assets	43768	13390	17100	80340	17100	3.00
2	Total Assets	43659	13457	18700	80740	18700	5.00
3	Total Assets	47664	14670	20300	88020	20300	6.00
4	Total Assets	40618	12557	16400	75340	16400	2.00
5	Total Assets	37495	11640	14500	69840	14500	1.00
6	Total Assets	42892	13240	18500	79440	18500	4.00
1	Stock Price	34.14	10.60	15.10	63.59	15.10	3.00
2	Stock Price	38.48	11.80	17.10	70.80	17.10	6.00
3	Stock Price	29.17	9.08	10.30	54.50	10.30	1.00
4	Stock Price	36.65	11.28	16.30	67.67	16.30	4.00
5	Stock Price	33.16	10.30	14.20	61.81	14.20	2.00
6	Stock Price	37.80	11.61	16.90	69.63	16.90	5.00
1	R.O.I.	50.29%	16.72%	18.90%	100.30%	16.72%	5.00
2	R.O.I.	48.04%	15.83%	13.60%	95.00%	15.83%	2.00

3	R.O.I.	39.24%	13.48%	12.80%	80.86%	13.48%	1.00
4	R.O.I.	48.91%	16.10%	16.20%	96.60%	16.10%	3.00
5	R.O.I.	53.66%	17.40%	17.60%	104.40%	17.40%	6.00
6	R.O.I.	49.91%	16.40%	15.80%	98.40%	16.40%	4.00
1	Shareholder Val.	6761	2057	4100	12340	6761	6.00
2	Shareholder Val.	4015	1052	171	6311	4015	2.00
3	Shareholder Val.	1125	683	3720	4100	1125	1.00
4	Shareholder Val.	5071	1564	4860	9386	5071	5.00
5	Shareholder Val.	5038	1454	3240	8722	5038	4.00
6	Shareholder Val.	4370	1198	1900	7186	4370	3.00
1	Industry Mkt Shr	51.73%	16.62%	16.65%	99.70%	16.62%	4.00
2	Industry Mkt Shr	48.11%	15.63%	14.70%	93.80%	15.63%	1.00
3	Industry Mkt Shr	57.93%	18.35%	18.90%	110.10%	18.35%	6.00
4	Industry Mkt Shr	50.26%	16.28%	15.50%	97.70%	16.28%	3.00
5	Industry Mkt Shr	50.31%	16.18%	16.05%	97.05%	16.18%	2.00
6	Industry Mkt Shr	52.66%	16.94%	18.15%	101.65%	16.94%	5.00

6.2.3 OVERALL RANKING (as at 31 Dec 1995)

As explained in S.5.3.3.8, the way STRATPLAN calculates results is based purely on ranking for each of the 6 criteria. Thus, the difference in magnitude is immaterial. For any criterion, the formula used is:-

<u>RANKING</u> :	1st	2nd	3rd	4th	5th	6th
<u>SCORE</u> :	6	5	4	3	2	1

Consequently, based on the overall results at the end of the game {Column [SELECT] in S.6.2.2 [C]} above, the score of the firms are:-

FIRM	Stock	R.O.I.	ShrHldVa	Mkt.Shr	Assets	Profits	Total
1	3.00	5.00	6.00	4.00	3.00	6.00	27.00
2	6.00	2.00	2.00	1.00	5.00	4.00	20.00
3	1.00	1.00	1.00	6.00	6.00	1.00	16.00
4	4.00	3.00	5.00	3.00	2.00	3.00	20.00
5	2.00	6.00	4.00	2.00	1.00	2.00	17.00
6	5.00	4.00	3.00	5.00	4.00	5.00	26.00

Each firm has its own criteria. For the sake of comparison, assuming that every firm is following Firm 1's criteria, then the total score for each firm is in the last column of the following table. However, only the pointed figure is valid and it is for Firm 1 only.

		<u>FIRM 1 CRITERIA</u>					<u>RESULT</u>	
Wts:	0.17	0.17	0.17	0.17	0.17	0.17		
1	0.50	0.83	1.00	0.67	0.50	1.00	4.50	<-- 1st
2	1.00	0.33	0.33	0.17	0.83	0.67	3.33	
3	0.17	0.17	0.17	1.00	1.00	0.17	2.67	
4	0.67	0.50	0.83	0.50	0.33	0.50	3.33	
5	0.33	1.00	0.67	0.33	0.17	0.33	2.83	
6	0.83	0.67	0.50	0.83	0.67	0.83	4.33	

By the same reasoning, Firm 2--6 results are highlighted by arrows in the following tables respectively. It is worth-noting here that for this pilot test, although all Firms 2--6 are making the same decisions every period, their results are not all the same. This is because they have assumed different criteria weighting (See S.6.2.2 [B] above).

		<u>FIRM 2 CRITERIA</u>						
Wts:		0.15	0.20	0.10	0.15	0.15	0.25	
1	0.45	1.00	0.60	0.60	0.45	1.50	4.60	
2	0.90	0.40	0.20	0.15	0.75	1.00	3.40	<-- 3rd
3	0.15	0.20	0.10	0.90	0.90	0.25	2.50	
4	0.60	0.60	0.50	0.45	0.30	0.75	3.20	
5	0.30	1.20	0.40	0.30	0.15	0.50	2.85	
6	0.75	0.80	0.30	0.75	0.60	1.25	4.45	

		<u>FIRM 3 CRITERIA</u>						
Wts:	0.15	0.20	0.15	0.15	0.20	0.15		
1	0.45	1.00	0.90	0.60	0.60	0.90	4.45	
2	0.90	0.40	0.30	0.15	1.00	0.60	3.35	
3	0.15	0.20	0.15	0.90	1.20	0.15	2.75	<-- 5th
4	0.60	0.60	0.75	0.45	0.40	0.45	3.25	
5	0.30	1.20	0.60	0.30	0.20	0.30	2.90	
6	0.75	0.80	0.45	0.75	0.80	0.75	4.30	

		<u>FIRM 4 CRITERIA</u>						
Wts:	0.10	0.20	0.15	0.25	0.10	0.20		
1	0.30	1.00	0.90	1.00	0.30	1.20	4.70	
2	0.60	0.40	0.30	0.25	0.50	0.80	2.85	
3	0.10	0.20	0.15	1.50	0.60	0.20	2.75	
4	0.40	0.60	0.75	0.75	0.20	0.60	3.30	<-- 4th
5	0.20	1.20	0.60	0.50	0.10	0.40	3.00	
6	0.50	0.80	0.45	1.25	0.40	1.00	4.40	

		<u>FIRM 5 CRITERIA</u>						
Wts:	0.10	0.10	0.15	0.15	0.20	0.30		
1	0.30	0.50	0.90	0.60	0.60	1.80	4.70	
2	0.60	0.20	0.30	0.15	1.00	1.20	3.45	
3	0.10	0.10	0.15	0.90	1.20	0.30	2.75	
4	0.40	0.30	0.75	0.45	0.40	0.90	3.20	
5	0.20	0.60	0.60	0.30	0.20	0.60	2.50	<-- 6th
6	0.50	0.40	0.45	0.75	0.80	1.50	4.40	

		<u>FIRM 6 CRITERIA</u>						
Wts:	0.10	0.20	0.15	0.15	0.15	0.25		

1	0.30	1.00	0.90	0.60	0.45	1.50	4.75
2	0.60	0.40	0.30	0.15	0.75	1.00	3.20
3	0.10	0.20	0.15	0.90	0.90	0.25	2.50
4	0.40	0.60	0.75	0.45	0.30	0.75	3.25
5	0.20	1.20	0.60	0.30	0.15	0.50	2.95
6	0.50	0.80	0.45	0.75	0.60	1.25	4.35 < == 2nd

From the above results, it is seen that the ES-DSS [E1] & [E3] have enabled the author to win the game by following the recommendations. This proves that the knowledge of the DSS in the simulated environment can be represented effectively using the VP-Expert. However, one may argue that although the author is trying to follow the "Blind" play, it may not be the case in view of his previous experience. To clear this doubt, immediately after playing the game, each of the 10 subjects were given a copy of the ES-DSS [E1] & [E3] to go through. They were also advised to enter the 1991 decisions according to the recommendations of the ES.

The finding of this mini-experiment is that all the students can go through and use the ES-DSS without any help from the author. At the end they shared the view that the ES-DSS is user-friendly and easy to use. Further, all their 1991 decisions are almost identical. The minor differences are accounted for from their difference in Criteria Weighting. For instance, Firm 4 goes for the minimum price because their weighting is highest on the market share. Whereas Firm 5 goes for the maximum price within the range recommended because their highest weighting is on profits. The same line of actions apply to other marketing variables like advertising, salesmen, R&D quality, etc.

Overall, it is fair to comment that the ES-DSS is an invaluable tool for optimal decision making with due considerations on the effects of important variables. Further, relevant information is retrieved which helps the users to answer important questions and hence make correct decisions during the course of consultation. Finally, the peer group response and success of the ES-DSS has proven that it is a suitable decision support tool for STRATPLAN.

6.3 LONGITUDINAL RESEARCH IN UK & HK

As explained in Section 2.2.6 of Research Methodology, there are obvious advantages in using longitudinal research as a research approach. Three cases in UK and two cases in HK are reviewed based on this principle. They are selected because in the ES-MIS, the questionnaire data from these two places were compared and found to be of insignificant difference. Further, the author has been living and working in these two places for considerable length of time. This provides a better insight into the background of the case studies, and also gives the author a chance to follow up the cases "longitudinally". Last but not the least, these are representative cases with recorded successes in their implementation.

It is a worthwhile exercise as the process dynamics of change due to introduction of MISs and DSSs can be assessed critically. Further, these cases can enhance the validity of the ES developed. The background information of these 5 firms are already detailed in APP.5. The same coding (CU3, CU4, CU5, CH3 & CH4) are used for the purpose here. The revised version of ES-MIS after the validation in S.6.1 are given to the responsible personnel in each organisation to test their present state of development. After that, they are given the same questionnaire (APP.11) for evaluating the effectiveness of the ES-MIS. However, in view of the resource constraint, ES-DSS is not tested by this group of subjects. -

6.3.1 Case CU3 : A Manufacturer of Electrical Water Heater in UK **(Employees: about 280)**

In 1988, the author was requested by the Customer Services Department to develop the fault analysis system using spreadsheet software. The objective was to do statistical analysis of fault by code so that consistent faults could be highlighted which led to improvement actions. Further, spare parts can be planned according to the service requirement. The ultimate objective is to improve product quality and capitalise on repair activities if there were a genuine need.

There was one major problem in the course of development. The product database was in the minicomputer system. In order to analyse the fault by code effectively, there is a need for end-user computing. A request was sent to the computer service department in Dec 1988 to download an extract of the database of the maintenance record to a PC. The file size was estimated to be about 20 MB. Unfortunately, the supplier of the minicomputer did not support file download to PC at that time for commercial reasons. It was not until late 1989 that such a utility was available. It then took another 6 months for the company's computer staff to go through training. During that period, a parallel run was done to extract the maintenance data directly onto the PC. This enables some preliminary analysis to be conducted.

When the data file was available in August 90, the full scale analysis was conducted. The finding was that forecasting of maintenance requirement was difficult, not because of the lack of data, but because it was difficult to update the service record until heaters are sold to customers. However, there was a useful by-product as a result of the exercise. The forecasting model can be applied to sales forecasting after some modifications. The method used for forecasting was based on seasonal, cyclical, trend, and irregularity factors.

Although at present, there are many stand alone PCs in the company, they are not yet networked. The system operation is largely based on the mini-system. For instance, the accounting system is running on the minicomputer and there is no intention to change it to a PC network software. Because of this, there is a file transfer problem to PC and end-user computing is limited.

Other stand-alone systems include a store control system, and a quality control system. The users interviewed seem to be satisfied with these systems although an integrated system would be preferred. There are continuous developments by end-users.

For instance, in 1989, the author was invited again to develop better forecasting models for both sales and customer services requirements. The approach is to use end-user computing. A DSS called Root-To-Mean Average Decomposition Method has been experimented and recommended. However, although every effort has been made to ensure easiness of use, the spreadsheet programme for the Method is still quite tedious. As the next step, the author is currently looking into the possibility of using Neural Network to assist self-learning within the DSS. Besides, it will help to further improve the forecasting accuracy. If successful, it will become a true ES for the task.

One major comment on the information system is that there is a lack of vision from the Computer Services Dept. to the need of the users. Distributed computing is also not encouraged. Unfortunately, the nature of business is information intensive. A lot of analysis in sales, marketing, production, purchasing, and finance can be done more effectively by the end-users, provided there is a sound information strategy to avoid overuse and misuse of information.

Result and Comments on the use of ES-MIS:

When running the ES-MIS by the Manager of the Computer Services Dept., the score was 15 which is within the mean range of 13--21. However, with their significant investment in information systems over the past 7 years, they could have done better if the strategies were better focused. The Manager was then asked to fill in the questionnaire form APP.11. The 7-point scale results are listed:-

1.	ES-MIS							
1.2	Ease of use	-3	-2	-1	0	1	(2)	3
1.3	Adequacy of Information	-3	-2	-1	0	1	2	(3)
1.4	Value as aid to Install MIS	-3	-2	-1	0	(1)	2	3
1.5	Value as learning tool	-3	-2	-1	0	1	(2)	3
2.	ES-CASE							
2.2	Ease of use	-3	-2	-1	0	1	2	(3)
2.3	Adequacy of Information	-3	-2	-1	0	1	2	(3)
2.4	Value as aid to Install MIS	-3	-2	-1	0	1	(2)	3
2.5	Value as learning tool	-3	-2	-1	0	1	(2)	3

The Manager likes the ES-MIS as a tool for evaluation and comparison. He thinks that it is not only simple to use, but also able to provide a fair judgement of the effectiveness of PC based MIS of the organisation. He realises that their company has started from the minicomputer platform and this is somewhat retarding the developing of the PC system. Nevertheless, they are looking into the End-user computing under PC-LAN environment seriously. He also said that the "Applications", "Tools", and "Achievement" of the consultation will certainly be useful in their future development.

6.3.2 Case CU4: A Manufacturer of Precision Ballscrews in UK **(Employees: about 140)**

The author was invited as a consultant to develop the MIS for this firm in late 1989. It was not until 1989 that the company started to consider computerisation seriously. In mid-1989, a system analyst was employed to develop the information system. With the advice from the author, he started off by developing the Production Planning and Control System using DBase IV package. Now he rationalises the operation by keeping track of the job progress. Each worker at the shop floor is asked to fill in a job card to reflect his job progress. The information is then used as job control data. Various databases and reports are used to monitor work progress. There is a supplementary spreadsheet used for rough cut production schedule.

Another major project the author looked after was the new information system supported on a network under Novell Netware. Eight workstations are now installed, 3 in Production Control Department, 2 in Sales Department, 1 in Accounting Department, and 2 on Shop Floor. A dedicated file server with 130MB hard disk is used to support the system. Since it is a common database, spreadsheet and database modifications are updated instantaneously. Now, the lead time is cut down from 8 weeks to 5, and more accurate progress information and profit details can be extracted for each order.

A third project done by the author was to set up the Nominal Ledger for the company. In the past the company used the Purchase Ledger and Sales Ledger Package from Pergasus. These are more related to transaction processing. There is a pressing need for the company to install the computerised Nominal Ledger system so that balance sheet, profit & loss account, budgetary reports, and other management reports can be readily available. Since a standard package has been used, the main focus for setting up the Nominal Ledger system was to design an effective accounting coding system. Further, the reports have to confirm with the existing manual report format, with some enhancement of details.

There are plans to further develop the system by installing shop floor data collection devices. Further, there are scopes for downloading CAD files to the CNC machines for more efficient processing. Also, the data file from purchase requisition of the production planning system can be linked to the Purchasing Ledger of the accounting system.

This is a typical case of successful implementation of MIS via focused effort. It is a good strategy to appoint someone who is fully dedicated towards continuous improvement of MIS and also giving the person the best support. Further results have to be reflected fairly quickly otherwise other users will be lacking confidence. For standard applications like accounting, it is more effective to use packages as development and debugging time can be much reduced. Moreover there are a lot of standard features like taxation, audit trace, trial balance, that can be done with the press of a key.

On the other hand, for production planning and control, the experience is that it is more effective to develop an application in-house. This is because such applications tend to be product and company specific. Standard packages tends to be over-complicated and ironically, lacking some of the features that is required by a specific company. Also, if applications are tailor-made, it can resemble the manual systems easily. This is important as users will be familiarised with the system very readily.

Another lesson from this case is that it is important to implement one system at a time rather than doing everything concurrently. This is because mistakes can be rectified more easily, and it helps to shorten the development cycle time. Of course, it does not imply that there is no need for an overall implementation strategy.

One hidden reason for the success of implementation is that the System Analyst has a strong manufacturing engineering background besides software experience. This is important as he can see the needs of the users far better than one without engineering background. This also enables the consultancy to be conducted more efficiently.

After one year, the management and users are all happy with the system. They have agreed that the MIS developed should be transferred to their sister company in another location of UK.

Result and Comments on the use of ES-MIS:

When running the ES-MIS by the System Analyst of the company, the score was 20 which is at the upper end of the mean range of 13--21. This score is remarkable in view of the infancy stage of their MIS development. The 7-point scale results answered by the System Analyst are as follows:-

1.	ES-MIS							
1.2	Ease of use	-3	-2	-1	0	1	(2)	3
1.3	Adequacy of Information	-3	-2	-1	0	1	2	(3)
1.4	Value as aid to install MIS	-3	-2	-1	0	(1)	2	3
1.5	Value as learning tool	-3	-2	-1	0	1	(2)	3
2.	ES-CASE							
2.2	Ease of use	-3	-2	-1	0	1	2	(3)
2.3	Adequacy of Information	-3	-2	-1	0	1	2	(3)
2.4	Value as aid to install MIS	-3	-2	-1	0	1	(2)	3
2.5	Value as learning tool	-3	-2	-1	0	1	(2)	3

The System Analyst likes the ES-MIS as a tool for evaluation and comparison. He also thinks that it is not only simple to use, but also able to provide a fair judgement of the effectiveness of PC based MIS of their organisation. He realises their company's strength is that they started from the PC-LAN, which is the most effective platform for SMEs. Further, end-user computing is encouraged. He has also said that the "Applications", and "Achievement" of the consultation are useful in their future development.

6.3.3 Case CU5: A Chartered Accountant and Solicitor Firm in UK (Employees: about 15)

The author was invited as a consultant to develop the MIS for this firm in late 1989. Before then, the weekly Cashbook entry, calculation and quarterly summary of Value Added Tax and balance sheet has been done manually. Since 1986, the firm has installed a PC to do word processing and use some accounting packages. In 1989, the firm decided to go for full scale computerisation.

The initial task was to computerise the Cashbook. It took the author almost half a year to code and debug the Cashbook using a spreadsheet software FIG.6.1. Since then, the benefits are plentiful. The data entry is faster, the presentation more professional, and more important, the VAT return for various retail schemes (there are 10 schemes from the VAT Office) can be obtained by the press of a button FIG.6.2. As additional benefits, the balance sheet and profit & loss accounts are available every quarter, or literally at any time. Also, there are summary reports of purchases by categories and by suppliers.

For standard applications like accounting, it is more effective to use packages as development and debugging time can be much reduced. However, for proprietary applications like the VAT return, it has to be developed in the most cost effective manner. Undoubtedly, spreadsheet is the obvious choice as a tool for such development. As the Chartered Accountant pointed out rightly, the spreadsheet is the greatest invention of mankind so far for accountants. With the use of spreadsheet, development cycle time is greatly reduced. On the other hand, the accountant contributes significantly to the development as he contributes actively to the simplification and validation of the package. Finally, the VAT Office has approved the VAT Cashbook developed so now it can be commercialised.

FIG. 6.2 : EXAMPLE OF PRINTOUT "WEEKLY CASHBOOK"

WEEKLY CASH BOOK SUMMARY FOR ABC Grocery Store										PRINTED 02-Jan-91
=====										
*** TAKINGS ***										
DAY	DATE	GROCERY	G-INVOICE	STANDARD	Z-VAT	STANDARD	EXEMPT	BANKINGS DATE		
---	----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Monday	01-Oct-90	129.87						1900.00	01-Oct-90	
Tuesday	02-Oct-90	98.81	127.30						02-Oct-90	
Wednesday	03-Oct-90	134.25							03-Oct-90	
Thursday	04-Oct-90	238.14	234.15						04-Oct-90	
Friday	05-Oct-90	232.15							05-Oct-90	
Saturday	06-Oct-90	413.10	154.30						06-Oct-90	
Sunday	07-Oct-90								07-Oct-90	
TOTAL		1246.12	515.75					1900.00		
=====										
*** CASH CONTROL ***					*** BANK CONTROL ***					
LAST PERIOD BALANCE			2200.54		LAST PERIOD BALANCE			1479.37		
ADD TAKINGS		1781.87			ADD LOGGMENTS			1300.00		
OTHER RECEIPTS		70.00	1831.87							
								TOTAL	3380.00	
LESS PURCHASES PAYMENTS		1184.81	4032.41		LESS PURCHASES PAYMENTS			426.56		
EXPENSES PAYMENTS		442.97			EXPENSES PAYMENTS			345.00	771.56	
BANKINGS		1900.00	3537.66		BANK BALANCE (****)				2608.44	
CASH BALANCE (****)			494.55							
=====										
(VAT @ 15%)										
CODE	DESCRIPTION	REMARK	S-CODE	SUPPLIER	CHEQUE	CASH	VAT	STD. RATE	Z-RATE	EXEMPT
101	Grocery	PD416	S106	Sam Pan Frozen Food	60.00					60.00
102	Food	PD417	S116	Birmingham W/S Mark.		50.40				50.40
103	Non-food	PD423	S123	Central Discount W/S		342.76	24.70	164.70		173.37
101	Grocery	PD424	S109	Misc. Grocery		56.52				56.52
101	Grocery	PD425	S113	Bosher CAC		498.13	6.78	45.28		444.08
101	Grocery	PD426	S114	Cowenry W/S Market		229.00				229.00
101	Grocery	PD458	S112	Lal & Sons	366.56		47.81	318.75		0.00
TOTAL PURCHASES(=)					426.56	1184.81	76.31	528.71		1013.35
=====										
CODE	EXPENSES	DESCRIPTIONS	REMARK	CHEQUE	CASH	VAT	STD. RATE	Z-RATE	EXEMPT	
210	Telephone	For July--Sep 90			180.97	23.61	157.37		0.00	
230	Motor Fuel	For Sep 90			84.00	8.35	55.65		0.00	
202	Rates	For 1/10 year			141.00				141.00	
240	Part-time Assistant Wages	For J. Blogg			57.00				57.00	
203	Gas	For July--Sep 90		115.00		13.00	100.00			
206	Electricity	For July--Sep 90		230.00		30.00	200.00			
TOTAL EXPENSES(=)				345.00	442.97	76.95	513.02		198.00	
=====										
CODE	RECEIPT	DESCRIPTIONS	REMARK	CHEQUE	CASH	VAT	STD. RATE	Z-RATE	EXEMPT	
329	CAP Drawings	For Oct 90			-200.00				-200.00	
321	Rent Received	For Oct--Dec 90		270.00					270.00	
TOTAL RECEIPTS(=)				270.00	-200.00				70.00	
=====										

FIG.6.2: EXAMPLE OF PRINTOUT FOR "VAT" RETURN

[Retail Scheme "D" – one of the 10 from VAT Office]			
VAT for:	ABC Grocery Store		Quarter end: Dec 90
	STD-VAT	Z-VAT	TOTAL
COST OF GOODS	3329.28 [A]	7280.82 [E]	10610.10 [H]
VAT ON COG	499.39 [B]	0.00	499.39 [J]
TOTAL COG	3828.67 [C]	7280.82 [F]	11109.49 [K]
GROSS TAKINGS	20419.82 [D]	464.88 [G]	20884.70 [L]
PROFIT MARGIN	0.81	-14.66	0.47
S = C*L/K			<u>7197.51</u>
O.T. = S*3/23			<u>938.81D</u>
<hr/>			
	MAN. ADJ.	Scheme D	VAT-Table
OUTPUT TAX :-			
Computed		938.81	
Other Receipts		0.00	
Fuel Benefit (Manual)	15.65	15.65	
VAT on Std-Service (3/23)		0.00	
Manual Adjustment	0.00	0.00	
Total VAT Due [Box 1]		954.46	[BOX 1]
INPUT TAX :-			
Purchases		499.39	
Expenses 170.62			
Manual Adjustment	0.00	0.00	
VAT Deductible [BOX 2]		670.01 [BOX 2]	
NET PAYABLE [BOX 3]		284.45	[BOX 3]
VALUE OF OUTPUTS (exclude VAT):-			
Other Receipts		0.00	
Manual Adjustment	104.35	104.35	
Value of Output [BOX 4]		20050.24	[BOX 4]
VALUE OF INPUTS (exclude VAT):-			
Purchases: Std.		3329.28	
Purchases: Zero		7280.82	
Expenses: Std.		1137.44	
Expenses: Zero		0.00	
Manual Adjustment	0.00	0.00	
Value of Input [BOX 5]		11747.54	[BOX 5]

With this successful experience, the Accountants decided to ask the author again to install a network with 5 terminals for the office to use. Further, other software (including the solicitor's client billing system) are loaded onto the network and data is shared by assigned users. The spreadsheet data are archived and saved on a tape daily. The tapes are stored on a monthly basis for data security. This is an important step towards integrated MIS as by now information can be shared and stored systematically on tape. There is no problem of mishandling of data or flooding of floppy diskettes within the office operation.

As an additional bonus to the implementation, the firm has been awarded as Grade C training house by the Chartered Accountants Association. This is the highest grade award and implies that the accounting firm do not have to go outside for training its staff on computer applications in accountancy.

This is a typical case of successful implementation of MIS in the services sector via focused effort. It is a good strategy to appoint a consultant who is fully dedicated towards continuous improvement of MIS and also giving the person the best support. Further results have to be reflected fairly quickly otherwise other users will be lacking confidence.

Result and Comments on the use of ES-MIS:

When running the ES-MIS by the Chartered Accountant, the score was 22 which is above the mean range of 13--21. This score is remarkable in view of the early stage of their MIS development. The 7-point scale results answered by the Accountant are as follows:-

1.	ES-MIS							
1.2	Ease of use	-3	-2	-1	0	1	2	(3)
1.3	Adequacy of Information	-3	-2	-1	0	(1)	2	3
1.4	Value as aid to Install MIS	-3	-2	-1	0	1	(2)	3
1.5	Value as learning tool	-3	-2	-1	0	1	(2)	3
2.	ES-CASE							
2.2	Ease of use	-3	-2	-1	0	1	2	(3)
2.3	Adequacy of Information	-3	-2	-1	0	(1)	2	3
2.4	Value as aid to Install MIS	-3	-2	-1	0	(1)	2	3
2.5	Value as learning tool	-3	-2	-1	0	1	(2)	3

The Accountant likes the ES-MIS as a tool for evaluation and comparison. He also thinks that it is not only simple to use, but also able to provide a fair comparison of effectiveness of PC based MIS to other organisations. The drawback he reckons is that the consultation is too brief. It would be better if further questions and details are provided for serious users. Further, recommendations need to be elaborated more.

6.3.4 Case CH3: A Manufacturer of Electrical Appliance in HK (Employees: about 250)

The firm started using four PCs on a Local Area Network (LAN) in 1984. The author was invited as a consultant to develop the MIS for this firm in 1986. A software package developed in Canada was recommended and adopted. It consists of nine modules, namely: Inventory, Order Entry, Accounts Receivable, General Ledger, Bill-of-materials, Purchasing, Accounts Payable, Job Cost/Work-in-progress, Materials Requirement Planning. The database is all integrated. So far, the firm has used the first five. They find that the most cost-benefit modules are the Inventory and Order Entry.

The author initially helped to set up the Inventory Module. It can keep track of up to 32,000 items, each with 24 fields including full details of description, cost, markup, quantity discounts, location, vendor, lot size, lead time, safety stock, ABC class, type, period-to-date and year-to-date consumptions and valuations. Furthermore, it can provide some 20 different kinds of reports for operation and MIS like: price list, reorder report, full details listing, valuation report, physical inventory worksheet, activity report, bin labels, cost of goods sold/received, spares usage analysis, price level report, etc. Further, it allows global price update and conversion of stock file to ASCII format for outside use. Thus, user can design his own reports or analyse data using spreadsheet or database software.

The Order Entry module can keep track of up to 32,000 orders. The procedure follows a ordering cycle: customer file maintenance, salesperson entry, order edit, acknowledgment, print packing list and invoice, backorder items applied, period end processing, etc. The kinds of report generated from the system are: backordered items report, order report, customer listing, commission report, product usage report, etc.

The major benefit from using the system is that inventory records are much clearer and accurate which gives opportunities to savings in stock. Moreover, customer orders are kept in close attention with timely feedback and correction actions. Since the system is a turn-key one, the manpower required is in its understanding and data entry. This can be handled easily by the production personnel with clerical support.

When the author visited the firm in May 1990, they have started using the Job Cost and Materials Requirement Planning (MRP) modules to exercise better planning and cost control over production. Their network has been expanded and extended. There is a full-time System Analyst doing system development and maintenance. They have updated with the latest version of the software package which provides more features and runs MRP much faster than before. Further, there are additional reporting features which enables them to produce tailor-made reports.

Result and Comments on the use of ES-MIS:

When running the ES-MIS by the System Analyst, the score was 23 which is above the mean range of 13–21. This score is a reflection of their commitment towards their MIS development. The 7-point scale results answered by the System Analyst are as follows:-

1.	ES-MIS							
1.2	Ease of use	-3	-2	-1	0	1	2	(3)
1.3	Adequacy of information	-3	-2	-1	0	1	(2)	3
1.4	Value as aid to install MIS	-3	-2	-1	0	1	(2)	3
1.5	Value as learning tool	-3	-2	-1	0	(1)	2	3
2.	ES-CASE							
2.2	Ease of use	-3	-2	-1	0	1	(2)	3
2.3	Adequacy of information	-3	-2	-1	0	1	2	(3)
2.4	Value as aid to install MIS	-3	-2	-1	0	(1)	2	3
2.5	Value as learning tool	-3	-2	-1	0	1	2	(3)

The System Analyst finds the ES-MIS as a suitable tool for evaluation and comparison. He also thinks that it is easy to use, but yet providing good index for assessing the effectiveness of PC based MIS. He likes the ES-CASE in particular because a number of cases, particular the oversea ones, trigger off his inspiration in the more imaginative use of MIS/DSS.

6.3.5 CH4: A Construction Firm in HK (Employees: about 35)

The firm had a Class 'C' licence for Government contracts which imposes no limit to the value of tendering. The author was invited as a consultant to develop the MIS for this firm in 1986. The first job was to set up a database to record all the works done for the Government to demolish structures. Since there were a few hundred jobs to be done a year and each job consists of a number of predetermined activities, job costing and billing had become a tedious task. Before computerisation, one full time clerk was employed to keep record and check billings. There were frequent mistakes due to documentation error from communications with several Government offices. Now not only clerical work was reduced, but also billings were more accurate and follow up much easier. Further the database provides decision support for determining the optimum discount rate for subsequent tendering.

After this task, the management had gained confidence in the use of computer, the second project by the author was to use spreadsheet to store up commonly used data for tendering of construction projects. Each type of standardised work with unit quantity was stored up in groups. This helps to select costs for tendering, and calculation of total could be done quickly. Moreover, what-if situation could be performed which was so important in tendering.

The third task was to do project planning, including resources allocation and budgetary control. Other office jobs like word processing and document filing were

also handled using PCs. The firm's directors were very pleased with the contribution from the relatively low-cost PCs.

When the author visited the firm in May 90, they had started distributed computing. In each of their 5 construction sites at that time, they installed a stand-alone PC to process the scheduling and bill of materials independently. The office administration system and accounts are still handled by the head-office. Their business has improved a lot since 1986. This is partially due to the more effective information systems which enables them to bid ten per cent more precisely. In Sept 90, they have successfully bided two contracts worth a total sum of £60 million which is more than what they have completed in the last five years.

Nevertheless, the management style is still traditional. They would like to invest to a bare minimum and are not too concern about continuous improvement and long term information strategies. Consequently, the suggestions of LAN implementation and employing a full-time MIS staff has not be taken up seriously. There is a potential problem in the longer run, especially when the volume of business increases at such a rapid rate.

Result and Comments on the use of ES-MIS:

When running the ES-MIS by the Director, the score was 13 which is at the lower end of the mean range of 13--21. This score is a fair reflection of their mediocre commitment towards their MIS development. The 7-point scale results answered by the System Analyst are as follows:-

1.	ES-MIS							
1.2	Ease of use	-3	-2	-1	0	1	(2)	3
1.3	Adequacy of Information	-3	-2	-1	0	1	2	(3)
1.4	Value as aid to Install MIS	-3	-2	-1	0	1	(2)	3
1.5	Value as learning tool	-3	-2	-1	0	1	(2)	3
2.	ES-CASE							
2.2	Ease of use	-3	-2	-1	0	1	2	(3)
2.3	Adequacy of Information	-3	-2	-1	0	1	2	(3)
2.4	Value as aid to Install MIS	-3	-2	-1	(0)	1	2	3
2.5	Value as learning tool	-3	-2	-1	0	1	(2)	3

The Director finds the ES-MIS as a suitable tool for evaluation and comparison. She also thinks that it is easy to use, and yet providing good inspirations for improvement. Their score, though low, is reasonable to her. The "Applications", "Development Packages", and "Achievements" in the ES-MIS are all useful information for consideration. She finds that the ES-CASE has provided good examples of LAN implementation which she will study in detail latter.

6.4 COMMERCIALISATION OF RESULTS

After substantial quality research work has been done, it is worthwhile to commercialise the results so that more people/firms can benefit from the findings. This is similar to what the author has done: after the research work for APO, a book was published. Today, since software development is fast advancing and cheaply available, it is more cost-effective to develop knowledge commercially in software format. There are many advantages over printed work if it is done properly. Examples are:-

- more user-friendly,
- more efficient to search,
- more concise information with user-interaction,
- can be tailor-made to user's environment,
- editing and updating is easier.

The first product is to package the ES-MIS & ES-CASE developed using the Runtime version of VP-Expert which is available from the publisher Paperback Inc. at around £10 a copy (for the older version 2.01). Then the price of ESs developed can be added on top of the ES shell. The ideal selling price should be £49, including VAT. (Note: VAT is only chargeable to software, since printed matter is VAT free.) A manual has to be included to guide users to install and use the ESs.

The second product is to package the ES-DSS developed using the Runtime version of VP-Expert. However, since this has to be sold together with STRATPLAN, there needs to be a joint agreement with the publisher on joint promotional activities. It would be natural to go to the same publisher, Prentice-Hall for publishing the above two products. In fact, an enquiry has been made, and the response from the publisher is very positive. This is a higher end product compared with the first one, and is recommended as a follow-on text for average readers. The target price, together with STRATPLAN costing £15, is at £69 including VAT. Again a manual is included.

It is suggested further to try out and implement a more adventurous approach to package the product. The traditional way of selling software is through computer shops or mail order. However, unlike other application packages, ESs are more educational in nature. Therefore, it would be more suitable to consider the products as reference materials. The idea is to package each of them in the form of a textbook and then include the software as a complement. Thus, the software is seen as an additional bonus, rather than a product in its own right.

After determining the Product and Price, the next "P" in the marketing plan is the "Place". This includes the distribution channels and after-sales services. Apart from distributing through trade magazines and direct mailing, it can also be distributed through the traditional retail outlet. This could be bookshops and computer shops.

It is also important to provide good after-sales service. This could be in the form of toll-free phone enquiry service for the first 15 minutes. Further questionnaire feedback from the users is important for continuous improvement of the service. Users should be encouraged to join the club so that information can be exchanged amongst users. Eventually, the database should grow and a data-bank can be established which is freely available to members through bulletin board.

The last "P" is "Promotion". This can be done through trade magazines like PC World, PC User, Computer Shopper, etc. It can also channel through direct mailing, or through seminars, articles, and trade exhibitions. Another way is to offer inspection copies to academic institutes and training houses. The final objective is to get the message to the right customers at the right time.

The budget for doing some or all of the above depends on the extent and the choice of channels. It can range from say £1000 to £10000. The suggestion is to do a pilot promotion first. One should try to provide the best services to the first batch of users. This is followed by an assessment of the value of the service to them. The results of the assessment can be used as examples of further promotion and reference. If things works out to be promising, a full scale marketing and promotion plan can be launched. However, the first £1000-2000 has to be considered as venture capital, and could possibly be financed from the Task Force Grant of City Council or Venture Capital Grant from the Dept. of Trade & Industry.

In order to test out the idea, the Director of a computer training firm has been approached. Basing on the above products and prices, he has agreed to purchase one set for evaluation. If it is found suitable, he will recommend the product to his trainees who are mostly young school-leavers/graduates who are thinking of setting up their own business.

The ultimate objective of the project is to promote the better use of MISs for SMEs through sharing of knowledge and experience, with the possibility of establishing a cooperative organisation to enhance such activities.

EPILOGUE

In this Chapter, the ES-MIS (+ ES-CASE) and ES-DSS have been validated. The models are further improved after validation. The validation process has demonstrated that knowledge can be effectively built into ESs which can then be acquired by third party without the need to consult an expert personally. Longitudinal research has also been conducted for 5 SMEs. The findings reflected the importance of an information strategy and a focused approach in the development of MISs/DSSs. Finally, a plan has been suggested for the marketing of the ESs developed.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

The scope of the research was based on firms in UK, Japan, and the newly industrialised countries of Asia (i.e., South Korea, Taiwan, HK, and Singapore). This mix of countries has enabled comparison of applications across cultural and geographical differences. Furthermore, the research objectives can be extended to SMEs in various countries where social and economic conditions are similar.

The scope of study was focused on the functional areas of SMEs. These are:-

- Business Planning & Marketing
- Finance
- Human Resources
- Purchasing
- Production/Operations
- Distribution

The conclusions drawn are dependent on the validity of achieving the objectives in Section 1.2.3. Based on the foregone work, the conclusions are as follows:-

7.1.1 STATE OF MIS & DSS DEVELOPMENT

The constituents of contemporary MISs and DSSs have been reviewed via literature search in Chapter 2. The general findings are that the development of both MISs and DSSs are very fast, both in hardware and software technology and also in the new applications in business. The benefits are plentiful. However, it is important for managers of SMEs to develop the specific functional applications that are most suitable for their organisation.

The review of the research methodology has established the direction for the present work. Techniques which have been used in the research include: action research, user development, game approach, and longitudinal research. They are found to be very useful tools in achieving the following objectives of the research.

7.1.2. FACTORS CRITICAL TO THE SUCCESS OF MIS

The factors critical to the success of developing MISs for SMEs are identified based on a study of enterprises in industrialised Southeast Asian countries and the UK.

Firstly, they are verified via questionnaire survey in Chapter 3. Based on the analysis, in order for firms to use information effectively, they could look into the priority of applications, and achievements. This is an important step before any implementation. Efforts have been concentrated on the areas with high priority so that effectiveness could be achieved. Efficiency is then maximised by using the appropriate languages and software packages. This is particularly relevant for new users and systems as there are so many software packages available in the market, and technologies are improving all the time. Finally, guidelines could be obtained for the investment requirement in MIS personnel, and hardware configurations.

The questionnaire survey findings have been further verified via intensive case studies. The venues selected for the study were Singapore, HK, Taiwan, South Korea, Japan, and UK. This sequence fell roughly into the chronological order of the surveys being done. The SMEs visited in these countries contribute to case studies and their experience could be shared by SMEs of similar operation. Further, this approach has provided some understanding on cultural / environmental difference for effective applications of IT by firms from different countries. The above findings are developed into the ES-MIS and ES-CASE.

7.1.3 FACTORS CRITICAL TO THE SUCCESS OF DSS

The factors critical to the successful use of DSSs are identified based on the controlled experiment of playing a simulated business game. STRATPLAN has been chosen as it is recognised as a very suitable tool. From the results of the games conducted in HK it is found that the success of the game depends very much on the effectiveness of using the decision support spreadsheet. This is apparent from the reports of all winning teams. Before one makes the best use of the spreadsheet, the CSFs must be identified. Then the spreadsheet is used to do "what-if" analysis so that the values for the optimum results of the CSFs could be identified. A combination of these two steps will ensure that the game is successful.

On the contrary, the failure teams have admitted that they fail because of major mistakes in decision making. Had they been able to use the decision spreadsheet effectively, the failure would not have occurred. This evidence supports the relevance and usefulness of the decision support spreadsheet in the business decision making process.

The result of STRATPLAN played in UK has revealed the difference between HK and UK students in their decision process. UK students tend to spend more time in developing the strategy and revising the tactics during the course of the game. On the other hand, HK students tend to spend more time in doing "what-if" analysis with the use of the spreadsheet. In fact for the game to be played successfully, both

aspects are equally important. Further, it is necessary to fine tune the decisions by taking into account the actions of the competitors. This is what the winning teams have done.

Overall, there is insignificant difference in claiming that the decision process are different for the two groups of students. One explanation is that the game is well structured. Thus decision factors are fairly logical and there is little scope for deviation. However, the fundamental difference between winning and losing teams for both groups of students lies in the ability to make the best use of the spreadsheet to arrive at a set of rational decisions. Finally, their experience is tapped for the subsequent development of ES-DSS.

7.1.4 ES ADVISORY SERVICE

Guidelines, in the form of Expert System, are produced to enable user managers of SMEs to use effectively MISs and DSSs to achieve better productivity for their work. Firstly, the appropriate ES Shell for this purpose has been identified as VP-Expert. Then the ES-MIS and ES-DSS have been developed based on the findings in 7.13 & 7.14. They are:-

- [1] **EXPERT SYSTEM FOR EFFECTIVE APPLICATIONS OF MICROCOMPUTER-BASED MIS**
 - [MISM] Manufacturing Industry (Up to 300 Employees)
 - [MISMP] Manufacturing Industry (Up to 300 Employees) + Printout
 - [MISS] Services Industry (Up to 150 Employees)
 - [MISSP] Services Industry (Up to 150 Employees) + Printout
- [2] **CASE STUDIES OF EFFECTIVE APPLICATIONS OF MICROCOMPUTER-BASED MIS IN MANUFACTURING INDUSTRIES**
 - [M1] Garment, Textile, or Footwear (9 cases)
 - [M2] Electrical or Electronic Products (14 cases)
 - [M3] Plastic or Metal Products (16 cases)
 - [M4] Food or Household Consumable (10 cases)
 - [M5] Building or Construction (7 cases)
- [3] **CASE STUDIES OF EFFECTIVE APPLICATIONS OF MICROCOMPUTER-BASED MIS IN SERVICES INDUSTRIES**
 - [S1] Trading or Wholesale (10 cases)
 - [S2] Retail or Restaurant (11 cases)
 - [S3] Finance or Insurance (10 cases)
 - [S4] Real Estate or Business Services (10 cases)
 - [S5] Community, Social or Personal Services (17 cases)
 - [S6] Transport or Distribution (18 cases)
 - [S7] Training Institute or Software House (26 cases)
- [4] **EXPERT SYSTEM FOR EFFECTIVE APPLICATIONS OF DSS FOR "STRATPLAN"**
 - [E1] Decision for all rounds except last TWO

- [E2] Decision for all rounds except last TWO (with Printout)
- [E3] Decision for last TWO rounds only
- [E4] Decision for last TWO rounds only (with Printout)

The development process has demonstrated the fact that knowledge could be efficiently built into ES to be used by a third party. Pilot tests have been run and results are found satisfactory. After further improvement, the ES are validated and results are analysed.

The results of the validation have proven that the knowledge built into ES could be used by a third party *without the need to consult an expert personally*. Thus they could be used effectively as training tools. Longitudinal research has also been conducted in five SMEs. The findings reflected the importance of information strategy and focused approach in the development of MISs/DSSs. Further, all cases have shown great faith in PCs (in particular LAN) based MISs/DSSs development. Finally, a plan has been suggested for the marketing of the ES developed.

7.1.5 VALUE OF ES ADVISORY SERVICE

There are two valuable contributions as a result of the research. They are the contribution to knowledge, and the contribution to good management practice.

7.1.5.1 Contribution to Knowledge

The ES Advisory Service has its unique values. Firstly, the ES-MIS provides an unbiased and adequate measurement to the effectiveness of MIS development in SMEs. The deficiency areas will highlight the scope for improvement. Secondly, the Case Studies in the ES-CASE provide good opportunities for SMEs to learn from other SMEs' success, without the need of actually doing an intensive search on available literatures, or going round companies to find an appropriate case experience. Thirdly, the Software House Experience in the ES-CASE provide further insight to SMEs for the various creative use of MISs/DSSs, and the kind of assistance they could obtain from software houses. Finally, the ES-DSS provides a systematic approach for SMEs to acquire the knowledge and experience in DSSs which is important as a competitive edge for their business.

All the above four areas of knowledge are new in terms of its user-friendliness, width, depth, and conceptual framework. Moreover, they have been validated in the best possible ways. Thus they form a set of distinct knowledge which is important and valuable to SMEs for the integration of their information systems.

7.1.5.2 Contribution to Good Management Practice

In the design of questionnaires, a major concern is on the effectiveness of using MISs. Thus, the questions focus on good practice of PC based MISs. Examples are LAN implementation, various important applications in business, use of efficient software packages, and the objectives and achievement of using MISs.

This is further enhanced by the write-up of the case studies. There are many examples of success in MIS/DSS installation basing on good management practices. They are listed under the CSFs of S.5.2.6. Further when Hall's [1980] grouping of CSFs is adopted, it shows that the SME studied favour "cost reduction" whilst system houses favour "differentiation" as their strategy for success.

The last contribution to good management practice is from the ES-DSS. With the use of this tool, SME managers are trained to make more rational decisions in their business. The training is effected both through the STRATPLAN business game, and also through the understanding of the ES-DSS mechanism. At an advanced stage of their information development cycle, SME managers could formulate their own DSS model for making crucial decisions. Furthermore, the values of ES for the organisation based on actual business parameters could be more fully explored.

7.1.6 LIMITATIONS OF THE RESEARCH AND THEIR IMPLICATIONS

Research could be defined as: *seeking through methodical processes to add to one's own body of knowledge and, hopefully, to that of others, by the discovery of non-trivial facts and insights* [Howard and Sharp, 1983]. In order to do so, one must define his/her scope of knowledge. Such scope is crucial to the understanding and use of the knowledge developed. It also opens up scopes for further development of the knowledge.

The overall strand of research has been explained in S.1.3 and Fig.1.7. However, like any other research activities, it is not without limitations. Since there are three main "products" of the research, it is logical to go through their limitations one by one:-

7.1.6.1 Limitations of ES-MIS and their implications

The ES-MIS is based on questionnaire surveys conducted in HK & UK during 1987-90. On the other hand, the pace of hardware and software development has been swift. Thus, some of the mean scores in Fig.5.4 may have been shifted over time. For instance, more and more SMEs have gone through computerisation during the recent years. Thus, the mean number of years' experience (Q.3.1) is reducing continuously. Likewise, with the advancement in end-user computing, the number of programmer/system analysts (Q.3.2) in SMEs tends to reduce as well. Use of LAN (Q.4.2) is certainly becoming more popular. The average costs of hardware (Q.7) and software (Q.8) have come down as well.

The implication of all these changes over time is that the mean figures have to be adjusted downward, until they come to a stable level. If these are not corrected, the mean overall score by SMEs would tend to become higher and higher until they stabilise. Further, if the ES-MIS were to be used by SMEs in other countries, a pilot survey would need to be conducted to find out the differences in means for the current year.

7.1.6.2 Limitations of ES-CASE and their implications

The ES-CASE is based on 67 field surveys conducted in the 6 countries during 1987-90. Although efforts have been made to cover as many industrial sectors as possible, there are still some which are not covered. Moreover, since they are from different countries, there are bound to be some cultural differences in their implementation. Fortunately, the CSFs adopted are fairly universal. With regard to change over time, one important parameter is again the advancement in hardware/software technology. However, this should be considered as an enhancement rather than a limitation.

The implications of all these changes are that the SME managers have to be more ambitious in their planning and implementation. They should study and analyse the various success factors of business, not only in their trade, but also in other trades. This will provide them with a better chance of successful implementation. Then they should make the best use of technological advancement as their competitive advantages.

7.1.6.3 Limitations of ES-DSS and their implications

The ES-DSS is based on experimentation on 130 subjects using the STRATPLAN business game during 1987-90. The quasi-experimental non-equivalent control group design of Campbell and Stanley [1973] has been adopted. The limitation of the ES-DSS results is that its knowledge is acquired based on qualitative assessment of the decision criteria of the subjects. This is unavoidable as human decision making is very complicated and thus quantitative assessment is difficult, if not impossible. To partly counteract with this weakness, a questionnaire was used during the validation stage of the ES-DSS. The other limitation is that the quasi-experimental design is not as good as a true experimental design in terms of the interaction of selection and maturation.

One implication for these limitations is that the ES-DSS should only be used as a training tool for the understanding of DSSs in a business environment. On the other hand, the ES-DSS could be used as a basis for developing a real-life model for SMEs.

7.1.7 OVERALL CONCLUSION

Based on the discussion of the above 6 sections, the objectives in S.1.2.3 have been achieved successfully. Thus, the aim of the research *"To develop and validate a knowledge-based advisory service to enable SMEs to use modern microcomputer-based MISs/DSSs technology to improve the quality and productivity of their business operations"* has been met.

7.2 RECOMMENDATIONS

In order to use the ES-MIS, ES-CASE, and ES-DSS effectively, the background in developing these ES have to be well understood. The following sections suggest the best possible ways to make use of the advice from these ES. The end result of such applications will be a practical management training tool which has proven to be workable. Moreover, further works are suggested for those who want to develop and improve the ES for both research and more advanced or popular applications.

7.2.1 RECOMMENDATION TO THE USE OF ES-MIS

The ES-MIS has been developed based on intensive questionnaires and field surveys. It has been prepared with the utmost care, validated and improved. Yet, like any other questionnaire survey, it is subjected to confidence limit in its accuracy. A generally acceptable level of 95% confidence limit is aimed at. Further, when the ES is used, some of the answers could be subjective, and could vary slightly even if answered by the same person at different times. It should therefore be understood that there is no hard line between success and failure in implementation. The mean range score (13-21) however acts as a guidance to the degree of success in MIS development. It is useful to take note of the areas of low score and try to consider and reconsider the areas which could give you higher score.

The ES-CASE is to provide a qualitative approach to effective MIS development. This is supplementary to the quantitative approach adopted by the ES-MIS. They are in effect a collection of successful case studies. Obviously, not all cases are of direct relevance to your organisation. However, it is worthwhile to note the factors of success which are universal. Then, try to find the more relevant cases which match with the operation of your firm. They will then become valuable evidence to be based upon.

One underpinning principle that can be used when considering the implementation for improvement is the Kepner-Tregoe (K-T) [1981] Method of problem solving and decision making process. In fact, since 1957, they have discovered that the most effective managers are also the better investigators. They reckon that problem solving is a process that follows a logical sequence. The process begins with identifying the problem, continues with analysis to find the real cause, and concludes with decision making. K-T also find out that any improvement of product/process is also a potential problem area. Therefore, effective managers always look forward to solve potential problem in advance, even before they occur. K-T concepts are important to the MIS/DSS development because they help to identify the real problem by investigating into "Changes". Further, such implementation could usually be the source of new problems, if they are not solved in advance.

Another principle that should be used in applying the two ES developed is the Plan-Do-Check-Action Cycle [Deming, 1982]. In other words, if some areas of

improvement are spotted, there should be a good plan to implement it. This includes the commitment from all levels, and the allocation of resources, etc. Then, there should be a pilot test to "Do" the work. The results of the pilot test are further "Checked" so that a more effective implementation scheme can be drawn up. Finally, the scheme is "Actioned" accordingly, ready to feedback for the next stage of development, and hence the word "Cycle".

7.2.2 RECOMMENDATION TO THE USE OF ES-DSS

The use of ES-DSS is not as direct as the ES-MIS. This is because DSS has to be tailor-made by nature. One way to use the ES-DSS is to use the STRATPLAN as a learning tool to improve your decision making process. This will also help to familiarise oneself with the mechanism of DSSs in general, and understand the decision parameters of firms in operation.

STRATPLAN should be played under a competitive environment. It is worthwhile to draw in the functional managers of SMEs so that each can have his own firm (up to a maximum of 5 + the facilitator's). Firstly, there should be an introduction of the STRATPLAN, and also an explanation of the use of ES-DSS by the facilitator competing against other teams. For an initial game, the simple scenario adopted in S.4.2 is recommended. This will be followed by the running of the game, and the debriefing and presentation. Next, the facilitator will debrief on his results based on ES-DSS. Finally, each participant will be given a copy of the ES-DSS, and have a chance to try out and comment on the value of the ES-DSS. Based on these steps the following schedule is recommended:-

ACTIVITY	DESCRIPTION	DURATION (Estimate)	DAY
1	Introduction to STRATPLAN	1 hour	1
2	STRATPLAN game under Scenario of S.4.2	5 hours	1
3	STRATPLAN debriefing and presentation	2 hours	2
4	Debriefing of ES-DSS by facilitator	2 hours	2
5	Evaluation of ES-DSS by everyone	2 hours	2
		<u>12 hours</u>	

After this stage, you can then consider whether it is possible to build up a scenario for your firm based on industrial and competitors' data. It may be difficult at first, but the model takes time to develop. Once it is developed, it will be a very valuable tool to understand your business and your competitions. STRATPLAN could then be run using real-life data which is much more meaningful to you. Your ES-DSS will still be the same, with some minor changes if you consider necessary. Further, you can update your data annually to reflect the changes, and your actual performance against your game performance. It will then be a decision support tool to help you to decide on your annual strategies and even test it out before the actual implementation.

7.2.3 RECOMMENDATION FOR FURTHER WORK

ES-MIS, ES-CASE, and ES-DSS were developed based on thorough analysis, testing and validation. Unfortunately, there was insufficient time and resources to conduct an intensive validation using a large number of SMEs. Thus, if there is an opportunity for further work, it would be very useful to further validate these models in a systematic manner. For instance, such validation could be conducted across representative samples of industrial sectors, or from different countries. More specific recommendations are:-

7.2.3.1 Recommendations for Improving ES-MIS

More questionnaire surveys should be conducted. If they were conducted yearly, the changes over time can be observed and analysed. Questionnaires can be given to the same SMEs that were surveyed in the previous years so that longitudinal research can be conducted. The ES-MIS can also be made available freely on a bulletin board. SME managers could be requested to use it to assess their own company. Provided that they have declared that they have filled in true information, their scores can then be accumulated into the score distributions. Further, they should be requested to fill in a questionnaire on the bulletin board. At regular intervals, these questionnaires could be analysed, and if appropriate, merged with the original set of data. Thus, the knowledge could be expanded very rapidly.

7.2.3.2 Recommendations for Improving ES-CASE

More field surveys could be conducted. If possible, the researcher should be involved in the IS development cycle so that Action Learning can be conducted. This is similar to the longitudinal research of the five cases in S.6.3. The advantage of action learning conducted in the future is that one can make use of the ES-CASE developed to arrive at a quicker and better result. Such results can be developed into an extension of the ES-CASE and can be called "ES-CASEAL" standing for "ES-CASE for Action Learning".

7.2.3.3 Recommendations for Improving ES-DSS

As has been mentioned previously, the most valuable task to accomplish in ES-DSS is to use industrial and company data for an SME in order to make the DSS a real-life one. It may be difficult at the beginning, but once the required data is installed, it can always be updated and improved. The final product will be of value to the SME to do what-if analysis before it makes a strategic moves in its business. It is also valuable for simulating its operational data, so that SME managers do not have to undertake fire-fighting due to wrong decision or lack of budget, etc. Once sufficient real-life case studies based on ES-DSS have been accumulated, they can be used as solid evidence to convince other SMEs of the value of ES-DSS.

7.2.3.4 Recommendations in General

Regarding software improvement, the three ESs can be modified to include windowing features, and more colour elements. Further, they can be recoded using Prolog or other AI languages. Although the process is more tedious, the advantage is that the source code can be compiled and hence the object code (in the form of executable files) can be distributed free of licensing requirement. The ES-MIS and ES-DSS could also be enhanced by Artificial Neural Network Shells (eg., Neurun, Neuroshell, Neuroware, etc.) to include self-learning features so that both the database and knowledge-base can grow in size and accuracy.

More interactive graphics can be included to improve the presentation of these advisory services.

Since there is no boundary to ambition, one possibility is to offer the development work as a proposal to the "ALVEY" project. The ALVEY Committee has in the past funded smaller projects and community clubs to further R&D in specific areas of interest. Examples are the ALFEX (ALvey Financial EXpert systems) and ARIES (Alvey Research into Insurance Expert Systems). The ALFEX Club members agreed jointly to construct a company financial health adviser within the specific domain (for the pilot project) of high-technology retailing. A financial consultant could use such a system to assess the long-term 'expert' opinion of risks relating to loanworthiness. In the case of the ALFEX, club members were from accounting firms. The focus of interest of the clubs' membership was not confined to the systems built, but also to the lessons learned during the construction process. Consequently, they can pass these lessons on to their clients.

The idea here is to convince the ALVEY Committee to fund another club which can be called "AMIDSES" standing for Alvey MIS/DSs Expert Systems. The aim of the club will be the same as that for this thesis, i.e., *"To develop and validate a knowledge-based advisory service to enable SMEs to use modern microcomputer-based MIS/DSS technology to improve the quality and productivity of their business operations."* If this proposal is accepted, then the Advisory Services can be supplied at a token value to all those SMEs wanting to improve their PC-based MISs/DSSs. The beneficiary population will be as huge as the number of SMEs in the country. The reciprocal benefit to the club is that more experience can be gained, and hence the ES Advisory Services can be further improved.

There is literally no limits as to the scope of further work. Like any other ES development, it is only limited by the imagination of the person who is creating it.

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BIBLIOGRAPHIES

Capron H.L., and Duffy, R.E., "Using Microcomputers: A Complete Introduction", Benjamin/Cummings Publishing Co., 1989.

Higgins J.C., "Computer-based Planning Systems", Arnold, ISBN 0-7131-3547-6, 1985.

Holsple C.W. and Whinston A.B., "Business Expert Systems", Irwin, 1987.

Knight T., and Silk D., "Managing Information", McGraw-Hill, ISBN 0-07-707086-0, 1990.

Loebbecke J.K., and Vasarhelyi M.A., "Microcomputers: Applications to Business Problems", Irwin, ISBN 0-256-03453-2, 1986.

Parkinson L.K., and S.T., "Using The Microcomputer in Marketing", MacGraw-Hill, ISBN 0-07-084163-2, 1987.

Reynolds G.W., "Information Systems for Managers", West, 1988.

Rogerson S., Benyon D.R., et al., "A Casebook for Systems Development", Edward Arnold, ISBN 0-7131-3600-6, 1986.

Weidlein J.R. and Cross T.B., "Networking Personal Computers in Organisations", Dow Jones Irwin, ISBN 0-87094-640-4, 1986.

REFERENCES

Ariano C. & Lehouillier S., "Use of expert systems for editing a plan of nursing tasks", *MONTECH '87 Conference: COMPINT*, pp.9-12, 1987.

Baird P.J. & Kazamek T.J., "Moving to micro-based cost accounting", *Comput. Healthcare (USA)* vol.9, no.3, pp.29-31, 1988.

Barki & Hartwick, "Rethinking the concept of user involvement", *MIS Quarterly*, Vol.13, No.1, pp.52-63, Mar 1989.

Baroudi J.J., "The problem of statistical power of MIS research", *MIS Quarterly*, Vol.13, No.1, pp.86-106, Mar 1989.

Baroudi, Olson & Ives, "An empirical study of the impact of user involvement on system usage and information satisfaction", *ACM Communications*, Vol.29, No.3, pp.232-238, Mar 1986.

Beaumont J.R. & Beaumont C.D., "Applied management information systems: Thoughts on current practice and future potential", *Future (UK)*, Vol.19, iss.4, pp.442-445, 1987.

Bobrow, Mittal & Stefik, "Expert Systems: perils and promise", *ACM Communications* Vol.29, No.9, pp.880-894, Sep 1986.

Bonczek, R.H., Holsapple, C.W., and Whinston, A.B., "Future directions in developing DSS", *Decision Sciences*, Vol.11, No.4, 1980.

Bowen K.C., "Research games: An approach to the study of decision processes", *Taylor & Francis*, 1978.

Braden, Kanter & Kopcso, "Development an ES strategy", *MIS Quarterly*, Vol.13, No.4, pp.458-467, Dec 1989.

Buchanan, B.G., "Expert systems: Working systems and the research literature", *Expert Systems*, Vol.3, No.1., 1986.

Buckley J.W., & Chiang H.F., "Research methodology and business decisions", *National Asso. of Accountants and the Society of Ind. Accountants of Canada*, New York, 1976.

Campbell D.T. & Stanley J.C., "Experimental and Quasi-Experimental Designs for Research", RMC Publishing Co., Chicago, 1973.

Canada J.R. & Hodge G.L., "Microcomputer software costing less than Ut in interactive business applications.", *IBM Research Report RJ2392*, San Jose, CA, Nov 1978.

Tavakolian H., "Linking the IT structure with organismputer-based logistics planning system", *Interfaces (USA)* vol.17, no.4, pp.16-26, 1987.

Carlsson, S.A., "A longitudinal study of spreadsheet program use", *J. manage. Inf. Syst. (USA)* vol.5, no.1, pp.82-100, 1988.

Chaudhry S.S. & Khidhathong T., "Resource management using microcomputers", *Comput. Ind. Eng. (UK)* vol.15, pp.166-71, 1988.

Chu C.H. & Wang H.P., "On the design of an intelligent micro-based DSS for line balancing", *Ind. Eng. (UK)* vol.14, no.4, pp.419-27, 1988.

Chuk & Liu, "A generalised software system shell for DSS development", *Comput. Ind. Eng. (UK)* vol.16, no.2, pp.313-19, 1989.

Churchill, G.A., "Marketing Research: Methodological Foundations", *HRW Publishing*, 1983.

Churchill, Miller & Trueblood, "Auditing Management Games & Accounting Education", *R. Irwin*, 1964.

Connell, N., and Powell, P., "Success and failure the commercial application of ESS", *Operational Research Society Conference*, Edinburgh, 1987.

Cooper, D.F., "Board war games for decision making research", *European Journal of O.R.* vol.5, no.1, pp.36-41, 1980.

Costanza, C., "Microcomputers and DSS" *DBA Thesis, George Washington Univ.*, pp.127-139, 1985.

Deming W.E., "Out of the crisis", *Cambridge Uni. Press*, pp.88, 1982.

Department of Trade & Industry, UK, "*The Enterprise Initiative*", 2nd Ed. pp.1-4, 16-17, 1988.

Dologite D.G., "Developing a knowledge based system on a PC using expert system shell", *J. Syst. Mgt.*, USA, Vol.38 no.10, pp.30-7, 1987.

Duke, R.D., "Gaming : The Futures Language", *Sage Publications*, 1974.

Edwards A., and Connell, N.A.D., "Expert System in Accounting", *Prentice Hall*, 1989.

Elfner E.S., "Decision support systems for microcomputers in the industrial engineering environment", *Comput. Ind. Eng. (UK)* vol.15, pp.85-90; 1988.

Evans J.R. & Berman B., "PAINTCO II -- Marketing Game", *Macmillan Pub.*, New Yorlogitek, 1988.

- Feigenbaum, E.A. & McCorduck, P., "The Fifth Generation", *Michael Joseph*, 1983.
- Fisher E.L., "Expert systems can lay groundwork for intelligent CIM decision making", *Ind. Eng.*, March 85, pp.78.
- Flensburg, P., "Two research methodologies for studying user development of data systems", *Proceedings of colloquium on Research Methods in Information Systems*, pp.299-314, 1985.
- Fletcher K. & Buttery A., "The structure and content of the marketing information system: A guide for management", *Journal of Marketing Intelligence & Planning (UK)* vol.6, iss.4, pp.27-35, 1988.
- Frank M.W. & Krassa M.A., "Computers and the law", *Soc. Sci. Comput. Rev. (USA)* vol.6, no.3, pp.341-52, 1988.
- Fripp, J.W., "The Effectiveness of Models for Decision Making in a Business Game Environment", *Ph.D. Thesis, Henley, The Management College*, 1982.
- Frischia, A.J., "AI market prospects are good", *The Industrial and Process Control Magazine*, Mar 1985.
- Galliers, R.D., "In search of a paradigm for information systems research", *Proceedings of colloquium on Research Methods in Information Systems*, pp.281-298, 1985.
- Garellick H., "Executive information systems: marketing hype or invaluable management aid?", *Ind. Manage. + Data Syst. (GB)* pp.20-2, 1987.
- Gates B., "Software into the future", *Working with Compaq Conference*, London, 24 Jan 1991.
- Gongla P., Sakamoto G., et al, "SPARK: A knowledge-based system for identifying competitive uses of Information Technology", *System Journal*, Vol. 28, No.4, 1989.
- Greenacre M.J., "Theory & Applications of Correspondence Analysis", *Academic Press*, 1984.
- Grzesik J. & Niklewicz M., "A microcomputer-aided decision planning system (MSWDP) for chemical industrial groups using the microcomputer", *Chemoautomatyka (Poland)* no.4, pp.15-16, 1988.
- Gupta J.N.D. & Harris T.M., "DSS for small business", *Journal of Systems Management*, Vol.40 Issue 2, pp.37-41, 1989.
- Gurbaxani & Whang, "The impact of IS on organisations and markets", *ACM Communications*, Vol.34, No.1, PP.59-73, Jan 1991.

- Hall W. K., "Survival Strategies in a Hostile Environment", *Harvard Business Review*, Sep/Oct 1980.
- Hewett, J. and Sasson, R., "Expert systems 1986: The Ovum Report", *Ovum*, 1986.
- Hinton R.W., "STRATPLAN Participant and Instructor's Guide", *Prentice-Hall*, ISBN 0-13-851429-1, 1985.
- Hirschheim & Klein, "Four paradigms of IS development", *ACM Communications* Vol.32, No.10, pp.1199-1216, Oct 1989.
- HMSO, "Report on Information Technology", 1980.
- Ho, S.K., "Impact of IT development on business and management teaching : a case at CPHK", *Seminar of Asian Institutions of Higher Learning*, Hong Kong, 1986.
- Ho, S.K., "IT applications in manufacturing: Case studies in selected Asian countries", *Proceedings of Conference for Beijing-Hong Kong Academic Exchange centre*, Beijing, China, pp. 3-1 to 3-12, 1988.
- Ho, S.K., "IT Development for Small & Medium Enterprises in Asian NICs and Japan", *Asian Productivity Organisation Press, Tokyo*, ISBN 92-833-2058-1, 220 pp., 1988.
- Ho, S.K., "IT Development for industrial engineering in Hong Kong", *10th Anniversary of IIE (H.K.)*, Hong Kong, pg.51-58, 1989.
- Ho, S.K., "A Development of user-friendly CAD/CAM software interface", *Proceeding of the 4th Int. Manu. Conf. China*, 1989.
- Ho, S.K., "IT for manufacturing: Case studies in Hong Kong & U.K.", *Proceeding of the 5th Int. Manu. Conf. China*, 1991.
- Holsapple & Whinston, "Management support through artificial intelligence", *Human System Management*, No.5, 1985.
- Holtham C., "IT management into the 1990s: A position paper", *Journal of Information Technology*, Vol.4 #4, Chapman & Hall, Dec 89.
- Howard K. and Sharp J.A., "The management of a student research project", Gower, UK, 1983.
- Huff, Malcolm & Martin, "Growth stages of end user computing", *ACM Communications*, Vol.31, No.5, pp.542-550, May 1988.
- Huttinger, "DSS approach for a competitive delivery strategy", *Proceedings of the 1987 Int. Conf. on Systems, Man., and Cybernetics* vol.3, pp.1015-16, 1987.

- Jacquet-Lagrece E. & Meziani R., "Linear programming and interactivity: a manpower scheduling DSS", *Operational Research '87 Proceedings of the 11th Int. Conference*, pp.176-89, 1988.
- Japan Bureau of SMEs, "Annual Report Regarding Trends for SMEs", pp.196-200, 1986.
- Jenster, P.V., "Firm performance and monitoring of critical success factors in different strategic contexts", *Journal MIS*, Vol.3, No.3, pp.17-34, Winter 1986-87.
- Kepner C. & Tregoe B., "The New Rational Manager", *Princeton Research Press*, 1981.
- Klein H.K. & Lyytinen K.J., "The critical theory of Jurgen Habermas as a basis for a theory of information systems", *Proceedings of colloquium on Research Methods in Information Systems*, pp.219-236, 1985.
- Kopcsó D. & Pipino L., "A comparison of the manipulation of certainty factors by individuals and expert system shells", *Proceedings of the 21st Annual Hawaii Int. Conf. on System Sciences*, Vol.III, pp.181-8, 1988.
- Lee A.S., "A scientific methodology for MIS case studies", *MIS Quarterly*, Vol.13, No.1, pp.32-50, Mar 1989.
- Kumar S. & Hsu C., "An expert system framework for forecasting method selection", *IEEE Journal TH0213*, pp.86-95, Sep 1988.
- Lefrançois P. & Cherkez C., "Adaptive limits for PC-based inventory control", *Fac. des Sci. de l'Admin., Laval Univ., Que., Canada*, 1987.
- Lincoln D.J. & Warberg W.B., "The role of microcomputers in small business marketing", *Journal of Small Business Management*, Vol.25, iss.2, pp.8-17, 1987.
- Madsen O.B.G., "Microcomputer-based interactive distribution planning", *Proceedings of the 1988 IEEE Int. Conf. on Systems*, Vol.1.1, pp.341-4, 1988.
- Mahmoud E. "Review of selected software for sales forecasting and DSS", *Journal of the Academy of Marketing Science*, Vol.16, No.3&4, P. 104-112, Fall 1988.
- Main L., "Decision system with decision-modelling software", *Library Software Review (USA)*, Vol.6, No.3, pp.128-33, 1987.
- Major M.J., "PCs at the top", *Journal of Bank Administration*, Vol.65, iss.5, pp.38-42, 1989.
- Mason C.H. & Perreault W.D., "The Marketing Game", *Irwin*, 1987.

- McAlister J., "How PCs can help managers", *Mach. Des. (USA)*, Vol.60, No.1, pp.129-33, 1988.
- Morris D.C., "The quest for decision support", *Journal of Computers in Healthcare*, Vol.8, iss.8, pp.22-26, 1987.
- Moynihan T., "What chief executives and senior managers want from their IT departments", *MIS Quarterly*, Vol.14, No.1, pp.14-25, Mar 1990.
- Napier, Batsell & Guadango, "Impact of a restricted natural language interface on ease of learning and productivity", *ACM Communications*, Vol.32, No.10, pp.1190-1198, Oct 1989.
- Nolan R.L., "Managing the crises in data processing", *Harvard Business Review*, March/April, 1979.
- O'Keefe R. & Belton V., "Microcomputer based expert system shells -- the spreadsheets of AI", *Expert Systems and AI in DSS*, Proceedings of the 2nd Mini Euroconference, pp.197-211, 1987.
- Pacek T. & Radcliff F., "Computer and the law", *Social Science Computing Review (USA)*, Vol.6, No.3, pp.341-52, 1988.
- PC World*, "Contest", USA, Oct. 1986.
- PC World*, "IBM POWERstation 320" P.123-128, UK, Apr. 1990.
- Pendegrift N., "Job-Shop decision support with a microcomputer spreadsheet", *Production & Inventory Management*, Vol.28, iss.4, pp.11-14, 1987.
- Peters G., "Evaluating your computer investment strategy", *Journal of Information Technology*, Vol.3, pp.178-188, 1988.
- Pettigrew A.M., "Contextualist research: A natural way to link theory and practice", *Proceedings of the Conference on Conducting Research with Theory and Practice in Mind*, University of Southern California, 1983.
- Porter G.L., "Expert systems: Machines that think like you -- sometimes better", *Journal of Financial Executive*, Vol.4, iss.3, pp.44-46, 1988.
- Prekel H.L., "Unusual applications of SLAM in management decision making", *Simulation in the Factory of the Future, Proceedings of the European Simulation Multiconference*, pp.105-10, 1988.
- Reid W.S., "The buddy system", *Journal of Perspective*, Vol.13, Iss.1, pp.8-13, 1987.

Rushinek A. & Rushinek S., "Manufacturing resource planning system (MRP) case study: feature selection system (FSS) for microcomputer users and manufacturers", *Comput. Ind Eng. (UK)*, Vol.16, No.2, pp.321-8, 1989.

Scrivens T., "Networking: Directions through the 90s", *Working with Compaq Conference*, London, 23 Jan 1991.

Silk D., "Current issues in information management", *Int. Journal of Inf. Mangt.*, No.9, pp.85-89, 1988.

Silk D., "Managing IS benefits for the 1990s", *Journal of IT*, No.5, pp.185-193, 1990.

Silk D., "Current Issues in Information Management", *Int. Journal of Inf. Mangt.*, No.10, pp.178-181, 1990.

Silver M.S., "User perceptions of DSS restrictiveness: an experiment", *J. Manage. Inf. Syst. (USA)*, Vol.5, No.1, pp.51-56, 1988.

Sounderpandian J., "Decision analysis using spreadsheets", *Coll. Microcomput. (USA)*, Vol.7, No.2, pp.157-63, 1989.

Spero L. & Aronson M., "Strategic Management Game", *Reality Development Corp.*, 1987.

SPSS Inc., "SPSSX User Reference Manual", SPSS Inc., Netherlands, 1988.

SPSS Inc., "SPSS/PC+ for the IBM PC", SPSS Inc., Netherlands, 1989.

Stair R.M. & Crittenden W.F., "The use, operation, and control of the small business computer", *Inf. Manage. (Netherlands)*, Vol.16, No.3, pp.125-30, 1989.

Straub & Carlson, "Validating instruments in MIS research", *MIS Quarterly*, Vol.13, No.2, pp.146-169, June 1989.

Straub & Wetherbe, "IT for the 1990s: an organisational impact perspective", *ACM Communications*, Vol.32, No.11, pp.1328-1339, Nov 1989.

Sutton, J.A., "Evaluation of a DSS - A case study with the Office Products Division of IBM.", *IBM Research Report RJ2214*, San Jose, CA, Mar 1978.

Sutton, J.A., and Spragues, R.H., "A study of display generation and management in interactive business applications.", *IBM Research Report RJ2392*, San Jose, CA, Nov 1978.

Tavakolian H., "Linking the IT structure with organisational competitive strategy: a survey", *MIS Quarterly*, Vol.13, No.3, pp.308-340, Sep 1989.

Tran H.V., "Successful DSS development with traditional tools and techniques", *Journal of Information System Management*, Summer 1990.

Turban, E. and Watkins, P., "Decision Support and Expert Systems", *Macmillan*, 1988.

Veerakool V. & Daily M., "A decision support system for production planning and bid preparation for a small job shop manufacturer", *Comput. Ind. Eng. (UK)*, Vol.15, pp.162-5, 1988.

Wagner, G.R., "Strategic thinking supported by risk analysis" *DSS-81 Transactions*, pp.113-121, June 1981.

Walvoord B., "Charting the company course with management accounting reports", *Bus. Software (USA)*, Vol.5, No.3, pp.52-9, 1987.

Welter T.R., "Tools at the top", *Industry Week*, Vol.237, iss.10, pp.41-45, 1988.

Williamson M., "PC Week", *USA*, April 21, 1987.

Wood-Harper, T., "Research methods in information systems: Using action research", *Proceedings of colloquium on Research Methods in Information Systems*, pp.169-192, 1985.

Wu M.S., "Choosing PC software for decision-making", *J. Syst. Manage. (USA)*, Vol.39, No.12, pp.19-26, 1988.

APP.1: RESEARCH SCHEDULE

<u>Task</u>	<u>Description</u>	<u>Schedule (months)</u>	
		<u>Commence</u>	<u>Duration</u>
1.	Background preparation, research objectives, literature survey	1/87	2
2.	Questionnaire survey in HK	3/87	2
3.	Field work in Japan, South Korea, Taiwan, HK and Singapore	5/87	3
4.	Analysis of results and publication	8/87	5
5.	Conducting Business Game in HK	1/88	4
6.	Choice and familiarisation of ES	5/88	3
7.	Planning research work in UK	8/88	2
8.	Development of prototype ES	10/88	2
9.	Conduct questionnaire survey in UK and compare results with those in HK	12/88	2
10.	Conduct field survey in UK	2/89	2
11.	Build the knowledge of MIS developed in an expert system shell	4/89	6
12.	Conduct business game in UK	10/89	3
13.	Build the knowledge of DSS developed in an ES shell	1/90	3
14.	Consolidate longitudinal research findings in UK and HK	4/90	4
15.	Validate and improve the models developed	8/90	3
16.	Consolidate results and write to journals	11/90	1
17.	Write up and edit thesis	12/90	3
18.	Prepare for Viva Voce	3/91	1
19.	Revise and improve thesis	7/91	6

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APP.2.1: SURVEY ON USE OF COMPUTERS IN BUSINESS AND INDUSTRY (HK)

1. 1.1 Number of employees : _____
 1.2 Year established : 19__
2. Type of Business
- A. Manufacturing- A1: Garment or Textile _____
 A2: Electrical or Electronic _____
 A3: Plastics or Metals _____
 A4: Building or Construction _____
 A5: Others - _____
- B. Services - B1: Trading or Wholesale _____
 B2: Retail, Restaurant or Hotel _____
 B3: Finance or Insurance _____
 B4: Real Estate or Business Services _____
 B5: Community, Social or Personal Services _____
 B6: Transport or Distribution _____
 B7: Others - _____
- C. Special Group- C1: Training Institute _____
 C2: Software House _____
3. 3.1 When did your firm start using computer? 19__
 3.2 Number of computer programmers/system analysts: _____
 3.3 Number of computer end-users: _____
4. Hardware Configuration
- Microcomputer: Number of IBM-PC (& Compatibles) _____
 -- number with Hard Disks _____
 Number of other Non IBM-compatibles _____
 -- number with Hard Disks _____
 Is networking being used? Yes/No* _____
 Is Chinese character card included? Yes/No* _____
- Minicomputer: Number of terminals _____
 RAM capacity _____ MB
 Disk storage capacity _____ MB
 Is Chinese character system included? Yes/No* _____
5. Major Applications (Please "\/" wherever applicable)
- D1 : Sales Control (customers, accounts receivable, etc.) _____
 D2 : Personnel Data _____
 D3 : Inventory Control _____
 D4 : Accounting (general ledger, payroll, etc.) _____
 D5 : Finance (budgetary control, financial analysis, etc.) _____
 D6 : Purchasing (vendor details, accounts payable, etc.) _____
 D7 : Production/Operations Planning and Control _____
 D8 : Transport/Distribution _____
 D9 : Business Planning and forecasting _____
 D10: Computer Aided Design _____
 D11: Word Processing _____
 D12: Document Filing System _____
 D13: Telex (Fax) Terminal _____
 D14: External On-line Database (VIEWDATA, DIALOG, etc.) _____
 D15: Others : _____

* Please delete whichever inapplicable.

6. Major Software Used (Please "\/" wherever applicable)
 OWN -- Own development
 SOFT -- Developed by software houses
- | | <u>OWN</u> | <u>SOFT</u> |
|---|----------------|-------------|
| 6.1 <u>Using high-level languages</u> - | | |
| COBOL | _____ | _____ |
| RPG | _____ | _____ |
| BASIC | _____ | _____ |
| PASCAL | _____ | _____ |
| FORTRAN | _____ | _____ |
| Others: _____ | | |
| 6.2 <u>Using development packages</u> - | | |
| E1 : Word Processing (e.g. Wordstar, Multimate, etc.) | | _____ |
| E2 : Database (e.g. Dbase III+/ IV, etc.) | | _____ |
| E3 : Integrated (e.g. LOTUS 1-2-3, Framework, etc.) | | _____ |
| E4 : Accounting System (e.g. DPI, SAGE, PERCASUS, etc.) | | _____ |
| E5 : Inventory System (e.g. INMASS, MRP, MICROSS, etc.) | | _____ |
| E6 : Drawing (e.g. AUTOCAD, COREL DRAW, etc.) | | _____ |
| E7 : Project Planning (e.g. Milestone, HPM, etc.) | | _____ |
| E8 : Statistics (e.g. Minitab, SPSS, SAS, Minitab, etc.) | | _____ |
| E9 : Forecasting (e.g. PC-GIVE, ESP. LRP, etc.) | | _____ |
| E10: Financial Analysis (e.g., IFPS, Ultra-plan, etc.) | | _____ |
| E11: Decision Supporting I (e.g. Sales Edge, etc.) | | _____ |
| E12: Decision Supporting II (e.g. Don Jones, etc.) | | _____ |
| E13: Decision Supporting III (e.g. Operation Research, etc.) | | _____ |
| E14: Decision Supporting IV (e.g. 4-GL, AI, etc.) | | _____ |
| E15: Desktop Manager (e.g., Sidekick, Window, etc.)" | | _____ |
| E16: Others - _____ | | _____ |
| 7. Total Cost of the above Hardwares | HK\$ _____,000 | |
| 8. Total Cost of the above Softwares | HK\$ _____,000 | |
| 9. <u>Objectives [O] and Achievement [A]</u> (Please "\/" wherever applicable) | <u>[O]</u> | <u>[A]</u> |
| F1 : Greater capability to meet future increase in business | _____ | _____ |
| F2 : Better control of source and use of funds | _____ | _____ |
| F3 : Better control of inventory | _____ | _____ |
| F4 : Better retrieval of marketing & operation information | _____ | _____ |
| F5 : Reduce overtime requirement | _____ | _____ |
| F6 : Reduce cost of production/operation | _____ | _____ |
| F7 : More systematic flow of materials and goods | _____ | _____ |
| F8 : Improve human resources management efficiency | _____ | _____ |
| F9 : Standardising procedures from planning to implement | _____ | _____ |
| F10: Simplification of business forecasting | _____ | _____ |
| F11: Saving of raw materials and fuel | _____ | _____ |
| F12: Improve product/service quality | _____ | _____ |
| F13: Security of information | _____ | _____ |
| F14: Training of staffs in data processing | _____ | _____ |
| F15: Others - _____ | _____ | _____ |
| 10. Do you think that computerisation in your firm
is worthwhile (i.e. Benefit > Cost) ? | Yes/No* | |

-- THANKS FOR YOUR KIND CO-OPERATION --

APP.2.2: SURVEY ON USE OF COMPUTERS IN BUSINESS AND INDUSTRY (UK)

1. 1.1 Number of employees : _____
 1.2 Year established : 19__
2. Type of Business
 A. Manufacturing- A1: Garment or Textile _____
 A2: Electrical or Electronic _____
 A3: Plastics or Metals _____
 A4: Building or Construction _____
 A5: Others - _____
 B. Services - B1: Trading or Wholesale _____
 B2: Retail, Restaurant or Hotel _____
 B3: Finance or Insurance _____
 B4: Real Estate or Business Services _____
 B5: Community, Social or Personal Services _____
 B6: Transport or Distribution _____
 B7: Others - _____
 C. Special Group- C1: Training Institute _____
 C2: Software House _____
3. 3.1 When did your firm start using computer? 19__
 3.2 Number of computer programmers/system analysts: _____
 3.3 Number of computer end-users: _____
4. Hardware Configuration
 Microcomputer: Number of IBM-PC (& Compatibles) _____
 -- number with Hard Disks _____
 Number of other Non IBM-compatibles _____
 -- number with Hard Disks _____
 Is networking being used? Yes/No* _____
 Minicomputer: Number of terminals _____
 RAM capacity _____ MB
 Disk storage capacity _____ MB
5. Major Applications (Please "\/" wherever applicable)
 D1 : Sales Control (customers, accounts receivable, etc.) _____
 D2 : Personnel Data _____
 D3 : Inventory Control _____
 D4 : Accounting (general ledger, payroll, etc.) _____
 D5 : Finance (budgetary control, financial analysis, etc.) _____
 D6 : Purchasing (vendor details, accounts payable, etc.) _____
 D7 : Production/Operations Planning and Control _____
 D8 : Transport/Distribution _____
 D9 : Business Planning and forecasting _____
 D10: Computer Aided Design _____
 D11: Word Processing _____
 D12: Document Filing System _____
 D13: Telex (Fax) Terminal _____
 D14: External On-line Database (VIEWDATA, DIALOG, etc.) _____
 D15: Others : _____

* Please delete whichever inapplicable.

6. Major Software Used (Please "\/" wherever applicable)OWN -- Own developmentSOFT -- Developed by software housesOWNSOFT6.1 Using high-level languages -

COBOL

RPG

BASIC

PASCAL

FORTRAN

Others: _____

6.2 Using development packages -

E1 : Word Processing (e.g. Wordstar, Multimate, etc.)

E2 : Database (e.g. Dbase III+/ IV, etc.)

E3 : Integrated (e.g. LOTUS 1-2-3, Framework, etc.)

E4 : Accounting System (e.g. BPI, SAGE, PERGASUS, etc.)

E5 : Inventory System (e.g. INMASS, MRP, MICROSS, etc.)

E6 : Drawing (e.g. AUTOCAD, COREL DRAW, etc.)

E7 : Project Planning (e.g. Milestone, HPM, etc.)

E8 : Statistics (e.g. Minitab, SPSS, SAS, Minitab, etc.)

E9 : Forecasting (e.g. PC-GIVE, ESP. IRR, etc.)

E10: Financial Analysis (e.g., IFPS, Ultra-plan, etc.)

E11: Decision Supporting I (e.g. Sales Edge, etc.)

E12: Decision Supporting II (e.g. Don Jones, etc.)

E13: Decision Supporting III (e.g. Operation Research, etc.)

E14: Decision Supporting IV (e.g. 4-GL, AI, etc.)

E15: Desktop Manager (e.g., Sidekick, Window, etc.)

E16: Others - _____

7. Total Cost of the above Hardwares

£ _____,000

8. Total Cost of the above Softwares

£ _____,000

9. Objectives [O] and Achievement [A] (Please "\/" wherever applicable)[O] [A]

F1 : Greater capability to meet future increase in business

F2 : Better control of source and use of funds

F3 : Better control of inventory

F4 : Better retrieval of marketing & operation information

F5 : Reduce overtime requirement

F6 : Reduce cost of production/operation

F7 : More systematic flow of materials and goods

F8 : Improve human resources management efficiency

F9 : Standardising procedures from planning to implement

F10: Simplification of business forecasting

F11: Saving of raw materials and fuel

F12: Improve product/service quality

F13: Security of information

F14: Training of staffs in data processing

F15: Others - _____

10. Do you think that computerisation in your firm
is worthwhile (i.e. Benefit > Cost) ?

Yes/No*

-- THANKS FOR YOUR KIND CO-OPERATION --

APP.2.3: EXAMPLE OF "SPSS" LISTING FOR QUESTIONNAIRE SURVEY -- HK

TITLE SURVEY ON I.T. APPLICATIONS OF HK'S SMALL & MEDIUM FIRMS.
 SUBTITLE '***CREATE SYSTEM FILE***'.

SET
 DISK=' \SPSS\APO.LIS' /BEEP=OFF/EJECT=OFF/MORE=OFF/PRINTER=OFF/WIDTH=132.
 DATA LIST FILE ='\SPSS\APO.DAT' /COMPANY 1-4 EMPLOYEE 5-8 YEAR 9-10
 BUSINESS 11-12 START 13-14 PROGSA 15-16 USER 17-19 PC 20-21 HDISK 22-23
 NONPC 24-25 NHDISK 26-27 NETWORK 28 CHINCARD 29 TERMINAL 30-32 RAM 33-35
 STORAGE 36-38 CHINSYS 39 D1 TO D15 40-54
 /COBOLO 1 COBOLS 2 RPGO 3 RPGS 4 BASICO 5 BASICS 6 PASCALO 7 PASCALS 8
 OTHERO 9 OTHERS 10 E1 TO E16 11-26 CHINSOFT 27 HARDCOST 28-31 SOFTCOST
 32-35
 F1 TO F15 36-50 BENEFIT 51.

RECODE COMPANY (1 THRU 9000=1) (9001 THRU HI=2).
 RECODE EMPLOYEE PROGSA USER PC HDISK NONPC NHDISK TERMINAL RAM STORAGE
 HARDCOST SOFTCOST
 (1 THRU 5=1) (6 THRU 10=2) (11 THRU 20=3) (21 THRU 35=4)
 (36 THRU 50=5) (51 THRU 75=6) (76 THRU 100=7) (101 THRU 150=8)
 (151 THRU 200=9) (201 THRU 300=10) (301 THRU 500=11) (501 THRU 1000=12)
 (1001 THRU 2000=13) (2001 THRU HI=14).
 RECODE YEAR START
 (01 THRU 20=1) (21 THRU 40=2) (41 THRU 60=3) (61 THRU 70=4)
 (71 THRU 75=5) (76 THRU 80=6) (81 THRU 84=7) (85 THRU 87=8).

SUBTITLE '***DEFINING VALUE LABELS***'.
 VALUE LABELS COMPANY 1 'SURVEY' 2 'STUDENTS'
 /EMPLOYEE PROGSA USER PC HDISK NONPC NHDISK TERMINAL RAM STORAGE
 HARDCOST SOFTCOST
 1 '1-5' 2 '6-10' 3 '11-20' 4 '21-35' 5 '36-50' 6 '51-75' 7 '76-100'
 8 '101-150' 9 '151-200' 10 '201-300' 11 '301-500' 12 '501-1000'
 13 '1001-2000' 14 '>2000'
 /YEAR START 1 'BEFORE 1920' 2 '1921-1940' 3 '1941-1960' 4 '1961-1970'
 5 '1971-1975' 6 '1976-1980' 7 '1981-1987'
 /NETWORK CHINCARD CHINSYS D1 TO D15 E1 TO E16 CHINSOFT BENEFIT
 1 'YES' 2 'NO'
 /COBOLO RPGO BASICO PASCALO OTHERO 1 'YES' 0 'NO'
 /COBOLS RPGS BASICS PASCALS OTHERS 1 'YES' 0 'NO'
 /F1 TO F15 1 'AIMED' 2 'ACHIEVED' 0 'NO'.

MISSING VALUES ALL (0).

IF (BUSINESS LE 5 AND EMPLOYEE LE 10) GROUP=1.
 IF (BUSINESS GE 6 AND EMPLOYEE LE 5) GROUP=2.
 IF (BUSINESS LE 5 AND EMPLOYEE GT 10) GROUP=3.
 IF (BUSINESS GE 6 AND EMPLOYEE GT 5) GROUP=4.

VALUE LABELS GROUP 1 'S&M MANUFACTURING' 2 'S&M SERVICE'
 3 'LARGE MANUFACTURING' 4 'LARGE SERVICE'.

SUBTITLE 'ALL S&M MANUFACTURING FIRM SAMPLES IN HK'.
 PROCESS IF (GROUP EQ 1).
 CROSSTABS TABLE = EMPLOYEE YEAR BUSINESS START PROGSA USER PC HDISK NONPC
 NHDISK NETWORK CHINCARD TERMINAL RAM STORAGE CHINSYS D1 TO D15
 COBOLO COBOLS RPGO RPGS BASICO BASICS PASCALO PASCALS OTHERO OTHERS
 E1 TO E16 CHINSOFT HARDCOST SOFTCOST F1 TO F15 BENEFIT BY COMPANY
 /STATISTICS 1 2 3.

SUBTITLE 'ALL S&M SERVICES FIRM SAMPLES IN HK'.
 PROCESS IF (GROUP EQ 2).
 CROSSTABS TABLE = EMPLOYEE YEAR BUSINESS START PROGSA USER PC HDISK NONPC
 NHDISK NETWORK CHINCARD TERMINAL RAM STORAGE CHINSYS D1 TO D15
 COBOLO COBOLS RPGO RPGS BASICO BASICS PASCALO PASCALS OTHERO OTHERS
 E1 TO E16 CHINSOFT HARDCOST SOFTCOST F1 TO F15 BENEFIT BY COMPANY
 /STATISTICS 1 2 3.

SUBTITLE 'ALL LARGE MANUFACTURING FIRM SAMPLES IN HK'.
 PROCESS IF (GROUP EQ 3).
 CROSSTABS TABLE = EMPLOYEE YEAR BUSINESS START PROGSA USER PC HDISK NONPC
 NHDISK NETWORK CHINCARD TERMINAL RAM STORAGE CHINSYS D1 TO D15
 COBOLO COBOLS RPGO RPGS BASICO BASICS PASCALO PASCALS OTHERO OTHERS
 E1 TO E16 CHINSOFT HARDCOST SOFTCOST F1 TO F15 BENEFIT BY COMPANY
 /STATISTICS 1 2 3.

SUBTITLE 'ALL LARGE SERVICES FIRM SAMPLES IN HK'.
 PROCESS IF (GROUP EQ 4).
 CROSSTABS TABLE = EMPLOYEE YEAR BUSINESS START PROGSA USER PC HDISK NONPC
 NHDISK NETWORK CHINCARD TERMINAL RAM STORAGE CHINSYS D1 TO D15
 COBOLO COBOLS RPGO RPGS BASICO BASICS PASCALO PASCALS OTHERO OTHERS
 E1 TO E16 CHINSOFT HARDCOST SOFTCOST F1 TO F15 BENEFIT BY COMPANY
 /STATISTICS 1 2 3.

SAMPLE DATA

000101606006740203038360000220089994002121121122222122
 0010000000221222222222222209000000202000000000001
 000645000107691499914000000220010.10101111111222211212
 1000000010111221122222122199999992022102200000101
 000703007105770109001000400221201.51122122112122222222
 000010020022222222222222221350010002002020200002001
 002606901840305006004000000220000069992121111211212222
 001000000021122222222222222230000050212222111012201
 00290072770881010080003000022004256908211212222212222
 0200020000112222222222222000000001101000000000001
 003101007102800001002000000220067682002121121122212222
 000200000012211222212222222080010001010200200000122
 0032004086068602010000000000015064999122222222222222
 00000000022122212112222222999900000000000000000011
 00330390600783000400001020022012032000211111122212222
 02000200001212222222222222120000000220020202220001
 00410700400583020001212060022011015147111111222212112
 1200000000112222222222221110004001212022200121201
 00440230830284020250800002012005001070211111122212222
 10000010002112222222222220000000001011011000011001

SAMPLE LISTINGSURVEY ON I.T. APPLICATIONS TO HK'S SMALL & MEDIUM FIRMS
ALL S&M MANUFACTURING FIRM SAMPLES IN HK

EMPLOYEE

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
1-5	1	1	1.6	1.6	1.6
6-10	2	5	8.2	8.2	9.8
11-20	3	4	6.6	6.6	16.4
21-35	4	5	8.2	8.2	24.6
36-50	5	3	4.9	4.9	29.5
51-75	6	8	13.1	13.1	42.6
76-100	7	8	13.1	13.1	55.7
101-150	8	8	13.1	13.1	68.9
151-200	9	10	16.4	16.4	85.2
201-300	10	9	14.8	14.8	100.0
	TOTAL	61	100.0	100.0	

Valid Cases 61 Missing Cases 0

SURVEY ON I.T. APPLICATIONS TO HK'S SMALL & MEDIUM FIRMS
ALL S&M MANUFACTURING FIRM SAMPLES IN HK

YEAR

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
BEFORE 1920	1	2	3.3	3.3	3.3
1921-1940	2	2	3.3	3.3	6.6
1941-1960	3	10	16.4	16.4	23.0
1961-1970	4	16	26.2	26.2	49.2
1971-1975	5	13	21.3	21.3	70.5
1976-1980	6	11	18.0	18.0	88.5
1981-1985	7	7	11.5	11.5	100.0
	TOTAL	61	100.0	100.0	

Valid Cases 61 Missing Cases 0

APP.2.4: EXAMPLE OF "SPSS" LISTING FOR QUESTIONNAIRE SURVEY -- UK

TITLE SURVEY ON I.T. APPLICATIONS TO UK'S SMALL & MEDIUM ENTERPRISES.
 SUBTITLE '***CREATE SYSTEM FILE***'.

SET DISK=OFF/BEEP=OFF/EJECT=OFF/MORE=OFF/PRINTER=ON/WIDTH=132.
 DATA LIST FILE = '\SPSS\DATA\UK1.DAT' /COMPANY 1-3 EMPLOYEE 4-6 YEAR 7-8
 BUSINESS 9-10 START 11-12 PROGSA 13-14 USER 15-17 PC 18-19 HDISK 20-21
 NONPC 22-23 NHDISK 24-25 NETWORK 26 TERMINAL 27-28
 STORAGE 29-31 D1 TO D15 32-46
 /COBOLO 1 COBOLS 2 RPGO 3 RPGS 4 BASICO 5 BASICS 6 PASCALO 7 PASCALS 8
 FORTO 9 FORTS 10 OTHERO 11 OTHERS 12 E1 TO E16 13-28 HARDCOST 29-31
 SOFTCOST 32-34 F1 TO F15 35-49 BENEFIT 50.

RECODE EMPLOYEE PROGSA USER PC HDISK NONPC NHDISK TERMINAL STORAGE
 HARDCOST SOFTCOST
 (1 THRU 5=1) (6 THRU 10=2) (11 THRU 20=3) (21 THRU 35=4)
 (36 THRU 50=5) (51 THRU 75=6) (76 THRU 100=7) (101 THRU 150=8)
 (151 THRU 200=9) (201 THRU 300=10) (301 THRU 500=11) (501 THRU 1000=12)
 (1001 THRU 2000=13) (2001 THRU HI=14).
 RECODE YEAR START
 (00 THRU 20=1) (21 THRU 40=2) (41 THRU 60=3) (61 THRU 70=4)
 (71 THRU 75=5) (76 THRU 80=6) (81 THRU 84=7) (85 THRU 87=8).

SUBTITLE '***DEFINING VALUE LABELS***'.
 VALUE LABELS EMPLOYEE PROGSA USER PC HDISK NONPC NHDISK TERMINAL STORAGE
 HARDCOST SOFTCOST
 1 '1-5' 2 '6-10' 3 '11-20' 4 '21-35' 5 '36-50' 6 '51-75' 7 '76-100'
 8 '101-150' 9 '151-200' 10 '201-300' 11 '301-500' 12 '501-1000'
 13 '1001-2000' 14 '>2000'
 /YEAR START 1 'BEFORE 1920' 2 '1921-1940' 3 '1941-1960' 4 '1961-1970'
 5 '1971-1975' 6 '1976-1980' 7 '1981-1987'
 /NETWORK D1 TO D15 E1 TO E16 BENEFIT
 1 'YES' 2 'NO'
 /COBOLO RPGO BASICO PASCALO FORTO OTHERO 1 'YES' 0 'NO'
 /COBOLS RPGS BASICS PASCALS FORTS OTHERS 1 'YES' 0 'NO'
 /F1 TO F15 1 'AIMED' 2 'ACHIEVED' 0 'NO'.

MISSING VALUES ALL (0).

IF (BUSINESS LE 7 AND EMPLOYEE LE 10) GROUP=1.
 IF (BUSINESS GT 7 AND EMPLOYEE LE 5) GROUP=2.
 IF (BUSINESS LE 7 AND EMPLOYEE GT 10) GROUP=3.
 IF (BUSINESS GT 7 AND EMPLOYEE GT 5) GROUP=4.

VALUE LABELS GROUP 1 'S&M MANUFACTURING' 2 'S&M SERVICE'
 3 'LARGE MANUFACTURING' 4 'LARGE SERVICE'.

SUBTITLE 'ALL S&M MANUFACTURING FIRM SAMPLES IN UK'.
 PROCESS IF (GROUP EQ 1).
 FREQUENCIES VARIABLE EMPLOYEE YEAR BUSINESS START PROGSA USER PC HDISK
 NONPC
 NHDISK NETWORK TERMINAL STORAGE D1 TO D15
 COBOLO COBOLS RPGO RPGS BASICO BASICS PASCALO PASCALS FORTO FORTS
 OTHERO OTHERS E1 TO E16 HARDCOST SOFTCOST F1 TO F15 BENEFIT.

SUBTITLE 'ALL S&M SERVICES FIRM SAMPLES IN UK'.
 PROCESS IF (GROUP EQ 2).
 FREQUENCIES VARIABLE EMPLOYEE YEAR BUSINESS START PROGSA USER PC HDISK
 NONPC
 NHDISK NETWORK TERMINAL STORAGE D1 TO D15
 COBOLO COBOLS RPGO RPGS BASICO BASICS PASCALO PASCALS FORTO FORTS
 OTHERO OTHERS E1 TO E16 HARDCOST SOFTCOST F1 TO F15 BENEFIT.

SUBTITLE 'ALL LARGE MANUFACTURING FIRM SAMPLES IN UK'.
 PROCESS IF (GROUP EQ 3).
 FREQUENCIES VARIABLE EMPLOYEE YEAR BUSINESS START PROGSA USER PC HDISK
 NONPC
 NHDISK NETWORK TERMINAL STORAGE D1 TO D15
 COBOLO COBOLS RPGO RPGS BASICO BASICS PASCALO PASCALS FORTO FORTS
 OTHERO OTHERS E1 TO E16 HARDCOST SOFTCOST F1 TO F15 BENEFIT.

SUBTITLE 'ALL LARGE SERVICES FIRM SAMPLES IN UK'.
 PROCESS IF (GROUP EQ 4).
 FREQUENCIES VARIABLE EMPLOYEE YEAR BUSINESS START PROGSA USER PC HDISK
 NONPC
 NHDISK NETWORK TERMINAL STORAGE D1 TO D15
 COBOLO COBOLS RPGO RPGS BASICO BASICS PASCALO PASCALS FORTO FORTS
 OTHERO OTHERS E1 TO E16 HARDCOST SOFTCOST F1 TO F15 BENEFIT.

SAMPLE DATA

001200700484000200704000000000100111101010000
 0000000000010110000100000100150011200001202002201
 0020252508700001000000000010080101001000010000
 0000010000000000000000000000500500022002200000001
 0031081901800001002010000000404010111110001011
 010000000001110000000000000130151200021001000201
 0040707314820001105050000100000111111001010000
 000000000000111000000000000220101200000200002201
 00517572078300040000000000180601111111111111111
 01000100000011111100110001000600501111011000101110
 0061306410790203034240200110100000010000010001
 10001000001011010001000001111070501001000002020101
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 000011000001100000000000000800502221000001000001
 0080443414790001400000501109070100101100010000
 00000000000110000000000000000200102202000200000001
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 0100010000001100000000000000040022121100100002001
 0102502314770206502021010024600110111001010000
 1100000000010000000110000012500501100000002020001

SAMPLE LISTINGSURVEY ON I.T. APPLICATIONS TO UK'S SMALL & MEDIUM FIRMS
ALL S&M MANUFACTURING FIRM SAMPLES IN UK

EMPLOYEE

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
1-5	1	0	0.0	0.0	0.0
6-10	2	1	1.9	1.9	1.9
11-20	3	3	5.7	5.7	7.5
21-35	4	1	1.9	1.9	9.4
36-50	5	3	5.7	5.7	15.1
51-75	6	5	9.4	9.4	24.5
76-100	7	8	15.1	15.1	39.6
101-150	8	15	28.3	28.3	67.9
151-200	9	11	20.8	20.8	88.7
201-300	10	6	11.3	11.3	100.0
	TOTAL	53	100.0	100.0	

Valid Cases 53 Missing Cases 0

SURVEY ON I.T. APPLICATIONS TO UK'S SMALL & MEDIUM FIRMS
ALL S&M MANUFACTURING FIRM SAMPLES IN UK

YEAR

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
BEFORE 1920	1	11	20.8	20.8	20.8
1921-1940	2	10	18.9	18.9	39.6
1941-1960	3	12	22.6	22.6	62.3
1961-1970	4	9	17.0	17.0	79.2
1971-1975	5	5	9.4	9.4	88.7
1976-1980	6	3	5.7	5.7	94.3
1981-1985	7	3	5.7	5.7	100.0
	TOTAL	53	100.0	100.0	

Valid Cases 53 Missing Cases 0

APP.3.1: COMPARISON BETWEEN HK & UK -- SME MANUFACTURING

QUE. CODE	DESCRIPTION	Sample==>	HK 61	UK 53	P (1)	Z (2)	CONCLUSION	VALIDITY
			[P1%]	[P2%]			[Z >1.96?]	(>10%?)
1.2	Established before 1970		49	79	62.95	3.31	DIFFERENT	Valid
2.	TYPE OF BUSINESS :-							
A1	Garment & Textile		16	6	11.35	1.68	SAME	Valid
A2	Electrical & Electronic		13	19	15.79	0.88	SAME	Valid
A3	Plastics & Toys		10	6	8.14	0.78	SAME	Invalid
A4	Building & Construction		18	23	20.32	0.66	SAME	Valid
A5	Other Manufacturing		43	46	44.39	0.32	SAME	Valid
3.1	Computerised before 1980		49	34	42.03	1.62	SAME	Valid
3.2	Programmer/Analyst < 5		95	94	94.54	0.23	SAME	Valid
3.3	End-users < 10		53	43	48.35	1.07	SAME	Valid
4.1	Firms with IBM-PCs		70	83	76.04	1.62	SAME	Valid
4.2	Firms with IBM-PCs + HD		49	75	61.09	2.84	DIFFERENT	Valid
4.3	Firms with other PCs		53	47	50.21	0.64	SAME	Valid
4.4	Firms with other PCs+HD		23	30	26.25	0.65	SAME	Valid
4.5	Network installed		29	34	31.32	0.57	SAME	Valid
4.6	Minicomputer =< 10 term.		79	58	69.24	2.42	DIFFERENT	Valid
4.7	Mini. Storage =< 100 MB		50	56	52.79	0.64	SAME	Valid
5.	MAJOR APPLICATIONS :-							
D1	Sales control		56	91	72.27	4.16	DIFFERENT	Valid
D2	Personnel data		46	43	44.61	0.32	SAME	Valid
D3	Inventory control		62	60	61.07	0.22	SAME	Valid
D4	Accounting		67	96	80.48	3.90	DIFFERENT	Valid
D5	Finance		54	76	64.23	2.44	DIFFERENT	Valid
D6	Purchasing		46	87	65.06	4.58	DIFFERENT	Valid
D7	Production planning		26	47	35.76	2.33	DIFFERENT	Valid
D8	Transport/Distribution		3	9	5.79	1.37	SAME	Invalid
D9	Business planning		26	40	32.51	1.59	SAME	Valid
D10	CAD		23	30	26.25	0.85	SAME	Valid
D11	Wordprocessing		72	77	74.32	0.61	SAME	Valid
D12	Document filing		26	17	21.82	1.16	SAME	Valid
D13	Telex terminal		8	19	13.11	1.74	SAME	Valid
D14	External database access		12	13	12.46	0.16	SAME	Valid
6.A	LANGUAGES USED :-							
6.1	COBOL (own)		27	4	16.31	3.32	DIFFERENT	Valid
6.2	COBOL (software house)		21	19	20.07	0.27	SAME	Valid
6.3	RPG (own)		9	0	4.82	2.24	DIFFERENT	Invalid
6.4	RPG (software house)		9	4	6.68	1.07	SAME	Invalid
6.5	BASIC (own)		27	21	24.21	0.75	SAME	Valid
6.6	BASIC (software house)		20	36	27.44	1.91	SAME	Valid
6.7	PASCAL (own)		9	2	5.75	1.60	SAME	Invalid
6.8	PASCAL (software house)		3	2	2.54	0.34	SAME	Invalid

QUE. CODE DESCRIPTION	Sample==>	HK 61	UK 53	P (1)	Z (2)	CONCLUSION [Z >1.96?]	VALIDITY (>10%?)
6.B USING DEVELOPMENT PACKAGES :-							
E1	Word Processing	75	81	77.79	0.77	SAME	Valid
E2	Database	61	51	56.35	1.07	SAME	Valid
E3	Integrated	54	60	56.79	0.65	SAME	Valid
E4	Accounting System	26	59	41.34	3.57	DIFFERENT	Valid
E5	Inventory System	21	25	22.86	0.51	SAME	Valid
E6	Drawing	21	28	24.25	0.87	SAME	Valid
E7	Project Planning	15	11	13.14	0.63	SAME	Valid
E8	Statistics	7	2	4.68	1.26	SAME	Invalid
E9	Forecasting	3	6	4.39	0.78	SAME	Invalid
E10	Financial Analysis	5	8	6.39	0.65	SAME	Invalid
E11	Decision Support I	0	0	0.00	ERR		Invalid
E12	Decision Support II	0	2	0.93	1.11	SAME	Invalid
E13	Decision Support III	0	4	1.86	1.58	SAME	Invalid
E14	Decision Support IV	2	2	2.00	0.00	SAME	Invalid
E15	Desktop Manager	25	6	16.17	2.75	DIFFERENT	Valid
7.	Total H/W cost =< £20000	32	38	34.79	0.67	SAME	Valid
8.	Total S/W cost =< £10000	57	55	56.07	0.21	SAME	Valid
9. ACHIEVEMENT :-							
F1B	Greater capability	30	68	47.67	4.05	DIFFERENT	Valid
F2B	Control cash flow	18	49	32.41	3.53	DIFFERENT	Valid
F3B	Control inventory	39	40	39.46	0.11	SAME	Valid
F4B	Information retrieval	26	26	26.00	0.00	SAME	Valid
F5B	Reduce overtime	26	15	20.89	1.44	SAME	Valid
F6B	Reduce production cost	18	13	15.68	0.73	SAME	Valid
F7B	Better logistics	20	23	21.39	0.39	SAME	Valid
F8B	Better efficiency of HRM	16	21	18.32	0.69	SAME	Valid
F9B	Standardise procedures	12	11	11.54	0.17	SAME	Valid
F10B	Simplify forecasting	18	25	21.25	0.91	SAME	Valid
F11B	Save raw materials	7	4	5.61	0.69	SAME	Invalid
F12B	Improve quality	30	15	23.03	1.90	SAME	Valid
F13B	Security of information	20	19	19.54	0.13	SAME	Valid
F14B	Training in DP	20	9	14.89	1.65	SAME	Valid
10.	Computerisation is worth	97	98	97.46	0.34	SAME	Valid

No. of Valid Questions (N) ==> 57

$$(1) P = (N1*P1 + N2*P2)/(N1 + N2)$$

$$(2) Z = @ABS((P1-P2)/@SQRT[P*(100-P)*(1/N1+1/N2)])$$

Using NORMAL APPROX. to find out confidence interval in no. of questions:-

Interval attributable to "chance" = $N*P \pm 1.96*SQRT[N*P*(1-P)]$

At 95% confidence interval, P = 0.05

Therefore "Interval" is from : 4.50 to 1.20

This is much less than the "DIFFERENT" conclusions which are valid (13).

CONCLUSION : There is a difference in response between UK & HK firms.

=====

APP.3.2: REVISED COMPARISON BETWEEN HK & UK — SME MANUFACTURING

QUE. CODE DESCRIPTION	Sample==>	HK Rank 61	UK Rank 53	P (1)	Z (2)	CONCL. (3)	VALID? (4)
		[P1%]	[P2%]				
1.2	Established before 1970	49	79				
2.	TYPE OF BUSINESS :-						
A1	Garment & Textile	16	6				
A2	Electrical & Electronic	13	19				
A3	Plastics & Toys	10	6				
A4	Building & Construction	18	23				
A5	Other Manufacturing	43	46				
3.1	Computerised before 1980	49	34	42.03	1.62	SAME	Valid
3.2	Programmer/Analyst < 5	95	94	94.54	0.23	SAME	Valid
3.3	End-users < 10	53	43	48.35	1.07	SAME	Valid
4.1	Firms with IBM-PCs	70	83	76.04	1.62	SAME	Valid
4.2	Firms with IBM-PCs + HD	49	75				
4.3	Firms with other PCs	53	47	50.21	0.84	SAME	Valid
4.4	Firms with other PCs+HD	23	30				
4.5	Network installed	29	34	31.32	0.57	SAME	Valid
4.6	Minicomputer =< 10 term.	79	58				
4.7	Mini. Storage =< 100 MB	50	56				
5.	MAJOR APPLICATIONS :-						
D1	Sales control	56 4th	91 2nd			SAME	Valid
D2	Personnel data	46	43				
D3	Inventory control	62 3rd	60 6th			SAME	Valid
D4	Accounting	67 2nd	96 1st			SAME	Valid
D5	Finance	54 5th	76 5th			SAME	Valid
D6	Purchasing	46 6th	87 3rd			SAME	Valid
D7	Production planning	26	47				
D8	Transport/Distribution	3	9				
D9	Business planning	26	40				
D10	CAD	23	30				
D11	Word processing	72 1st	77 4th			SAME	Valid
D12	Document filing	26	17				
D13	Telex terminal	8	19				
D14	External database access	12	13				
	Mean no. of D answered:	527	&	705	==>	6.16	
6.A	LANGUAGES USED :-						
6.1	COBOL (own)	27 2nd	4				
6.2	COBOL (software house)	21	19				
6.3	RPG (own)	9	0				
6.4	RPG (software house)	9	4				
6.5	BASIC (own)	27 1st	21 2nd			SAME	Valid
6.6	BASIC (software house)	20	36 1st			DIFFER	Valid
6.7	PASCAL (own)	9	2				
6.8	PASCAL (software house)	3	2				
	Mean no. of 6 answered:	125	&	88	==>	1.07	

QUE. CODE	DESCRIPTION	Sample size:	HK Rank 61	UK Rank 53	P {1}	Z {2}	CONCL. {3}	VALID? {4}
6.B USING DEVELOPMENT PACKAG			[P1%]	[P2%]				
E1	Word Processing		75 1st	81 1st	77.79	0.77	SAME	Valid
E2	Database		61 2nd	51 2nd	56.35	1.07	SAME	Valid
E3	Integrated		54 3rd	60 3rd	56.79	0.65	SAME	Valid
E4	Accounting System		26 4th	59 4th	41.34	3.57	SAME	Valid
E5	Inventory System		21	25				
E6	Drawing		21	28				
E7	Project Planning		15	11				
E8	Statistics		7	2				
E9	Forecasting		3	6				
E10	Financial Analysis		5	8				
E11	Decision Support I		0	0				
E12	Decision Support II		0	2				
E13	Decision Support III		0	4				
E14	Decision Support IV		2	2				
E15	Desktop Manager		25	6				
Mean no. of E answered:			315	&	345	==>	3.30	
7.	Total H/W cost =< £20,00		32	38	34.79	0.67	SAME	Valid
8.	Total S/W cost =< £10,00		57	55	56.07	0.21	SAME	Valid
9. ACHIEVEMENT :-								
F1B	Greater capability		30 2nd	68 1st			SAME	Valid
F2B	Control cash flow		18	49 2nd			DIFFER	Valid
F3B	Control inventory		39 1st	40 3rd			SAME	Valid
F4B	Information retrieval		26 4th	26 4th			SAME	Valid
F5B	Reduce overtime		26	15				
F6B	Reduce production cost		18	13				
F7B	Better logistics		20	23				
F8B	Better efficiency of HRM		16	21				
F9B	Standardise procedures		12	11				
F10B	Simplify forecasting		18	25				
F11B	Save raw materials		7	4				
F12B	Improve quality		30 3rd	15				
F13B	Security of information		20	19				
F14B	Training in DP		20	9				
Mean no. of F answered:			300	&	338	==>	3.19	
10.	Computerisation is worth		97	98	97.46	0.34	SAME	Valid

No. of Valid Questions (N) ==> 25
 No. of Valid "DIFFER" = 2

$$(1) P = (N1 \cdot P1 + N2 \cdot P2) / (N1 + N2)$$

$$(2) Z = @ABS((P1 - P2) / @SQRT[P * (100 - P) * (1/N1 + 1/N2)])$$

(3) Conclusion is SAME if $(Z < 1.96)$ or for Q.5, 6 & 9, if both are ranked.

(4) Conclusion is Valid if av. freq. > 10% OR within the Mean No. of Question answered. These responses are used for the development of the ES-MIS.

Using NORMAL APPROX. to find out confidence interval in no. of questions:-

Interval attributable to "chance" = $N \cdot P \pm 1.96 \cdot \sqrt{N \cdot P \cdot (1 - P)}$

At 95% confidence interval, $P = 0.05$

Therefore "Interval" is from -0.89 to 3.39

This is greater than the "DIFFER" conclusions which are Valid (= 2).

CONCLUSION: There is no significant difference in response between UK & HK

APP.3.3: COMPARISON BETWEEN HK & UK -- SME SERVICES

QUE. CODE	DESCRIPTION	Sample=>	HK 155	UK 33	P (1)	Z (2)	CONCLUSION	VALIDITY
			[P1%]	[P2%]			[Z >1.96?]	(>10%?)
1.2	Established before 1970		26	64	32.67	4.23	DIFFER	Valid
2.	TYPE OF BUSINESS :-							
B1	Trading or Wholesale		28	33	28.88	0.58	SAME	Valid
B2	Retail or Restaurant		0	9	1.58	3.76	DIFFER	Invalid
B3	Finance or Insurance		21	6	18.37	2.02	DIFFER	Valid
B4	Real Estate or Business		2	3	2.18	0.36	SAME	Invalid
B5	Community, Social, Perso		1	0	0.82	0.58	SAME	Invalid
B6	Transport or Distributio		3	12	4.58	2.25	DIFFER	Invalid
B7	Other Services		32	30	31.65	0.22	SAME	Valid
C1	Training Institute		3	0	2.47	1.01	SAME	Invalid
C2	Software House		10	7	9.47	0.53	SAME	Invalid
	COMBINING TYPES OF BUSINESS :-							
	B2 + B4 + B5 + B6		6	24	9.16	3.25	DIFFER	Valid
	C1 + C2		13	7	11.95	0.96	SAME	Valid
3.1	Computerised before 1980		38	36	37.65	0.22	SAME	Valid
3.2	Programmer/Analyst < 5		79	82	79.53	0.39	SAME	Valid
3.3	End-users < 10		41	58	43.98	1.79	SAME	Valid
4.1	Firms with IBM-PCs		65	52	62.72	1.40	SAME	Valid
4.2	Firms with IBM-PCs + HD		53	51	52.65	0.21	SAME	Valid
4.3	Firms with other PCs		38	24	35.54	1.53	SAME	Valid
4.4	Firms with other PCs+HD		18	24	19.05	0.80	SAME	Valid
4.5	Network installed		28	30	28.35	0.23	SAME	Valid
4.6	Minicomputer =< 10 term.		65	71	66.05	0.66	SAME	Valid
4.7	Mini. Storage =< 100 MB		28	67	34.85	4.27	DIFFER	Valid
5.	MAJOR APPLICATIONS :-							
D1	Sales control		58	82	62.21	2.58	DIFFER	Valid
D2	Personnel data		36	36	36.00	0.00	SAME	Valid
D3	Inventory control		46	58	48.11	1.25	SAME	Valid
D4	Accounting		80	73	78.77	0.89	SAME	Valid
D5	Finance		46	70	50.21	2.50	DIFFER	Valid
D6	Purchasing		39	79	46.02	4.19	DIFFER	Valid
D7	Production planning		15	24	16.58	1.26	SAME	Valid
D8	Transport/Distribution		6	12	7.05	1.22	SAME	Invalid
D9	Business planning		27	36	28.58	1.04	SAME	Valid
D10	CAD		10	3	8.77	1.29	SAME	Invalid
D11	Word processing		72	73	72.18	0.12	SAME	Valid
D12	Document filing		30	6	25.79	2.86	DIFFER	Valid
D13	Telex terminal		23	6	20.02	2.22	DIFFER	Valid
D14	External database access		22	15	20.77	0.90	SAME	Valid
6.A	LANGUAGES USED :-							
6.1	COBOL (own)		32	6	27.44	3.04	DIFFER	Valid
6.2	COBOL (software house)		24	36	26.11	1.43	SAME	Valid
6.3	RPG (own)		11	0	9.07	2.00	DIFFER	Invalid
6.4	RPG (software house)		12	3	10.42	1.54	SAME	Invalid
6.5	BASIC (own)		23	18	22.12	0.63	SAME	Valid
6.6	BASIC (software house)		18	33	20.63	1.93	SAME	Valid

QUE. CODE	DESCRIPTION	Sample==>	HK 155	UK 33	P (1)	Z (2)	CONCLUSION [Z >1.96?]	VALIDITY (>10%?)
6.7	PASCAL (own)		8	3	7.12	1.01	SAME	Invalid
6.8	PASCAL (software house)		1	0	0.82	0.58	SAME	Invalid
6.B USING DEVELOPMENT PACKAGES :-								
E1	Word Processing		75	64	73.07	1.29	SAME	Valid
E2	Database		62	42	58.49	2.12	DIFFER	Valid
E3	Integrated		56	39	53.02	1.78	SAME	Valid
E4	Accounting System		27	42	29.63	1.71	SAME	Valid
E5	Inventory System		10	9	9.82	0.18	SAME	Invalid
E6	Drawing		10	0	8.24	1.90	SAME	Invalid
E7	Project Planning		6	3	5.47	0.69	SAME	Invalid
E8	Statistics		6	3	5.47	0.69	SAME	Invalid
E9	Forecasting		2	3	2.18	0.36	SAME	Invalid
E10	Financial Analysis		5	6	5.18	0.24	SAME	Invalid
E11	Decision Support I		3	0	2.47	1.01	SAME	Invalid
E12	Decision Support II		2	3	2.18	0.36	SAME	Invalid
E13	Decision Support III		1	0	0.82	0.58	SAME	Invalid
E14	Decision Support IV		6	3	5.47	0.69	SAME	Invalid
E15	Desktop Manager		21	3	17.84	2.45	DIFFER	Valid
7.	Total H/W cost =< £20000		30	55	34.39	2.75	DIFFER	Valid
8.	Total S/W cost =< £10000		46	68	49.86	2.30	DIFFER	Valid
9. ACHIEVEMENT :-								
F1B	Greater capability		44	46	44.35	0.21	SAME	Valid
F2B	Control cash flow		31	46	33.63	1.66	SAME	Valid
F3B	Control inventory		32	33	32.18	0.11	SAME	Valid
F4B	Information retrieval		39	27	36.89	1.30	SAME	Valid
F5B	Reduce overtime		27	6	23.31	2.59	DIFFER	Valid
F6B	Reduce production cost		24	15	22.42	1.13	SAME	Valid
F7B	Better logistics		15	18	15.53	0.43	SAME	Valid
F8B	Better efficiency of HRM		25	30	25.88	0.60	SAME	Valid
F9B	Standardise procedures		16	9	14.77	1.03	SAME	Valid
F10B	Simplify forecasting		17	24	18.23	0.95	SAME	Valid
F11B	Save raw materials		5	0	4.12	1.31	SAME	Invalid
F12B	Improve quality		36	31	35.12	0.55	SAME	Valid
F13B	Security of information		21	9	18.89	1.60	SAME	Valid
F14B	Training in DP		24	15	22.42	1.13	SAME	Valid
10.	Computerisation is worth		91	95	91.70	0.76	SAME	Valid

No. of valid questions (N) ==> 51

$$(1) P = (N1 \cdot P1 + N2 \cdot P2) / (N1 + N2)$$

$$(2) Z = @ABS((P1 - P2) / @SQRT(P * (100 - P) * (1/N1 + 1/N2)))$$

Using NORMAL APPROX. to find out confidence interval in no. of questions:-

Interval attributable to "chance" = $N \cdot P \pm 1.96 \cdot \sqrt{N \cdot P \cdot (1 - P)}$

At 95% confidence interval, P= 0.05

Therefore "Interval" is from : 4.11 to 0.99

This is much less than the "DIFFER" conclusions which are valid (14).

CONCLUSION : There is a difference in response between UK & HK firms.

=====

APP.3.4: REVISED COMPARISON BETWEEN HK & UK — SME SERVICES

QUE. CODE DESCRIPTION	Sample==>	HK Rank 155	UK Rank 33	P (1)	Z (2)	CONCL. (3)	VALID? (4)
		[P1%]	[P2%]				
1.2 Established before 1970		26	64	32.67			
2. TYPE OF BUSINESS :-							
B1 Trading or Wholesale		28	33	28.88			
B2 Retail or Restaurant		0	9	1.58			
B3 Finance or Insurance		21	6	18.37			
B4 Real Estate or Business		2	3	2.18			
B5 Community, Social, Perso		1	0	0.82			
B6 Transport or Distributio		3	12	4.58			
B7 Other Services		32	30	31.65			
C1 Training Institute		3	0	2.47			
C2 Software House		10	7	9.47			
COMBINING TYPES OF BUSINESS :-							
B2 + B4 + B5 + B6		6	24				
C1 + C2		13	7				
3.1 Computerised before 1980		38	36	37.65	0.22	SAME	Valid
3.2 Programmer/Analyst < 5		79	82	79.53	0.39	SAME	Valid
3.3 End-users < 10		41	58	43.98	1.79	SAME	Valid
4.1 Firms with IBM-PCs		65	52	62.72	1.40	SAME	Valid
4.2 Firms with IBM-PCs + HD		53	51	52.65			
4.3 Firms with other PCs		38	24	35.54	1.53	SAME	Valid
4.4 Firms with other PCs+HD		18	24	19.05			
4.5 Network installed		28	30	28.35	0.23	SAME	Valid
4.6 Minicomputer =< 10 term.		65	71	66.05			
4.7 Mini. Storage =< 100 MB		28	67	34.85			
5. MAJOR APPLICATIONS :-							
D1 Sales control		58 3rd	82 1st	62.21		SAME	Valid
D2 Personnel data		36	36	36.00			
D3 Inventory control		46 4th	58 6th	48.11		SAME	Valid
D4 Accounting		80 1st	73 3rd	78.77		SAME	Valid
D5 Finance		46 5th	70 5th	50.21		SAME	Valid
D6 Purchasing		39 6th	79 2nd	46.02		SAME	Valid
D7 Production planning		15	24	16.58			
D8 Transport/Distribution		6	12	7.05			
D9 Business planning		27	36	28.58			
D10 CAD		10	3	8.77			
D11 Word processing		72 2nd	73 4th	72.18		SAME	Valid
D12 Document filing		30	6	25.79			
D13 Telex terminal		23	6	20.02			
D14 External database access		22	15	20.77			
Mean no. of Q.D answered: 510 & 573 ==> 5.42							
6.A LANGUAGES USED :-		[P1%]	[P2%]				
6.1 COBOL (own)		32 1st	6	27.44		DIFFER	Valid
6.2 COBOL (software house)		24 2nd	36 1st	26.11		SAME	Valid
6.3 RPG (own)		11	0	9.07			
6.4 RPG (software house)		12	3	10.42			
6.5 BASIC (own)		23	18	22.12			
6.6 BASIC (software house)		18	33 2nd	20.63			
6.7 PASCAL (own)		8	3	7.12			
6.8 PASCAL (software house)		1	0	0.82			
Mean no. of Q.6 answered: 129 & 99 ==> 1.14							

QUE. CODE DESCRIPTION	Sample size:	HK Rank	UK Rank	P	Z	CONCL.	VALID?
		155	33	(1)	{2}	{3}	{4}
6.B USING DEVELOPMENT PACKAGES :-							
E1	Word Processing	75 1st	64 1st	73.07		SAME	Valid
E2	Database	62 2nd	42 2nd	58.49		SAME	Valid
E3	Integrated	56 3rd	39 4th	53.02		SAME	Valid
E4	Accounting System	27 4th	42 3rd	29.63		SAME	Valid
E5	Inventory System	10	9	9.82			
E6	Drawing	10	0	8.24			
E7	Project Planning	6	3	5.47			
E8	Statistics	6	3	5.47			
E9	Forecasting	2	3	2.18			
E10	Financial Analysis	5	6	5.18			
E11	Decision Support I	3	0	2.47			
E12	Decision Support II	2	3	2.18			
E13	Decision Support III	1	0	0.82			
E14	Decision Support IV	6	3	5.47			
E15	Desktop Manager	21	3	17.84			
Mean no. of Q.E answered:		292	&	220	==>	2.56	
7.	Total H/W cost =< £20,00	30		55		34.39	2.75 DIFFER Valid
8.	Total S/W cost =< £10,00	46		68		49.86	2.30 DIFFER Valid
9. ACHIEVEMENT :-							
F1B	Greater capability	44 1st	46 1st	44.35		SAME	Valid
F2B	Control cash flow	31	46 2nd	33.63		DIFFER	Valid
F3B	Control inventory	32 4th	33 3rd	32.18		SAME	
F4B	Information retrieval	39 2nd	27	36.89			Valid
F5B	Reduce overtime	27	6	23.31			
F6B	Reduce production cost	24	15	22.42			
F7B	Better logistics	15	18	15.53			
F8B	Better efficiency of HRM	25	30	25.88			
F9B	Standardise procedures	16	9	14.77			
F10B	Simplify forecasting	17	24	18.23			
F11B	Save raw materials	5	0	4.12			
F12B	Improve quality	36 3rd	31 4th	35.12		SAME	Valid
F13B	Security of information	21	9	18.89			
F14B	Training in DP	24	15	22.42			
Mean no. of Q.F answered:		356	&	309	==>	3.33	
10.	Computerisation is worth	91		95		91.70	0.76 SAME Valid

No. of Valid Questions (N) ==> 25
 No. of Valid "DIFFER" = 4

$$(1) P = (N1 \cdot P1 + N2 \cdot P2) / (N1 + N2)$$

$$(2) Z = \frac{P1 - P2}{\sqrt{P \cdot (100 - P) \cdot (1/N1 + 1/N2)}}$$

(3) Conclusion is SAME if (Z < 1.96) or for Q.5, 6 & 9, if both are ranked.

(4) Conclusion is Valid if av. freq. > 10% OR within the Mean No. of Question answered. These responses are used for the development of the ES-MIS.

Using NORMAL APPROX. to find out confidence interval in no. of question:-

Interval attributable to "chance" = $N \cdot P \pm 1.96 \cdot \sqrt{N \cdot P \cdot (1 - P)}$

At 95% confidence interval, P 0.05

Therefore "Interval" is from -0.89 to 3.39

This is about the same no. of "DIFFER" conclusions which are Valid (= 4).

CONCLUSION: There is no significant difference in response between UK & HK

APP.3.5: EXAMPLE OF "SPSS" LISTING FOR FACTOR ANALYSIS —
HK & UK SURVEYS

SPSS-X RELEASE 3.1 FOR IBM VM/CMS

University of Warwick (Sky) IBM 4381-2 VM/CMS

```

1  TITLE FACTOR ANALYSIS USING PROXIMITY OF SME-M ON APPLICATIONS (D)
2
3  FILE HANDLE DATA1/NAME='XMD DAT A'
4  DATA LIST FILE=DATA1
5  / D1 1 D2 TO D15 2-29

```

This command will read 1 records from XMD DAT A1

<u>Variable</u>	<u>Rec</u>	<u>Start</u>	<u>End</u>	<u>Format</u>
D1	1	1	1	F1.0
D2	1	2	3	F2.0
D3	1	4	5	F2.0
D4	1	6	7	F2.0
D5	1	8	9	F2.0
D6	1	10	11	F2.0
D7	1	12	13	F2.0
D8	1	14	15	F2.0
D9	1	16	17	F2.0
D10	1	18	19	F2.0
D11	1	20	21	F2.0
D12	1	22	23	F2.0
D13	1	24	25	F2.0
D14	1	26	27	F2.0
D15	1	28	29	F2.0

```

6 0 PROXIMITIES D1 TO D15
7 0 / VIEW = VARIABLE
8 0 / MEASURE = JACCARD
9 0 / MATRIX = OUT(*).

```

***** PROXIMITIES *****

Data Information

114 unweighted cases accepted.
0 cases rejected because of missing value.

Jaccard measure used.

Jaccard Similarity Coefficient Matrix

Variable	D1	D2	D3	D4	D5	D6	D7	D8
D2	.4066							
D3	.7333	.4545						
D4	.6600	.4839	.6436					
D5	.5417	.5190	.5102	.6809				
D6	.6966	.4302	.6413	.6771	.6067			
D7	.3690	.3385	.3855	.3889	.3544	.4103		
D8	.0494	.0755	.0759	.0674	.0694	.0811	.1282	
D9	.3721	.3846	.3563	.4066	.4865	.3452	.3051	.0930
D10	.1954	.2667	.2093	.2000	.2000	.1928	.2857	.1000
D11	.5980	.5000	.6139	.7129	.5979	.6122	.3407	.0575
D12	.1957	.2239	.2222	.2500	.2750	.2651	.1695	.1143
D13	.0732	.1111	.1000	.1011	.1268	.0921	.0444	.0625
D14	.1412	.1897	.1412	.1889	.2192	.1948	.1429	.1304
D15	.0941	.1818	.1071	.1444	.1486	.1139	.1304	.1579
Variable	D9	D10	D11	D12	D13	D14		
D10	.2692							
D11	.4045	.2065						
D12	.1803	.1837	.3000					
D13	.1364	.0588	.1176	.0500				
D14	.2041	.1250	.1954	.2143	.1600			
D15	.1224	.1389	.1111	.1190	.0870	.3077		

```

11 RECODE ROWTYPE ('PROX'='CORR')
12 FACTOR MATRIX=IN(COR=*)
13 / PRINT=ALL
14 / FORMAT=SORT
15 / ROTATION=VARIMAX
16 / ROTATION=OBLIMIN.

```

EXTRACTION 1 FOR ANALYSIS 1, PRINCIPAL-COMPONENTS ANALYSIS (PC)

INITIAL STATISTICS:

<u>VARIABLE</u>	<u>COMMUNALITY</u>	<u>*</u>	<u>FACTOR</u>	<u>EIGENVALUE</u>	<u>PCT OF VAR</u>	<u>CUM PCT</u>
D1	1.00000	*	1	5.47137	36.5	36.5
D2	1.00000	*	2	1.45107	9.7	46.1
D3	1.00000	*	3	1.02384	6.8	53.0
D4	1.00000	*	4	.94713	6.3	59.3
D5	1.00000	*	5	.90352	6.0	65.3
D6	1.00000	*	6	.86518	5.8	71.1
D7	1.00000	*	7	.74263	5.0	76.0
D8	1.00000	*	8	.68615	4.6	80.6
D9	1.00000	*	9	.64274	4.3	84.9
D10	1.00000	*	10	.58483	3.9	88.8
D11	1.00000	*	11	.47958	3.2	92.0
D12	1.00000	*	12	.39788	2.7	94.6
D13	1.00000	*	13	.30945	2.1	96.7
D14	1.00000	*	14	.25015	1.7	98.4
D15	1.00000	*	15	.24448	1.6	100.0

PC EXTRACTED 3 FACTORS.

FACTOR MATRIX:

	<u>FACTOR 1</u>	<u>FACTOR 2</u>	<u>FACTOR 3</u>
D4	.84021	-.17799	.08857
D6	.80645	-.18738	.05326
D11	.80359	-.14651	.09534
D1	.79023	-.27082	.04394
D3	.78806	-.22395	.02717
D5	.78761	-.05567	.09573
D2	.66636	.07239	-.05074
D9	.58857	.13373	-.05507
D7	.55612	.07836	-.37287
D12	.39181	.27151	-.10869
D15	.24157	.61258	.09050
D14	.32341	.59093	.28946
D8	.15003	.47138	-.24591
D13	.17723	.30357	.62308
D10	.36516	.30729	-.54324

FINAL STATISTICS:

<u>VARIABLE</u>	<u>COMMUNALITY</u>	*	<u>FACTOR</u>	<u>EIGENVALUE</u>	<u>PCT OF VAR</u>	<u>CUM PCT</u>
D1	.69974	*	1	5.47137	36.5	36.5
D2	.45185	*	2	1.45107	9.7	46.1
D3	.67194	*	3	1.02384	6.8	53.0
D4	.74547	*				
D5	.63260	*				
D6	.68831	*				
D7	.45444	*				
D8	.30518	*				
D9	.36733	*				
D10	.52287	*				
D11	.67632	*				
D12	.23905	*				
D13	.51179	*				
D14	.53758	*				
D15	.44181	*				

VARIMAX ROTATION 1 FOR EXTRACTION 1 IN ANALYSIS 1 - KAISER
NORMALIZATION.

VARIMAX CONVERGED IN 5 ITERATIONS.

ROTATED FACTOR MATRIX:

	<u>FACTOR 1</u>	<u>FACTOR 2</u>	<u>FACTOR 3</u>
D4	.85410	.08301	.09538
D1	.83534	.04292	-.01019
D6	.82241	.09253	.05824
D3	.81540	.08330	.01110
D11	.80969	.08630	.11524
D5	.76328	.13711	.17665
D2	.59135	.28524	.14423
D9	.49707	.30239	.16975
D10	.18051	.69530	-.08273
D8	-.04791	.51483	.19451
D7	.45483	.48899	-.09199
D12	.26046	.36602	.19296
D14	.12485	.25297	.67675
D13	.12107	-.21095	.67278
D15	.02147	.38567	.54092

FACTOR TRANSFORMATION MATRIX:

	<u>FACTOR 1</u>	<u>FACTOR 2</u>	<u>FACTOR 3</u>
FACTOR 1	.93262	.30584	.19150
FACTOR 2	-.34723	.61621	.70691
FACTOR 3	.09820	-.72577	.68089

FACTOR SCORE COEFFICIENT MATRIX:

	<u>FACTOR 1</u>	<u>FACTOR 2</u>	<u>FACTOR 3</u>
D1	.20372	-.10198	-.07505
D2	.09140	.10396	.02484
D3	.19053	-.07031	-.06345
D4	.19430	-.09140	.00160
D5	.15676	-.04747	.06411
D6	.18741	-.07225	-.02764
D7	.04028	.32868	-.19033
D8	-.11081	.38288	.07135
D9	.06304	.12873	.04913
D10	-.06339	.53599	-.19879
D11	.18118	-.08488	.02016
D12	-.00861	.21425	.07371
D13	.01733	-.30287	.56846
D14	-.05852	.06383	.49170
D15	-.09673	.20948	.36707

APP.3.6: EXAMPLE OF "SPSS" LISTING FOR CLUSTER ANALYSIS —
HK & UK SURVEYS

SPSS-X RELEASE 3.1 FOR IBM VM/CMS
University of Warwick (Sky) IBM 4381-2 VM/CMS

```
1  TITLE CLUSTER ANALYSIS ON PROXIMITY OF SME-M ON APPLICATIONS (D)
2
3  FILE HANDLE DATA1/NAME='XMD DAT A'
4  DATA LIST FILE=DATA1
5  / D1 1 D2 TO D15 2-29
```

This command will read 1 records from XMD DAT A1

<u>Variable</u>	<u>Rec</u>	<u>Start</u>	<u>End</u>	<u>Format</u>
D1	1	1	1	F1.0
D2	1	2	3	F2.0
D3	1	4	5	F2.0
D4	1	6	7	F2.0
D5	1	8	9	F2.0
D6	1	10	11	F2.0
D7	1	12	13	F2.0
D8	1	14	15	F2.0
D9	1	16	17	F2.0
D10	1	18	19	F2.0
D11	1	20	21	F2.0
D12	1	22	23	F2.0
D13	1	24	25	F2.0
D14	1	26	27	F2.0
D15	1	28	29	F2.0

```
6 0 PROXIMITIES D1 TO D15
7 0 / VIEW = VARIABLE
8 0 / MEASURE = JACCARD
9 0 / MATRIX = OUT(*).
```

Data Information

114 unweighted cases accepted.
0 cases rejected because of missing value.

Jaccard measure used.

Jaccard Similarity Coefficient Matrix

Variable	D1	D2	D3	D4	D5	D6	D7	D8
D2	.4066							
D3	.7333	.4545						
D4	.6600	.4839	.6436					
D5	.5417	.5190	.5102	.6809				
D6	.6966	.4302	.6413	.6771	.6067			
D7	.3690	.3385	.3855	.3889	.3544	.4103		
D8	.0494	.0755	.0759	.0674	.0694	.0811	.1282	
D9	.3721	.3846	.3563	.4066	.4865	.3452	.3051	.0930
D10	.1954	.2667	.2093	.2000	.2000	.1928	.2857	.1000
D11	.5980	.5000	.6139	.7129	.5979	.6122	.3407	.0575
D12	.1957	.2239	.2222	.2500	.2750	.2651	.1695	.1143
D13	.0732	.1111	.1000	.1011	.1268	.0921	.0444	.0625
D14	.1412	.1897	.1412	.1889	.2192	.1948	.1429	.1304
D15	.0941	.1818	.1071	.1444	.1486	.1139	.1304	.1579
Variable	D9	D10	D11	D12	D13	D14		
D10	.2692							
D11	.4045	.2065						
D12	.1803	.1837	.3000					
D13	.1364	.0588	.1176	.0500				
D14	.2041	.1250	.1954	.2143	.1600			
D15	.1224	.1389	.1111	.1190	.0870	.3077		

11 0 CLUSTER
 12 0 / MATRIX IN(*)
 13 0 / PRINT = DISTANCE SCHEDULE

Agglomeration Schedule using Average Linkage (Between Groups)

Stage	Cluster 1	Combined Cluster 2	Coefficient	Stage Cluster 1	Cluster 1st Appears Cluster 2	Next Stage
1	1	3	.733333	0	0	3
2	4	11	.712871	0	0	4
3	1	6	.668966	1	0	5
4	4	5	.639394	2	0	6
5	1	4	.607045	3	4	7
6	1	2	.465705	5	0	8
7	1	9	.393692	6	0	10
8	1	7	.361546	7	0	12
9	14	15	.307692	8	0	11
10	1	12	.231292	10	0	12
11	1	10	.220928	11	9	13
12	1	14	.153115	12	0	14
13	1	13	.096808	13	0	0
14	1	8	.090183			

APP.4: FIELD SURVEY OF SME COMPUTERISATION
[for all countries surveyed]

HONG KONGCH1 A Toy Manufacturer (Employees: about 280)CSF: Effective Process in installing MIS.

The firm started computerising its business operation in 1981. At the initial stage, there was a flooding of computer printouts. Information security emerged to be a major problem. The firm then used the recommendation from a management consultant. This could be summarised by C.O.M.P.U.T.E.R. which stands for:-

C.ommunication
O.n-line real-time application
M.anagement upgrade
P.roject team approach
U.sers' participation
T.op level support
E.ducation
R.eview

Today, the benefits are plentiful. These include:-

- [1] Reduction of manpower in payroll, store, accounting, word processing, etc.
- [2] In six years, there was only an increase of 30% in employees, inclusive of the EDP personnel despite the real increase of sales of 150%.
- [3] Better customer and vendor services. Examples are rating of customers and vendors in priority, with the view to pay more attention to the major customers and follow up the less active ones.
- [4] Prompt management information for supporting decision making. Examples are stock, receipt, sales, order, credit, personnel, payroll, and liquidity available for short term investment.
- [5] Higher profit and better control of slow moving stocks, customer credits, sales result, statement with banks, etc. The stock on hand is reduced from 2.2 months to 1.1 months.
- [6] Production scheduling and capacity planning can be done more accurately and efficiently.
- [7] Increase of productivity and reduction of scrapes.

CH2 A Battery Manufacturer (Employees: about 180)CSF: Improvement in sales control and factory automation.

When the firm established its computer department in 1982, the staff were negative towards its use, because they were afraid that the computer would replace their jobs. It took two months for the department to convince them that computer was in fact helping their work. The firm's distribution network is through dealers and major retailers. The first module implemented was the 'Order Entry'. It

enables the 20 sales staff to improve their documentation. The module consists of product code, sales quantity, price, invoice number, accounts receivable details, sales statistics, analysis reports, etc.

Before using the module, it took two clerks to work for ten days to prepare the reports. Further, each sales staff had to spend two days a month to compile the accounts receivable monthly statement. Now it only takes a clerk to work for one day to print all statements. The reports are available on-line at any time, without any manual processing.

Another significant improvement is through the use of robots in an assembly line. This has improved not only the production rate, but also the quality. Before using robots for assembly, 36 assembly workers could only produce 6000 batteries a day. Now, 21 workers can produce 10000 batteries a day. The defective percentage has improved from 4% to 0.5%.

CH3 A Manufacturer of Electrical Appliance (Employees: about 250)

CSF: Effective use of LAN and integrated manufacturing database.

The firm started using four PCs on a Local Area Network (LAN) in 1984. A software package developed in Canada was used. It consists of nine modules, namely: Inventory, Order Entry, Accounts Receivable, General Ledger, Bill-of-materials, Purchasing, Accounts Payable, Job Cost/Work-in-progress, Materials Requirement Planning. The database is all integrated. By 1987, the firm has used the first five. They find that the most cost-benefit modules are the Inventory and Order Entry.

The Inventory module can keep track of up to 32,000 items, each with 24 fields including full details of description, cost, markup, quantity discounts, location, vendor, lot size, lead time, safety stock, ABC class, type, period-to-date and year-to-date consumptions and valuations. It can also provide some 20 different kinds of reports for operation and MIS like: price list, reorder report, full details listing, valuation report, physical inventory worksheet, activity report, bin labels, cost of goods sold/received, spares usage analysis, price level report, etc. Further, it allows global price update and conversion of stock file to ASCII format for outside use. Thus, user can design his own reports or analyse data using spreadsheet or database softwares.

The Order Entry module can keep track of up to 32,000 orders. The procedure follows a ordering cycle: customer file maintenance, salesperson entry, order edit, acknowledgment, print packing list and invoice, backorder items applied, period end processing, etc. The kinds of report generated from the system are: backordered items report, order report, customer listing, commission report, product usage report, etc.

The major benefit from using the system is that inventory records are much clearer and accurate which gives opportunities to savings in stock. Moreover, customer orders are kept in close attention with

timely feedback and correction actions. Since the system is a turn-key one, the manpower required is in its understanding and data entry. This can be handled easily by the production personnel with clerical support. The firm intends to use the job cost and materials requirement planning modules in the near future to exercise better planning and cost control over production.

CH4 A Construction Firm (Employees: about 35)

CSF: Office automation and DSS system for tendering.

The firm had a Class 'C' licence for Government contracts which imposes no limit to the value of tendering. They started using computer in 1986. The first job was to set up a database to record all the works done for the Government to demolish structures. Since there were a few hundred jobs to be done a year and each job consists of a number of predetermined activities, job costing and billing had become a tedious task. Before computerisation, one full time clerk was employed to keep record and check billings. There were frequent mistakes due to documentation error from communications with several Government offices. Now not only clerical work is reduced, but also billings are more accurate and follow up much easier. Further the database provides decision support for determining the optimum discount rate for subsequent tendering.

After this task, the management has gained confidence in the use of computer. The second project was to use spreadsheet to store up commonly used data for tendering of construction projects. Each type of standardised work with unit quantity was stored up in groups. This helps to select costs for tendering, and calculation of total can be done quickly. What-if analysis, a very important tool in tendering, can also be performed. The third task was to do project planning, including resources allocation and budgetary control. Other office jobs like word processing and document filing were also handled using PCs. The firm's director is very pleased with the contribution from the relatively low-cost PCs.

CH5 A Medium Size Department Store (Employees: about 180)

CSF: Real-time inventory and accounting system.

Generally speaking, department stores are operating at low profit margins due to keen competition. In order to survive, most store would either launch sales promotion or generate saving via better internal control, or use both. Moreover, better control enables more accurate information to be available for managerial decision and thus has become more and more important. The department store visited was the pioneer in using computer for stock and management control since 1978. Now, the computer system performs the following functions:-

- [1] General ledger, balance sheet, and profit/loss accounts
- [2] Accounts receivable, cash flow analysis
- [3] Personnel information, including those part-time staff
- [4] Payroll and other bonuses
- [5] Itemised stock analysis -- daily statistics on sales, profit,

- and monthly statistics on return on investment, turnover ration, etc.
- [6] Stock control — daily update of stock received, sold, on-hand, etc.
 - [7] Purchasing — daily reports on reorders, and possible suppliers, etc.
 - [8] Slow moving item analysis -- automatic diagnostic of slow moving goods for sales decision making
 - [9] Consumer trend analysis -- based on sales data, analyse the trend of consumer market
 - [10] Gift cheque accounts
 - [11] Accounts payable
 - [12] Accounts with franchised booths

The tangible savings after computerisation included:-

- (a) Saving in accounting staff
- (b) Increase of sales due to better market intelligence
- (c) Saving in stock holding costs
- (d) Reduction of losses due to stock-taking

The calculated saving has enabled the investment in computerisation to be returned within two years.

CH6 The Management Office of a Private Housing Estate (Employees: about 20)

CSF: Tailor-made management database.

The housing estate has 16 blocks totalling about 1600 flats. In 1986, the management office started using a PC to handle its operational activities. A stand alone PC with high quality Chinese character printer was used. The computer vendor developed the software jointly with the management office. The menu of the package are :-

A. Control Files Maintenance

- A.1 Management charges / car park licence fee table maintenance
- A.2 Collection charge table maintenance
- A.3 Supervisor password amendment
- A.4 Cashier password amendment

B. Master Files Maintenance

- B.1 Owner's / car park licensee file maintenance
- B.2 Owner's file listing
- B.3 Car park licensee file listing
- B.4 Owner's / car park licensee file enquiry
- B.5 Owner's / car park licensee address maintenance
- B.6 Delete owner's / car park licensee records listing

C. Daily Operation

- C.1 Current date entry
- C.2 Management charges / car park licence fee collection
- C.3 Adjustment entries for management charges
- C.4 Reverse entries for management charges
- C.5 Reverse entries for car park
- C.6 Management charges daily collection report

C.7 Car park licence fee daily collection report**D. Autopay Operations for Management Charges**

- D.1 Owner's autopay listing
- D.2 Non-transferrable account autopay maintenance
- D.3 Non-transferrable account autopay listing
- D.4 Owner's autopay updating

E. Print Reports

- E.1 Print reminder letter for management charges
- E.2 Print reminder letter for car park
- E.3 Print reminder letter register for management charges
- E.4 Print reminder letter register for car park
- E.5 Print management charge control report
- E.6 Print car park licence fee outstanding report

F. Month-end Operations

- F.1 Management charges month-end control report
- F.2 Car park licence fee month-end control report
- F.3 Management charges month-end maintenance
- F.4 Car park licence fee month-end maintenance

After using the system, both accuracy and quality of work and printouts are greatly improved at little cost. The Office is very satisfied with the results and is planning to install one more PC for accounting and word processing purposes.

CH7 A Paging Service Firm (Employees: about 20)

CSF: Tailor-made customer service database as competitive edge.

Paging service is very popular in HK. Thus, good service is highly essential in order to remain competitive. The firm has over 3000 customers. In 1986, it installs a LAN with one IBM PC/AT serving six terminals. The software system consists of the following sections:-

- [A] Customer Checking — When incoming calls are received, the telephone operator checks the paging details against the customer file for both validity and expiry of fee.
- [B] Message — All incoming messages are entered directly into the database for subsequent retrieval. The messages are confirmed with the pager for accuracy.
- [C] Purging — All messages are purged after three days in order to save storage space.
- [D] Billing and Reminder — This keeps track of all accounts receivable and issue reminder for fee.

Since there are many calls coming in daily and customer records change frequently, it requires a common database. Therefore the LAN has been the most cost-effective solution.

CH8 A Freight Forwarder (Employees: about 25)

CSF: Real-time logistic management.

The firm charters shipping en route HK — Singapore — India — UK.

Most of its business are channelled through agencies. Thus, quick response and accurate information are the keys to success. Since the combination of number of customers with goods details, destination and payment mode are numerous, record keeping had been tedious before. Since 1985, it has been using a LAN system to keep track of the booking of containers, goods details from customers, advise agencies of shipping details, print bill-of-lading, delivery order, and other shipping documents. Then accuracy and customer services are much improved. Moreover, the system allows on-line access to database of oversea agencies instantaneously via packet switching. Thus, the firm manages to monitor ship loading more accurately and reduce lead time for booking to meet some urgent demands. The firm is now looking into the feasibility of linking up with the "Hotline" service initiated by the HK Trade Facilitation Council in order to widen its customer contacts and provide better information to them.

CH9 A Life Insurance Firm (Employees: about 80)

CSF: Tailor-made customer database to provide human touch.

The firm established its EDP Department in 1985. Now, the most important systems are the customer information and staff systems. For every one of its 10,000 customers, there is a detail record on his name, sex, birthday, policy start-date, type, premium, payment method, address, beneficiary, etc. This not only provides accurate record and billing, but also enables customer services such as the mailing of birthday card, billing, reminder, and new product introduction to be implemented more effectively. Further, there is a "Policy Decision Making" system which enables a what-if calculation to be available to customers in order to suit their individual needs.

Staff system is equally important in the life insurance business because this is the only way to monitor the performance of the sales staff. For the 50 full-time sales staff and a lot more part-time sales persons, their sales details are entered into the computer on a daily and weekly basis respectively. Monthly reports are provided to each sales staff on increase of accounts, premium, and commission. As most of the routine work are being done by the computer, operating staff has reduced to a minimum and remains literally constant with increase of business.

CH10 A Publisher of Product Magazines (Employees: about 140)

CSF: Improve quality and efficiency via desk-top publishing and mailing database.

The firm is a major publisher in HK on product magazines. It has installed two systems, one on oversea buyers and the other on desktop publishing. There are about 100,000 oversea buyers on the database. The major problem of the firm is to sort out the best reader group for a particular magazine. Three days before despatching, the editor has to decide the potential buying group for a particular issue based on his experience and some keyword search. Basing on this search, the computer prints the mailing list of the desired number. Using this matching by computer, the magazines will be delivered to those

potential buyers only and thus ensuring cost-effectiveness.

The desktop publishing system has also been a great help to the editors. Not only word processing are useful to editing and record keeping, but also the image and graphic processing capabilities help tremendously the graphic work of editing. After using the system, the time spent on editing has been reduced to half, yet resulting in much better quality work. The firm now plans to compile a comprehensive index on various products and articles and put them into a database for better customer services.

JAPAN

CJ1 Precision Plastic Components Manufacturer (Employees: about 120)

CSF: Office automation, mould management system, and effective information system management.

The firm is designated as a "Training Factory" by the OA System Centre of the Small Business Corporation. It has two plants, one in Tokyo, the other in Hokkaido, with a total employee number of about 200. It started using computer for OA in 1981 when an Apple II microcomputer was used for payroll. Now, there are four stand-alone PCs used for the following jobs:-

ADMINISTRATION	--	Payroll, accounts, and personnel
SALES	--	Sales management
PRODUCTION	--	Production scheduling, quality and inventory data analysis
PURCHASING	--	Purchasing records and order control
ENGINEERING	--	Mould management on about 1500 moulds on aspects such as physical condition, history, jobs, inventory, etc.

The PCs are maintained by a full-time staff. There is also an on-line communication link with the Hokkaido office on production planning, stock control, and other information. According to their experience, the key elements for the introduction of OA are:-

- [1] Corporate awareness of the OA concept, i.e., tools for productivity. Some old people may have more resistance.
- [2] Standardisation and rationalisation of work for each department. Invite interested parties to participate.
- [3] Use software packages as far as possible in order to give appeals to employees, and prove that no technical know-how is required in using computers.
- [4] For all people using the computers, their understanding of the working system is more important than the computer itself.

CJ2 Precision Metallic Components Manufacturer (Employees: about 100)

CSF: CIM and "Quality, Cost, Delivery, and Service".

The factory has been improved not only by the computer technology, but also by the demand aroused from computer and communication. During the past few years there has been a rapid increase in the sales of precision rod components, DC motors, and optical fibre terminators for the computer and peripheral industry. The firm started using computer for sales and administration since 1968. Since 1978, the three plants of the firm has their own LAN and are linked by telecommunication lines. Since then, a lot of the production equipment have been replaced by CNC machines. In 1985, one plant started using computer for production and quality control. In 1986, another plant developed a system integrating EDP, CAD, and CAM using engineering working stations.

A capital development fund of US\$5.5 million was invested in this project. The firm has become one of the first batch of factories in Japan that applies CIM in the metal turning industry. There are altogether 80 CNC machines on LAN in the plant near Tokyo, producing 16,000 different kinds of product. With such a large possible combination, CIM is the logical answer, especially when precision is so important. Their corporate motto is "QCDS" which stands for Quality, Cost, Delivery, and Service.

CJ3 Manufacturer of Metal Panels for Computers (Employees: about 80)

CSF: OA & FA directed towards productivity and quality improvement.

The factory has 80 employees and specialises in the manufacturing of panels for computers. 80% of its business comes from subcontracting work for NEC and Nipon Telephone & Telecommunication (NTT). It is one of the manufacturers who seeks ways to improve their operation via OA and FA to form a CIM system. At the start of the cycle, orders are received via VAN and stored on floppy diskette. Then the information is transferred into production drawings and manufacturing planning based on the manufacturing database. The important processes are as follows:-

- [1] CAM -- The CAM system consists of 53 CNC machines, majority of them are sheet metal punching machines, supported by a range of tool and die making machines like lathes, milling, grinding and machining centers. Machines of similar nature are grouped together to form five units, each supported by a PC with harddisk. The PC is used to handle distributed computing, process control, and tooling management. All machines and PCs are hooked up to the host computer busbar via optical fibre which is chosen to eliminate interference from other electrical signals.
- [2] PRODUCTION PLANNING -- The new orders are matched against the manufacturing lead time and master production schedule. After adjustment of the schedule, the order is released to queue for manufacture.
- [3] ENGINEERING MANAGEMENT -- This monitors the combination of tooling and machine settings for a particular job. It includes

tool and material change sequencing, forecasting of machining time, machining traffic control, etc.

- [4] DIRECT NUMERICAL CONTROL (DNC) -- DNC is practicable with the use of optical fibre communication from the host computer, so that information can be transmitted reliably and in large volume. The advantages of using DNC are:-
- * Reduction of setup time
 - * Increase productivity of CNC machines
 - * Standardisation of machining process
 - * Improvement of quality
 - * Increase effectiveness of process control. Information available on-line are: status of machines, engagement of tooling, work-in-progress, inventory status, etc.
- [5] PREPARATION FOR PRODUCTION -- The database for tooling and materials are used for the selection of tools and materials for production. The system has the advantage of standardisation so that variety is reduced. Further, with the use of group technology and AI, tool setting parameters can largely be done by computer.
- [6] PRODUCTIVITY MANAGEMENT -- Information about the productivity of each machine are tracked and compared with norm so that any deficiency and problems can be analysed for improvement.
- [7] QUALITY MANAGEMENT -- With the installation of in-process control, quality control data can be logged and monitored. Moreover, tool life are determined from these real-time data and corrective action conducted promptly.

After adopting the CIM system, the firm experiences the following improvement:-

- * Reduction of inventory
- * Reduction of rejects from customers
- * Ability to cope with changing demands from customers

The firm is satisfied with the advantages achieved from the CIM and is looking forward to more productive use of the information available from the system.

CJ4 Distribution of Fresh Food and Household Consumable (Employees: about 200)

CSE: JIT home-delivery service through VAN.

In Japan, there is a trend for retailing to offer home-delivery services. This can be done effectively using VAN. One of such VAN service provider has 19 regional offices over the country served by local department stores, supermarkets, or restaurants. The regional office visited is a local department store which has established a distribution centre to provide such distribution service. For their 11,000 members, each is given a metal box of 52x38x100 cm standing at the front door. Weekly catalogues of about 1300 items of fresh food, household consumable, and garments, etc. are delivered by hand or with orders.

The consumers can make a choice of delivery date between odd days or even days of the week. Further, they are provided with an acoustic coupler at no charge if their telephone is of the pulse type. The whole process has eight steps:

- [1] Select the items and quantity to be purchased.
- [2] Telephone to the VAN Centre before 9:00 am on the day before delivery is required. After connection is made, dial the product code and then the quantity. The Audio Response Equipment confirms the order and waits for the next item.
- [3] After 9:00 am, the host computer processes the previous day's order and sends the requests to the various supply sources.
- [4] Upon receipt of batch order, the suppliers has to deliver the goods to the firm before 5:00 am the next day.
- [5] There are three teams of 50 housewives working part-time at the firm. The first team works from 8:30 am to 2:00 pm as Packer Ladies to sort and put items into boxes according to computer printed orders for delivery. For fresh food, special containers with canned refrigerant on top are used. It helps to keep cold for about 10 hours. Weekly catalogues are included whenever appropriate.
- [6] The second team works from 10:00 am to 3:00 pm as Delivery Ladies. Each of them is provided with a small van which could hold 20 boxes. They deliver the boxes to the customers nearby their home.
- [7] The third team works irregular hours as Fresh Ladies. They serve as "High Touch" consultants to the customers on various aspects of the products merchandised. They take care of such things as information regarding to the use of the products, claims, special requests, sales promotion, collection of overdue payment, and even deliver catalogues to those customers who has not ordered anything during the past week. Each of them is provided with a small car to do the visits. Although there is no fixed working hours or formal reports of visit, their performance is judged by the sales results of their own territory.
- [8] The payment is effected via autopay at bank on the second day of the month for month-end accounts on 20th of the previous month.

When asked about the security of the delivered goods, the answer was that there has been no theft cases reported since the firm launched its activities in Oct 1986. Altogether there are 40 wholesalers joining the scheme. The target area is the 30 km radius area within Osaka which had about 300,000 households. The firm takes the view that this system is somewhat similar to the Toyota's Just-In-Time concept. According to them, the telephone ordering system has in fact been used by Hong Kong's Jockey Club for betting few years ago. The most interesting observation for the system is that at about 1:00 pm, the whole distribution centre is completely empty, both of goods and people. The ladies can go away immediately after they finish their day's work.

The attractions they quote to the customers for becoming members are:-

- (a) Purchasing is independent of weather: hot, cold, rain, storm.
- (b) No worry of deterioration when carrying fresh food for a long time.
- (c) Weight is no longer a problem.
- (d) Eliminate fatigue due to walking steep slopes for some cases.

- (e) Save time in travelling to and from shops.
- (f) No need to rush to shops before they close or holidays.
- (g) Can buy at any convenient time, even at midnight.
- (h) During weekends, more time can be spared for leisure activities.
- (i) Cheap price and good quality products are available.
- (j) Free consultancy services on general household problems are provided.

CJ5 Distribution of Processed Food and Household Consumable
(Employees: about 30)

CSF: JIT distribution service to retailers.

As different from the last case, this case is the application of VAN between the wholesaler and retailers. In Japan, a typical distribution channel is as follows:

		SECONDARY		
MANUFACTURER ==>	PRIMARY	==> WHOLESALER	==> RETAILER	==> CUSTOMER
	WHOLESALE		(regional)	

The firm visited belongs to the secondary wholesaler whose main line of business is on processed food and household consumable. It is one of the five wholesalers joint together to share the same VAN. They have 80% of their business from 10 supermarket stores and 15 convenience stores, the balance are from other smaller retail shops. Yet, selling through VAN represents only 16% of the stores' turnover. The firm's target is to increase this percentage to 50%. They believe that it takes about 3 years for the concept to mature.

According to the president of the firm, their business exist not because of the products but because of their unique service. Their corporate motto is "Your success is our success". In the past, there was always a conflict between good service and high efficiency. With the use of computer, this conflict breaks. They are also very keen in educating their clients that computer can help to rationalise their business, and to develop their corporate identity. There is a change in business style from salesman oriented to service oriented like helping in sales promotion, merchandising, etc. Computer can also help to do a lot of data processing work, leaving executives more time in planning and making managerial decisions.

One way to do business successfully is to wisely concentrate the effort. For instance, the firm always provides standardised prices for its customers to sell so that there would be no cut-throat competition amongst retailers. Then, their efforts can be concentrated on the choice of suitable range of products to satisfy customers' changing needs. Analysing the computer stock movement reports helps as well. Their philosophy is to integrate computer with marketing.

CJ6 Distribution of Wire Ropes for Lifts and Cranes (Employees: about 6)

CSF: Customer database and CAD presentation.

The firm is a family-type business in the distribution of wireropes for used in lifts, cranes, and the like. They have about 400 customers and 100 suppliers with a daily transaction of 50 to 100. A PC was installed in early 1985 to handle order entry and invoicing. They used a package developed by a software house initially but found it inflexible later on. Half a year later, the manager started using a relational database language from the same vendor to develop his own application software. In the second phase of the development, he used a CAD package to include diagrams in the quotation. Since most of the accessories in the wire rope business can be represented by 2-dimensional diagrams, the CAD presentation gives a clear image to the customers. By then a second PC was acquired to meet the peak load.

In early 1987, the firm purchased a third PC as a work-station to handle accounting. The system has not been implemented fully. The manager is now actively looking into the possibility of linking the three PCs to form a LAN. Possibly, a simple solution is to use one as the server and its communication ports to connect to the other two. Then, some readily available multi-user operating systems can be used to handle jobs. The major problem foreseeable is the slight non-compatibility of the three PCs and this has to be experimented and solved.

CJ7 Manufacturing and Distribution of Toiletries and Hygiene Consumable (Employees: >300)

CSF: Automated offices, VAN and marketing information system.

Although it is a large enterprise, the firm is visited because of its pioneering and success in using IT for OA, VAN, marketing information, and distribution. Thus, SME can apply these ideas in a smaller scale as and where feasible. Since its founding in 1890, the firm has developed a wide range of household products for people who are concerned with cleanliness. It is the firm's belief that bodily cleanliness enriches one's mind and paves the way to a warm home and a peaceful society.

The first phase of OA was started in 1980 and finished in 1985. The theme of this phase can be broadly divided under the following headings:-

- [1] AUTOMATED OFFICES -- The key step was the wide introduction of mainframe computers into the firm to form a wide-area network amongst the eight plants and various offices. Thus, information flow regarding to sales, inventory, production scheduling, accounting, and other management information systems can be integrated. Routine works are automated and clerical efforts reduced to a minimum. When staff are made redundant due to automation, they are sent for retraining in computer programming and applications. Their talents are then used to develop more software to make further improvement to the system. In 1983, the OA Promotion Centre was established to serve this need. At present there are about 600 PCs in the firm with over 800 software developed by the staff on various applications. The

top management's belief is to buy computers whenever required. Furthermore, they also trust that when staff are given the opportunity for training, they can use computer and even write application programmes just like using paper and pencil to do composition.

- [2] VAN -- The firm pioneers in the use of VAN for marketing in Japan. In the past, there were only about 100 distributors handling the firm's business. Since 1980, it has decided that in order to improve efficiency, there should be a direct link with the retailers. Today there are around 8000 distributors and retailers using the VAN. The firm's salesmen need not go to office everyday because the routings are faxed to them daily. For those retailers without access to VAN, the firm's salesmen bring hand-held data collectors to contact them. The information is then sent to the VAN via telephone or even wireless radio channels. Instead of getting the orders via the head-office, the factories simply pick them up from the VAN and plan their production accordingly. Since, at that time, people were experimenting protocols for Japanese character communication, the firm had taken the lead to set a standard for such protocols for the communication industry. The advantages of using VAN were:
- (a) Save distribution cost as wholesalers are bypassed,
 - (b) Standardise prices,
 - (c) Marketing plans can be directed right to the sales outlet.
- [3] MARKETING INFORMATION SYSTEM -- Developing superior products requires a balancing of market needs and technological innovation. To respond promptly to changing market trends, the firm established a unique marketing information system. Through this system, sales by merchandise, region, and market share are recorded instantly in an integrated way. The firm constantly tries to determine new needs and develop diverse strategies to respond effectively to new market trends.

The firm has a system that answers questions from customers on how to use its products, using computers to give quick and accurate answers 24 hours a day. The toll-free answering service is run by six girls in a unit called "Living Science Institute". After office hours, the guard directs enquiries to their homes in turn. The enquiries can be from complaints on products to such things as children swallowing washing-up liquids. Thus immediate and accurate response is highly important. Now the information regarding the 1000 products of the firm are stored in laser diskettes which can be updated by laser writers. The enquiries are classified and brief descriptions are entered into the computer system so that other people can retrieve these information and their statistics on-line. The collected data serves as a basis for product improvement.

As a result of the success of the first phase of QA for this firm, it was awarded the first QA prize winner by the Japan QA Society in 1983. The second phase of the QA was Total Cost Reduction or Total Creative Revolution (TCR) and had started since 1985. The theme was to plant a culture within the firm to

harness the possible achievements from innovative ideas. The basic philosophy is that innovative improvements usually give a step rise to efficiency which is important to remain leadership in the business. The areas of improvement under this second phase are:-

- (a) TCR in OA -- The idea is to seek innovative improvement in OA. For instance, with the use of rationalisation, printouts of accounting statements can be reduced from three pages to one. The TCR would mean reducing the printout to zero which can be effected by modifying the accounting procedures. The improvement is known by the firm as "Office Mechanisation" which is a continuous process after the installation of OA equipment. First, the psychological effects of the accounting staff have to be overcome. They have to be educated that without papers, the information is still there. Second, the Tax Revenue Department Officials express deep concern for this innovation. They are subsequently convinced that auditing can still be done and even more effectively by computer.
- (b) Merchandising Information Services -- TCR when applied here is that "Product display should match customer preferences". The increasing variety of merchandise today means one can hardly rely upon intuition or past experience to produce effective shop displays. Customer preferences and regional characteristics have to be determined by computers and IT. The information thus obtained are used to optimise inventory planning and display effectiveness. Since April 1986, the firm has instituted a new support service for its wholesalers and retailers by providing them with market and other information and helping them in their store management. Upon request, the firm collects merchandising information from many sources, including the store in question. After this, data is analysed and processed using its artificial intelligence. The retailer is then informed of the sales trends and a profitable line of inventory is recommended. At this point, the retailer needs information on how to display the goods to maximum advantage. In response to this need, the firm makes full use of IT to develop display systems tailored to each individual shop. These systems are not limited to the display of the firm's products but are intended to help stores to display all their goods as efficiently as possible.
- (c) The TCR in Distribution -- A revolution in distribution has been set in motion by the need for retail outlets to display a large number of goods in limited space, while coping with rapid market fluctuations by keeping inventories to the minimum. This presents such difficult questions as how to deliver orders as small as a few bottles of shampoo and a few packages of detergent in less than 24 hours and at a low cost. The firm has taken the lead in revolutionising distribution in its efforts to respond to these challenges. This is done through the use of IT and automated warehouse. Until recent, the 23 scattered distribution centres are

amalgamated to form two automated centres. At one of the two new centres which opened in April 1986, a computerised system eliminates stock surplus, allows effective inventory control, and permits far greater efficiency in locating and delivering products to retailers without loss or damage. In spite of the longer distances resulting from the much wider areas covered, the centre has succeeded in reducing delivery time by employing computers to assemble orders and calculate the shortest routes, taking into account such factors as the order of delivery stops and road conditions.

CJ8 Manufacturing and Distribution of Garments and Related Accessories (Employees: about 280)

CSF: Computer-aid customised tailoring, VAN, and FA.

The firm is a garment manufacturer with seven branch offices and three plants scattered around the country and employing 420 people. In 1981, the firm started looking into the possibility of using OA to help its operation. A project team was organised comprising staff from production, accounting, sales and three system engineers from NEC. The objective then was to solve bottleneck problems for the office computer they purchased at that time. During discussion, the team agreed that no computer "jargon" should be used. They held meetings twice a week to look for solution of operational problems using computer. Then, the team agreed on the following ideas:-

- [1] Priority should be given to sales rather than production.
- [2] Customer's preference should be met as far as possible.
- [3] Inventory control is important because poor inventory management can turn profits into losses.
- [4] Standardisation in products is important to facilitate automated production.
- [5] There should be an integrated information flow linking all retailers, offices, and plants.

The solution arrived at is to revert to the former practice of tailor-made instead of making to order. However, with the multi-plant operation and growing numbers of retailers, the tailor-made solution can only be achieved by a very efficient communication and information system. At that time, NEC's C&C-VAN just started to expand its applications. So, they gave the firm a cheap rate for experimenting the VAN for the new venture. Since then, they have developed a comprehensive information system with graphic processing capability.

Now, when the customers arrives at one of the 360 franchised retailers, they can make their choice from a detailed catalogue according to the following procedures:

- (a) Find out the types of garment.
- (b) Find out the preferred style.
- (c) Determine the grade according to price ranges.
- (d) Give the quantity of order.
- (e) Select the materials from samples.
- (f) Select the colour.

- (g) Select the basic designs
- (h) Determine the optional accessories and details

The catalogue is so designed that it allows many thousands of combination for the finished products. This means that the design can meet the individual tastes with great variety and elegance. After confirmation by the customers, the above information is processed by the PC at the shop and a computer sketches the expected finished product on the screen. Then the information is exported to the VAN via the PC. The factory confirms the delivery date via the VAN either as ex-stock or based on the computerised production planning system. The PC calculates the price. After the customer pays a deposit, the order is confirmed to the factory via the VAN again.

The system is not only successful in providing a tailor-made solution to the customers, but also it helps to minimise stock holding. After installing the system, the *sell-from-stock inventory is reduced from 90% to 60%, with 50% as the next target*. The cost reduction enables the prices to come down to a competitive level despite imported garments are selling cheaply due to the appreciation of Yen.

CJ9 Manufacturing and Distribution of Bakery Products (Employees: about 260)

CSF: JIT bakery service and VAN.

The firm started business in 1900. It manufactures and distributes a range of bakery products via 300 sales outlets throughout the Tokyo area. The firm owns some shops but others are franchised shops which they have no employees. Before computerisation, both communication and stock control were major problems. Delivery to shops were based on assumptions. In those days, discarded products amounted to US\$1 million a year.

In 1982, the firm started computerising its order entry system. Four girls answer incoming calls from the shops at prescribed times during the day. The orders are entered into the computer and processed in the evening. During the daytime when orders are not yet finalised, production is still continuing based on predicted requirements for the next day. In the evening when orders are processed, the production schedule is adjusted according to the actual demand. With the use of this system, the annual scraps manage to come down to 20% of that in the past. Thus the return-on-investment period for the capital outlet is only one year. Moreover, the stocks are kept much fresher than before due to faster turn-round time. The director sees this system as an analogy to the Toyota's Just-In-Time system, except that it is simpler because there is no subcontracting.

Apart from using computer for the order entry system, the firm takes one step further to use it in performance evaluation. Improvement is particular important these days when Japan experience a slow growth period due to the appreciation of Yen. The method used is "Management By Result". The sales figures of this year is compared with those of last year, in group first, then by individual shop. To complement the scheme, the firm changes its annual bonus payment to half-annually and is measured according to actual performance which

can be improved through increased sales and better stock control.

Other applications of the computer system include accounting, personnel records, and management information on sales and expenditure. The firm is also planning to install Audio Response Equipment so that orders can be entered directly to the computer via telephone line. VAN is not required for this firm because the shops are within Tokyo area and that there is only one office and plant.

CJ10 Manufacturing and Distribution of Spectacles and Related Accessories (Employees: about 250)

CSF: JIT customised services and VAN.

The firm is a large spectacles manufacturer and distributor with nine regional offices, two factories, and 32 overseas offices/factories worldwide. It has established its own VAN using a computer network and sells PCs and software to its retailers at a premium cost. The main purpose of the software is to enable the retailers to enter measured data of lens requirement of their customers and pass the data to its factory for manufacture and delivery. The software also allows transmission of the shape of the lens required to fit the spectacles. As an additional service, it provides some educational features on optics and eye-protection to the customers. If vision equipment is added to the system, the appearance of the customer after wearing various spectacles, can be viewed and selection for aesthetics can be made more easily.

Other software provided by the firm include invoicing, point-of-sales, customer filing, and shop accounting. Thus the clerical activities can be automated, releasing shop managers to concentrate on sales promotion and other customer services. When one shop manager was interviewed, he was very pleased with the basic system and was hoping to acquire the other software step by step.

CJ11 Human Resources Recruitment and Development (Employees: about 8)

CSF: On-line human resources services and VAN.

The firm just started their business in Feb 1987 as a joint partnership by four persons. Their belief is that in this era of intelligence and technology, human resources is more important than ever. Thus their business is to add value to human resources by providing information services in their recruitment and development:-

[1] HUMAN RESOURCES RECRUITMENT SERVICE

In Japan, there are about 60 national universities, 60 municipal / prefectural universities, and 800 private universities and colleges which altogether turn out 320,000 graduates per annum. For large companies, since they have to recruit a number graduates of different speciality, they are confronted with a large volume of selection work to match applicants against vacancies. Consequently, the firm has an idea to centralise the activity using a global database for all fresh

graduates of the year. Then the participation companies can retrieve from the database the desired group of potential candidates for interview. Many companies can share the same database, and the firm's market size is about 2500 large enterprises in Japan.

When a graduate wants to make use of the free service, he fills in a form from the university's appointment service giving personal particulars and other information such as department and course of study, specialism, extracurricular activities, expected working place, job expected, etc. Then the computer updates this information in batch to the database maintained by the firm. Employers can use the database service for a fee. In return, they can decide on their criteria and scan the database for such records. If satisfied, the employer will decide the schedule for interview and invitation letters will be sent by the firm. The firm also provides interview slips for the use of their client and results of interviews are updated to the database. Statistical analysis of the interview are sent to the employer in return. They do the job using a PC with a 60 MB harddisk. In the near future, they will upgrade the hardware to give a quicker and more comprehensive service.

The human resources public database system is a new venture in Japan. According to the firm's Director, even the Japan Government's Job Security Office has not been using database of this kind. The firm is now actively studying the possibility of using VAN for the service. By then, students can enter and update their personal data directly into the system via terminals at university or home. Likewise, the participating companies can retrieve their desired information at their own terminals. They foresee that such system would be available by 1989.

[2] HUMAN RESOURCES DEVELOPMENT SERVICE

In order to give a fuller range of service in the human resource area, the second product-line of the firm is on "Physical Fitness Test Program". According to the Director, "Adult Disease" is growing in Japan because of industrialisation. Moreover, most companies have deferred the retirement age to 60. Since individual's health condition are mostly different, there should be some tests available to qualify the health conditions of employees. Further, for some trades such as drivers and some factory workers, they may require some special fitness in order to qualify for the job. Therefore, a test program based on objective data can be very useful to serve the screening and advise on remedial actions.

The program used by the firm is based on the Cooper's Aerobic Theory which correlates the degree of exercise with the rate of oxygen consumed. The program requires the company to choose 7 testing parameters from 21 relating to physical ability, endurance strength, and momentary ability. For each parameter there are statistical data on their means and standard deviations as supplied by the National Athletics Association based on some 50,000 people grouped under different sex and age. When companies send their employees for testing, their physiological data are inputted into the computer. Then the comments and recommended kinds of exercise suitable to them are printed in a computer form with diagrammatic explanation on various physical exercises pre-printed at the back.

Since both of these two schemes are related to the personnel departments of the participating companies, the firm is also offering training to personnel staff as well.

KOREA

CK1 A Construction Firm (Employees: >300)

CSF: Tendering DSS and on-line site control system.

This firm takes a conscious view towards computerisation and has gained considerable success for its business. The total system can be broadly divided into two:-

- [1] HEADQUARTERS SYSTEM -- This consists of construction material control system, estimation system, and heavy equipment utilisation system. The estimation system has been developed with good success. The firm also believes that know-how can be extracted from experienced employees in developing the estimation system, and subsequently, knowledge can be passed on. In one incident, with the use of this system, the firm managed to submit a multi-million dollar project using only 1/6 the time and 1/6 the manpower of their competitor who use manual system.
- [2] SITE SYSTEM -- PCs are used at construction sites as stand alone equipment because communication with headquarters is frequently a problem. The main task of the site system is for budgeting, material, labour, service costing, and cost management. The information system is mainly on operational level rather than management level, and has been developed by the EDP staff at headquarter. However, the firm is still reluctant to use some kind of project control software because this may be additional burden to the site staff who are not so knowledgeable. In the longer run, they like to review the situation.

CK2 An Electronic Product Manufacturer (Employees: about 150)

CSF: Distributed computing.

The firm has its headquarters in the U.S., with branches in South Korea, HK, Singapore, and other parts of the world. Their customers are also from various regions. The current practice is that all inter-branch activities are channelled through the head-office in the U.S. Thus, it is inefficient and freight costs are high. The MIS Manager of the firm explained that the problem is due to Government restrictions and lack of suitable software to do the distributed processing. In order to conform with their head-office system, they have to use the same brand of minicomputer and same software package. The simplified business cycle can be described as follows:-

Worldwide Order Entry ==> Scheduling ==> Manufacturing Order ==>

Finished Goods ==> Allocation ==> Invoice/Packing List ==>

Ship to Worldwide.

Apart from the 30 terminals for the minicomputer, they also had 22 PCs. Ten PCs are hooked up in a LAN under the Xenix operating system. Half of these PCs are also used as emulated terminals for the minicomputer. The other half are mainly used in cost accounting for the local operation. All these ten PCs can further be used as telex terminal to communicate with the head-office via satellite at 9600 Baud using packet switching. Then the remaining 12 stand-alone PCs are reserved for end-user computing using such general purpose software as spreadsheet, database, word processing, etc. According to the MIS Manager, the major difficulties during the course of computerisation in their firm were:-

- [1] English problem.
- [2] Software package not fitting exactly their need.
- [3] Keeping MIS personnel after training them for 2-3 years.
- [4] Wrong conception of user involvement. Most users think that the MIS people would handling everything.
- [5] Lack of information of new hardware/software products.
- [6] Exceedingly long lead-time required for export licensing and documentary credits make planning horizon much longer.

CK3 A Shipping Company (Employees: >300)

CSF: Modem communication with agencies.

The firm has a fleet of five ocean-going vessels and an inventory of 7000 containers worldwide. The use of computer system is mainly for the following purposes:-

- [1] Shipping documentation can be sent to their local offices via computer-to-computer communication, and to oversea offices using the computer as telex terminals.
- [2] Keep track of container inventory.
- [3] Voyage cost-profit estimation.
- [4] Commission accounting to agents.
- [5] Internal accounting and cost control.
- [6] Staff payroll.
- [7] Management report for exceptions.

Although the firm is using mainframe computer for the above processing, they have a view that their agents should install microcomputers in order that communication can be faster and more accurate. However, the rental for data line in South Korea is very expensive (US\$1280/line/month). Therefore, dial-up modem would be a cheaper solution.

CK4 A Garment Manufacturer (Employees: >300)

CSF: Turn-key material requirement planning software package.

The degree of computerisation of this firm is moderate. The main

purpose of the present computer system is to process accounting, sales, and inventory information of their range of products. Material requirement planning, data collection points at factory floor, and CAD/CAM have yet to be developed. The existing system is based on a software package with a total of 16 modules and has been recommended by a software house. The firm is satisfied with the convenience and accuracy provided by the computer system.

SINAPAPORE

CSI A Manufacturer of Electrical Switches (Employees: about 150)

CSF: People commitment, software flexibility, and hardware performance.

The firm is the local manufacturing and marketing office of a multi-national enterprise. Both the firm and the associated consultant firm said that this was the first LAN implementation in Singapore at end-user level. In 1983, the management of the company began to consider using computer system, with three-fold objectives:

- * Increase productivity
- * Improve data accuracy
- * Provide timely information

The need became more pressing with the increase in business volume and the subsequent opening of a new factory about 10 km away. The feasibility study confirmed the need to computerise and recommended to install an in-house minicomputer system. A popular minicomputer system was then selected. Meanwhile, to ease the immediate work load, 2 PCs were installed using spreadsheet applications. They were mainly used for the preparation of various reports. Soon, the firm acquired two more PCs to meet the increasing user requirements. Since then the spreadsheet has become an integral part of their day-to-day operation. However, spreadsheet on PC, while useful, was far from satisfying the need for an integrated computer system. The minicomputer system was still much looked upon as the long term solution.

The approach then was to seek for a total solution, which integrated the three major functions of marketing, finance, and manufacturing. A system specification was prepared to identify many areas for automation in line with the total system approach. Apparently, the minicomputer system seemed to meet the broad specifications. After a careful and thorough evaluation of the software, however, it was found that unless major modifications were made, the system would not be suitable for the company's marketing requirements without heavy modifications on the software. A search for an alternative solution was imminent. One suggestions was a local area network (LAN) system, relatively unknown at that time, on which an attractive software X was running.

Unlike the minicomputer system, X was trading rather than manufacturing oriented. The management then had to prioritise their requirements. The conclusion was that a flexible system for

marketing and accounting functions was more needed than for the manufacturing function. So a decision was made to install X based on the following 3 reasons:-

- [1] **SOFTWARE FLEXIBILITY** -- X was a highly flexible system. Its major strength lay in its concept of user-defined transaction input, and user-defined report selection, sequence and ranges. These provided the company with the flexibility to configure the system to meet most of their requirements. It also provided them with the much needed features of flexible pricing and discounts matrix in the order processing module.
- [2] **CONSULTANTS' COMMITMENT** -- Due to the absence of the local distributor for both the software and hardware at that time, implementation and maintenance support were their prime concern. This was overcome by commitment from the consultants the company was dealing with. The confidence on the performance of the LAN also increased after references from overseas users are sought.
- [3] **SYSTEM COST** -- The cost was not the deciding factor. However, it was so attractive that the LAN system had to be considered positively. This if implemented would incur only 40% (if 1 workstation) to 50% (if 13 workstations) of the equivalent costs of the minicomputer system. Regarding the cost breakdown, about 60% was on hardware, 10% on software, and 30% on implementation. The total cost of the system was US\$120,000.

So in Jan 1985, a Novell S/Net with 1 MB RAM, 70 MB disk capacity and 7 workstations was installed. The project was divided into two phases:-

- * Phase 1-- Order Processing, Stock Control, Sales Ledger, Sales Analysis
- * Phase 2-- General Ledger, Purchase Ledger

There are three important factors which have contributed to the successful implementation of the system:-

- (a) People Commitment -- Commitment from all levels, including the consultants, is vital to the project. Users themselves, apart from their normal day-to-day work, has spent many hours on various tasks of the implementation process, e.g. data gathering, conversion, validation, test preparation, etc.
- (b) Software Flexibility -- Although some of the company's requirement are rather peculiar, they are important to their business. By selecting a powerful and flexible software, one can avoid many "cannot do" situations. The open-minded attitude of the management further allowed the maximisation of the use of the system facilities with much creativity.
- (c) Hardware Performance -- The company is pleasantly surprised by the stable performance of the system, (though not 100% problem free). First, the system was tested under "loaded" condition by running concurrently a micro-MRP with I/O intensive activity. The average speed was only degraded by about 5%. Second, adding more workstations did not affect the overall speed performance.

In fact there was a improvement in the speed of about 10% when multiple workstations are accessing the same file. One can explain this by the directory/file caching feature of the Netware. However, to a very large extent, the performance can be constricted by the capability of the processor in the PC. Fortunately, this has been improved by the later PC/AT or 'Turbo' models, together with insertion of RAM cards.

The benefits of computerisation in the company are many-fold. The average monthly overtime hours in the marketing and the finance departments has been reduced by 40%, and they are expected to fall further. Some of the reports which previously took up to 10 days to produce, presently take less than 1 day. Information is now more accurate and up-to-date, particularly sales analysis. The system can now provide detailed sales analysis, which is impossible under the manual system. The staff strength has been maintained at the right level with greater efficiency and productivity. The system minimised duplications and reconcile of discrepancies.

Of course there are set-backs too. Some areas which are not covered by the present system, but are previously part of the manual system, has to be maintained separately. This requires additional effort. There is more control reports now but some of it may not be presented in the layout format which the users prefer. On the whole, however, the company is pleased with the system as most of their objectives have been achieved.

The successful implementation of the LAN system has given the company much encouragement and enthusiasm to further explore new development areas. Important project which they are currently engaging in are the areas of marketing information, demand forecasting, and material requirement planning systems. Barely one year after the initial installation of the LAN system, they have increased the disk capacity up to nearly 200 MB, and the RAM memory up to 5 MB. There are now 13 workstations on the network. Moreover, the inventory system at the remote branch has been linked up with telephone line via modems and a delegated terminal. This allows on-line access and updating of information.

Total cost of above hardware = £43,000

Total cost of above software = £31,000

CS2 A Trading Firm (Employees: about 45)

CSF: Continuous improvement in OA.

The firm first implemented computerisation on a minicomputer and subsequently changed to a LAN system. The Director of the firm said that they were the first trading company in Singapore to implement business system on a minicomputer.

In 1978, the company purchased a minicomputer system to do word processing in order to improve office productivity. Shortly after the purchase, the Director started thinking to maximise the utilisation of the system by using it for accounting and management information as well. Then the company signed a contract with a

supplier to install an in-house written accounting system. However, since this was also the first project by the computer supplier, the system has never been implemented successfully. One big limitation at that time was the disk storage capacity which was far from adequate for any real business application. Eventually, the vendor was aware of the fact, but harddisk was not yet available in those days. Subsequently, the vendor broke the contract and was sued for damages by the company.

In 1984, the company reconsider again the implementation of an integrated business system, but this time on a LAN system. After gaining experience from the previous implementation, the company director decided to use accounting software packages as the main integration vehicle instead. Moreover, software packages such as spreadsheet and database were used to supplement the system. Now, the system consists of the following functions: sales control, personnel data, inventory control, accounting & budgetary control, purchasing, forecasting, and operations planning & control. The minicomputer is still used for its original purpose of word processing. It is worthwhile to mention that the company director still considers computerisation beneficial despite the unpleasant experience. Moreover, he is anxiously looking for some decision supports software to help him in monitoring his trading business.

Total cost of above hardware = £90,000
Total cost of above software = £15,000

CS3 A Distribution Services Organisation (Employees: about 100)

CSF: Corporate software system and user participation.

The firm started using computer in 1974. The existing distribution system was implemented in the IBM System 36. The software was supplied by their headquarters in the US. Thus, they only took one year to implement all the five subsystems. The present system consists of the following functions: sales control, inventory control, accounting & budgetary control, purchasing distribution control, forecasting, word processing, and used as telex terminals. Other than the minicomputer system, there are 14 other microcomputers hooked up to the mini as emulated terminals and stand alone PC workstations. With this hardware configuration, the EDP Manager said that end-user computing was greatly encouraged.

The distribution control system consists of two fixed order delivery schedule per day. Rush orders are allowed in the system. The delivery routing is separated by zones in order to minimise travelling. The inventory control system uses periodic reorder point technique, some daily and some weekly via telex using the PC network to the US headquarter. First-in-first-out costing system is used in according with the usual accounting practice. There are about 3,000 active items plus a further 10,000 inactive ones maintained by the system. However, the pricing system is still not yet computerised, and thus the computer only checks the minimum price of each item. Multi-currency entries are available.

The EPD Manager has commented that the major difficulty in computerising their system is in user's participation. If users are not actively involved in the analysis and design stages, it is highly possibly that there will be problems during implementation. Further the lack of manpower in the EDP Department is a big hurdle for promoting end-user computing within the company.

Total cost of above hardware = £63,000

Total cost of above software = £6,000

CS4 A Country Club Management Office (Employees: about 45)

CSF: LAN, POS and member-oriented services.

The EDP Supervisor of the company said that they were the first club house in Singapore to computerise. The Club started using computer in 1984. The hardware configuration consists of a LAN with a server linking to 5 Point-Of-Sales (POS) terminals. The CPU and disk server is a 1 MB RAM microcomputer with 40 MB disk storage capacity. Besides, there are 4 receipt printers and 1 card reader attached to the 5 POS terminals. The updating of POS transactions are in batch mode. Every morning before the club opened, previous day's transaction data are polled from the POS terminals to the CPU via a master POS terminal installed next to the master server.

The computerisation was implemented in two phases. The first phase consisted of the membership and accounting systems. The membership system which required to be run on the network was written in 'C', a powerful but difficult computer language. The accounting system which consisted of accounts payable, general, fixed assets, etc. was implemented using a standard software package. It took about 27 months for the first phase to be fully implemented. The second phase consisted of the sales control, personnel data, and cashbook systems. As this was built upon the first phase, it has only taken 3 months for implementation. The future development will be the POS statistics systems and installing card readers to the remaining 4 POS terminals. However, the EDP Supervisor envisages problems during these development because their vendor's programmer has recently changed job, and it is quite difficult to find a competent 'C' language programmer for the job. Thus, the EDP Supervisor has started learning the language himself already.

Besides the above POS and accounting systems, the EDP Supervisor has also implemented a bulletin board for their members to make inquiries, look for club-related information and use the mailbox to communicate with other club members using their home-computers. The system has been on for 6 months and about 100 members has been using it regularly. They have gone one step further by issuing bimonthly magazine to promote its use.

Another system implemented is the download of accounting information from the network server to PCs used by the Accounting Supervisor. She then can manipulate the data by spreadsheet packages for financial analysis and management reporting, etc. Furthermore, the PCs are also used as terminal emulators for the network server in order to run the accounting software packages.

Total cost of above hardware = £30,000

Total cost of above software = £15,000

CS5 A Mould and Die Maker (Employees: about 80)

CSF: Use of CAD/CAM for mould making.

The company has been using conventional machine tools for the production of plastic moulds and progressive dies. In 1986, the company assigned a project to the Grumman International / Nanyang Technological Institute CAD/CAM Centre (GINTIC) for the development of solid modelling. It can be downloaded to the CNC machines for production. This eliminates the painstaking and expensive model making process. Moreover, design can be modified very quickly. The company is happy with the result and is considering seriously the purchase of the CNC machining centre for the production work, with the support of GINTIC on the software development.

CS6 An Architectural Firm (Employees: about 45)

CSF: Use of CAD for architectural design and OA.

The firm's experience with Computer Aided Design & Drafting (CADD) started in 1980. In 1982, they changed to Computervision Designer V System running CADD 4 software for 2D and 3D operations. Other computer applications include Digitizer for area calculation, word processing, mail-list, accounting and time-scheduling. Electronic spreadsheets are extensively used for economic modelling of projects and accounting.

According to the principal partner of the firm, all computer systems currently available requires a high degree of human adaptation to the system's requirements. The human and machine interface has the following characteristics:-

- [1] It is ideal to carry a portable system to meetings with which the geometrical and economic aspects of a design can be interactively developed in conjunction with other inputs.
- [2] The machine has its own interface language which is different from human language habits.
- [3] The machine is too precise at a time in the design process where there is value in vagueness.
- [4] The machine is not fast enough to respond to the designer's need to quickly evaluate geometrical alternatives at the preliminary design stage.
- [5] The screen resolution is not fine enough for critical form and space evaluation by itself.
- [6] Multiple display and relative visual referencing is essential.

However, it is envisaged that in the next year or two, the advancement in computer technology would solve most of the above problems.

TAIWAN

CT1 Multiple-product Sales and Distribution Corporation (Employees: >300)

CSF: Development of company-wide computerisation.

Although the company is very large by number of employees, it is strategically divided into some 30 divisions, each is similar to a SME. The product line includes animal feeds, flour, edible oils, livestock, aquatic feeds, noodles, canning, dairy foods, soy sauce, chain store, baking, merchandise, powdered milk, carbonated drinks, market development, vending machine, international business, electronic products, purchasing, and other staff supporting divisions.

The Information Division has separated from the Financial Division since 1983 to take the full responsibility in the development of company-wide computerisation. The Division is divided into two sections, one for software development and the other for operation and data processing. By far the Division has developed various application softwares, such as:-

- * Personnel and payroll system
- * Financial accounting system
- * Cost calculation system,
- * Order handling and sales management system
- * Account receivable and payable system
- * Retailing management system for the Chain Store Division
- * Inventory management system of Baking Division

The systems currently under development are:-

- * Material handling system
- * Material management system
- * On-line operation of order handling
- * Sales management system

Further, the company is considering to establish their own computer network in order to solve the data communication problem among the five plants and numerous distribution outlets.

CT2 A Manufacturer of Electronic Subassemblies (Employees: about 150)

CSF: Management commitment and training in "Total Business System".

Like many other SME in Taiwan, the company is a family-managed firm. In May 1984, the Factory Manager bought a microcomputer with harddisk and Chinese character capability. The software was on inventory control, and was developed by a software house. However, since the data was different from the actual, the system has never been successful. The Manager believed that the major problem was lack of total participation in the project and hence incomplete information was given to the software house. Nevertheless, it has been a very good experience for the company.

In June 1985, the company decided to develop a total business system in order to have the benefit of system integration. Every week, they invited the software house staff for discussion of the project. The Production Manager thought that the main purpose of using computer was to help to solve problems. The most severe problem then was in material management. "The production lead time is short -- from 30 to 45 days. However, more than 100 parts per sub-assembly is not uncommon. So what we need is the coordination between person and materials in order to minimise the lead times." Material system is the theme of manufacturing. It encompasses order entry, purchasing, bill-of-materials, inventory, purchasing, and maintenance activities. The package was implemented in Jan 1986. As one microcomputer was insufficient, the Company purchased the second one. Furthermore, payroll and accounting systems were implemented shortly, together with engineering drawing filing and vendor information systems. A new ten-digit material coding system has been used for the finished product:-

- Digit 1-2: Macro position code
- Digit 3-4: Micro position code
- Digit 5-8: Assembly sequence code
- Digit 9-10: Component type code

There had been some confusion immediately after the coding change, but it was quickly smoothed.

One key contribute to the success of the computerisation is the management's commitment to training all related staff. A training program has been organised on basic concepts and computer operations lasting for two months with 2 X 3 hr. weekly. Due emphasis has been made on the importance of accurate completion of information on all forms. So far, the benefits of computerisation has been on the following areas:-

- [1] Reports of various kinds can be retrieved rapidly.
- [2] Information processing and filing is much tidier and with less errors.
- [3] Materials would not be overdrawn. The quantity is based on the bill-of-materials. Fraud is minimised.
- [4] Inventory level has dropped from US\$300,000 to US\$150,000, thus releasing the valuable cash for other purposes.
- [5] Company's image to customers and vendors is improved. Moreover, information is communicated in a more accurate and tidy manner.

CT3 A Manufacturer of Electrical Switches (Employees: about 80)

CSF: Management commitment and careful choice of software house and packages.

The company has about 80 vendors and 800 customers, mostly in the domestic market. One of the seven software modules is designed in-house, the other six modules make use of readily available package. The hardware consists of a super-microcomputer supporting two 40 MB harddisk and four Chinese character terminals.

In early 1984, the company bought a personnel computer and a software package to handle the accounts receivable. However, since the capacity was very limited, the company decided one month later, to upgrade this computer. In the second stage, various factors were

considered, including capacity, speed, and system fault of the hardware. Software had to be compatible with the operation of the company, price, and support from the supplier. The company director believed in the accuracy of computer, so in the second stage, he put more concern on the speed of processing. The accounts receivable module was implemented quite smoothly. Then, other modules such as general ledger, accounts payable, bills, inventory control, sales analysis were implemented one after the other. The first module which took two days for explanation, whereas the other modules only took half day each. Furthermore, the director requested the software house to give training to himself and three other persons for 34 X3-hour sessions.

There were some minor alterations to the software which was implemented by the software house. One of which was to have multiple pricing for different customers. However, though small as it appeared, the company demanded the software house to amend in order that their daily operation would not be affected by the software package. On the other hand, the company put great emphasis on the accurate and timely entry of information by their staff. "This is the first step towards rationalisation," according to the director.

One drawback of the implementation is that, there has been little time for designing a good coding system. Thus it is impossible to tell from the coding about the item it represents. The advantages of computerisation are:-

- [1] Processing of customer billings is much quicker.
- [2] Lead time and effort in producing financial reports is reduced.
- [3] Inventory level and hence capital tie-up is minimised.
- [4] Vendor delivery is more punctual as more accurate information is given to them with longer lead time.
- [5] Company image is improved by producing better documentations.
- [6] Upgrading of management level -- more time is released to management decision making.

From the experience of the director, he has the following suggestions for computerisation by SME:-

- * Computerisation must be top-down -- the management must be the prime-mover.
- * Consider using software packages first.
- * Select software house with more products which implies more experience.
- * Implement step by step and invest in proportion to the size of operation.
- * The company should give the best support to the implementation, in terms of provision of information, and completion of forms, etc. Moreover, more slack time should be provided for the coding system.

U.K.CU1 A Manufacturer of Industrial Fasteners (Employees: about 160)

CSF: Automation of production control system.

The firm is specialised in the manufacturing of industrial fasteners. Raw materials including brass, stainless steel and plastic are purchased from 150 suppliers. Products are supplied to 450 customers from a range of over 5000 including size and colour variations. In 1984, the firm decided to develop, using a PC and a database package, the production control documentation system designed by management services department. There has been considerable saving in the clerical effort now. For instance, there is no need to write 350 production control and 150 quality control tickets which have to be done daily in the past. Subsequently a second project was undertaken with the company to computerise the monitoring of production progress.

Total cost of above hardware = £3,000

Total cost of above software = £1,000

CU2 A Manufacturer of Office Furniture (Employees: about 90)

CSF: Development of production information system.

The firm produce a full range of office furniture. There are 150 products' allowing for size and design variations. They are supplied to 300 customers and orders are normally manufactured over a 6-week cycle. A PC-based production information system has been designed comprising 4 main processes:-

- * Input of data on a customer's order and allocation of the relevant parts to be assembled for that order.
- * Input of a job for manufacturing a batch of parts, print the material requisition tickets and production tickets and monitor the progress of that batch.
- * Print part requisition tickets and the assembly ticket for an order and monitor the assembly of that order.
- * Input bought-in parts and adjust stock levels as appropriate.

Benefits include:-

- * Reduction of work-in-progress (£300,000) by 40% over 3 years.
- * Reduction in clerical effort.
- * Improved pricing strategy as a result of more accurate labour and material usage figures.
- * Better customer service.

Total cost of above hardware = £4,000

Total cost of above software = £2,000

CU3 A Manufacturer of Electrical Water Heater (Employees: about 280)

CSF: Continuous computerisation in various business applications.

The principal activity of the company is in the design, development, manufacture and marketing of a range of electric and mixer showers, spa baths, and allied products. The company continues the expansion achieved in recent years and the directors are confident that growth would continue for the foreseeable future particularly through its policy of investment in the research and development of existing and new products and markets, and in the customer service department.

The company embarks upon a new initiative regarding employee involvement, which is a logical progression in moving from BS5750 Part 1 certification to a "total quality management system". The company improves the level of training offered to all employees with regard to their individual roles within the company and in the important areas of product knowledge and knowledge of company procedures.

In 1983, the management of the company began to consider using a computer system. The initial stage was to install a minicomputer system for the processing of sales, accounts, and customer services records. By 1990, about 1.3 million Triton water heaters have been installed in the country. The database grows larger and larger.

The company is one of the first in UK to approve on the BS5750 quality management system. Since approval in 1984, the company has continuously revised the procedure to meet the changes in products and operations. Now, the revision is the responsibilities of departmental managers. Since the procedures are on the minicomputer network word processor, changes can be made readily and effectively. The requirement for printing is also kept to the minimal.

In 1988, the Customer Services Department developed the fault analysis system using spreadsheet software. The objective is to do statistical analysis of faults by codes so that consistent faults can be highlighted. This led to improvement actions. Further, spare part can be planned according to the service requirement. The ultimate objective is to improve product quality and capitalise on repair activities if there is a genuine need.

Although at present, there are many stand alone PC in the company, these are not yet networked. The system operation is largely based on the mini-system. For instance, the accounting system is running on the minicomputer and there is no intention of changing it to a PC network software. Because of this, there is file transfer problem to PC and end-user computing is limited. For instance, the fault analysis spreadsheet data has to be extracted from printouts and keyed in manual.

Other stand-alone system includes store control system, and quality control system. The users interviewed seem to be satisfied with these system although an integrated system would be preferred. There are continuous development work by end-users. For instance, work is going on to develop better forecasting models for both sales and customer services requirements. The approach is mainly based on end-user computing.

Total cost of above hardware = £150,000
Total cost of above software = £70,000

CU4 A Manufacturer of Precision Ballscrews (Employees: about 140)

CSF: LAN implementation of production control, OA and FA.

The company specialises in the manufacturing of precision ballscrews for the machine tool and aerospace industries. The manufacturing processes are material and capital intensive and the products have high value-added contents. Expansive CNC machine tools have been installed. In 1986, a CAD software running on PC was used to produce drawings. A stand-alone PC was also used to automate the accounting system using Sales and Purchase Ledgers.

It was not until 1989 that the company started considering seriously on computerisation. In mid-1989, a system engineer was employed to develop the information system. He started off by developing the Production Planning and Control System by using DBase IV package. Now he rationalises the operation by keeping track of the job progress. Each worker at the shop floor are asked to fill in a job card to reflect his job progress. The information are then used as job control data. Various databases and reports are used to monitor work progress. There is a supplementary spreadsheet used for rough cut production schedule.

The new information system is supported on a network under Novell Netware. Eight workstations are installed, 3 in Production Control Department, 2 in Sales Department, 1 in Accounting Department, and 2 on Shop' Floor. A dedicated file server with 130 MB Harddisk is used to support the system. Since it is a common database, spreadsheet and database modifications are updated instantaneously. Now, the lead time is cut down from 8 weeks to 5, and more accurate progress information and profit details can be extracted for each order. Further, the accounting system has been enhanced with the Nominal Ledger.

There are plans to further develop the system by installing shop floor data collection devices. Further, there are scopes for downloading CAD files to the CNC machines for more efficient processing. Also, the data file from purchase requisition of the production planning system can be linked to the Purchasing Ledger of the accounting system.

Total cost of above hardware = £28,000
Total cost of above software = £5,000

CU5 A Chartered Accountant and Solicitor Firm (Employees: about 15)

CSF: LAN implementation of OA and computerisation of accounting procedures.

The firm is run by three brothers, two accountants and one solicitor. Their father started the accounting service business in 1980 and passed on to the brothers in 1987. He has developed a method of bookkeeping for small businesses. It is a simple and

effective system. All his client has to do is to complete a form every week entering his takings, purchases, expenses, receipt, cash and bank control. Every quarter, these weekly "Cashbooks" are consolidated to give the the balance sheet, and above the Value Added Tax (VAT) return. In the UK, there are about 10 different retail schemes for retailers. The Cashbook has been designed in such a manner as to be able to separate the VAT component from the transactions. Thus, the quarterly summary will pick up the various standard, zero, and exempt VAT amounts and the accountant will calculate the VAT according to the scheme of choice.

The weekly Cashbook entry, calculation and quarterly summary of VAT and balance sheet has been done manually. Since 1986, the firm has installed a PC to do word processing and use some accounting packages. In 1989, the firm decided to go for full scale computerisation. The initial task was to computerise the Cashbook. It took almost half a year to code and debug the Cashbook using a spreadsheet software. Since then, the benefits are plentiful. The data entry is faster, the presentation more professional, and more important, the VAT return for various retail scheme can be obtained by the press of a button. As an additional benefits, the balance sheet is available every quarter, and there are summary reports of purchases by categories and by suppliers.

With this successful experience, the Accountants have decided to install a network and 5 terminals for the office to use. Further, other software (including the solicitor's client billing system) are loaded onto the network and data are shared by assigned users. The spreadsheet data are archived and saved to a tape daily. The tapes are stored on a monthly basis for data security.

As an additional bonus to the implementation, the firm has been awarded as Grade C training house by the Chartered Accountants Association. This is the highest grade award and implies that the accounting firm do not have to go outside for training its staff on computer applications in accountancy.

Total cost of above hardware = £12,000
Total cost of above software = £3,000

CUB A Computer Training School (Employees: about 5)

CSF: Training on OA for the young generation.

The school is funded by the City Council as part of the Youth Training Scheme. The aim of the school is to train young school-leavers and unemployed in a particular skill so that they can be better equipped for job opportunities.

The grant was approved in 1989. The partners of the school consists of a musical instrument expert and a computer expert. Because of this combination, the partners decided to go for training in both MIDI music recording and office automation applications. Thus, the training is targeting at youths who are interested in music as a career, and are prepared to learn modern office skill for their business venture. Another target group are those who are interested

in either music recording or computer literacy.

With these hybrid of objectives in mind, the school was set up to provide both kinds of facilities. On the office automation side, modules are designed on the common skills like word processing, spreadsheet, database, graphics, and desktop publishing. It is an interesting combination and the trainees find that it is good for their career development.

Total cost of above hardware = £10,000

Total cost of above software = £2,000

CU7 A Nursing Home (Employees: about 4)

CSF: Effective residents database.

In the UK, there are thousands of nursing homes for the elderly. They are usually small setups capable of accommodation 10-20 people. However, the DHSS, which is the funding organisation, has strict rules to their operations. This includes regular medical checkup, medication records, and resident details. Further, the accounts has to be kept for inspection if necessary. In terms of operation, nursing homes have to keep an inventory of the purchases and expenses, and issue billing regularly to the residents' supporters.

In the market, there is a software package available. However, its cost is high (about £1200). Small nursing homes are reluctant to pay for this expense. Further they are somewhat over-cue as a large number of applications and reports are not required for small nursing homes. One nursing home decided to ask a computer firm to write a simple program using database language to suit their particular application. Further, since the owner of the nursing home has many years of experience as a nurse, he has developed his own physiological testing plan for the elderly. This knowledge is also built into the software and used for the residence of the nursing home.

The computer firm is willing to write the software at cost of £400. The benefit is that it can be further developed and commercialised. It is agreed that the future revenue will be shared by both parties.

Total cost of above hardware = £1,000

Total cost of above software = £400

APP.5: FIELD SURVEY OF SYSTEM HOUSES
[for all countries surveyed]

HONG KONG

SHI A System House Specialising in LAN (Employees: about 10)

CSF: Commitment in LAN hardware and software development.

The firm develops a range of LAN interface cards and software, and has its manufacturing facilities in Taiwan. Traditionally, the network link control for Carrier Sensed Multiple Access method (CSMA) are the Collision Detection (CD) and the Collision Avoidance (CA). The firm developed a double CSMA with priority called No Collision (NC). It assures 100% reliability in data transmission with no chance for loss due to data collision. The design has registered patent in the USA and UK and has been well received by users including some financial institutes and the General Electric Information Services Ltd. where data reliability is of primary importance. An interface card is developed based on the technology at 1 MB/sec data transfer rate. The operating system used is the Novell Netware. Moreover, another intelligent card for the Ethernet standard at 10 MB/sec is available basing on the conventional CSMA/CD access method.

A range of utility software for the LAN has also been developed. These include:-

- * SHARE -- Allows the system owner to activate the network, initialise the system, configure shared resources, and maintain user accounts.
- * SEND -- Super-user can send messages directly to all or any one station, and the user can send messages to one station at a time.
- * STAT -- Allows superuser to display all user names and their associated numbers, to display current user names, to display read write protection attributes, and to display or change the read write protection attributes of a public file.
- * LOCK -- This function differs from the standard record lock function in that it allows more discrimination between data, and prevents the waste of disk space.
- * LOOK -- The superuser can monitor any current users console display.
- * MAIL -- Provides for the sending of mail to one or more users on the system.
- * MAP -- Allows the user to change his virtual disk and default.. printer server.
- * TERM -- Locks a remote keyboard to the users terminal, allowing the user to operate a remote PC just as if it were his. With this utility, it is possible to send telex messages by way of a remote telex server, from any PC on the network.

The firm fabricates its products in a partnership factory in Taiwan and sells in HK, Taiwan, USA, and Europe through its distributors. With the success of its product at low prices, and the increasing

trend for LAN installation worldwide, the firm is expecting rapid growth of business. Although at present most of their customers in HK are larger enterprises, they envisage that SME will require LAN soon and its market size is immense.

SH2 A System House Specialising in LAN and Manufacturing Control Software (Employees: about 15)

CSF: Specialisation in LAN and integrated business software.

The system house is an agent for a USA brand of LAN system with over 80,000 network nodes installed worldwide. This network uses a proprietary 1 MB/sec protocol with CSMA/CA handling contention. There is no collision detection mechanism. However, a randomized transmit start time is implemented on each station to reduce the probability that two PCs will transmit simultaneously. The bus topology permits easy attachment or detachment of devices anywhere along the network. The medium is twisted-pair cable, with cable runs up to 1 km. Again, the network operating system used is Novell Netware.

On the software side, it sells an integrated accounting and manufacturing control package from the USA. The package consists of nine modules: general ledger, accounts receivable, order entry, accounts payable, purchasing, inventory, bill-of-materials, job costing, and materials requirement planning. The package is now developed in the 'C' language and is very powerful for PCs. Over ten of this' package have been sold in HK. However, the drawback of the package is that changes in format and capability is not possible. For instance, Chinese character input is not supported; there is no multi-currency provided; and fields like taxation and zip code is rather meaningless to local users. Thus, the firm is actively developing a package of its own basing on the logic of the original. Then, they can make the necessary alteration to meet a particular customer's requirement.

SH3 A System House Specialising in LAN based on Work-stations (Employees: about 15)

CSF: Customised software development based on 4-GL productivity tool.

The system house markets a low cost software/hardware system product from the USA with an integrated application development environment built around a network database. It includes a complete set of 4th generation productivity tools for application design and development. Because the software is non-procedural, it needs no computer programming languages and can develop customised application programs through a Menu-Driven process. Additionally, it speeds up the development and maintenance of business applications, and ensures more timely delivery of software systems. By increasing programmer's productivity, it can significantly decrease the high cost of software development and maintenance.

On the hardware side, a powerful multi-user business system, complete with integrated software that can support up to eight terminals, can

be available at a cheap cost per user. Moreover, it can operate under a multi-user, multi-tasking environment. An experience from a systems engineer is that it took him only half a day to develop and debug an order entry system for a SME in the shipping business. Furthermore, the system supports the Chinese character when Chinese character adaptor card is included at each terminal.

SH4 A System House Specialising in low-cost LAN (Employees: about 5)

CSF: Low-cost LAN and bulletin board.

The firm aims its market at the lower end, mainly for small enterprises. The LAN solution they suggest is to use a PC with harddisk as server. Then through the use of low-cost multi-user network software, the PC are hooked up by two others. Users can then share the same software and database. Performance for such a small system is acceptable, but will deteriorate if more than two terminals are connected.

The firm has also pioneered in HK to establish a bulletin board since 1984. The configuration is based on the non-proprietary software RBBS developed by Columbia University in the USA. It uses a PC with 20 MB harddisk for the job. Users can dial up freely using telephone line for limited access to its database for such information as user list, information exchange, file up-load, down-load, etc. For a fee, the user can use the data-line which gives more reliable data access. In HK such service is very scarce, and therefore, the firm has collected over 1500 members.

JAPAN

SJ1 A System House Centre (Employees: about 50)

CSF: Software application experience sharing through "System House Association".

System house centres are emerging organisations associating themselves with the "System House Association", a newly established industry classified under the Standard Industrial Classification Code of SITC:83069 since 1986. The Association arises as a result of the "Inter-Industry Exchange" movement generated in Japan a few years ago. The aim of the Association is to avoid competition for the development of the same software package. Moreover, because of the rapid advancement of technology, there is a need for firms of different but related business to be located in the same building for speedy exchange of information. Each firm within the Centre has different products to work for and innovate. There is a room allocated in the building for monthly meeting of all firms. Sometimes outside firms are also invited for discussion on related topics. It also serves as a place of meeting during tea-time or evening so that members have ample opportunity to exchange views.

The Centre visited has eight firms located in a three-storey building. There is about 6-8 people in each firm. Some of them have manufacturing plant located in other places. The main products / services offered by these firms are:-

- * Application softwares
- * Office automation systems
- * Artificial intelligence development
- * Intelligent card systems
- * Remote control video equipment
- * Computer-based production equipment
- * Computer-based testing equipment
- * Chinese character application softwares

One interesting strategy adopted by this Centre is that they are endeavouring to develop the market for the People's Republic of China by including a Hong Kong based software house. The latter has good connection with the Department of Microcomputer System Research Institute of Computer System Engineering under the Ministry of Electronic Industry of China. Several system engineers are working there in developing Chinese character operating systems and application softwares. The rationale for this arrangement is that Chinese and Japanese character use a lot of common Kanji (Chinese character). Thus, software developed in Japanese can be converted into Chinese readily.

SJ2 An Information System House (Employees: about 145)

CSF: Application software development for various industries.

Established in 1978 the firm has 82 system engineers, 92 programmers, and 20 part-time workers in its five regional offices over the country. It is a subsidiary of a large electric appliance company. As a result, about half of its services is for the parent company. About 60% of the total business comes from on-line leasing via its own network linking the five regional centres. 30% of the business is on software development, and the balance on sales of packages. However, with the advent of office and microcomputers, the on-line leasing will give way to software development in the near future. Examples of proprietary software developed by the firm includes accounting and operation control packages for the electric, drug, and agriculture industries; CAD system for engineering and real estates; image processing systems; school time-tabling; pipeline calculation; sales supporting system; total quality control tools; etc.

According to the Manager of the Tokyo Office, the difficulties in implementing OA for SME in Japan are:-

- * Working procedures vary from company to company.
- * For first time computer user, there is a lack of knowledge.
- * People usually want packages adjusted to their system.
- * System design and implementation takes long time, and sometimes not tolerated by firms.
- * Requirement of system engineers to act as consultants.

As a result, they always try to convince SME to use existing packages first, and leave software development as a supporting step.

SJ3 A System House Specialising in Financial Services (Employees: about 55)

CSF: Specialisation in financial services.

Established since 1986, the system house has 35 System Engineers and 20 Programmers. Its main line of business is in the development of banking, financial, and insurance systems and terminals that support IBM mini and mainframes. They believe that with the use of telecommunication equipment, distance is no longer a constraint on business activities. As a result of this belief, their main products are software for communication interfacing and bank teller machines. In Japan, although there are over 1500 banks of various sizes, the 20 larger ones have many branches controlling most of the business. They are highly automated. However, in order to meet competition, the smaller banks are undergoing computerisation rapidly. They also need communication with larger banks and clearing houses. As bank operations are standardised, software developed are highly portable. Since for bank operations, quality and reliability is very important, the system house is developing their application software based on a well-known brand of teller machines.

Besides concentrating in the banking sector, the software house is also engaged in the insurance business. They have developed insurance management systems and insurance invoicing management systems for their clients as well. Moreover, they see the recruitment for computer engineers as an emerging business as such manpower is in great shortage in Japan. Other customers include security firms, automobile industry and wholesale business.

SJ4 VAN for Pharmacies (Employees: about 15)

CSF: Use VAN for stock minimisation and as competitive edge.

This is a highly successful case for VAN application. The firm was established in 1980 by a university professor. At that time, small pharmacy retail outlets were facing tough competition from big department stores and supermarkets. There had been some measures taken like joint purchasing system by retailers. However, the result was not successful because stock control emerged to be a major problem. For instance, it was very likely that when one item had been sold, nine items remained behind. Therefore, the firm believed that the only solution was through rationalisation of the operation. The key step was to devise a system so that minimum stocks were carried at all time. The solution was to use VAN for information flow.

Under the VAN system, each participating retailer can access on-line to data such as product name, item code, capacity, minimum order quantity, cost and selling prices, profit, month-to-date purchases, etc. Moreover, with collective delivery services provided by the wholesalers/suppliers, there are two deliveries per week, and minimum order quantity can be as low as one unit. The system also provides statistical data on stock movement and conducts A-B-C analysis on inventory. Based on these information, retailers can plan their

orders according to demand patterns. Further, retailers can get some urgent items from the nearby store, subject to a penalty cost for their "poor" planning.

There are now about 1050 retailers and 80 suppliers joining the scheme. One interesting feature of the firm is that it is cooperative in nature rather than profit-taking. It charges the members 4% of the turnover for the services provided. 80% of the administration is in fact done by the members, and the balance by employees. The retailers are also the shareholders of the firm. Any profit arising from the VAN activity is reinvested in fund for education and training of the members. There are monthly meetings amongst members in group of 8-10 retailers. Labour representatives are also invited. Through these meetings, the members exchange experience. Training materials such as videos, role playing exercises, new product and application information from suppliers, selling and supervisory skills, etc. are disseminated to the retailers via the VAN. The firm also helps its members to transfer payments to the suppliers so that credit discount can be obtained in time. The corporate identity of the firm is "Harmony" amongst the membership retailers.

The firm continues to expand in not only its membership, but also the range of services it can provide. By 1989, they also provide POS system and accounting system to their members. Their future plan is to diversify into the liquor and perishable food business.

When one of the retailers was interviewed, he perceived that the VAN system was a great help to his business. He checks his stock twice a week using a hand-held data terminal. Then he updates the stock file through his PC provided by the firm. Any deficient items are checked against the outstanding orders in his stock record stored on a floppy diskette. He then sends his request using his PC to the VAN via dial-up modem. The suppliers pick up such information periodically from the VAN and process accordingly. The retailer is very pleased with the set up and can now concentrate his effort on the sales and promotional activities.

SJ5 VAN for General Retailers (Employees: about 20)

CSF: VAN for order processing and distribution.

The firm visited is one of the regional franchisee of a VAN system providing services to wholesalers and retailers over Japan. There are about 300 wholesalers and 1200 retailers nationwide joining the scheme. The standard rate for the retailers is US\$6600 for purchasing of equipment and US\$130 as monthly subscription. The equipment, known as "Regi-Phone", is a register machine connected with public telephone network. Wholesalers have to install PC for information processing. The firm provides software for retailers and wholesalers. Ordering data are sent to the firm in batch daily via the telephone line. The firm's minicomputer processes the orders and sends them to the wholesalers for action. Further, the firm provides inventory control and accounting reports to the retailers by batch through facsimile or mailing.

The drawbacks of the operation as compared with SJ4 are:-

1. The range of products is not concentrated, and specialisation is lacking.
2. There is no user participation in the management of the firm.
3. The firm's objective is profit making rather than cooperative.
4. There is no contribution to the improvement of the retailers' business.

SJ6 VAN for Electronic Bulletin Board (Employees: about 15)

CSF: Information services to the public.

The software house visited has developed an effective Japanese character relational database management system using BASIC and Assembler. The product is listed in the software catalogue of NEC, the largest computer firm in Japan. Amongst other products, they have also developed an electronic bulletin board and is the major information provider to NEC's PC-VAN, the largest VAN bulletin board system in Japan. As their membership number increases, they are promoting the sales of PC-VAN as well. The PC-VAN consists of the following functions:-

- [1] Electronic Mailing
- [2] Electronic Notice Board which includes:-
 - * General notice such as wanted, sales, donation, exchange
 - * Special notice such as picnic, audio and video programme education and training courses
 - * Regional notice by prefecture
- [3] Information which includes:-
 - * News
 - * Touring and transport
 - * Financial news
 - * Entertainment and dining-out
 - * Position vacant
 - * Medical and health information
 - * Educational
 - * Communication
- [4] Special Interest Group for exchange of information amongst subscribers such as hobby groups
- [5] Closed User Group, access of which is subject to further subscription. The information provided by the software house is on this group.

For more business oriented users, they can subscribe to the NEC's C&C-VAN through the software house. This is a super-set of the PC-VAN. The additional information available are:-

- [6] Special new reports
- [7] Company information
- [8] Japan industrial news
- [9] Japan Productivity Center information
- [10] Japan External Trade Organisation news which include:
 - * Trade statistics
 - * Japan overseas investment information
 - * World economic information
 - * Other country's data
- [11] Access to overseas databases via the link with MARK*NET of General Electric Company

SOUTH KOREASK1 A Large Accounting Firm with Management Services Division
(Employees: about 80)

CSF: Focus on accounting and management services applications.

It is the Government regulation that accounting firms in South Korea must have Korean people as partners. Therefore, all overseas accounting firms have to cooperate with local ones. Consequently, they are benefitted from the know-how of overseas accounting firms. The firm visited has a joint partnership with one of the 'Big Eight' accounting firms. They have a very strong Management Services Division providing a range of services including general management, organisation and personnel, systems and procedures, financial management, electronic data processing, etc. In the EDP section, they have recently started providing services to SME by offering a software package developed in the U.S. It consists of seven modules on sales, general ledger, cost accounting fixed asset, payroll, production control, inventory, and purchase. They are grouped under sales forecasting, profit planning, and management analysis. The design is based on distributed processing. However, they have to modify the system to allow Korean character input. Two hardware solutions offered are minicomputer and LAN. The operating system employed is the UNIX family which has the advantage of 'portability' to other computers.

The firm usually recommends their users to start with accounting and payroll first as these are most cost-effective and also they are internal systems. Since the package launched about two years ago, they have installed 270 systems, most of them are their accounting clients. Previously, the firm inclined to recommend the minicomputer solution mainly because of the limitation of the LAN server maximum fixed disk capacity at 30 MB. This has limited the application to relatively smaller program modules and databases. However, the barrier is now overcome as higher and higher capacity harddisk is available. The advantage of the LAN solution is that distributed computing can be done much more effectively.

SK2 A System House with Experience in Hotel, Small Bank, and School Systems (Employees: about 15)

CSF: Market segmentation in software development.

This software house is distinguishing itself using market segmentation. First, they have a joint venture with a US software house in marketing and giving support to their hotel information system of less than 1000 rooms. The system consists of front-counter processing and back-counter processing which provides the usual accounting, payroll, inventory, house-keeping, and other operational databases. In addition, there are point-of-sales terminals and customer history database which help to provide efficient service and "human touch" to old customers. They have been marketing the products quite successfully as more and more hotels are undergoing computerisation in order to remain competitive.

Their second line of product is rather special. It is a computer system for small banks. In South Korea, apart from the 7-8 nation wide and central banks, there are about 50 secondary banks whose main interests are in capital investment and stock exchange for their clients. Also, under the category of "small banks" there are about 300 cooperative credit banks plus another 2000 village credit union and 2000 miniature banks which is resulted from the New Village Movement. Thus computer systems for small banks have an immense market. Moreover, these systems are indispensable for the upgrading of these banks for provision of better and more accurate customer services. The package developed by the software house has about 300 programme files totalling 10 MB. It provides applications such as transaction, interest calculation, loan, managerial decision making, etc. The operating system used is a special kind for the brand of minicomputer they represent, although conversion to the more popular PC are quite possible.

The third market segment they enter into is the school. They choose primary schools rather than secondary because there is a larger number. Also, this is the group which needs more help. A typical system consists of pupil management, examination optical marker and data processing, accounting, pupil records and fees, general management, library automation, etc. So far, the sales of this system is not as successful as the first two products because of the limited funding of primary schools.

SK3 A System House with Experience in Manufacturing Information Systems (Employees: about 20)

CSF: Database management systems.

The firm has its main interest in serving big clients using mainframe computers such as IBM, FACOM, and DEC. They have also good connection with some Japanese software houses and frequently do subcontracting work for them. Recently they have started launching into the SME market because PC are much more powerful and affordable. However, they have yet to employ specialist to develop the LAN solution for this particular sector. Thus, their SME activities are limited to odd jobs as per the customers request, such as information search and retrieval system.

SINGAPORE

SS1 Management Consultant Department of an Accounting Firm (Employees: about 25)

CSF: Carefully selected range of LAN/OA products with own experience.

The Consultant offers a wide variety of application software packages to meet the accounting, manufacturing, marketing, distribution and administrative needs of businesses. These packages include transaction processing applications, such as purchasing, accounts

payable, order processing, accounts receivable, inventory, manufacturing resource planning (MRPII) and payroll as well as general ledger, cost accounting, budgeting forecasting, and sales analysis. They are pleased with the experience of implementing the OMICRON accounting and inventory system on the Novell Netware operating system which has so far been giving them very little trouble. Besides the above software/hardware combination, they can also offer the following to their clients:-

- * Accounting Software -- SHORTLANDS, SUN, PEGASUS
- * Manufacturing Control Software -- MICROSS, MICRO-MRP, MRPII, ASKMANMAN, MM3000, MAPICS
- * Network Systems -- ETHERNET, OMININET, G-NET

SS2 Management Consultant Group of an Accounting Firm (Employees: about 9)

CSF: Understanding of the real need of users.

They help their clients in two ways. Firstly, to decide whether the computer systems in place are suitable for the needs of their business, and secondly to help their clients bridge the gap between people and computers by translating varied demands into workable, realistic information systems. They view IT as a tool leading to crucial decisions which can be translated into operational success and increased profits. Besides the usual type of accounting software packages used for their clients, the Consultant has developed a manufacturing package named PCR which is suitable for the Just-in-time material system. Their first reference site is in Malaysia.

The Consultant has pointed out the major difficulties during the course of computerisation for their clients as:-

- * Understanding of computers
- * Fear
- * Too busy with day-to-day work

SS3 A System House Specialising in Accounting Packages (Employees: about 4)

CSF: Customised business applications based on self-developed package.

The system house has developed a software package on general accounting using DBase III. It consists of 8 modules: general ledger, accounts receivable, disbursement ledger, order processing & invoicing, inventory control, accounts payable, payroll and job costing. Further, some specialised applications such as leasing, hire purchase, legal office accounting, etc. can be hooked up to the system. Each module costs about US\$800 which includes modification and installation for the particular customer. The usual hardware recommended is the stand alone PC/AT compatibles with 30 MB harddisk. According to the promotion leaflet, the features of the software package are:

- * Fully localised, proven applications

- * User-friendly, easy to operate menu-driven systems
- * Comprehensive, self-instructing documentations
- * State-of-the-art design with fast database access
- * Reliable, on-going software support
- * Backup by experienced data processing professionals
- * Total solution approach
- * Fully warranted with training and implementation assistance
- * Widely accepted with large user group

The package has been developed and improved since 1982. There are about 40 customers per annum. The Director feels that the major difficulty for implementation for their clients is the lack of systematic manual system in existing setup. Their three major type of customers are, in descending order: trading & wholesale, retail & restaurant, and transport & distribution. The major applications are, in descending order: accounting, sales control, and inventory control. Their next step to improve is to port all the existing software packages to the multi-user environment, targetting at the SME requiring 2-3 terminals.

SS4 A System House with a Subsidiary Computer Training Centre
(Employees: about 6)

CSF: Emphasis on user training.

Apart from the usual accounting systems, this system house has diverse interest in other operational systems like commodity trading, container tracking, market research, patient history, and manufacturing control. Moreover, besides using database languages, they also use the 4-GL like ORACLE, INGRES to run on the UNIX operating system. The drawback of these languages is that the CPU consumption is very high. For manufacturing control, they have been using a package for their clients which has over 15,000 reference sites worldwide. Their target customers are from the electronic industries and the trading & wholesale group. The three major applications are, in descending order: sales control, inventory control, and accounting.

When asked about the major difficulties faced by their clients during the course of computerisation, the Director raised the following points:

- * Lack of understanding of the basic manual systems involved
- * Do not realise the limitations of a given hardware and software
- * Lack of training on how to use software

To partly solve the last problem, they have also opened a training centre to offer basic computer literacy programmes for their clients and the public at large.

SS5 An Independent Consultant and Supplier of CAD/CAM Equipment
(Employees: about 12)

CSF: Specialised in CAD/CAM and engineering applications.

The company is specialised in several product ranges including:

- * Marine Science Systems
- * Printed Circuit Board CAD/CAM Systems
- * Graphics Art CAD/CAM Systems
- * Factory Automation Systems
- * Graphics & CAD-Database Applications
- * Technical Computing and Engineering Applications

The Business Manager of the company said that the three major types of customers are, in descending order, machine tool & die maker, electronic & plastics, and architectural offices. From their experience, the major applications for manufacturers are on CNC machining using parts programming, because programming is easier and cost less expensive than a true CAD/CAM system. Moreover, there should also be a high potential for the Graphic Art CAD/CAM Systems because it is easy to use and there is great time saving with much better quality film produced.

SS6 Commonly Used Software Encountered during Field Survey

CSF: Recommend package solution first.

The following is a list of commonly used imported software based on the information supplied by the interviewees; excluding those general purpose packages in office automation like word processing, spreadsheet, and database:-

- ACCOUNTING -- IUS, OMICRON, PEACHTREE, PEGASUS, SHORTLANDS, SUN, SYBIZ.
- MANUFACTURING -- ASKMANMAN by MCBA, BPCS by IBM, KEWILL by Micros, MAPICS by IBM, MICRO-MRP by Max, MM3000 by HP, MRPII by Profit-Key, PCR by Arthur Young.
- 4-GL -- INGRES, ORACLE, POWERHOUSE.
- EXPERT SYSTEM -- MI by Techknowledge, PC+ by Texas Instrument, XI+ by Expert Systems.
- NETWORK O.S. -- Network by Novell.
- NETWORK H/WARE -- Ethernet, G-Net, Omninet.

SS7 THE "SINGAPORE DEVELOPED SOFTWARE DIRECTORY"

CSF: Comprehensive source of software information.

It is worthwhile quoting here the "Singapore Developed Software Directory" published in 1986. Altogether there are 191 software under 49 categories such as accounting, data communication, database management, hotel systems, import/export documentation, insurance, manufacturing resources planning, travel agency systems, etc. A sample page of such software is shown below:-

SAMPLE PAGE OF SINGAPORE DEVELOPED SOFTWARE DIRECTORYIMPORT/EXPORT DOCUMENTATION

1. Package Name : INWARD/OUTWARD PERMIT PREPARATION
2. Name of Supplier : XXX
3. Address of Supplier: XXX
4. Contact Person(s) : XXX
5. Telephone Number(s): XXX
6. Name of Developer : XXX
7. Package Function(s): Import/Export documentation
8. Hardware Requirement: IBM-PC, XT, AT, and compatibles, IBM S/36
9. Operating System : MS-DOS, PC-DOS, CP/M-86, SSP
10. Minimum Memory Req'd: 640 KB for PC, 128 KB for System 36
11. Peripheral(s) Req'd.: PC computer with minimum of 10 MB HD, printer
12. Source Language : dBase III, COBOL
13. Source Listings : Not Available
14. Pricing Structure : Purchase
15. BASIC/STANDARD MODULE(s)
 - (A) Names(s) : INWARD/OUTWARD PERMIT PREPARATION SOFTWARE
 - (B) Price Range : S\$1,000 for PC version, S\$4,000 for System 36 version
16. OPTIONAL MODULE(s)
 - (A) Name(s) : N.A.
 - (B) Price Range : N.A.
17. Customisation : Available
18. Maintenance Cost : S\$500 per year
19. Physical Medium : 8" and 5-1/4" floppy diskette
20. Documentation : Included
21. Training Recommended: One day at S\$300
22. Date of First Install: January 1986
23. No. of Current Users: 10
24. Product Description: The system enables importers/ exporters, manufacturers, freight forwarders and shipping agencies to prepare and print the inward/ outward declaration forms for their incoming and outgoing shipments. The forms were then submitted to Trade Development Board for approval. Future development of the system include online dial-up to Trade Development Board's computer for the online submission of the permits.

TAIWANST1 A Major Hardware / Software Production Firm (Employees: about 30)

CSF: Have faith and committed to IT development.

The firm is not only a very successful hardware / software house, but it is also a very good example of how a SME can grow to large enterprise making use of the facilities provided by Government supports. It started as a SME in 1978 with some research and manufacturing activities in microcomputer. Throughout its history, it has obtained assistance in one form or another from Industry Development Board, China Productivity Center, Electronic Research & Service Organisation, Science-based Industrial Park, Small and Medium Business Credit Guarantee Fund, and National Taiwan Institute of Technology. Today, the firm has diversified into a group company producing the full range of microcomputer based hardware, peripherals, and software with an annual turnover of about US\$100 million. One achievement is that, in the COMDEX 86 exhibition in USA, the company's latest microcomputer based on the Intel 80386 microprocessor was the first release of 32-bit microcomputers from Asian countries, and has won the fastest processing speed award.

The company has been developing the Chinese character input/output ever since it established in 1978. Their product has changed from the first generation at a speed of about 30 seconds per screen display to the fourth generation of Chinese character workstation at 0.59 sec/screen. As a result of this development, a few worldwide famous computer hardware manufacturers have asked them to supply the Chinese character terminal as original equipment manufacturers. Their approach to develop their line of microcomputer product is firstly to obtain original licence of operating system and BIOS. Then through the assistance of the above organisations, they have managed to put the high technology product into mass production with very stringent quality control. As they have already entered into the market of the world's most popular IBM compatible PCs, there is much room for growth. In fact, though not as successful as this one, there are now over ten such manufacturers in Taiwan.

One of the subsidiaries of the group is a software publishing company. At present, they are marketing hundreds of software packages from other software houses but using the company's microcomputers. It is their belief that, without writing their own packages, they will be able to offer the best software for their customers. Moreover, they are promoting the use of microcomputers for SME via their distribution network of over 70 franchised PC stores throughout the country.

ST2 An Experienced Software House Specialised in Application Software (Employees: about 20)

CSF: Trust in software package solution for SME.

Although the firm is not large by size, they have very good experience in writing application software for the financial and

public sectors. It is recognised as the "Class A" software house by the Software Industry Association of Taiwan. (There are only 7-8 such software houses which can tender for government projects of more than US\$300,000.) Currently, their technical expertise consists of, but not limited to, the following:-

- * Bilingual software systems
- * File management systems
- * Management information systems
- * Language processors
- * Business graphic
- * CAD/CAM services
- * Data communication/ Local area network
- * Integrated software packages
- * Interbank information systems

The company has adopted a very aggressive strategy for expansion by selling part of its shares to a large Japanese software house. Through this merging, the company can have experts from more advanced countries to help them for meeting their clients growing needs. On the other hand, they can do subcontracting job for their Japanese counterpart to gain more experience. The company has some experience for development systems for SME. They have found that some SME are lacking specific knowledge about their needs. Moreover, their specifications are normally too loosely structured and they usually demand for additional services at no cost. The company director believes that for SME, the most logical solution for computerising their information system is by using application packages, with some modifications when necessary.

ST3 A System House Specialising in Chinese software for OA
(employees: about 15)

CSF: Belief in market niche in software development.

Although small in size, the firm has been exporting its products overseas. Their main interest is in the development of productivity tools for office automation in the Kanji (Chinese character) part of the world. They have developed two very useful tools, one is the Kanji based word processing package with graphic and "What-you-see-is- what-you-get" capabilities. This product has been well accepted by the users and IBM has requested them to develop on the IBM/5550 series computers with full Chinese, Korean, and Japanese capabilities.

Another successful product developed is the Kanji version of the "Sidekick". Again, the package is developed from source code using "C" and Assembly Languages and is distinct from the English version. It free from possible bugs of the usual "patched" Kanji version from the English original software. Also it is able to improve some of the original features.

A third product developed by the company is a filing system for the document cover sheet used in all Taiwan government documentations. The success of this company is in its awareness of the needs of its customers, and in producing products required by a large number of end-users.

ST4 Information Industry Institute (Employees: > 150)

CSF: Comprehensive source of software information. Also devoted to improvement of the software industry.

It is a Government subsidised organisation aiming at improving the information industry's development and set guidelines for the future direction of change. It has actively involved in several projects to this effect. One of these was to compile and publish a software directory on microcomputers. The directory was compiled basing on the questionnaire survey which had 120 returns providing information for 1718 software packages. A sample page of the software directory is shown below:-

SAMPLE PAGE OF PC SOFTWARE DIRECTORY COMPILED BY III

1. Classification Code: 2170
2. Supplier's Name : XXX
3. Telephone : XXX
4. Software Name : Chinese Page-Maker System
5. Chinese Capability : Yes
6. Completion Date : December 1986
7. Developer : Local
8. Potential Users : Newspaper and books publishers, office document processing
9. Main Functions :
 - (a) Document input and editing
 - (b) Small-area type-set
 - (c) Page formater
 - (d) Page printing
 - (e) Film output
 - (f) Image processing
 - (g) Chinese character formation
10. Limitation(s) : Image processing supporting system is required between CPU and Page Formater
11. Forth-coming Release: XXX
12. Operating Environment
 - Hardware Requirement: 32 Bit Workstation
 - Language Used ✓ : C
 - Operating System : UNIX, MS-DOS
 - Compulsory Accessory: Typesetter, Scanner
 - Main Memory Req'd. : 4 MB (Inclusive of O.S.)
 - Disk Storage Req'd. : 120 MB
13. Chinese Environment
 - Input Method : Large keyboard
 - Internal Code : BIG-5 Standard Code
 - Character Set : 24 X 24
110 X 110 (for high quality)

-
14. Price
 Monthly Rental : XXX
 Purchase : XXX
 Maintenance p.a. : XXX
 Other Charges : XXX
15. Documentation : Manuals for Users / Operation / Programming / Other Purposes
16. Supporting Services: System maintenance, and Chinese character formation
17. Number of Users : XXX
18. Reference User : XXX
19. Target Users : SME / Large Enterprises / General Users

In April 1987, the Institute publishes an evaluation report on the General Ledger systems produced by some local software houses. The objectives of the report is to:-

- * Understand the needs and difficulties encountered by the users
- * Promote the circulation of software packages
- * Develop a set of comprehensive general ledger system design
- * Provide potential users with a set of reference for their selection

The scheme of judgement is based on five selected schemes from reputable software consultants in the USA. There are 20 packages for the evaluation exercise, and their price range for the package is from US\$300-6000. All packages are run on PC, mostly on IBM PC/XT/AT compatibles. The functional capabilities for comparison are:-

- * Input -- auto-numbering of entries
- * Processing -- auto-account closing
- * Control -- editing of transactions
- * Graphic support -- presentation of charts and graphs
- * Output support -- report generator
- * Reporting -- general financial accounting reports

The three most difficult problems during development, in descending order, are:

- * Definition of scope of the ledgers
- * Lacking a set of standard accounting codes
- * Lacking a set of common Chinese operating system

The three most difficult problems during operation, in descending order, are:

- * Functions of the package is not sufficient, superfluous, or not suitable
- * Lacking instructions in case of abnormal operations
- * Fault within the package

The three most important benefits brought to the company, in descending order, are:

- * Reduction of time in preparing financial reports
- * Providing accurate accounting information

- * Helping the accounting staff in their work

The three most significant problems brought to the company, in descending order, are:

- * Difficulty in tracing accounting information of the previous financial year
- * Problem in the computer operation affecting normal accounting operations
- * Low security of information

The three highest expectations from the support of the Government, in descending order, are:

- * Develop with the software industry for some more appropriate packages
- * Simplify the procedures in the application of computer accounting authorisation
- * Provide venture capital to software houses in developing packages

Although the above findings are based on the general ledger packages, some of the points are equally valid for other commonly used packages like sales order, inventory control, personnel, etc. Moreover, the survey pinpoints some basic but important considerations for the software developers and Government organisations. Thus, it has achieved its objectives to a considerable extent.

U.K.

SU1 A Software House specialised in Accounting Software (Employees: about 10)

CSF: Meeting the surging need of OA.

The software house started business in 1985 in a small office sponsored by the City Council to help small firms starting their business. The firm's business was to help other small business to install hardware and software. Very soon, the company was granted the agency for a popular accounting software for the Coventry area. Because of the popularity of the software, the business has developed very fast. Further, the company has a policy of allocating two technical support staff for each sales staff. Thus customer satisfaction are generally good.

By 1989, the business annual turnover has almost 10-fold to half a million pounds. The director see customer services and continuous improvement in hardware and software support as the key to success. Consequently, they were awarded by the Council as the model SME of the year.

SU2 A Software House specialised in Manufacturing Information System
(Employees: about 30)

CSF: Specialised in manufacturing industry software support and EDI.

The main objective of the firm is to improve the cost-effectiveness of the manufacturing operation of its clients. The firm has been developing a proprietary software package for the manufacturing industry during the past decade. It has the scope to deal with many issues affecting performance in manufacturing companies. These are usually, but not always computer related. Typical assignments cover projects to develop better delivery performance, reducing lead times, lowering inventory levels, rationalising product ranges, improving work-flow and factory layouts as well as planning for profit improvement.

Sometimes the assignments can be facilitated by assistance under the Department of Trade & Industry's "Enterprise Scheme", or the Department of Employment's "Scheme for Managing Business Change". Some of the projects undertaken include business planning for a clothing operation; studies of manufacturing methods and systems for a pump manufacturer, a food equipment manufacturer and a specialist garment manufacturer.

Another important service provided by the firm is on Electronic Data Interchange (EDI). Just as leading chain store operators such as Littlewoods and Marks and Spencers are requiring their manufacturing suppliers to link via EDI into their reporting systems, so major engineering businesses are beginning to insist on EDI as a condition for doing business with a potential supplier. Suppliers who are able to communicate immediately with companies like General Motors, Ford, Metal Box, Vickers, and British Steel for example are already experiencing a significant competitive advantage. The firm developed a low cost, PC-based unit which can be installed quickly and easily to enable suppliers and their customers to receive and process orders and to transmit stock availability information. The system provides numerous reporting facilities, including automatic label printing, picking lists, stock deficiency reports, etc. It has also proved to be easy to implement and to use, leading to rapid acceptance by users.

APP.6.1: INDUSTRY INITIALIZATION

Industry Name	SCEN-UK
Number of Firms	6
Number of Products and Markets	2
Number of Markets	1
Starting Year	1990
Market Names	U.K.
Initial Sales Branches	3
Initial Sales Force	14
Cost To Hire Salesmen	2,500
Cost To Fire Salesmen	3,500
Cost To Open New Branch	30,000
Base Salesperson Salary	12,500
Base Branch Operating Cost	37,500
Admin. Overhead	50,000
Depreciation Period	20
A/R Lag Period	60
Initial Debt/Assets Ratio	0.20
Tax Rate	35%
Shares of Common Stock	1,000,000
Market Rate of Entry (0 - .8)	0.50
Market Entry Impact (0 - 1)	0.50

YEAR	<u>Market Growth</u>	<u>Interest Rate</u>
1990	2%	15%
1991	4%	12%
1992	6%	9%
1993	8%	10%
1994	6%	10%
1995	5%	10%
1996	5%	10%
1997	5%	10%

PRODUCT PARAMETERS

	HOOVER	FUMP
Product Name		
Initial Price	30	75
Base Demand (units)	40,000	32,000
Advertising Weight	90%	90%
Salesman Weight	80%	20%
R&D Weight	50%	10%
Branch Weight	30%	20%
Initial Salesman Commission	1.00%	1.00%
Branch Admin. Expense	1.25%	1.00%
Inventory Carry Cost/unit	2	2
Shipping Cost/unit	3	3
Initial Production Cost/unit	15	48
Initial Production Capacity	129,000	73,000
Price For Unit of New Capacity	35	44
Selling Price For Capacity	15	20
Overtime Rate	140%	140%
Quality Decay Rate	60%	70%
Advertising Decay Rate	90%	70%
Market Share Decay Rate	30%	40%
Payback R&D Cost (yrs)	4	4
Payback Tech Investment (yrs)	3	3
Starting Elasticity	-4.0	-7.0

APP.6.2: "STRATPLAN" REPORTS

STRATPLAN: FIRM 1 as at 31 Dec 1990

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[A] DECISIONS

Dividends Paid (000)	529
Stock Traded (000)	0
Sales Branches	3
Sales Force	14
Notes Payable (000)	0
Capital moved (000)	0
HOOVER Price	30.0
Production (000)	136
Shipments+-(000)	0
Capacity (000)	129
Tech. Inv. (000)	120
R&D: Qual. (000)	120
R&D: Costs (000)	120
Advertising(000)	258
Commission Rate	1.00%
PUMP Price	75.0
Production (000)	78
Shipments+-(000)	0
Capacity (000)	73
Tech. Inv. (000)	160
R&D: Qual. (000)	160
R&D: Costs (000)	160
Advertising(000)	367
Commission Rate	1.00%

[B] BALANCE SHEET (000)

Assets:Cash	1,269
Acct Rec.:HOOVER	673
: PUMP	962
Inventory:HOOVER	0
: PUMP	0
Plant Val:HOOVER	3,545
: PUMP	2,593
Total Assets	9,042
Liab. : Notes Payable	1,653
Emergency loan	0
Equity: Captl Invested	1,983
Retnd Earnings	5,406
Total Liab. & O.E.	9,042

[C] INCOME STATEMENT (000)

Sales income :HOOVER	4,094
: PUMP	5,850
Cost of Goods :HOOVER	1,963
: PUMP	3,650
Gross profit	4,331
Expenses:	
Admin.	66
Inven.Carry :HOOVER	0
: PUMP	0
Advertising :HOOVER	258
: PUMP	367
R&D Quality :HOOVER	120
: PUMP	160
R&D Cost :HOOVER	120
: PUMP	160
Depreciation:HOOVER	187
: PUMP	136
Sales Force :Salary	175
Commission:HOOVER	41
Commission: PUMP	58
Branch Ops :Base	113
:HOOVER	51
: PUMP	58
Shipping :HOOVER	0
: PUMP	0
Consulting Fees	0
Total Expenses	2,071
EBIT	2,261
Interest	248
Taxes Due	704
Net Profit	1,308

[D] MARKET INDEX

	Actual	Forecast
UK : HOOVER	2.00%	4.00%
: PUMP	2.00%	4.00%

[E] OPERATIONS

HOOVER : unit sales	136,467
: unit inventory	0
: mkt. share (%)	17.0%
: unit cost	14.08
: capac. price	35.93
: capac. sell	15.40
PUMP : unit sales	77,997
: unit inventory	0
: mkt. share (%)	17.00%
: unit cost	45.62

: capac. price	46.19
: capac. sell	21.00
Interest Rate on Debt	15.00%
Debt/Assets Ratio	0.18
Debt/Equity Ratio	0.22
Inventory Turnover	24.00
HOOVER	0.00
PUMP	0.00
Gross Profit Margin	44.0%
HOOVER	52.0%
PUMP	38.0%
Net Operating Margin	23.0%
HOOVER	33.0%
PUMP	21.0%
Profit Margin on Sales	13.0%
Return on Assets	17.0%
Return on Investment	18.0%

[F] COMPETITIVE ANALYSIS (As at 31 Dec 1991)

FIRM	1	2	3	4	5	6
Stock Value	8.02	8.42	8.42	8.42	8.42	8.42
Shares Out	1099871	1000000	1000000	1000000	1000000	1000000
Dividends (000)	523	529	529	529	529	529
Earnings/Share	1.17	1.56	1.56	1.56	1.56	1.56
HOOVER Sold	167242	139655	139655	139655	139655	139655
PUMP Sold	105833	79223	79223	79223	79223	79223
Price HOOVER	29	30	30	30	30	30
Price PUMP	71	75	75	75	75	75
Sales Branches	4	3	3	3	3	3
Sales Force	16	14	14	14	14	14
HOOVER Comm.	1.20%	1.00%	1.00%	1.00%	1.00%	1.00%
PUMP Comm.	1.20%	1.00%	1.00%	1.00%	1.00%	1.00%
Advert. (000)	812	625	625	625	625	625
R & D (000)	961	560	560	560	560	560
Cash Avail(000)	1523	2314	2314	2314	2314	2314
Profits (000)	1292	1563	1563	1563	1563	1563

APP.6.3: DECISION SUPPORT SPREADSHEETS FOR "STRATPLAN"

[A] Market Forecast: PRODUCT 1 MARKET A				1991
1990 TOTAL DEMAND	818802	1991 TOTAL DEMAND	913435	
1990 FIRM DEMAND	136467	1991 FIRM DEMAND	160145	
1990 MARKET SHARE	16.67%	1991 MARKET SHARE	17.53%	
1991 MARKETING CONTRIBUTION (000)				1,434
	Industry	Average	Your	Firm
	1990	1991	1990	1991
Price =>	30.0	28.5 [D1]	30.0	28.5 [D7]
Est. Unit Cost =>			13.9	13.4 [D8]
Advertising (000) =>	258	284 [D2]	258	335 [D9]
R&D Quality (000) =>	120	132 [D3]	120	156 [D10]
Branches =>	3	3 [D4]	3	4 [D11]
Salesmen (No.) =>	14	14 [D5]	14	16 [D12]
Commission (%) =>	1.00%	1.10% [D6]	1.00%	1.20% [D13]
Firms in market =>	6	6		

[B] Market Forecast: PRODUCT 2 MARKET A				1991
1990 TOTAL DEMAND	467982	1991 TOTAL DEMAND	554295	
1990 FIRM DEMAND	77997	1991 FIRM DEMAND	94863	
1990 MARKET SHARE	16.67%	1991 MARKET SHARE	17.11%	
1991 MARKETING CONTRIBUTION (000)				1,511
	Industry	Average	Your	Firm
	1990	1991	1990	1991
Price =>	75.0	71.3 [D14]	75.0	71.3 [D20]
Est. Unit Cost =>			45.3	43.3 [D21]
Advertising (000) =>	367	404 [D15]	367	477 [D22]
R&D Quality (000) =>	160	176 [D16]	160	208 [D23]
Branches =>	3	3 [D17]	3	3 [D24]
Salesmen (No.) =>	14	14 [D18]	14	15 [D25]
Commission (%) =>	1.00%	1.10% [D19]	1.00%	1.20% [D26]
Firms in market =>	6	6		

[C] Production Schedule			
PRODUCT =>	1	PRODUCTION YEAR =>	1991
		Market A	
Est. Unit Sales =>		160,145	
Beginning Inventory =>		0	
Shipments (+,-) =>		0	

Desired Inventory	=>	0
New Units Needed	=>	160,145
1990 Capacity	=>	129,000
1990 Production	=>	136,000
1991 Capacity	=>	141,900 [D27]
1991 Production	=>	176,800 [D28]
1991 Excess/Shortage	=>	16,655

[D] Production Schedule

PRODUCT =>	2	PRODUCTION YEAR =>	1991
		<u>Market A</u>	
Est. Unit Sales	=>	94,863	
Beginning Inventory	=>	0	
Shipments (+,-)	=>	0	
Desired Ending Inventory	=>	0	[Assume = 0]
New Units Needed	=>	94,863	
1990 Capacity	=>	73,000	
1990 Production	=>	78,000	
1991 Capacity	=>	80,300	[D29]
1991 Production	=>	101,400	[D30]
1991 Excess/Shortage	=>	6,537	

[E] INVESTMENTS AT BEGINNING OF YEAR 1991

	<u>Market A</u>	
Funds Avail.* (000)	1,269	
Funds Used:		
PRODUCT 1:-		
Tech. Invest. (000)	246	[D31]
New Capacity (000)	463	
PRODUCT 2:-		
Tech. Invest. (000)	351	[D32]
New Capacity (000)	337	
Total Invest. (000)	1,397	
Balance (+,-) (000)	(128)	

*Funds available from cash, sale of assets. Use loans or sale of stock (next worksheet) to raise funds if balance is negative.

[F] CAPITAL BUDGET MANAGEMENT 1991

	<u>Market A</u>	
Balance (+,-) Local	(128)	
In \$	(128)	

Cash Trans. In \$	0	
Local	0	
Stock (in 000 \$)	0	[D33]
(Sales=+/Buy Back=-)		
Dividends (in 000 \$)	523	[D34]
Loans Out. (000)	1,653	
New Loans (+,-)	0	[D37]
Cash Position Before	1991	
Local (000)	(652)	
In \$ (000)	(652)	

[G]

OPERATING BUDGET

1991

Market A		
Prod 1 Revenues(000)	4,564	
Prod 2 Revenues(000)	6,759	
Est Cost Goods (000)	7,627	
Est. Expenses (000)	2,087	
R&D Cost Prod 1(000)	246	[D35]
R&D Cost Prod 2(000)	351	[D36]
Total Expenses (000)	2,683	
EBIT	1,013	
Interest	248	
Taxes	268	
Net Income	497	
Cash Position After*	1991	
	271	

*If negative, adjust investments, loans, equity to avoid emergency loan.

APP.6.4: EXAMPLE OF DEBRIEF SUMMARIES GENERATED FROM "STRATPLAN"**[A] METHOD TABLE**

	<u>NPV</u>	<u>Average</u>	<u>Ending</u>	<u>Cumulative</u>
Stock Price	0	0	1	0
R.O.I.	0	1	0	0
Shareholder Val.	1	0	0	0
Market Share	0	1	0	0
Total Assets	0	0	1	0
Profits	0	0	0	1

To select a method, enter a 1 in the appropriate column. Enter 0 in the remaining cells in the row. For example, to evaluate stock price by its ending value, place a 1 under "Ending" in the stock price row

Ending year : 1995
Rate of return : 10.00%

[B] FIRM WEIGHTS

<u>Firm</u>	<u>Stock</u>	<u>R.O.I.</u>	<u>ShrHldVal</u>	<u>Mkt.Shr.</u>	<u>Assets</u>	<u>Profits</u>
1	0.10	0.20	0.10	0.25	0.10	0.25
2	0.10	0.30	0.20	0.10	0.10	0.20
3	0.20	0.15	0.10	0.20	0.10	0.25
4	0.20	0.10	0.20	0.10	0.20	0.20
5	0.15	0.20	0.15	0.05	0.15	0.30
6	0.10	0.20	0.10	0.30	0.10	0.20

[C] OVERALL RESULTSRAW RANKINGS

<u>Firm Rank</u>	<u>Stock</u>	<u>R.O.I.</u>	<u>ShrHldVal</u>	<u>Mkt.Shr.</u>	<u>Assets</u>	<u>Profits</u>	<u>Total</u>
1	1.00	2.00	3.00	4.00	5.00	6.00	21.00
2	2.00	3.00	4.00	5.00	6.00	1.00	21.00
3	3.00	4.00	5.00	6.00	1.00	2.00	21.00
4	4.00	5.00	6.00	1.00	2.00	3.00	21.00
5	5.00	6.00	1.00	2.00	3.00	4.00	21.00
6	6.00	1.00	2.00	3.00	4.00	5.00	21.00

<u>FIRM 1 CRITERIA</u>							
<u>Wts:</u>	0.10	0.20	0.10	0.25	0.10	0.25	
1	0.10	0.40	0.30	1.00	0.50	1.50	<u>3.80</u> {2nd}
2	0.20	0.60	0.40	1.25	0.60	0.25	3.30
3	0.30	0.80	0.50	1.50	0.10	0.50	3.70
4	0.40	1.00	0.60	0.25	0.20	0.75	3.20
5	0.50	1.20	0.10	0.50	0.30	1.00	3.60
6	0.60	0.20	0.20	0.75	0.40	1.25	3.40
<u>FIRM 2 CRITERIA</u>							
<u>Wts:</u>	0.10	0.30	0.20	0.10	0.10	0.20	
1	0.10	0.60	0.60	0.40	0.50	1.20	3.40
2	0.20	0.90	0.80	0.50	0.60	0.20	<u>3.20</u> {6th}
3	0.30	1.20	1.00	0.60	0.10	0.40	3.60
4	0.40	1.50	1.20	0.10	0.20	0.60	4.00
5	0.50	1.80	0.20	0.20	0.30	0.80	3.80
6	0.60	0.30	0.40	0.30	0.40	1.00	3.00
<u>FIRM 3 CRITERIA</u>							
<u>Wts:</u>	0.20	0.15	0.10	0.20	0.10	0.25	
1	0.20	0.30	0.30	0.80	0.50	1.50	3.60
2	0.40	0.45	0.40	1.00	0.60	0.25	3.10
3	0.60	0.60	0.50	1.20	0.10	0.50	<u>3.50</u> {4th}
4	0.80	0.75	0.60	0.20	0.20	0.75	3.30
5	1.00	0.90	0.10	0.40	0.30	1.00	3.70
6	1.20	0.15	0.20	0.60	0.40	1.25	3.80
<u>FIRM 4 CRITERIA</u>							
<u>Wts:</u>	0.20	0.10	0.20	0.10	0.20	0.20	
1	0.20	0.20	0.60	0.40	1.00	1.20	3.60
2	0.40	0.30	0.80	0.50	1.20	0.20	3.40
3	0.60	0.40	1.00	0.60	0.20	0.40	3.20
4	0.80	0.50	1.20	0.10	0.40	0.60	<u>3.60</u> {3rd}
5	1.00	0.60	0.20	0.20	0.60	0.80	3.40
6	1.20	0.10	0.40	0.30	0.80	1.00	3.80
<u>FIRM 5 CRITERIA</u>							
<u>Wts:</u>	0.15	0.20	0.15	0.05	0.15	0.30	
1	0.15	0.40	0.45	0.20	0.75	1.80	3.75
2	0.30	0.60	0.60	0.25	0.90	0.30	2.95
3	0.45	0.80	0.75	0.30	0.15	0.60	3.05
4	0.60	1.00	0.90	0.05	0.30	0.90	3.75
5	0.75	1.20	0.15	0.10	0.45	1.20	<u>3.85</u> {1st}
6	0.90	0.20	0.30	0.15	0.60	1.50	3.65
<u>FIRM 6 CRITERIA</u>							
<u>Wts:</u>	0.10	0.20	0.10	0.30	0.10	0.20	
1	0.10	0.40	0.30	1.20	0.50	1.20	3.70
2	0.20	0.60	0.40	1.50	0.60	0.20	3.50
3	0.30	0.80	0.50	1.80	0.10	0.40	3.90
4	0.40	1.00	0.60	0.30	0.20	0.60	3.10
5	0.50	1.20	0.10	0.60	0.30	0.80	3.50
6	0.60	0.20	0.20	0.90	0.40	1.00	<u>3.30</u> {5th}

NOTE: The above table shows that, although each firm are performing equally well in terms of ranking in the 6 criteria, because of the difference in their choice of weighting, they end up in different positions.

APP.6.5: EXAMPLE OF WINNING TEAM DECISION TREE FOR ROUND 1 HKDECISION TREE FOR MARKET FORECAST1. INDUSTRIAL AVERAGE PRICE

Is last year's Industrial Average Price increased?

- YES
=> Industrial Average Price is 105% of last year value
- NO
=> Industrial Average Price is 95% of last year value

2. INDUSTRIAL AVERAGE ADVERTISING

Is last year's Industrial Average Advertising increased?

- YES
=> Industrial Average Advertising is 105% of last year value
- NO
=> Industrial Average Advertising is same as last year

3. INDUSTRIAL AVERAGE R & D QUALITY

Is last year's Industrial Average R & D Quality increased?

- YES
=> Industrial Average R & D Quality is 105% of last year value
- NO
=> Industrial Average R & D Quality is same as last year

4. INDUSTRIAL AVERAGE BRANCHES

Is last year's Industrial Average Branches increased?

- YES => Industrial Average Branches is the same as last year
- NO

5. INDUSTRIAL AVERAGE SALESMEN NO.

Is last year's Industrial Average Salesmen increased?

- YES
=> Industrial Average Salesmen is increased by 1
- NO
=> Industrial Average Salesmen is the same as last year

6. INDUSTRIAL AVERAGE COMMISSION

Is last year's Industrial Average Commission increased?

- YES
=> Industrial Average Commission is 108% of last year value
- NO
=> Industrial Average Commission is the same as last year

7. FIRMS IN MARKET

Are the 6 firms in the market last year?

- YES => Firms in the market is 6
- NO

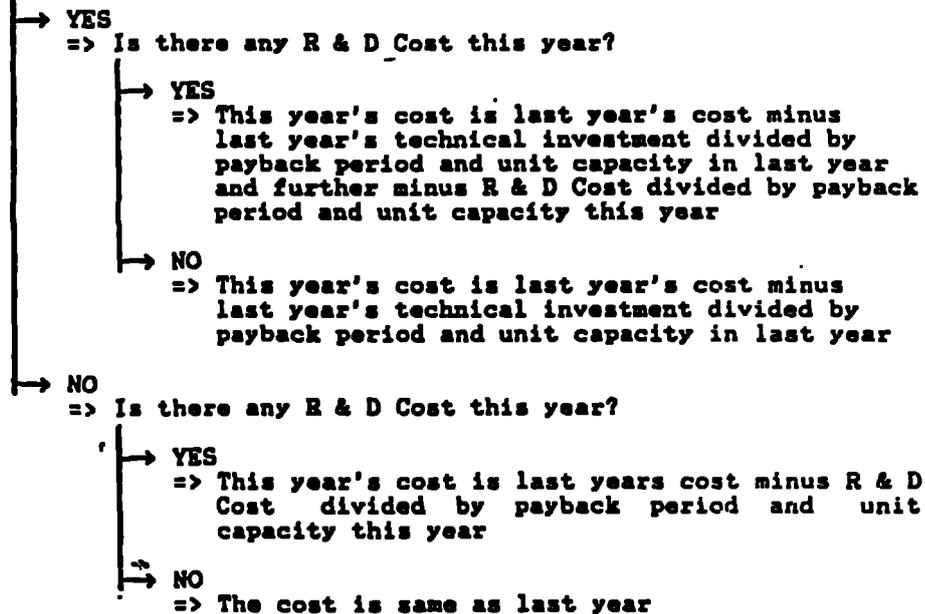
8. FIRM PRICE

Is there any change in the cost?

- YES => Price is 60% markup on cost
- NO

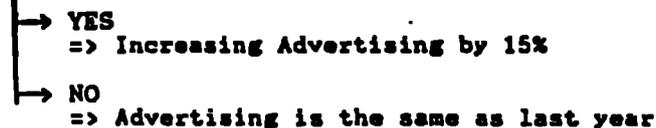
9. ESTIMATED UNIT COST

Is there any technical investment last year?



10. ADVERTISING

Is increasing Advertising increased Marketing Contribution?



11. R&D QUALITY

Is increasing R&D Quality increased Marketing Contribution?

- YES
=> Increasing R&D Quality by 15%
- NO
=> R&D Quality is the same as last year

12. BRANCHES

Is increasing Branches increased Marketing Contribution?

- YES
=> Add one more branch
- NO
=> Branches are same as last year

13. SALESMEN NO.

Is there any change in Branch Number?

- YES
=> Salesmen no. = 5 times Branch No.
- NO
=> Salesmen no. is the same as last year

14. COMMISSION

Is increasing commission increased Marketing Contribution?

- YES
=> Increase commission by 10%
- NO
=> Commission is the same as last year

PRODUCTION SCHEDULE

1. DESIRED INVENTORY

Is production in the own market?

- YES
=> Desired Inventory is zero
- NO
=> Will there be any new entrants?
 - YES
=> Desired Inventory is 5% of estimated sales
 - NO
=> Desired Inventory is 2% of estimated sales

2. SHIPMENTS

Is the production cost + shipment lower in markets A or B or C?

- Market A
=> Production in Market A and Shipped to other markets
- Market B
=> Production in Market B and Shipped to other markets
- Market C
=> Production in Market C and Shipped to other markets

3. CAPACITY

Increase Capacity to meet New Units Needed.

4. PRODUCTION

Production is rounding off (to the nearest thousand) of New Units Needed.

FINANCIAL**1. TECHNICAL INVESTMENTS**

Can the Technical investments payback?

- YES
 - => Investment > 0.1 * capacity price * unit capacity
 - Investment < 0.7 * capacity price * unit capacity
- NO
 - => No investment

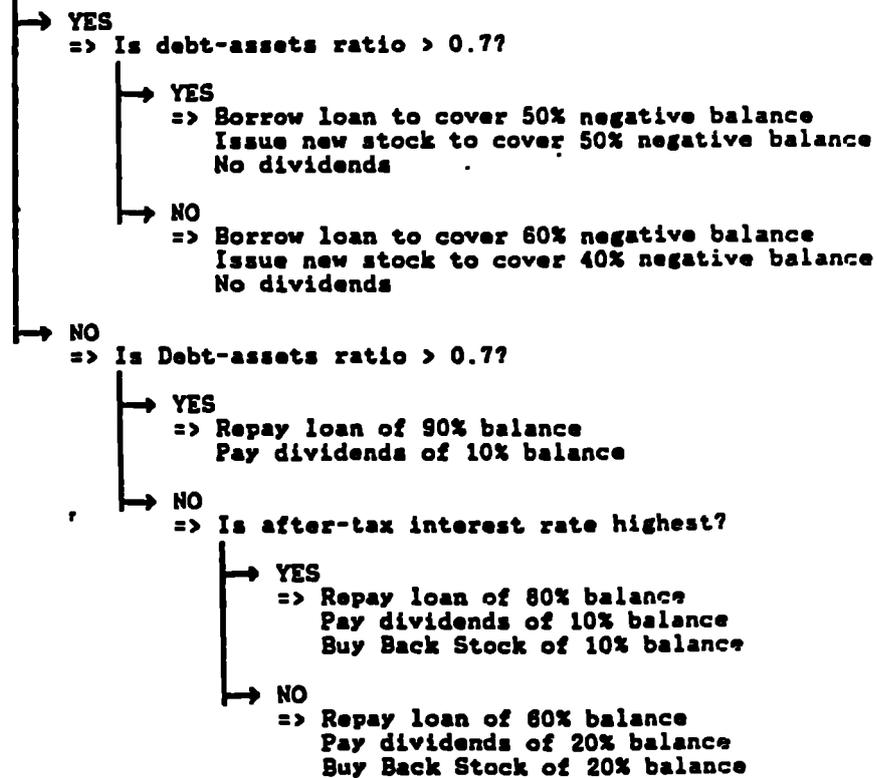
2. CAPITAL BUDGET MANAGEMENT FOR MARKETS A & B

Is the balance in B or C negative?

- YES
 - => Is Debt-assets ratio > 0.7?
 - YES
 - => Borrow loan to cover 50% negative balance
 - Transfer cash to cover 50% negative balance
 - NO
 - => Borrow loan to cover 60% negative balance
 - Transfer cash to cover 40% negative balance
- NO
 - => Is Debt-assets ratio > 0.7?
 - YES
 - => Repay loan of 90% balance
 - Transfer the remaining fund to market A
 - NO
 - => Is the after-tax interest rate highest?
 - YES
 - => Repay loan of 80% balance
 - Transfer the remaining fund to market A
 - NO
 - => Repay loan of 70% balance
 - Transfer the remaining fund to market A

3. CAPITAL BUDGET MANAGEMENT FOR MARKET A

Is the balance (after Cash Transactions) negative?

4. R & D COST

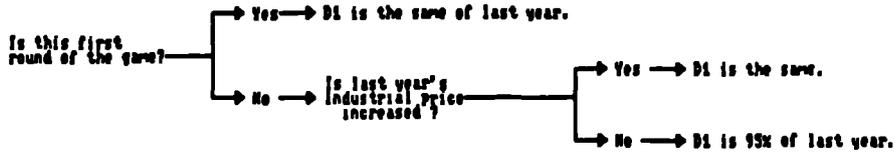
Can the R & D Cost payback?



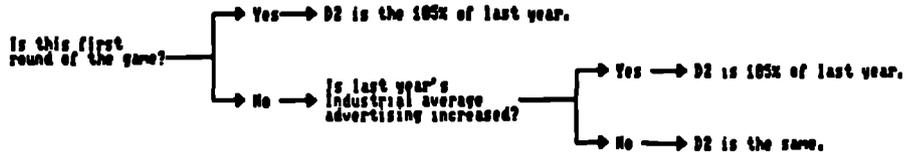
APP.6.6: EXAMPLE OF WINNING TEAM DECISION TREE FOR ROUND 2 HK

MARKET FORECAST

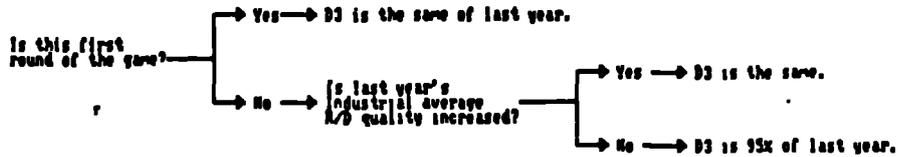
D1



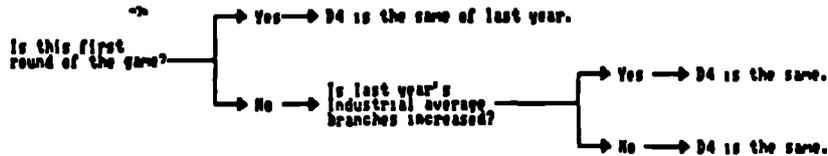
D2



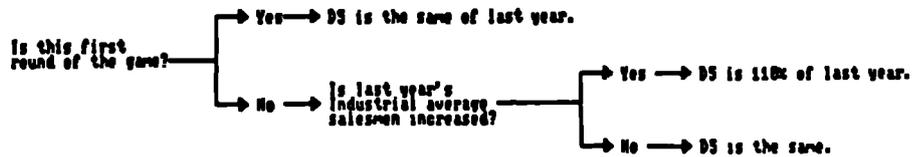
D3



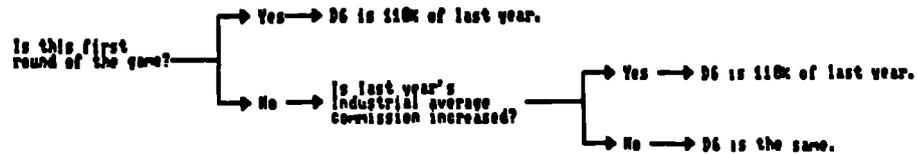
D4



D5



D6



MARKET FORECAST

D7

Is your firm entering into the market during this round?

Yes → D7 is (D7*1).
No → D7 is the same.

D8

Is last year's price higher than this year's industrial average?

Yes → D8 is the same.
No → D8 is 95% of last year's value.

D9

Is estimated unit cost last year increased?

Yes → D9 is 95% of last year's value.
No → D9 is 90% of last year's value.

D10

Is last year's advertising higher than this year's industrial average?

Yes → D10 is the same.
No → D10 is 110% of last year's value.

D11

Is last year's R&D Quality higher than this year's industrial average?

Yes → D11 is the same.
No → D11 is 90% of last year's value.

D12

Is last year's branches more than this year's industrial average?

Yes → D12 is the same.
No → D12 is (D12*1).

D13

Is last year's salesmen more than this year's industrial average?

Yes → D13 is the same.
No → D13 is (D13*1).

D14

Is last year's commission higher than this year's industrial average?

Yes → D14 is the same.
No → D14 is (D14*0.9).

D15

Is this year's market share lower than last year's market share?

Yes → D8 - D14 has to be adjusted.
No → D8 - D14 is O.K.

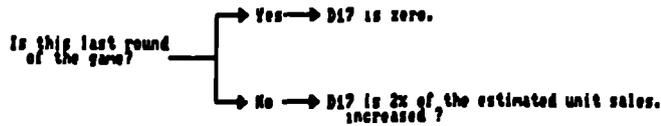
D16

Is market contribution greater than zero?

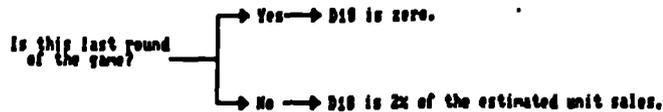
Yes → D8 - D14 is O.K.
No → D8 - D14 has to be adjusted.

Production Schedule

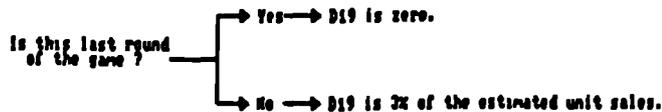
D17



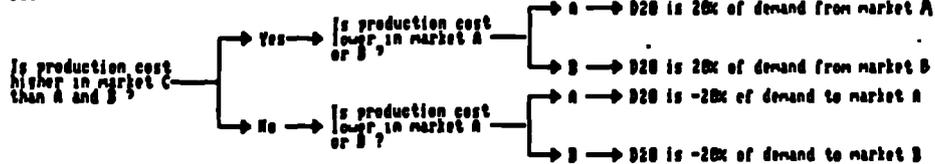
D18



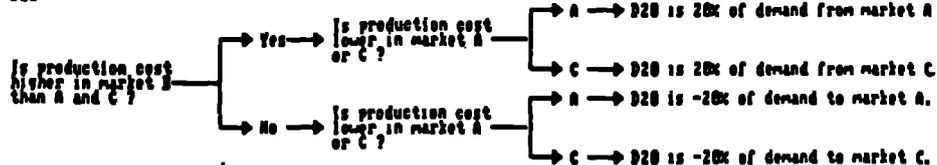
D19



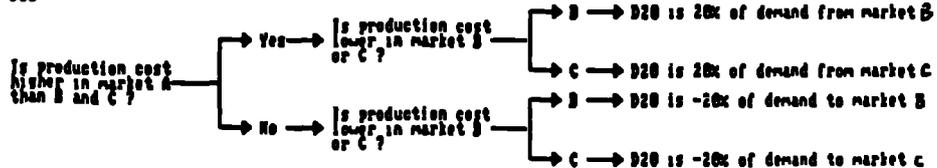
D20



D21

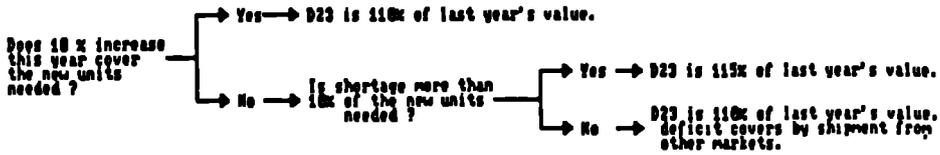


D22

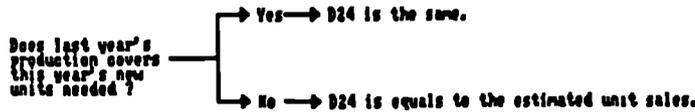


Production Schedule

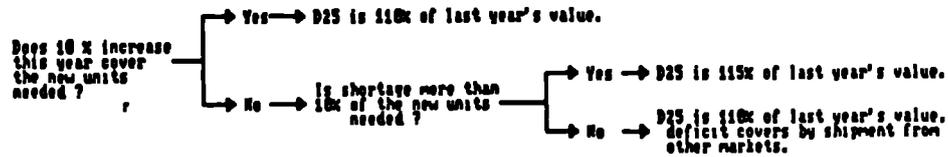
D23



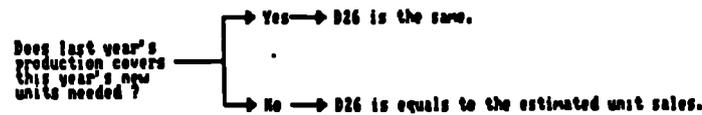
D24



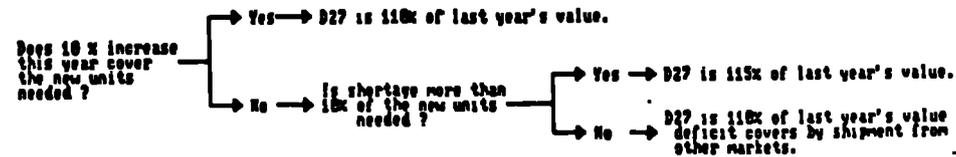
D25



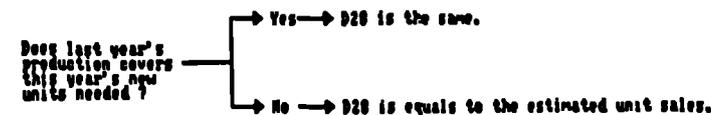
D26



D27

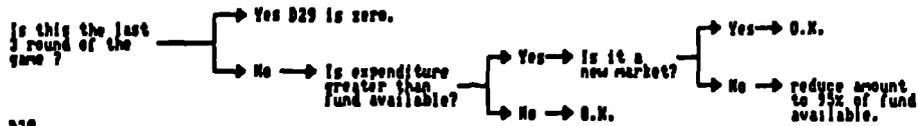


D28

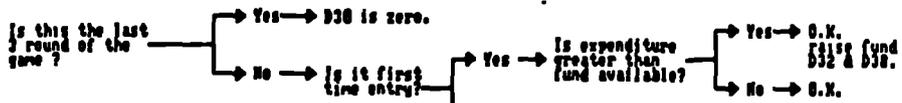


Investments

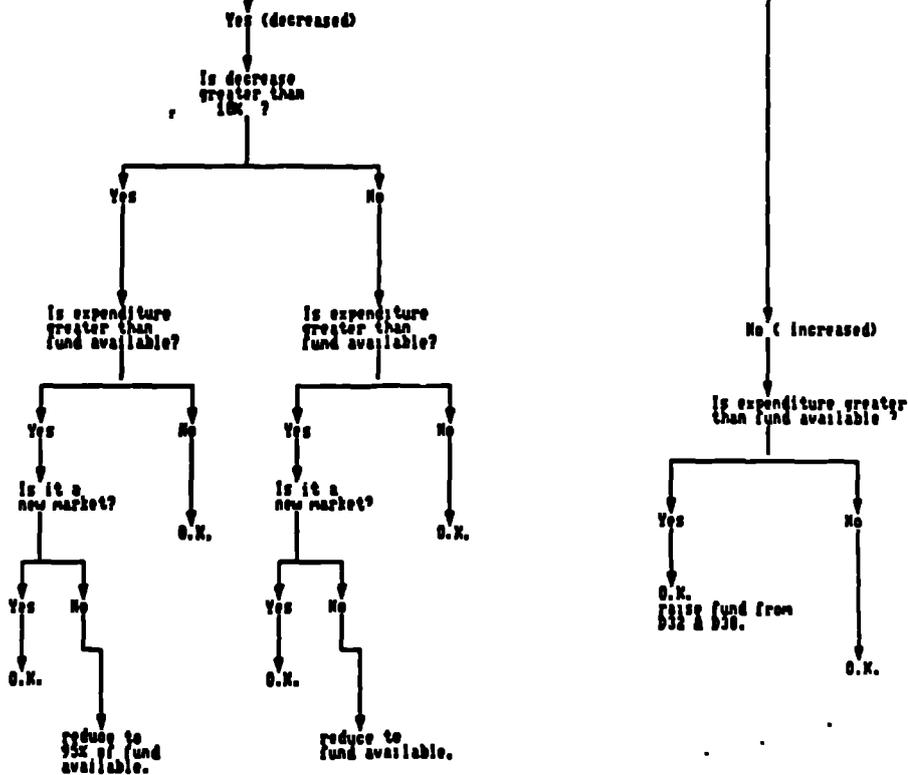
B29



B30

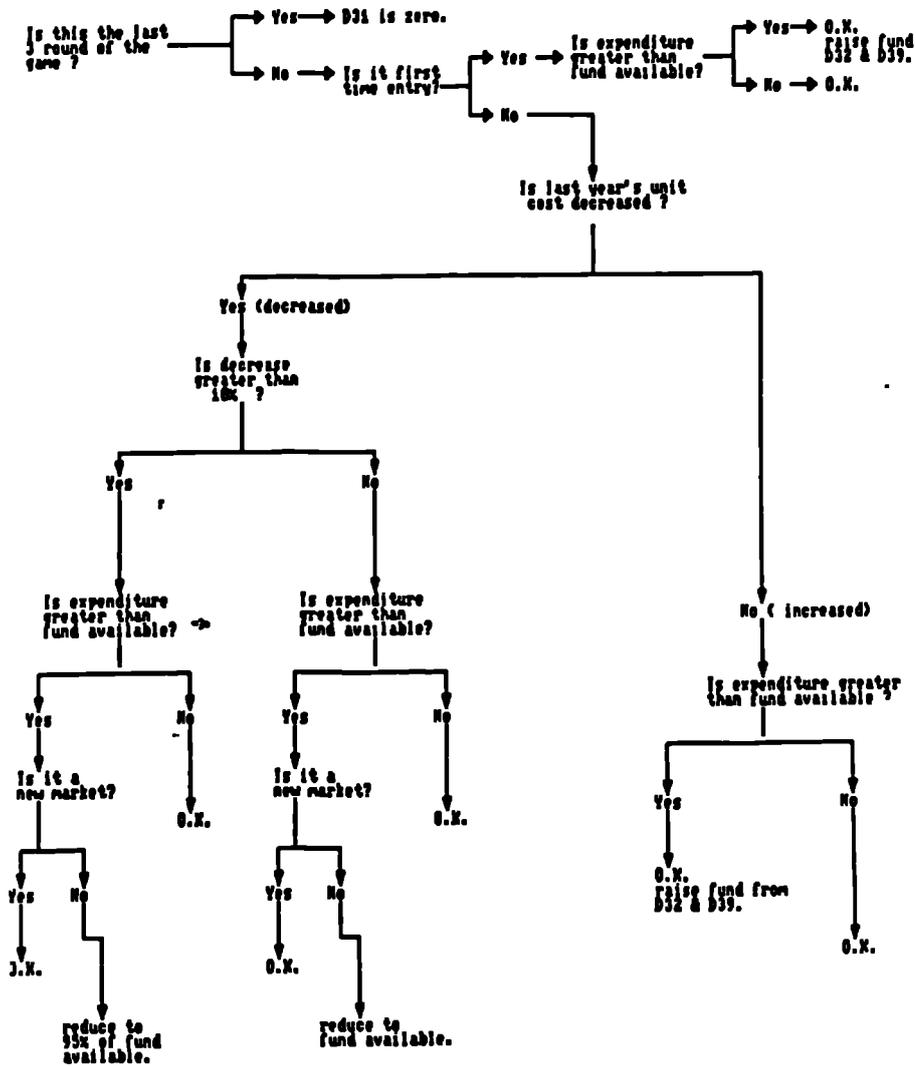


Is last year's unit cost decreased?



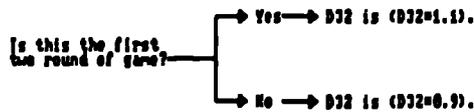
Investments

B31

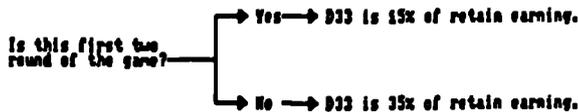


Capital Budget Management

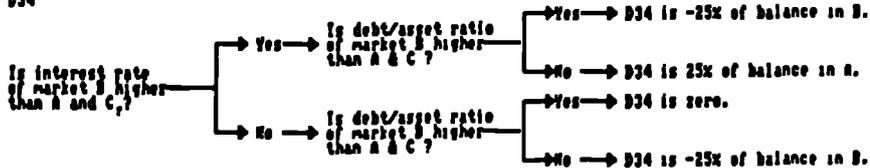
D32



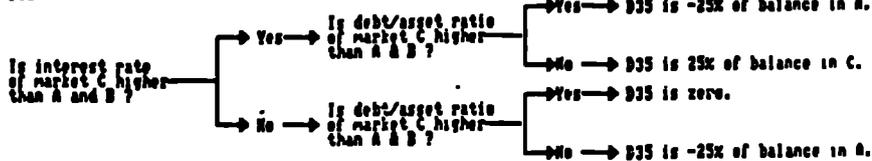
D33



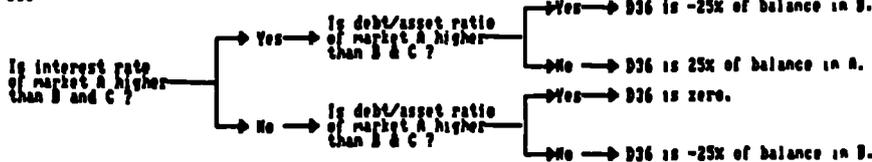
D34



D35

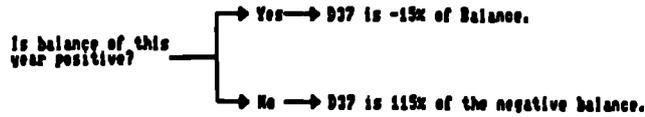


D36

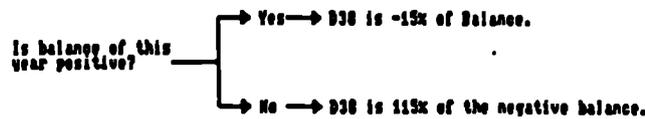


Capital Budget Management

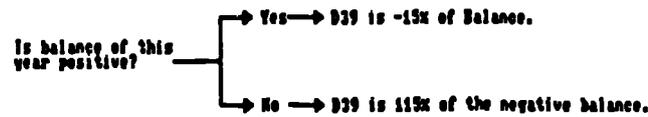
D37



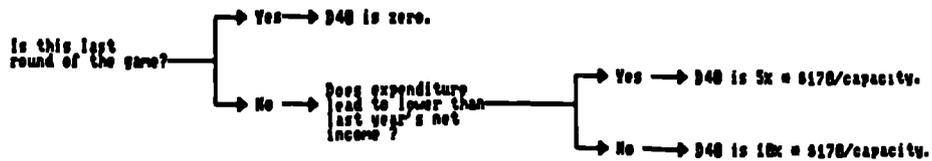
D38



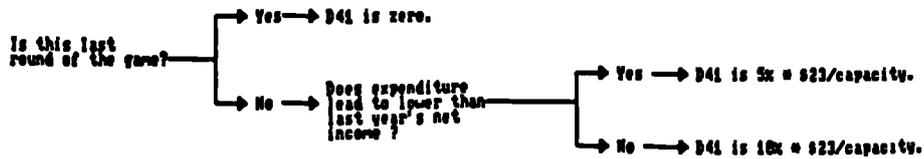
D39



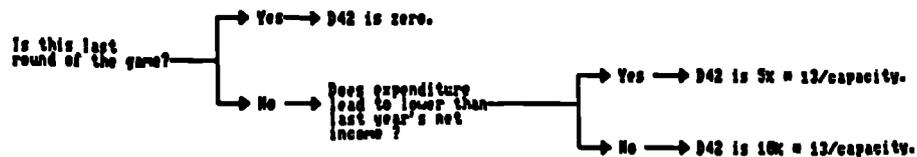
D40



D41



D42



APP.7: VP-EXPERT LISTING OF M.I.S. FOR MANUFACTURING [ES-MISMP]

BKCOLOR = 3;
RUNTIME;
ACTIONS
RESET ALL
COLOR = 30

DISPLAY"

****> ATTENTION <****"

COLOR = 4
DISPLAY"

Your Computer MUST be on-line to a Printer !!!

If you have not yet done so, please RESET Computer now.

Otherwise you will have to RESET your computer !"

COLOR = 15
DISPLAY"

After making sure your printer is on-line, Press any key to continue ...~"

PRINTON
CLS
COLOR = 4
DISPLAY
"

```

*****
*
*      EXPERT SYSTEM FOR EFFECTIVE APPLICATIONS      *
*              of                                     *
*      MICROCOMPUTER-BASED                             *
*      MANAGEMENT INFORMATION SYSTEMS                 *
*              for                                     *
*      MANUFACTURING FIRMS UP TO 300 EMPLOYEES        *
*
*              by                                     *
*
*              Samuel K.M. HO                          *
*              MSc, MBCS, MMS                          *
*
*****

```

Press any key to continue~"

CLS
COLOR = 15

DISPLAY"

***** INSTRUCTIONS *****

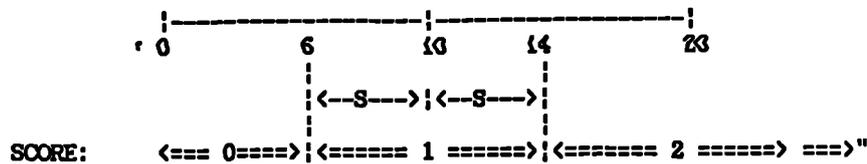
1. It is important that you should do this consultation seriously. Dummy run is not recommended. This is because it will affect your actual decisions. Therefore, you should set aside about 5 minutes for this consultation and think carefully before you answer each question.
2. When you are answering questions, it is useful to jot down your answers on a piece of paper as the screen will scroll and some information vanishes.
3. There will be scores assigned to each question. At the end of the the consultation, your total score will be compared with the mid-range from a survey of 114 Manufacturers with some success in computerisation.

Press any key to continue~"

COLOR = 14
CLS

DISPLAY"

***** SCORING SYSTEM *****



DISPLAY
"

For example, IF the mean no. of years' experience for Manufacturing Firms is 10. Then assuming normal distribution about the mean line of 10, the standard deviation 'S' = 4 (calculated from the sample data). The scoring system is such that score of 1 point will be assigned for firms within the +/- (standard deviation). In this case, firms which has experience between 6--14 years will be awarded a score of 1. Consequently, those with less than 6 years' experience will score 0, and more than 14 years' experience will score 2 point.

Press any key to continue~"

COLOR = 0
CLS
FIND EMPNO

LOOP1 = ON

WHILE TRUE EMPNO <= 300 AND LOOP1 = ON THEN

FIND YEAR

FIND SCORE3A

DISPLAY "Your Score for COMPUTING HISTORY is : {SCORE3A}

HINT: The mid-range for COMPUTING HISTORY is 6 to 14 years.

```

"
  FIND PROSA
  PROSAR = (PROSA / EMPNO)
  FIND SCORE3B
  DISPLAY "Your Score for PROGRAMMER/ANALYST NUMBER is : {SCORE3B}
HINT: The mid-range for ANALYST/EMPLOYEE is 1% to 4%.
"
  FIND ENDUSER
  ENDR = (ENDUSER / EMPNO)
  FIND SCORE3C
  DISPLAY "Your Score for END-USER NUMBERS is : {SCORE3C}
HINT: The mid-range for USER/EMPLOYEE is 4% to 12%.
"
  FIND PC
  PCR = (PC / EMPNO)
  FIND SCORE4A
  DISPLAY "Your Score for PC NUMBER is : {SCORE4A}
HINT: The mid-range for PC/EMPLOYEE is 3% to 9%.
"
  FIND SCORE4B
  DISPLAY "Your Score for NETWORKING is : {SCORE4B}

```

Press any key to continue~"

CLS

DISPLAY

"From the following list of MAJOR APPLICATIONS, make a choice of < 6 > in any sequence. Write the code down. Then enter them one by one:-

- ```

D1 Sales Control (customer details, accounts receivable, etc.)
D2 Personnel Data
D3 Inventory Control
D4 Accounting (general ledger, payroll, etc.)
D5 Finance (budgetary control, financial analysis, etc.)
D6 Purchasing (vendor details, accounts payable, etc.)
D7 Production/Operations Planning and Control
D8 Transport/Distribution
D9 Business Planning and Forecasting
D10 Computer Aided Design
D11 Word Processing
D12 Document Filing System
D13 Telex (Fax) Terminal
D14 External On-line Database Access (VIEWDATA, DIALOG, etc.)
"

```

```

 FIND SCORE5A
 FIND SCORE5B
 FIND SCORE5C
 FIND SCORE5D
 FIND SCORE5E
 FIND SCORE5F
 SCORE5 = (SCORE5A+SCORE5B+SCORE5C+SCORE5D+SCORE5E+SCORE5F)

```

DISPLAY "Your Score for MAJOR APPLICATIONS is : {SCORE5}

HINT: Firms successful in computerisation tends to focus on the following:-

- ```

D1 Sales Control (customer details, accounts receivable, etc.)
D3 Inventory Control

```

- D4 Accounting (general ledger, payroll, etc.)
 D5 Finance (budgetary control, financial analysis, etc.)
 D6 Purchasing (vendor details, accounts payable, etc.)
 D11 Word Processing

From the list of PROGRAMMING LANGUAGES, please make a choice of 1 out of 5 for both your software developed by your own firm and by software consultant.

```
"
      FIND SCORE6A
      FIND SCORE6B
      SCORE6 = (SCORE6A+SCORE6B)
      DISPLAY "Your Score for MAJOR DEVELOPMENT LANGUAGES is: {SCORE6}
HINT: Manufacturing firms tend to use BASIC for both own development and
      by software consultants.
```

Press any key to continue~"

CLS

DISPLAY

"From the following list of DEVELOPMENT PACKAGES, make a choice < 4 > in any sequence. Write the code down. Then enter them one by one:-"

DISPLAY"

- E1 Word Processing (e.g. Wordstar, Multimate, Word, etc.)
- E2 Database (e.g. Dbase III+/ IV, Dataflex, etc.)
- E3 Integrated (e.g. LOTUS 1-2-3, Framework, Excel, etc.)
- E4 Accounting System (e.g. PROMAS, BPI, SAGE, PERGASUS, etc.)
- E5 Inventory System (e.g. INMASS, MRP, MICROSS, DAC EASY, etc.)
- E6 Drawing (e.g. AUTOCAD, COREL DRAW, etc.)
- E7 Project Planning (e.g. Milestone, HTPM, etc.)
- E8 Statistics (e.g. Minitab, SPSS, SAS, etc.)
- E9 Forecasting (e.g. PC-GIVE, ESP. LRP, etc.)
- E10 Financial Analysis (e.g., IFPS, Ultra-plan, etc.)
- E11 Decision Supporting I (e.g. Sales Edge, Negotiation Edge, etc.)
- E12 Decision Supporting II (e.g. Don Jones, Stratplan, etc.)
- E13 Decision Supporting III (e.g. Operational Research, etc.)
- E14 Decision Supporting IV (e.g. 4-GL, AI, etc.)
- E15 Desktop Manager (e.g., Sidekick, Window, etc.)

"

```
      FIND SCORE6C
      FIND SCORE6D
      FIND SCORE6E
      FIND SCORE6F
      SCORE6T = (SCORE6C+SCORE6D+SCORE6E+SCORE6F)
```

DISPLAY "Your Score for DEVELOPMENT PACKAGES is : {SCORE6T}

HINT: Firms successful in computerisation tend to use the following tools:-

- E1 Word Processing (e.g. Wordstar, Multimate, etc.)
- E2 Database (e.g. Dbase III+/ IV, etc.)
- E3 Integrated (e.g. LOTUS 1-2-3, Framework, etc.)
- E4 Accounting System (e.g. PROMAS, BPI, SAGE, PERGASUS, etc.)

"

```
      FIND HARD
      HARDR = (HARD / EMPNO)
      FIND SCORE7
      DISPLAY "Your Score for HARDWARE INVESTMENT is : {SCORE7}
```

HINT: The mid-range for HARDWARE INVESTMENT/EMPLOYEE is L250 to L750.

```
"
  FIND SOFT
  SOFTR = (SOFT / EMPNO)
  FIND SCORE8
```

```
  DISPLAY "Your Score for SOFTWARE INVESTMENT is : {SCORE8}
```

HINT: The mid-range for SOFTWARE INVESTMENT/EMPLOYEE is L80 to L260.

Press any key to continue~"

CLS

DISPLAY

"From the list of MAJOR ACHIEVEMENTS, make a choice of < 4 >. Write the code down. Then enter them one by one:-

- F1 Greater capability to meet future increase in business
- F2 Better control of source and use of funds
- F3 Better control of inventory
- F4 Better filing & reporting of marketing and operation information
- F5 Reduce overtime requirement
- F6 Reduce cost of production/operation
- F7 More systematic flow of materials and goods
- F8 Improve human resources management efficiency
- F9 Standardising procedures from planning to implementation
- F10 Simplification of business forecasting
- F11 Saving of raw materials and fuel
- F12 Improve product/service quality
- F13 Security of information
- F14 Training of staffs in data processing

"

```
  FIND SCORE9A
  FIND SCORE9B
  FIND SCORE9C
  FIND SCORE9D
  SCORE9 = (SCORE9A+SCORE9B+SCORE9C+SCORE9D)
```

```
  DISPLAY "Your Score for MAJOR ACHIEVEMENTS is : {SCORE9}
```

HINT: Firms successful in computerisation tend to achieve the following:-

- F1 Greater capability to meet future increase in business
- F2 Better control of source and use of funds
- F3 Better control of inventory
- F4 Better filing & reporting of marketing and operation information

```
"
  FIND SCORE10
```

```
  DISPLAY "Your Score for CONFIDENCE IN COMPUTERISATION is : {SCORE10}
```

```
"
SCORET = (SCORE3A+SCORE3B+SCORE3C+SCORE4A+SCORE4B+SCORE5+SCORE6
+SCORE6T+SCORE7+SCORE8+SCORE9+SCORE10)
```

COLOR = 1

DISPLAY

"=====

Your Total Score for the Consultation is :"

COLOR = 30

DISPLAY

"

====> {SCORET} <====

COLOR = 1

DISPLAY"

The MEAN SCORE for a successfully computerised manufacturing firm up to 300 employees is < 17 > with 95% confidence limit between 9 and 25. However, for sake of comparison:-

Score below 13 is LOW as it is within the Lower Quartile.
Score above 21 is HIGH as it is within the Upper Quartile.

Press any key to continue~"

CLS
COLOR = 4
FIND RECOMMEND
COLOR = 14

DISPLAY"

*** THANK YOU FOR USING THIS CONSULTANCY SERVICE ***
*** THE AUTHOR HOPES THAT IT IS OF VALUE TO YOU! ***

Press ENTER to start again
or Q to go to Case Studies."

LOOP1 = OFF
PRINTOFF
END;

RULE 1

IF YEAR < 6
THEN SCORE3A = 0
DISPLAY "Your firm has less COMPUTERISATION EXPERIENCE than the average firm.";

RULE 1A

IF YEAR <= 14
THEN SCORE3A = 1
DISPLAY "Your firm has about the same COMPUTERISATION EXPERIENCE as the av. firm."
ELSE SCORE3A = 2
DISPLAY "Your firm has more COMPUTERISATION EXPERIENCE than the av. firm."
;

RULE 2

IF PROSAR < .01
THEN SCORE3B = 0
DISPLAY "Your firm has less PROGRAMMERS/ANALAYTS than the average firm.";

RULE 2A

IF PROSAR <= .04
THEN SCORE3B = 1
DISPLAY "Your firm has about the same number of PROGRAMMERS/ANALYSTS as the average firm."

```
ELSE    SCORE3B = 2
DISPLAY "Your firm has more PROGRAMMERS/ANALYSTS than the average firm.";

RULE 3
IF      ENDR < .04
THEN    SCORE3C = 0
DISPLAY "Your firm has less END-USERS than the average firm.";

RULE 3A
IF      ENDR <= .12
THEN    SCORE3C = 1
DISPLAY "Your firm has about the same number of END-USERS as the average
firm."
ELSE    SCORE3C = 2
DISPLAY "Your firm has more END-USERS than the average firm.";

RULE 4A
IF      PCR < .03
THEN    SCORE4A = 0
DISPLAY "Your firm has less PERSONAL COMPUTERS than the average firm.";

RULE 4A1
IF      PCR <= .09
THEN    SCORE4A = 1
DISPLAY
"Your firm has about the same number of PERSONAL COMPUTERS as the average
firm."
ELSE    SCORE4A = 2
DISPLAY "Your firm has more PERSONAL COMPUTERS than the average firm.";

RULE 4B
IF      NETWORK = NO
THEN    SCORE4B=0
DISPLAY
"Your firm has less CONSIDERATION IN NETWORKING than the average firm.
Firms should start planning for NETWORKING before it is too late !";

RULE 4B1
IF      NETWORK = PLANNED
THEN    SCORE4B=1
DISPLAY
"Your firm has given about the same CONSIDERATION IN NETWORKING than the
average firm. Yet, it is worthwhile to give serious thought in installing
NETWORKING before it is too late !"
ELSE    SCORE4B=2
DISPLAY "Your firm has NETWORKING and this is better than the average
firm.";

RULE 5A
IF      Q5A=D1 OR Q5A=D3 OR Q5A=D4 OR Q5A=D5 OR Q5A=D6 OR Q5A=D11 AND
Q5A<>UNKNOWN
THEN    SCORE5A=1
DISPLAY "Congratulations, you have hit ONE MAJOR APPLICATION !!";
```

```
RULE 5B
IF      Q5B=D1 OR Q5B=D3 OR Q5B=D4 OR Q5B=D5 OR Q5B=D6 OR Q5B=D11 AND
Q5B<>UNKNOWN
THEN    SCORE5B=1
DISPLAY "Congratulations, you have hit ONE MAJOR APPLICATION !!";

RULE 5C
IF      Q5C=D1 OR Q5C=D3 OR Q5C=D4 OR Q5C=D5 OR Q5C=D6 OR Q5C=D11 AND
Q5C<>UNKNOWN
THEN    SCORE5C=1
DISPLAY "Congratulations, you have hit ONE MAJOR APPLICATION !!";

RULE 5D
IF      Q5D=D1 OR Q5D=D3 OR Q5D=D4 OR Q5D=D5 OR Q5D=D6 OR Q5D=D11 AND
Q5D<>UNKNOWN
THEN    SCORE5D=1
DISPLAY "Congratulations, you have hit ONE MAJOR APPLICATION !!";

RULE 5E
IF      Q5E=D1 OR Q5E=D3 OR Q5E=D4 OR Q5E=D5 OR Q5E=D6 OR Q5E=D11 AND
Q5E<>UNKNOWN
THEN    SCORE5E=1
DISPLAY "Congratulations, you have hit ONE MAJOR APPLICATION !!";

RULE 5F
IF      Q5F=D1 OR Q5F=D3 OR Q5F=D4 OR Q5F=D5 OR Q5F=D6 OR Q5F=D11 AND
Q5F<>UNKNOWN
THEN    SCORE5F=1
DISPLAY "Congratulations, you have hit ONE MAJOR APPLICATION !!";

RULE 6A
IF      Q6A=BASIC AND Q6A<>UNKNOWN
THEN    SCORE6A=1
DISPLAY "Congratulations, you have hit the MAJOR SELF-DEVELOPMENT LANGUAGE
!!";

RULE 6B
IF      Q6B=BASIC AND Q6B<>UNKNOWN
THEN    SCORE6B=1
DISPLAY "Congratulations, you have hit the MAJOR THIRD PARTY DEVELOPMENT LANGUAGE
!!";

RULE 6C
IF      Q6C=E1 OR Q6C=E2 OR Q6C=E3 OR Q6C=E4 AND Q6C<>UNKNOWN
THEN    SCORE6C=1
DISPLAY "Congratulations, you have hit ONE DEVELOPMENT PACKAGE !!";

RULE 6D
IF      Q6D=E1 OR Q6D=E2 OR Q6D=E3 OR Q6D=E4 AND Q6D<>UNKNOWN
THEN    SCORE6D=1
DISPLAY "Congratulations, you have hit ONE DEVELOPMENT PACKAGE !!";

RULE 6E
IF      Q6E=E1 OR Q6E=E2 OR Q6E=E3 OR Q6E=E4 AND Q6E<>UNKNOWN
THEN    SCORE6E=1
```

DISPLAY "Congratulations, you have hit ONE DEVELOPMENT PACKAGE !!";

RULE 6F

IF Q6F=E1 OR Q6F=E2 OR Q6F=E3 OR Q6F=E4 AND Q6F<>UNKNOWN
THEN SCORE6F=1
DISPLAY "Congratulations, you have hit ONE DEVELOPMENT PACKAGE !!";

RULE 7

IF HARDR < 250
THEN SCORE7 = 0
DISPLAY "Your firm has less HARDWARE INVESTMENT than the average firm.";

RULE 7A

IF HARDR <= 750
THEN SCORE7 = 1
DISPLAY
"Your firm has about the same AMOUNT OF HARDWARE INVESTMENT as the average
firm."
ELSE SCORE7 = 2
DISPLAY "Your firm has more HARDWARE INVESTMENT than the average firm.";

RULE 8

IF SOFTR < 80
THEN SCORE8 = 0
DISPLAY "Your firm has less SOFTWARE INVESTMENT than the average firm.";

RULE 8A

IF SOFTR <= 260
THEN SCORE8 = 1
DISPLAY
"Your firm has about the same AMOUNT OF SOFTWARE INVESTMENT as the average
firm."
ELSE SCORE8 = 2
DISPLAY "Your firm has more SOFTWARE INVESTMENT than the average firm.";

RULE 9A

IF Q9A=F1 OR Q9A=F2 OR Q9A=F3 OR Q9A=F4 AND Q9A<>UNKNOWN
THEN SCORE9A=1
DISPLAY "Congratulations, you have hit ONE MAJOR ACHIEVEMENT !!";

RULE 9B

IF Q9B=F1 OR Q9B=F2 OR Q9B=F3 OR Q9B=F4 AND Q9B<>UNKNOWN
THEN SCORE9B=1
DISPLAY "Congratulations, you have hit ONE MAJOR ACHIEVEMENT !!";

RULE 9C

IF Q9C=F1 OR Q9C=F2 OR Q9C=F3 OR Q9C=F4 AND Q9C<>UNKNOWN
THEN SCORE9C=1
DISPLAY "Congratulations, you have hit ONE MAJOR ACHIEVEMENT !!";

RULE 9D

IF Q9D=F1 OR Q9D=F2 OR Q9D=F3 OR Q9D=F4 AND Q9D<>UNKNOWN
THEN SCORE9D=1

```
DISPLAY "Congratulations, you have hit ONE MAJOR ACHIEVEMENT !!";
```

```
RULE 10
IF WORTH=NO AND WORTH<>UNKNOWN
THEN SCORE10=0
DISPLAY "Your firm has LESS FAITH IN COMPUTERISATION than the av. firm."
ELSE SCORE10=1
DISPLAY "Your firm has SAME FAITH IN COMPUTERISATION as 97% of the firm.";
```

```
RULE 11
IF EMPNO > 300
THEN COMEMPNO = UNQUA
DISPLAY
"THIS CONSULTANCY IS LIMITED TO FIRM SIZE OF NO MORE THAN 300 EMPLOYEES
!!!";
```

```
RULE 12
IF EMPNO <= 300
THEN COMEMPNO = QUA;
```

```
RULE 13
IF SCORET < 13
THEN RECOMMEND = VALUE
DISPLAY"
```

*** SUGGESTIONS ***

Your Total Score is within the LOWER QUARTILE of the population.
This indicates that your firm is at the INITIAL STAGE of MIS growth.
Certainly this is not a problem, as any firm has to start somewhere."

```
DISPLAY"
```

1. You should go through the printed version of this consultation and focus your attention to those areas where you did not score. They are the potential areas for improving your MIS !!!
2. Go through the Case Studies which come after this consultation (or [M] of your MAIN MENU). Again, they will give light to new ideas of improvement.
3. Follow the Plan-Do-Action-Check cycle to improve your MIS.
4. Look into the ES-DSS (or [E] of your MAIN MENU). Try to gain some understanding and experience of a typical Decision Support Systems which you could consider when improving your MIS.

Press any key to continue~"

```
;
```

```
RULE 14
IF SCORET >= 13 AND SCORET <= 21
THEN RECOMMEND = VALUE
DISPLAY"
```

*** SUGGESTIONS ***

Your Total Score is within the MID-RANGE of the population.
This indicates that your firm is at the DEVELOPING STAGE of MIS growth.
This is a fast growing stage and there are ample areas for development.
Thus, you should make use of the opportunity for further improvement."

DISPLAY"

1. You should go through the printed version of this consultation and focus your attention to those areas where you did not score. They are the potential areas for improving your MIS !!!
2. Go through the Case Studies which come after this consultation (or [M] of your MAIN MENU). Again, they will give light to new ideas of improvement.
3. Follow the Plan-Do-Action-Check cycle to improve your MIS.
4. Look into the ES-DSS (or [E] of your MAIN MENU). Try to gain some understanding and experience of a typical Decision Support Systems which can be useful for your firm.

Press any key to continue~"

;

RULE 15

IF SCORET > 21
THEN RECOMMEND = VALUE
DISPLAY"

*** SUGGESTIONS ***

Your Total Score is within the UPPER QUARTILE of the population.
This indicates that your firm is at the MATURE stage of MIS growth.
This is a stage demanding integration of MIS and move onto DSS.
Thus, you still need to consider for further improvement."

DISPLAY"

1. You should go through the printed version of this consultation and focus your attention to those areas where you did not score. They are the potential areas for improving your MIS !!!
2. Go through the Case Studies which come after this consultation (or [M] of your MAIN MENU). Again, they will give light to new ideas of improvement.
3. Follow the Plan-Do-Action-Check cycle to improve your MIS.
4. Look into the ES-DSS (or [E] of your MAIN MENU). Try to gain some understanding and experience of a typical Decision Support Systems which will be useful for your firm for the next stage of development.

Press any key to continue~"

;

ASK Q5A: "What is your 1st APPLICATION ?";
ASK Q5B: "What is your 2nd APPLICATION ?";
ASK Q5C: "What is your 3rd APPLICATION ?";
ASK Q5D: "What is your 4th APPLICATION ?";
ASK Q5E: "What is your 5th APPLICATION ?";
ASK Q5F: "What is your last APPLICATION ?";

ASK Q6A:
"What is the CHOICE OF HIGH LEVEL LANGUAGE FOR YOUR OWN PROGRAM DEVELOPMENT ?";
CHOICES Q6A: COBOL,RPG,BASIC,PASCAL,FORTRAN,NIL;
ASK Q6B:
"What is the CHOICE OF HIGH LEVEL LANGUAGE BY YOUR SOFTWARE CONSULTANT ?";
CHOICES Q6B: COBOL,RPG,BASIC,PASCAL,FORTRAN,NIL;

ASK Q6C: "What is your 1st DEVELOPMENT PACKAGE used ?";
ASK Q6D: "What is your 2nd DEVELOPMENT PACKAGE used ?";
ASK Q6E: "What is your 3rd DEVELOPMENT PACKAGE used ?";
ASK Q6F: "What is your last DEVELOPMENT PACKAGE used ?";

ASK Q9A: "What is your 1st ACHIEVEMENT ?";
ASK Q9B: "What is your 2nd ACHIEVEMENT ?";
ASK Q9C: "What is your 3rd ACHIEVEMENT ?";
ASK Q9D: "What is your last ACHIEVEMENT ?";

ASK WORTH:
"Do you think that computerisation in your firm is worthwhile (i.e. benefit > cost) ?";
CHOICES WORTH:YES,NO;

ASK EMPNO:"What is the number of employees in your firm ?
NOTE: You cannot use this consultation if your firm has over 300 people.";

ASK YEAR:"For how many years has your firm been using computers ?";

ASK PROSA:"What is the number of (programmers + system analysts) ?";

ASK ENDUSER:"How many End-Users are using the system ?";

ASK PC:"How many Personal Computers are there in your firm ?";

ASK NETWORK:"Is networking being used ?";
CHOICES NETWORK:YES,PLANNED,NO;

ASK HARD:"What is the total Hardware Investment in Pound Sterling so far ?";

ASK SOFT:"What is the total Software Investment in Pound Sterling so far ?";

APP.8: VP-EXPERT LISTING OF CASE STUDIES FOR MANUFACTURING
(ES-CASE, [M1] for Garment, Textile & Footwear)

```
BKCOLOR = 3;
RUNTIME;
ACTIONS
RESET ALL
MOUSEOFF
```

```
COLOR = 4
```

```
DISPLAY"
```

```
  M1: Case Studies for the GARMENT, TEXTILE, or FOOTWEAR INDUSTRY
```

```
=====
```

```
Up to a maximum of 9 case studies from:-
```

	HK	JAPAN	KOREA	S'PORE	TAIWAN	UK
CASE EXPERIENCE:		1	1			
SOFTWARE HOUSES:	1		1	3	1	1"

```
LOOP1=ON
  WHILEKNOWN THEN
```

```
    COLOR = 14
```

```
  DISPLAY"
```

```
  IMPORTANT: If you want Printout, you must check that your Printer
  ***** is connected to the computer and switched on.
  "
```

```
    COLOR = 0
```

```
    FIND PRINT
    FIND TYPE
    FIND COUNTRY
    FIND MDISPLAY
```

```
  LOOP1=OFF
  END;
```

```
PLURAL: TYPE,COUNTRY,MDISPLAY;
```

```
RULE 1
IF TYPE=CASE AND COUNTRY=HONGKONG THEN
  MDISPLAY=OK
```

```
COLOR = 4
```

```
DISPLAY"
```

```
  * Sorry, there is no CASE from HONGKONG !
  Press ENTER to continue.....~"
```

```
COLOR = 0
```

```
;
```

```
RULE 2
IF TYPE = CASE AND COUNTRY = JAPAN AND PRINT = YES THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE CJ8,LINE
    DISPLAY "{LINE}"
    PDISPLAY " {LINE}"
  END
DISPLAY
"                               Press ENTER to continue .....~";

RULE 2A
IF TYPE = CASE AND COUNTRY = JAPAN AND PRINT = NO THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE CJ8,LINE
    DISPLAY "{LINE}"
  END
DISPLAY
"                               Press ENTER to continue .....~";

RULE 3
IF TYPE = CASE AND COUNTRY = KOREA AND PRINT = YES THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE CK4,LINE
    DISPLAY "{LINE}"
    PDISPLAY " {LINE}"
  END
DISPLAY
"                               Press ENTER to continue .....~";

RULE 3A
IF TYPE = CASE AND COUNTRY = KOREA AND PRINT = NO THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE CK4,LINE
    DISPLAY "{LINE}"
  END
DISPLAY
"                               Press ENTER to continue .....~";

RULE 4
IF TYPE=CASE AND COUNTRY=SINGAPORE THEN
  MDISPLAY=OK
  COLOR = 4
  DISPLAY"
    * Sorry, there is no CASE from SINGAPORE !
    Press ENTER to continue.....~"
  COLOR = 0
;
```

```
RULE 5
IF TYPE=CASE AND COUNTRY=TAIWAN THEN
  MDISPLAY=OK
  COLOR = 4
  DISPLAY"
    * Sorry, there is no CASE from TAIWAN !
                                     Press ENTER to continue.....~"
  COLOR = 0
  ;
```

```
RULE 6
IF TYPE=CASE AND COUNTRY=UK THEN
  MDISPLAY=OK
  COLOR = 4
  DISPLAY"
    * Sorry, there is no CASE from UK !
                                     Press ENTER to continue.....~"
  COLOR = 0
  ;
```

```
RULE 7
IF TYPE=SOFTHOUSE AND COUNTRY=HONGKONG AND PRINT=YES THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE SH2,LINE
    DISPLAY "(LINE)"
    PDISPLAY " (LINE)"
  END
  DISPLAY
"                                     Press ENTER to continue .....~";
```

```
RULE 7A
IF TYPE=SOFTHOUSE AND COUNTRY=HONGKONG AND PRINT=NO THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE SH2,LINE
    DISPLAY "(LINE)"
  END
  DISPLAY
"                                     Press ENTER to continue .....~";
```

```
RULE 8
IF TYPE=SOFTHOUSE AND COUNTRY=JAPAN THEN
  MDISPLAY=OK
  COLOR = 4
  DISPLAY"
    * Sorry, there is no SOFTHOUSE Case from JAPAN !
                                     Press ENTER to continue.....~"
  COLOR = 0
  ;
```

```
RULE 9
IF TYPE=SOFTHOUSE AND COUNTRY=KOREA AND PRINT=YES THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE SK3,LINE
    DISPLAY "{LINE}"
    PDISPLAY " (LINE)"
  END
DISPLAY
"                                     Press ENTER to continue .....~";
```

```
RULE 9A
IF TYPE=SOFTHOUSE AND COUNTRY=KOREA AND PRINT=NO THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE SK3,LINE
    DISPLAY "{LINE}"
  END
DISPLAY
"                                     Press ENTER to continue .....~";
```

```
RULE 10
IF TYPE=SOFTHOUSE AND COUNTRY=SINGAPORE AND PRINT=YES THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE SS5,LINE
    DISPLAY "{LINE}"
    PDISPLAY " (LINE)"
  END
DISPLAY
"                                     Press ENTER to continue .....~";
```

```
RULE 10A
IF TYPE=SOFTHOUSE AND COUNTRY=SINGAPORE AND PRINT=NO THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE SS5,LINE
    DISPLAY "{LINE}"
  END
DISPLAY
"                                     Press ENTER to continue .....~";
```

```
RULE 11
IF TYPE=SOFTHOUSE AND COUNTRY=SINGAPORE AND PRINT=YES THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE SS6,LINE
    DISPLAY "{LINE}"
```

```
        PDISPLAY " (LINE)"
    END
DISPLAY
"                                     Press ENTER to continue .....~";
```

```
RULE 11A
IF TYPE=SOFTHOUSE AND COUNTRY=SINGAPORE AND PRINT=NO THEN
    MDISPLAY = OK
    CLS
    WHILEKNOWN LINE
        RECEIVE SS6,LINE
        DISPLAY "(LINE)"
    END
DISPLAY
"                                     Press ENTER to continue .....~";
```

```
RULE 12
IF TYPE=SOFTHOUSE AND COUNTRY=SINGAPORE AND PRINT=YES THEN
    MDISPLAY = OK
    CLS
    WHILEKNOWN LINE
        RECEIVE SS7,LINE
        DISPLAY "{LINE}"
        PDISPLAY " (LINE)"
    END
DISPLAY
"                                     Press ENTER to continue .....~";
```

```
RULE 12A
IF TYPE=SOFTHOUSE AND COUNTRY=SINGAPORE AND PRINT=NO THEN
    MDISPLAY = OK
    CLS
    WHILEKNOWN LINE
        RECEIVE SS7,LINE
        DISPLAY "(LINE)"
    END
DISPLAY
"                                     Press ENTER to continue .....~";
```

```
RULE 13
IF TYPE=SOFTHOUSE AND COUNTRY=TAIWAN AND PRINT=YES THEN
    MDISPLAY = OK
    CLS
    WHILEKNOWN LINE
        RECEIVE ST4,LINE
        DISPLAY "{LINE}"
        PDISPLAY " (LINE)"
    END
DISPLAY
"                                     Press ENTER to continue .....~";
```

```
RULE 13A
IF TYPE=SOFTHOUSE AND COUNTRY=TAIWAN AND PRINT=NO THEN
    MDISPLAY = OK
```

```
CLS
WHILEKNOWN LINE
  RECEIVE ST4,LINE
  DISPLAY "(LINE)"
END
DISPLAY
"                               Press ENTER to continue .....~";
```

```
RULE 14
IF TYPE=SOFTHOUSE AND COUNTRY=UK AND PRINT=YES THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE SU2,LINE
    DISPLAY "{LINE}"
    PDISPLAY " (LINE)"
  END
DISPLAY
"                               Press ENTER to continue .....~";
```

```
RULE 14A
IF TYPE=SCFHOUSE AND COUNTRY=UK AND PRINT=NO THEN
  MDISPLAY = OK
  CLS
  WHILEKNOWN LINE
    RECEIVE SU2,LINE
    DISPLAY "(LINE)"
  END
DISPLAY
"                               Press ENTER to continue .....~";
```

->

```
ASK TYPE:
"Do you want to look at CASE STUDIES or experience of SOFTWARE HOUSES
?";
CHOICES TYPE:CASE,SOFTHOUSE;
```

```
ASK COUNTRY:
"Which COUNTRY do you want your search to come from?";
CHOICES COUNTRY: HONGKONG,JAPAN,KOREA,SINGAPORE,TAIWAN,UK;
```

```
ASK PRINT:"Do you want to PRINT as well?";
CHOICES PRINT:YES,NO;
```

APP.9: VP-EXPERT LISTING OF D.S.S. FOR STRATPLAN
EXCEPT LAST 2 ROUNDS (ES-DSS, [E1])

RUNTIME;
 ACTIONS
 RESET ALL

DISPLAY"

```
*****
*
*          EXPERT SYSTEM FOR DECISION PARAMETERS          *
*                of                                        *
*                BUSINESS GAME                            *
*                'STRATPLAN'                              *
*
*                by                                        *
*
*                Samuel K.M. HO                           *
*                MSc, MIEE, MBCS, MMS                     *
*
*****
```

Press any key to continue~"

CLS
 DISPLAY"

**** INSTRUCTIONS ****

1. It is important that you should do this consultation seriously, Dummy run is not recommended. This is because it will affect your actual decisions. Therefore, you should set aside 10 minutes for this consultation and think carefully before you answer any question.
2. It would be more adviseable to use the version of this consultation which outputs simultaneously to the printer (Option E2 of Menu).
3. When you are advised to make a choice between two suggestions, usually there is HINT given for you to decide. However, you can have your own judgement within suggested limits basing on the analysis of last year's results.

Press any key to continue~"

CLS
 WHILEKNOWN GO
 DISPLAY"

Capturing Last Year's Data from your Worksheet FIRM1.WK1

Please WAIT for about 1 minute until you see further Display "

WKS A,AJ4..AJ137,C:\LOTUS\DATAH\FIRM1

DISPLAY "

*** LAST YEAR'S DECISIONS ***

Dividends (000) = {A[1]}
 Stock Trade (000) = {A[2]}
 Sales Branch = {A[3]}
 Sales Force = {A[4]}
 Notes Payable (000) = {A[5]}

	PRODUCT 1	PRODUCT 2
	-----	-----
Price	{A[7]}	{A[16]}
Production (000)	{A[8]}	{A[17]}
Plant Capacity (000)	{A[10]}	{A[19]}
Technological Investment (000)	{A[11]}	{A[20]}
R&D Quality Investment (000)	{A[12]}	{A[21]}
R&D Cost Investment (000)	{A[13]}	{A[22]}
Advertising (000)	{A[14]}	{A[23]}
Salesmen Commission	{A[15]}	{A[24]}

2/.....~"

DISPLAY

"

*** BALANCE SHEET ***

	TOTAL	PRODUCT 1	PRODUCT 2
	-----	-----	-----
ASSETS			
=====			
Cash (000)	{A[25]}		
Accounts Receivable(000)		{A[26]}	{A[27]}
Inventory (000)		{A[28]}	{A[29]}
Plant Value (000)		{A[30]}	{A[31]}
Total Assets (000)	{A[32]}		

LIABILITIES & EQUITIES

=====

LIAB: Notes Payable	{A[33]}	{000}	
Emergency Loan	{A[34]}	{000}	
EQUI: Capital Invested	{A[35]}	{000}	
Retained Earnings	{A[36]}	{000}	
Total Liab. & Equity	{A[37]}	{000}	

3/.....~"

DISPLAY

"

*** INCOME STATEMENT ***

	TOTAL	PRODUCT 1	PRODUCT 2
	-----	-----	-----
REVENUE			
=====			
Sales Income (000)		{A[38]}	{A[39]}
Cost of Goods (000)		{A[40]}	{A[41]}
Gross Profit (000)	{A[42]}		

4/.....~"

DISPLAY

"

EXPENSES

=====

Administration (000)	{A[43]}		
Inventory Carrying (000)		{A[44]}	{A[45]}
Advertising (000)		{A[46]}	{A[47]}
R&D Quality (000)		{A[48]}	{A[49]}
R&D Cost (000)		{A[50]}	{A[51]}
Depreciation		{A[52]}	{A[53]}
Sales Force Salary (000)	{A[54]}		
Sales Force Commission		{A[55]}	{A[56]}
Branch Operation: Base	{A[57]}	{000}	
Branch Operation: (000)		{A[58]}	{A[59]}
Total Expenses (000)	{A[63]}		
EBIT (000)	{A[64]}		
Interest (000)	{A[65]}		
Taxes Due (000)	{A[66]}		
Net Profit (000)	{A[67]}		

5/.....~"

DISPLAY

"

*** OPERATIONS ***

	TOTAL	PRODUCT 1	PRODUCT 2
	-----	-----	-----
Market Index		{A[69]}	{A[70]}
Sales Quantities		{A[76]}	{A[82]}
Market Share (%)		{A[78]}	{A[84]}
Unit Cost		{A[79]}	{A[85]}
Capacity Price		{A[80]}	{A[86]}
Capacity Selling Price		{A[81]}	{A[87]}
Interest Rate on Debt	{A[88]}		
Debt/Assets Ratio	{A[89]}		
Debt/Equity Ratio	{A[90]}		
Inventory Turnover	{A[91]}	{A[92]}	{A[93]}
Gross Profit Margin	{A[94]}	{A[95]}	{A[96]}
Net Operating Margin	{A[97]}	{A[98]}	{A[99]}

DISPLAY

"

Profit Margin on Sales	{A[100]}
Return on Assets	{A[101]}
Return on Investment	{A[102]}

Press any Key to continue~" ..

DISPLAY

"

*** INDUSTRIAL AVERAGES ***

	OVERALL	PRODUCT 1	PRODUCT 2
	-----	-----	-----
Year	{A[103]}		
Team No.	{A[104]}		

No. of Teams	(A[105])		
Average Price		{A[106]}	{A[107]}
Average Advertising (000)		{A[108]}	{A[109]}
Advertising Weight		{A[110]}	{A[111]}
Average R&D Quality (000)		{A[112]}	{A[113]}
R&D Quality Weight		{A[114]}	{A[115]}
Average No. of Branch	(A[116])		
Branch Weight		{A[117]}	{A[118]}
Average Salesmen	(A[119])		
Salesmen Weight		{A[120]}	{A[121]}
Average Commission		{A[122]}	{A[123]}

DISPLAY

" Press any key to continue~"

D[1] = (A[106]*0.95)

DISPLAY"

D[1] Estimate of New Industrial Price = {D[1]}"

D[2] = (A[108]*1.1)

DISPLAY"

D[2] Estimate of New Industrial Advertising = {D[2]} (000)"

D[3] = (A[112]*1.1)

DISPLAY"

D[3] Estimate of New Industrial R&D Quality = {D[3]} (000)"

D[4] = (A[116])

DISPLAY"

D[4] Estimate of New Industrial No. of Branches = {D[4]}"

D[5] = (A[119])

DISPLAY"

D[5] Estimate of New Industrial No. of Salesmen = {D[5]}"

D[6] = (A[122]+0.001)

DISPLAY"

~ D[6] Estimate of New Industrial Commission Rate = {D[6]}

=====

"

DISPLAY

" Your Last Year's PRICE for HOOVER = {A[7]}"

FIND B7

FIND C7

D[7] = (A[7]*(1+C7/100))

DISPLAY"

D[7] Your Decision of NEW PRICE for HOOVER = {D[7]}

=====

"

DISPLAY

" Your Last Year's UNIT COST for HOOVER = {A[79]}"

E8 = (A[13]/A[38])

FIND B8

FIND C8

D[8] = (A[79]*(1+C8/100))

DISPLAY

" D[8] Your Decision of NEW UNIT COST for HOOVER = {D[8]}

=====

DISPLAY

" Your Last Year's ADVERTISING for HOOVER = {A[14]} (000)
 The ADVERTISING WEIGHT for HOOVER = {A[110]}
 HINT: If this is < 0.5, you should ALWAYS choose the LOWER value
 of the following RECOMMENDED Advertising."

FIND B9

FIND C9

D[9] = (A[46]*(1+C9/100))

DISPLAY

" D[9] Your Decision of NEW ADVERTISING for HOOVER = {D[9]} (000)

=====

DISPLAY

" Your Last Year's R&D QUALITY for HOOVER = {A[12]} (000)
 The R&D QUALITY WEIGHT for HOOVER = {A[114]}

HINT: If this is < 0.5, you should ALWAYS choose the LOWER value
 of the following RECOMMENDED R&D Quality."

FIND B10

FIND C10

D[10] = (A[12]*(1+C10/100))

DISPLAY

" D[10] Your Decision of NEW R&D COST for HOOVER = {D[10]} (000)

=====

DISPLAY

" Your Last Year's BRANCHES NO. for HOOVER = {A[3]}
 The BRANCH WEIGHT for HOOVER = {A[117]}

HINT: If this is < 0.4, you should ALWAYS choose the LOWER value
 of the following RECOMMENDED BRANCH NO."

FIND B11

FIND C11

D[11] = (A[3]+C11)

DISPLAY

" D[11] Your Decision of NEW BRANCH NO. for HOOVER = {D[11]}

=====

DISPLAY

" Your Last Year's SALESMEN NO. for HOOVER = {A[4]}
 The SALESMEN WEIGHT for HOOVER = {A[120]}

HINT: If this is < 0.5, you should ALWAYS choose the LOWER value
 of the following RECOMMENDED SALESMEN NO."

FIND B12

FIND C12

```

D[12] = (A[4]+C12)
DISPLAY
"   D[12] Your Decision of NEW SALESMEN NO. for HOOVER = {D[12]}

=====
"

DISPLAY
"   Your Last Year's COMMISSION for HOOVER = {A[15]}"
FIND B13
FIND C13
D[13] = (A[15]*(1+C13/100))
DISPLAY
"   D[13] Your Decision of NEW COMMISSION for HOOVER = {D[13]}

=====
"

D[14] = (A[107]*0.95)
DISPLAY"
   D[14] Estimate of New Industrial Price = {D[14]}"
D[15] = (A[109]*1.1)
DISPLAY"
   D[15] Estimate of New Industrial Advertising = {D[15]} (000)"
D[16] = (A[113]*1.1)
DISPLAY"
   D[16] Estimate of New Industrial R&D Quality = {D[16]} (000)"
D[17] = (A[116])
DISPLAY"
   D[17] Estimate of New Industrial No. of Branches = {D[17]}"
D[18] = (A[119])
DISPLAY"
   D[18] Estimate of New Industrial No. of Salesmen = {D[18]}"
D[19] = (A[123]+0.001)
DISPLAY"
   D[19] Estimate of New Industrial Commission Rate = {D[19]}

=====
"

DISPLAY
"   Your Last Year's PRICE for PUMP = {A[16]}"
FIND B20
FIND C20
D[20] = (A[16]*(1+C20/100))
DISPLAY
"   D[20] Your Decision of NEW PRICE for PUMP = {D[20]}

=====
"

DISPLAY
"   Your Last Year's UNIT COST for PUMP = {A[85]}"
E21 = (A[22]/A[39])
FIND B21
FIND C21

```

D[21] = (A[85]*(1+C21/100))

DISPLAY

" D[21] Your Decision of NEW UNIT COST for PUMP = {D[21]}

=====

"

DISPLAY

" Your Last Year's ADVERTISING for PUMP = {A[23]} (000)

The ADVERTISING WEIGHT for PUMP = {A[111]}

HINT: If this is < 0.5, you should ALWAYS choose the LOWER value
of the following RECOMMENDED Advertising."

FIND B22

FIND C22

D[22] = (A[47]*(1+C22/100))

DISPLAY

" D[22] Your Decision of NEW ADVERTISING for PUMP = {D[22]} (000)

=====

"

DISPLAY

" Your Last Year's R&D QUALITY for PUMP = {A[21]} (000)

The R&D QUALITY WEIGHT for PUMP = {A[115]}

HINT: If this is < 0.5, you should ALWAYS choose the LOWER value
of the following RECOMMENDED R&D Quality."

FIND B23

FIND C23

D[23] = (A[21]*(1+C23/100))

DISPLAY

" D[23] Your Decision of NEW R&D COST for PUMP = {D[123]} (000)

=====

"

DISPLAY

" Your Last Year's BRANCHES NO. for PUMP = {A[3]}

The BRANCH WEIGHT for PUMP = {A[118]}

HINT: If this is < 0.4, you should ALWAYS choose the LOWER value
of the following RECOMMENDED BRANCH NO."

FIND B24

FIND C24

D[24] = (A[3]+C24)

DISPLAY

" D[24] Your Decision of NEW BRANCH NO. for PUMP = {D[24]}

=====

"

DISPLAY

" Your Last Year's SALESMEN NO. for PUMP = {A[4]}

The SALESMEN WEIGHT for PUMP = {A[121]}

HINT: If this is < 0.5, you should ALWAYS choose the LOWER value
of the following RECOMMENDED SALESMEN NO."

```

FIND B25
FIND C25
D[25] = (A[4]+C25)
DISPLAY
"   D[25] Your Decision of NEW SALESMEN NO. for PUMP = {D[25]}

```

```

=====
"

```

```

DISPLAY
"   Your Last Year's COMMISSION for PUMP = {A[24]}"
FIND B26
FIND C26
D[26] = (A[24]*(1+C26/100))
DISPLAY
"   D[26] Your Decision of NEW COMMISSION for PUMP = {D[26]}

```

```

=====
"

```

```

DISPLAY
"   Your Last Year's CAPACITY for HOOVER = {A[10]}"
FIND B27
FIND C27
D[27] = (A[10]*(1+C27/100))
DISPLAY
"   D[27] Your Decision of NEW CAPACITY for HOOVER = {D[27]} (000)

```

```

=====
"

```

```

F[28] = (A[28]/A[7])
DISPLAY
"   Your Last Year's PRODUCTION for HOOVER = {A[8]}
   Your Last Year's EXCESS INVENTORY for HOOVER = {F[28]}"
FIND B28
FIND C28
D[28] = (A[8]*(1+C28/100)-A[28])
DISPLAY
"   D[28] Your Decision of NEW PRODUCTION UNITS for HOOVER = {D[28]}
(000)

```

```

=====
"

```

```

DISPLAY
"   Your Last Year's CAPACITY for PUMP = {A[19]}"
FIND B29
FIND C29
D[29] = (A[19]*(1+C29/100))
DISPLAY
"   D[29] Your Decision of NEW CAPACITY for PUMP = {D[29]} (000)

```

=====

F[29] = (A[29]/A[16])

DISPLAY

" Your Last Year's PRODUCTION for PUMP = {A[17]}
Your Last Year's EXCESS INVENTORY for PUMP = {F[29]}"

FIND B30

FIND C30

D[30] = (A[17]*(1+C30/100)-A[29])

DISPLAY

" D[30] Your Decision of NEW PRODUCTION UNITS for PUMP = {D[30]} (000)

=====

DISPLAY

" Your Last Year's TECH. INVESTMENT for HOOVER = {A[11]}
Your Last Year's DEBT/ASSET RATIO = {A[89]}

HINT: If this is > 0.5, you should ALWAYS choose the LOWER value
of the following RECOMMENDED TECH. INVESTMENT."

FIND B31

FIND C31

D[31] = (A[37]*C31/100)

DISPLAY

" D[31] Your Decision of TECH. INVESTMENT for HOOVER = {D[31]} (000)

=====

DISPLAY

" Your Last Year's TECH. INVESTMENT for PUMP = {A[20]}
Your Last Year's DEBT/ASSET RATIO = {A[89]}

HINT: If this is > 0.5, you should ALWAYS choose the LOWER value
of the following RECOMMENDED TECH. INVESTMENT."

FIND B32

FIND C32

D[32] = (A[38]*C32/100)

DISPLAY

" D[32] Your Decision of TECH. INVESTMENT for PUMP = {D[32]} (000)

=====

DISPLAY

" Your Last Year's STOCK TRADED = {A[2]}
Your Last Year's DEBT/ASSET RATIO = {A[89]}

HINT: If this is = or < 0.5, you should ALWAYS choose the 2nd Choice
of the following RECOMMENDED STOCK TRADE."

```

FIND B33
FIND C33
D[33] = ((A[35]+A[36])*C33/100)
DISPLAY
"   D[33] Your Decision of STOCK TRADE for Firm = {D[33]} (000)

```

```

=====
"
```

```

DISPLAY
"   Your Last Year's DIVIDENDS = {A[1]}
    Your Last Year's DEBT/ASSET RATIO = {A[89]}

    HINT: If this is > 0.5, you should ALWAYS choose the LOWER value
          of the following RECOMMENDED DIVIDENDS."

```

```

FIND B34
FIND C34
D[34] = (A[67]*C34/100)
DISPLAY
"   D[34] Your Decision of DIVIDENDS for Firm = {D[34]} (000)

```

```

=====
"
```

```

DISPLAY
"   Your Last Year's R&D COST for HOOVER = {A[13]}
    Your Last Year's DEBT/ASSET RATIO = {A[89]}

    HINT: If this is > 0.5, you should ALWAYS choose the LOWER value
          of the following RECOMMENDED R&D COST."

```

```

FIND B35
FIND C35
D[35] = (A[38]*C35/100)
DISPLAY
"   D[35] Your Decision of R&D COST for HOOVER = {D[35]} (000)

```

```

=====
"
```

```

DISPLAY
"   Your Last Year's R&D COST for PUMP = {A[22]}
    Your Last Year's DEBT/ASSET RATIO = {A[89]}

    HINT: If this is > 0.5, you should ALWAYS choose the LOWER value
          of the following RECOMMENDED R&D COST."

```

```

FIND B36
FIND C36
D[36] = (A[39]*C36/100)
DISPLAY
"   D[36] Your Decision of R&D COST for PUMP = {D[36]} (000)

```

```

=====
"
```

DISPLAY

" Your Last Year's Outstanding Loan = {A[33]}

HINT: If you decided to Sell Stock at 1st/2nd round, ask NO Loan.
However, you should raise 500,000 at 3rd round for investment."

FIND B37

FIND C37

D[37] = (C37)

DISPLAY

" D[37] Your Decision of Additional Loan = {D[37]} (000)

=====

DISPLAY"

Writing Results back to FIRM1.WK1

Please WAIT for about 1 minute until you see further Display !!"

PWKS D,AJ141..AJ177,C:\LOTUS\DATAH\FIRM1

DISPLAY"

END OF EXPORT TO FIRM1.WK1 !!"

FIND GO

END

DISPLAY"

*** THANK YOU FOR USING THIS CONSULTANCY SERVICE ***
*** THE AUTHOR HOPES THAT IT IS OF VALUE TO YOU! ***"

;

RULE 7

IF A[7] < (A[106])

THEN B7 = VALUE

DISPLAY"

LAST YEAR: Your firm had LOWER PRICE than the average firm.

RECOMMEND: Make no change."

ELSE B7 = VALUE

DISPLAY"

LAST YEAR: Your firm had HIGHER PRICE than the average firm.

RECOMMEND: Reduce figure by 5% if at 1st/2nd round ELSE no change."

;

RULE 8

IF E8 <= 0.05

THEN B8 = VALUE

DISPLAY"

LAST YEAR: Your firm had R&D COST less than 5% of your turnover.

RECOMMEND: Reduce UNIT COST by 5% if at 1st/2nd round ELSE by 10%."

ELSE B8 = VALUE

DISPLAY"

LAST YEAR: Your firm had R&D COST more than 5% of your turnover.
RECOMMEND: Reduce UNIT COST by 10% if at 1st/2nd round ELSE by 15%."

;

RULE 9

IF A[14] <= (A[108])

THEN B9 = VALUE

DISPLAY"

LAST YEAR: Your firm had LOWER ADVERTISING than the average firm.
RECOMMEND: Increase figure by 30% if at 1st/2nd round ELSE by 20%."

ELSE B9 = VALUE

DISPLAY"

LAST YEAR: Your firm had HIGHER ADVERTISING than the average firm.
RECOMMEND: Increase by 20% if at 1st/2nd round ELSE by 10%."

;

RULE 10

IF A[12] < (A[112])

THEN B10 = VALUE

DISPLAY"

LAST YEAR: Your firm had LOWER R&D QUALITY than the average firm.
RECOMMEND: Increase figure by 20% if at 1st/2nd round ELSE by 10%."

ELSE B10 = VALUE

DISPLAY"

LAST YEAR: Your firm had HIGHER R&D QUALITY than the average firm.
RECOMMEND: Increase by 10% if at 1st/2nd round ELSE No change."

;

RULE 11

IF A[3] <= (A[116])

THEN B11 = VALUE

DISPLAY"

LAST YEAR: Your firm had LESS BRANCHES than the average firm.
RECOMMEND: Increase figure by 1 if at 1st/2nd round ELSE No change."

ELSE B11 = VALUE

DISPLAY"

LAST YEAR: Your firm had MORE BRANCHES than the average firm.
RECOMMEND: Make no change."

;

RULE 12

IF A[4] <= (A[119])

THEN B12 = VALUE

DISPLAY"

LAST YEAR: Your firm had LESS SALESMEN than the average firm.
RECOMMEND: Increase figure by 3 if at 1st/2nd round ELSE by 2."

ELSE B12 = VALUE

DISPLAY"

LAST YEAR: Your firm had MORE SALESMEN than the average firm.
RECOMMEND: Increase figure by 2 if at 1st/2nd round ELSE by 1."

;

RULE 13

IF A[15] <= (A[122])

THEN B13 = VALUE

DISPLAY"

```

    LAST YEAR: Your firm had LOWER COMMISSION than the average firm.
    RECOMMEND: Increase figure by 20% if at 1st/2nd round ELSE by 10%."
ELSE B13 = VALUE
DISPLAY"
    LAST YEAR: Your firm had HIGHER COMMISSION than the average firm.
    RECOMMEND: Increase figure by 10% if at 1st/2nd round ELSE No change"
;

RULE 20
IF A[16] < (A[107])
THEN B20 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LOWER PRICE than the average firm.
    RECOMMEND: Make no change."
ELSE B20 = VALUE
DISPLAY"
    LAST YEAR: Your firm had HIGHER PRICE than the average firm.
    RECOMMEND: Reduce figure by 5% if at 1st/2nd round ELSE no change."
;

RULE 21
IF E21 <= 0.05
THEN B21 = VALUE
DISPLAY"
    LAST YEAR: Your firm had R&D COST less than 5% of your turnover.
    RECOMMEND: Reduce UNIT COST by 5% if at 1st/2nd round ELSE by 10%."
ELSE B21 = VALUE
DISPLAY"
    LAST YEAR: Your firm had R&D COST more than 5% of your turnover.
    RECOMMEND: Reduce UNIT COST by 10% if at 1st/2nd round ELSE by 15%."
;

RULE 22
IF A[23] <= (A[109])
THEN B22 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LOWER ADVERTISING than the average firm.
    RECOMMEND: Increase figure by 30% if at 1st/2nd round ELSE by 20%."
ELSE B22 = VALUE
DISPLAY"
    LAST YEAR: Your firm had HIGHER ADVERTISING than the average firm.
    RECOMMEND: Increase by 20% if at 1st/2nd round ELSE by 10%."
;

RULE 23
IF A[21] < (A[113])
THEN B23 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LOWER R&D QUALITY than the average firm.
    RECOMMEND: Increase figure by 20% if at 1st/2nd round ELSE by 10%."
ELSE B23 = VALUE
DISPLAY"
    LAST YEAR: Your firm had HIGHER R&D QUALITY than the average firm.
    RECOMMEND: Increase by 10% if at 1st/2nd round ELSE No change."
;

RULE 24
```

```

IF  A[3] <= (A[116])
THEN B24 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LESS BRANCHES than the average firm.
    RECOMMEND: Increase figure by 1 if at 1st/2nd round ELSE No
change."
ELSE B24 = VALUE
DISPLAY"
    LAST YEAR: Your firm had MORE BRANCHES than the average firm.
    RECOMMEND: Make no change."
;

RULE 25
IF  A[4] <= (A[119])
THEN B25 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LESS SALESMEN than the average firm.
    RECOMMEND: Increase figure by 3 if at 1st/2nd round ELSE by 2."
ELSE B25 = VALUE
DISPLAY"
    LAST YEAR: Your firm had MORE SALESMEN than the average firm.
    RECOMMEND: Increase by 2 if at 1st/2nd round ELSE by 1."
;

RULE 26
IF  A[24] <= (A[123])
THEN B26 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LOWER COMMISSION than the average firm.
    RECOMMEND: Increase figure by 20% if at 1st/2nd round ELSE by 10%."
ELSE B26 = VALUE
DISPLAY"
    LAST YEAR: Your firm had HIGHER COMMISSION than the average firm.
    RECOMMEND: Increase by 10% if at 1st/2nd round ELSE No change."
;

RULE 27
IF  A[10] <= (A[8]*0.8)
THEN B27 = VALUE
DISPLAY"
    LAST YEAR: Your firm had CAPACITY LESS than 80% of Production.
    RECOMMEND: Increase figure by 20% if at 1st/2nd round ELSE by 10%."
ELSE B27 = VALUE
DISPLAY"
    LAST YEAR: Your firm had CAPACITY MORE than 80% of Production.
    RECOMMEND: Increase by 10% if at 1st/2nd round ELSE No change."
;

RULE 28
IF  C7 <= (-5)
THEN B28 = VALUE
DISPLAY"
    THIS YEAR: Your firm decided to drop Price by more than 5%.
    RECOMMEND: Increase Production by 30% if 1st/2nd round ELSE by 20%.
    NOTE: Stock carried over from last year will then be deducted."
ELSE B28 = VALUE
DISPLAY"

```

```
THIS YEAR: Your firm decided to have little change in Price.
RECOMMEND: Increase Production by 20% if 1st/2nd round ELSE by 10%.
NOTE:      Stock carried over from last year will then be deducted."
;

RULE 29
IF  A[19] <= (A[17]*0.8)
THEN B29 = VALUE
DISPLAY"
    LAST YEAR: Your firm had CAPACITY LESS than 80% of Production.
    RECOMMEND: Increase by 20% if at 1st/2nd round ELSE by 10%."
ELSE B29 = VALUE
DISPLAY"
    LAST YEAR: Your firm had CAPACITY MORE than 80% of Production.
    RECOMMEND: Increase by 10% if at 1st/2nd round ELSE No change."
;

RULE 30
IF  C20 <= (-5)
THEN B30 = VALUE
DISPLAY"
    THIS YEAR: Your firm decided to drop Price by more than 5%.
    RECOMMEND: Increase Production by 30% if 1st/2nd round ELSE by 20%.
    NOTE:      Stock carried over from last year will then be deducted."
ELSE B30 = VALUE
DISPLAY"
    THIS YEAR: Your firm decided to have little change in Price.
    RECOMMEND: Increase Production by 20% if 1st/2nd round ELSE by 10%.
    NOTE:      Stock carried over from last year will then be deducted."
;

RULE 31
IF  A[102] <= (0.2)
THEN B31 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LESS than 20% R.O.I.
    RECOMMEND: Invest 8% of your last year's revenue."
ELSE B31 = VALUE
DISPLAY"
    LAST YEAR: Your firm had MORE than 20% R.O.I.
    RECOMMEND: Invest 6% of your last year's revenue."
;

RULE 32
IF  A[102] <= (0.2)
THEN B32 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LESS than 20% R.O.I.
    RECOMMEND: Invest 8% of last year's revenue."
ELSE B32 = VALUE
DISPLAY"
    LAST YEAR: Your firm had MORE than 20% R.O.I.
    RECOMMEND: Invest 6% of last year's revenue."
;

RULE 33
IF  A[103] = (1990)
```

```

THEN B33 = VALUE
DISPLAY"
This is the 1st round, you need to raise fund to finance your investments.
  RECOMMEND: Sell 10% (+10%) more of your existing shares."
ELSE B33 = VALUE
DISPLAY"
  This is not the 1st round, you should not do trading unnecessarily.
  RECOMMEND: No trading."
;

RULE 34
IF A[1] > (0)
THEN B34 = VALUE
DISPLAY"
  LAST YEAR: Your firm had PAID OUT Dividends.
  RECOMMEND: Pay 20% Profit as Dividends if at 1st/2nd round ELSE 30%."
ELSE B34 = VALUE
DISPLAY"
  LAST YEAR: Your firm had NOT PAID Dividends.
  RECOMMEND: Pay 10% Profit as Dividends if at 1st/2nd round ELSE 20%."
;

RULE 35
IF A[102] <= (0.2)
THEN B35 = VALUE
DISPLAY"
  LAST YEAR: Your firm had LESS than 20% R.O.I.
  RECOMMEND: Invest 4% of Last Year's Revenue if 1st/2nd round ELSE 3%"
ELSE B35 = VALUE
DISPLAY"
  LAST YEAR: Your firm had MORE than 20% R.O.I.
  RECOMMEND: Invest 3% of Last Year's Revenue if 1st/2nd round ELSE 2%"
;

RULE 36
IF A[102] <= (0.2)
THEN B36 = VALUE
DISPLAY"
  LAST YEAR: Your firm had LESS than 20% R.O.I.
  RECOMMEND: Invest 3% of Last Year's Revenue if 1st/2nd round ELSE 3%
ELSE B36 = VALUE
DISPLAY"
  LAST YEAR: Your firm had MORE than 20% R.O.I.
  RECOMMEND: Invest 3% of Last Year's Revenue if 1st/2nd round ELSE 2%"
;

RULE 37
IF A[103] > (1990)
THEN B37 = VALUE
DISPLAY"
  This is the 2nd/3rd Round. You need Loan to finance your investment.
  RECOMMEND: Raise 1000 (000) if 2nd round ELSE 500 (000) if 3rd
  round."
ELSE B37 = VALUE
DISPLAY"
  This is the 1st Round.
  You should not need any Loan unless you decided not to sell shares:

```

D[33]."
;

ASK C7:"

DECIDE: What is the CHANGE of your new PRICE from last year ?";

ASK C8:"

DECIDE: What is the CHANGE of your new UNIT COST from last year ?";

ASK C9:"

DECIDE: What is the CHANGE of your new ADVERTISING from last year ?";

ASK C10:"

DECIDE: What is the CHANGE of your new R&D QUALITY from last year ?";

ASK C11:"

DECIDE: What is the CHANGE of your new BRANCH NO. from last year ?";

ASK C12:"

DECIDE: What is the CHANGE of your new SALESMEN NO. from last year ?";

ASK C13:"

DECIDE: What is the CHANGE of your new COMMISSION from last year ?";

ASK C20:"

DECIDE: What is the CHANGE of your new PRICE from last year ?";

ASK C21:"

DECIDE: What is the CHANGE of your new UNIT COST from last year ?";

ASK C22:"

DECIDE: What is the CHANGE of your new ADVERTISING from last year ?";

ASK C23:"

DECIDE: What is the CHANGE of your new R&D QUALITY from last year ?";

ASK C24:"

DECIDE: What is the CHANGE of your new BRANCH NO. from last year ?";

ASK C25:"

DECIDE: What is the CHANGE of your new SALESMEN NO. from last year ?";

ASK C26:"

DECIDE: What is the CHANGE of your new COMMISSION from last year ?";

ASK C27:"

DECIDE: What is the CHANGE of your new CAPACITY from last year ?";

ASK C28:"

DECIDE: What is the CHANGE of your new PRODUCTION from last year ?";

ASK C29:"

DECIDE: What is the CHANGE of your new CAPACITY from last year ?";

ASK C30:"

DECIDE: What is the CHANGE of your new PRODUCTION from last year ?";

ASK C31:"

DECIDE: What is the CHANGE of your new TECH. INVESTMENT from last year?";

ASK C32:"

DECIDE: What is the CHANGE of your new TECH. INVESTMENT from last year?";

ASK C33:"

DECIDE: What is the CHANGE of your new STOCK TRADED ?";

ASK C34:"

DECIDE: What is the new DIVIDENDS as % of Last Year's Profit ?";

ASK C35:"

DECIDE: What is the new R&D COST as % of Last Year's Revenue ?";

ASK C36:"

DECIDE: What is the new R&D COST as % of Last Year's Revenue ?";

ASK C37:"

DECIDE: What is the LOAN (X1000) you want to borrow from Bank ?";

CHOICES C7,C20: 10%,5%,0,-5%,-10%;

CHOICES C8,C21: 0,-5%,-10%,-15%,-20%;

CHOICES C11,C24: 1,0,-1;

CHOICES C12,C25: 4,3,2,1,0;

CHOICES C13,C26,C27,C29: 20%,10%,0,-10%,-20%;

CHOICES C31,C32: 8%,6%,4%,2%,0;

CHOICES C9,C10,C22,C23,C28,C30,C34: 40%,30%,20%,10%,0;

CHOICES C35,C36: 4%,3%,2%,1%,0;

CHOICES C33:20%,10%,0;

CHOICES C37: 1500,1000,500,0;

APP.10: VP-EXPERT LISTING OF D.S.S. FOR STRATPLAN LAST 2 ROUND
(ES-DSS, [E3])

RUNTIME;
 ACTIONS
 RESET ALL
 DISPLAY

```
" *****
*
*          EXPERT SYSTEM FOR DECISION PARAMETERS          *
*                of                                       *
*                BUSINESS GAME                             *
*                'STRATPLAN'                               *
*          ==> LAST 2 ROUNDS ONLY <==                    *
*
*                by                                       *
*
*                Samuel K.M. HO                           *
*                MSc, MIEE, MBCS, MMS                       *
*
* *****
```

Press any key to continue~"

CLS
 DISPLAY" ' ,

***** INSTRUCTIONS *****

1. It is important that you should do this consultation seriously, Dummy run is not recommended. This is because it will affect your actual decisions. Therefore, you should set aside 10 minutes for this consultation and think carefully before you answer any question.
2. It would be more advisable to use the version of this consultation which outputs simultaneously to the printer (Option E4 of Menu).
3. When you are advised to make a choice between two suggestions, usually there is HINT given for you to decide. However, you can have your own judgement within suggested limits basing on the analysis of last year's results.

Press any key to continue~"

CLS
 WHILEKNOWN GO
 DISPLAY"

Capturing Last Year's Data from your Worksheet FIRM1.WK1

Please WAIT for about 1 minute until you see further Display !!

WKS A,AJ4..AJ137,C:\LOTUS\DATAH\FIRM1

DISPLAY "

*** LAST YEAR'S DECISIONS ***

Dividends (000) = {A[1]}
 Stock Trade (000) = {A[2]}
 Sales Branch = {A[3]}
 Sales Force = {A[4]}
 Notes Payable (000) = {A[5]}

	PRODUCT 1	PRODUCT 2
Price	{A[7]}	{A[16]}
Production (000)	{A[8]}	{A[17]}
Plant Capacity (000)	{A[10]}	{A[19]}
Technological Investment (000)	{A[11]}	{A[20]}
R&D Quality Investment (000)	{A[12]}	{A[21]}
R&D Cost Investment (000)	{A[13]}	{A[22]}
Advertising (000)	{A[14]}	{A[23]}
Salesmen Commission	{A[15]}	{A[24]}

2/.....~"

DISPLAY

"

*** BALANCE SHEET ***

	TOTAL	PRODUCT 1	PRODUCT 2
ASSETS			
=====			
Cash (000)	{A[25]}		
Accounts Receivable(000)		{A[26]}	{A[27]}
Inventory (000)		{A[28]}	{A[29]}
Plant Value(000)		{A[30]}	{A[31]}
Total Assets (000)	{A[32]}		

LIABILITIES & EQUITIES

=====

LIAB: Notes Payable {A[33]} (000)
 Emergency Loan {A[34]} (000)

EQUI: Capital Invested {A[35]} (000)
 Retained Earnings {A[36]} (000)

Total Liab. & Equity {A[37]} (000)

3/.....~"

DISPLAY

"

*** INCOME STATEMENT ***

	TOTAL	PRODUCT 1	PRODUCT 2
REVENUE			
=====			
Sales Income (000)		{A[38]}	{A[39]}
Cost of Goods (000)		{A[40]}	{A[41]}
Gross Profit (000)	{A[42]}		

4/.....~"

DISPLAY

"

EXPENSES

=====

Administration (000)	{A[43]}		
Inventory Carrying (000)		{A[44]}	{A[45]}
Advertising (000)		{A[46]}	{A[47]}
R&D Quality (000)		{A[48]}	{A[49]}
R&D Cost (000)		{A[50]}	{A[51]}
Depreciation		{A[52]}	{A[53]}
Sales Force Salary (000)	{A[54]}		
Sales Force Commission		{A[55]}	{A[56]}
Branch Operation: Base (000)	{A[57]}		
Branch Operation: (000)		{A[58]}	{A[59]}
Total Expenses (000)	{A[63]}		
EBIT (000)	{A[64]}		
Interest (000)	{A[65]}		
Taxes Due (000)	{A[66]}		
Net Profit (000)	{A[67]}		

5/.....~"

DISPLAY

"

*** OPERATIONS ***

	TOTAL	PRODUCT 1	PRODUCT 2
	-----	-----	-----
Market Index		{A[69]}	{A[70]}
Sales Quantities		{A[76]}	{A[82]}
Market Share (%)		{A[78]}	{A[84]}
Unit Cost		{A[79]}	{A[85]}
Capacity Price		{A[80]}	{A[86]}
Capacity Selling Price		{A[81]}	{A[87]}
Interest Rate on Debt	{A[88]}		
Debt/Assets Ratio	{A[89]}		
Debt/Equity Ratio	{A[90]}		
Inventory Turnover	{A[91]}	{A[92]}	{A[93]}
Gross Profit Margin	{A[94]}	{A[95]}	{A[96]}
Net Operating Margin	{A[97]}	{A[98]}	{A[99]}
Profit Margin on Sales	{A[100]}		
Return on Assets	{A[101]}		
Return on Investment	{A[102]}		

Press any Key to continue~"

DISPLAY

"

*** INDUSTRIAL AVERAGES ***

	OVERALL	PRODUCT 1	PRODUCT 2
	-----	-----	-----
Year	{A[103]}		
Team No.	{A[104]}		
No. of Teams	{A[105]}		
Average Price		{A[106]}	{A[107]}

Average Advertising (000)	{A[108]}	{A[109]}
Advertising Weight	{A[110]}	{A[111]}
Average R&D Quality (000)	{A[112]}	{A[113]}
R&D Quality Weight	{A[114]}	{A[115]}
Average No. of Branch	{A[116]}	
Branch Weight	{A[117]}	{A[118]}
Average Salesmen	{A[119]}	
Salesmen Weight	{A[120]}	{A[121]}
Average Commission	{A[122]}	{A[123]}

Press any key to continue~"

```

D[1] = (A[106]*0.95)
DISPLAY"
  D[1] Estimate of New Industrial Price = {D[1]}"
D[2] = (A[108]*1.1)
DISPLAY"
  D[2] Estimate of New Industrial Advertising = {D[2]} (000)"
D[3] = (A[112]*1.1)
DISPLAY"
  D[3] Estimate of New Industrial R&D Quality = {D[3]} (000)"
D[4] = (A[116])
DISPLAY"
  D[4] Estimate of New Industrial No. of Branches = {D[4]}"
D[5] = (A[119])
DISPLAY"
  D[5] Estimate of New Industrial No. of Salesmen = {D[5]}"
D[6] = (A[122]+0.001)
DISPLAY"
  D[6] Estimate of New Industrial Commission Rate = {D[6]}

```

```

=====
Your Last Year's PRICE for HOOVER = {A[7]}"
FIND B7
FIND C7
D[7] = (A[7]*(1+C7/100))
DISPLAY
"  D[7] Your Decision of NEW PRICE for HOOVER = {D[7]}

```

```

=====
Your Last Year's UNIT COST for HOOVER = {A[79]}"
E8 = (A[13]/A[38])
FIND B8
FIND C8
D[8] = (A[79]*(1+C8/100))
DISPLAY
"  D[8] Your Decision of NEW UNIT COST for HOOVER = {D[8]}

```

```

=====
Your Last Year's ADVERTISING for HOOVER = {A[14]} (000)
The ADVERTISING WEIGHT for HOOVER = {A[110]}

```

HINT: If this is = or > 0.5, you should choose the HIGHER value

of the following RECOMMENDED Advertising, and vice versa."

FIND B9

FIND C9

D[9] = (A[46]*(1+C9/100))

DISPLAY

" D[9] Your Decision of NEW ADVERTISING for HOOVER = {D[9]} (000)

=====

Your Last Year's R&D QUALITY for HOOVER = {A[12]} (000)

The R&D QUALITY WEIGHT for HOOVER = {A[114]}

HINT: If this is = or > 0.5, you should choose the HIGHER value
of the following RECOMMENDED R&D Quality, and vice versa."

FIND B10

FIND C10

D[10] = (A[38]*C10/100)

DISPLAY

" D[10] Your Decision of NEW R&D COST for HOOVER = {D[10]} (000)

=====

Your Last Year's BRANCHES NO. for HOOVER = {A[3]}

The BRANCH WEIGHT for HOOVER = {A[117]}

HINT: If this is = or > 0.4, you should choose the HIGHER value
of the following RECOMMENDED BRANCH NO., and vice versa."

FIND B11

FIND C11

D[11] = (A[3]+C11)

DISPLAY

" D[11] Your Decision of NEW BRANCH NO. for HOOVER = {D[11]}

=====

Your Last Year's SALESMEN NO. for HOOVER = {A[4]}

The SALESMEN WEIGHT for HOOVER = {A[120]}

HINT: If this is = or > 0.5, you should choose the HIGHER value
of the following RECOMMENDED SALESMEN NO., and vice versa."

FIND B12

FIND C12

D[12] = (A[4]+C12)

DISPLAY

" D[12] Your Decision of NEW SALESMEN NO. for HOOVER = {D[12]}

=====

Your Last Year's COMMISSION for HOOVER = {A[15]}"

FIND B13

FIND C13

D[13] = (A[15]*(1+C13/100))

DISPLAY

" D[13] Your Decision of NEW COMMISSION for HOOVER = {D[13]}

=====

"

```

D[14] = (A[107]*0.95)
DISPLAY"
      D[14] Estimate of New Industrial Price = {D[14]}"
D[15] = (A[109]*1.1)
DISPLAY"
      D[15] Estimate of New Industrial Advertising = {D[15]} (000)"
D[16] = (A[113]*1.1)
DISPLAY"
      D[16] Estimate of New Industrial R&D Quality = {D[16]} (000)"
D[17] = (A[116])
DISPLAY"
      D[17] Estimate of New Industrial No. of Branches = {D[17]}"
D[18] = (A[119])
DISPLAY"
      D[18] Estimate of New Industrial No. of Salesmen = {D[18]}"
D[19] = (A[123]+0.001)
DISPLAY"
      D[19] Estimate of New Industrial Commission Rate = {D[19]}

```

=====

```

      Your Last Year's PRICE for PUMP = {A[16]}"
FIND B20
FIND C20
D[20] = (A[16]*(1+C20/100))
DISPLAY
"      D[20] Your Decision of NEW PRICE for PUMP = {D[20]}

```

=====

```

      Your Last Year's UNIT COST for PUMP = {A[85]}"
E21 = (A[22]/A[39])
FIND B21
FIND C21
D[21] = (A[85]*(1+C21/100))
DISPLAY
"      D[21] Your Decision of NEW UNIT COST for PUMP = {D[21]}

```

=====

```

      Your Last Year's ADVERTISING for PUMP = {A[23]} (000)
      The ADVERTISING WEIGHT for PUMP = {A[111]}

      HINT: If this is = or > 0.5, you should choose the HIGHER value
            of the following RECOMMENDED Advertising, and vice versa."
FIND B22
FIND C22
D[22] = (A[47]*(1+C22/100))
DISPLAY
"      D[22] Your Decision of NEW ADVERTISING for PUMP = {D[22]} (000)

```

=====

```

      Your Last Year's R&D QUALITY for PUMP = {A[21]} (000)
      The R&D QUALITY WEIGHT for PUMP = {A[115]}

```

HINT: If this is = or > 0.5, you should choose the HIGHER value of the following RECOMMENDED R&D Quality, and vice versa."

FIND B23

FIND C23

D[23] = (A[39]*C23/100)

DISPLAY

" D[23] Your Decision of NEW R&D COST for PUMP = (D[123]) (000)

=====

Your Last Year's BRANCHES NO. for PUMP = {A[3]}

The BRANCH WEIGHT for PUMP = {A[118]}

HINT: If this is = or > 0.4, you should choose the HIGHER value of the following RECOMMENDED BRANCH NO., and vice versa."

FIND B24

FIND C24

D[24] = (A[3]+C24)

DISPLAY

" D[24] Your Decision of NEW BRANCH NO. for PUMP = (D[24])

=====

Your Last Year's SALESMEN NO. for PUMP = {A[4]}

The SALESMEN WEIGHT for PUMP = {A[121]}

HINT: If this is = or > 0.5, you should choose the HIGHER value of the following RECOMMENDED SALESMEN NO., and vice versa."

FIND B25

FIND C25

D[25] = (A[4]+C25)

DISPLAY

" D[25] Your Decision of NEW SALESMEN NO. for PUMP = (D[25])

=====

Your Last Year's COMMISSION for PUMP = {A[24]}"

FIND B26

FIND C26

D[26] = (A[24]*(1+C26/100))

DISPLAY

" D[26] Your Decision of NEW COMMISSION for PUMP = (D[26])

=====

Your Last Year's CAPACITY for HOOVER = {A[10]}"

FIND B27

FIND C27

D[27] = (A[10]*(1+C27/100))

DISPLAY

" D[27] Your Decision of NEW CAPACITY for HOOVER = (D[27]) (000)

=====

Your Last Year's PRODUCTION for HOOVER = {A[8]}

Your Last Year's EXCESS INVENTORY for HOOVER = {A[28]}"

```

FIND B28
FIND C28
D[28] = (A[8]*(1+C28/100)-A[28])
DISPLAY
"   D[28]   Your Decision of NEW PRODUCTION UNITS for HOOVER = {D[28]}
(000)

```

```

=====
Your Last Year's CAPACITY for PUMP = {A[19]}"

```

```

FIND B29
FIND C29
D[29] = (A[19]*(1+C29/100))
DISPLAY
"   D[29]   Your Decision of NEW CAPACITY for PUMP = {D[29]} (000)

```

```

=====
Your Last Year's PRODUCTION for PUMP = {A[17]}
Your Last Year's EXCESS INVENTORY for PUMP = {A[29]}"

```

```

FIND B30
FIND C30
D[30] = (A[17]*(1+C30/100)-A[29])
DISPLAY
"   D[30]   Your Decision of NEW PRODUCTION UNITS for PUMP = {D[30]} (000)

```

```

=====
Your Last Year's TECH. INVESTMENT for HOOVER = {A[11]}
Your Last Year's DEBT/ASSET RATIO = {A[89]}

```

HINT: If this is = or < 0.5, you should choose the HIGHER value
of the following RECOMMENDED TECH. INVESTMENT, and vice versa."

```

FIND B31
FIND C31
D[31] = (A[38]*C31/100)
DISPLAY
"   D[31]   Your Decision of TECH. INVESTMENT for HOOVER = {D[31]} (000)

```

```

=====
Your Last Year's TECH. INVESTMENT for PUMP = {A[20]}
Your Last Year's DEBT/ASSET RATIO = {A[89]}

```

HINT: If this is = or < 0.5, you should choose the HIGHER value
of the following RECOMMENDED TECH. INVESTMENT, and vice versa."

```

FIND B32
FIND C32
D[32] = (A[39]*C32/100)
DISPLAY
"   D[32]   Your Decision of TECH. INVESTMENT for PUMP = {D[32]} (000)

```

```

=====
Your Last Year's STOCK TRADED (+Sell/-Buy) = {A[2]}"
FIND B33
FIND C33

```

D[33] = ((A[35]+A[36])*C33/100)

DISPLAY

" D[33] Your Decision of STOCK TRADE for Firm = {D[33]} (000)

=====

Your Last Year's DIVIDENDS = {A[1]}

Your Last Year's DEBT/ASSET RATIO = {A[89]}

HINT: If this is = or < 0.5, you should choose the HIGHER value
of the following RECOMMENDED DIVIDENDS, and vice versa."

FIND B34

FIND C34

D[34] = (A[67]*C34/100)

DISPLAY

" D[34] Your Decision of DIVIDENDS for Firm = {D[34]} (000)

=====

Your Last Year's R&D COST for HOOVER = {A[13]}

Your Last Year's DEBT/ASSET RATIO = {A[89]}

HINT: If this is = or < 0.5, you should choose the HIGHER value
of the following RECOMMENDED R&D COST, and vice versa."

FIND B35

FIND C35

D[35] = (A[38]*C35/100)

DISPLAY

" D[35] Your Decision of R&D COST for HOOVER = {D[35]} (000)

=====

Your Last Year's R&D COST for PUMP = {A[22]}

Your Last Year's DEBT/ASSET RATIO = {A[89]}

HINT: If this is = or < 0.5, you should choose the HIGHER value
of the following RECOMMENDED R&D COST, and vice versa."

FIND B36

FIND C36

D[36] = (A[39]*C36/100)

DISPLAY

" D[36] Your Decision of R&D COST for PUMP = {D[36]} (000)

=====

Your Last Year's Outstanding Loan = {A[33]}

HINT: If you had raised Loan previously (e.g. in Round 2 & 3),
you should repay all you Loan in the LAST ROUND only."

FIND C37

D[37] = (-C37)

DISPLAY

" D[37] Your Decision of Loan Repayment = {D[37]} (000)

=====

Writing Results back to FIRM1.WK1

Please WAIT for about 1 minute until you see further Display !!"

PWKS D,AJ141..AJ177,C:\LOTUS\DATAH\FIRM1

DISPLAY"

END OF EXPORT TO FIRM1.WK1 !!"

FIND GO

END

DISPLAY"

*** THANK YOU FOR USING THIS CONSULTANCY SERVICE ***
*** THE AUTHOR HOPES THAT IT IS OF VALUE TO YOU! ***";

RULE 7

IF A[7] <= (A[106])

THEN B7 = VALUE

DISPLAY"

LAST YEAR: Your firm had LOWER PRICE than the average firm.

RECOMMEND: Keep old figure OR Increase figure by 5%."

ELSE B7 = VALUE

DISPLAY"

LAST YEAR: Your firm had HIGHER PRICE than the average firm.

RECOMMEND: Reduce figure by 5% OR Keep old figure."

;

RULE 8

IF E8 <= 0.05

THEN B8 = VALUE

DISPLAY"

LAST YEAR: Your firm had R&D COST less than 5% of your turnover.

RECOMMEND: Reduce UNIT COST by 5% OR by 10%."

ELSE B8 = VALUE

DISPLAY"

LAST YEAR: Your firm had R&D COST more than 5% of your turnover.

RECOMMEND: Reduce UNIT COST by 10% OR by 15%."

;

RULE 9

IF A[14] <= (A[108])

THEN B9 = VALUE

DISPLAY"

LAST YEAR: Your firm had LOWER ADVERTISING than the average firm.

RECOMMEND: Increase figure by 40% OR by 30%."

ELSE B9 = VALUE

DISPLAY"

LAST YEAR: Your firm had HIGHER ADVERTISING than the average firm.

RECOMMEND: Increase figure by 30% OR by 20%."

;

RULE 10

IF A[12] <= (A[112])

THEN B10 = VALUE

```
DISPLAY"
  LAST YEAR: Your firm had LOWER R&D QUALITY than the average firm.
  RECOMMEND: Increase figure by 10% OR Keep old figure."
ELSE B10 = VALUE
DISPLAY"
  LAST YEAR: Your firm had HIGHER R&D QUALITY than the average firm.
  RECOMMEND: Reduce figure by 20% OR by 10%."
;

RULE 11
IF A[3] <= (A[116])
THEN B11 = VALUE
DISPLAY"
  LAST YEAR: Your firm had LESS BRANCHES than the average firm.
  RECOMMEND: Keep old figure."
ELSE B11 = VALUE
DISPLAY"
  LAST YEAR: Your firm had MORE BRANCHES than the average firm.
  RECOMMEND: Keep old figure."
;

RULE 12
IF A[4] <= (A[119])
THEN B12 = VALUE
DISPLAY"
  LAST YEAR: Your firm had LESS SALESMEN than the average firm.
  RECOMMEND: Keep old figure."
ELSE B12 = VALUE
DISPLAY"
  LAST YEAR: Your firm had MORE SALESMEN than the average firm.
  RECOMMEND: Keep old figure."
;

RULE 13
IF A[15] <= (A[122])
THEN B13 = VALUE
DISPLAY"
  LAST YEAR: Your firm had LOWER COMMISSION than the average firm.
  RECOMMEND: Increase figure by 10% OR by 20%."
ELSE B13 = VALUE
DISPLAY"
  LAST YEAR: Your firm had HIGHER COMMISSION than the average firm.
  RECOMMEND: Keep old figure OR Increase figure by 10%."
;

RULE 20
IF A[16] <= (A[107])
THEN B20 = VALUE
DISPLAY"
  LAST YEAR: Your firm had LOWER PRICE than the average firm.
  RECOMMEND: Keep old figure OR Increase figure by 5%."
ELSE B20 = VALUE
DISPLAY"
  LAST YEAR: Your firm had HIGHER PRICE than the average firm.
  RECOMMEND: Reduce figure by 5% OR Keep old figure."
;
```

```
RULE 21
IF E21 <= 0.05
THEN B21 = VALUE
DISPLAY"
    LAST YEAR: Your firm had R&D COST less than 5% of your turnover.
    RECOMMEND: Reduce UNIT COST by 5% OR by 10%."
ELSE B21 = VALUE
DISPLAY"
    LAST YEAR: Your firm had R&D COST more than 5% of your turnover.
    RECOMMEND: Reduce UNIT COST by 10% OR by 15%."
;

RULE 22
IF A[23] <= (A[109])
THEN B22 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LOWER ADVERTISING than the average firm.
    RECOMMEND: Increase by 40% OR by 30%."
ELSE B22 = VALUE
DISPLAY"
    LAST YEAR: Your firm had HIGHER ADVERTISING than the average firm.
    RECOMMEND: Increase by 30% OR by 20%."
;

RULE 23
IF A[21] <= (A[113])
THEN B23 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LOWER R&D QUALITY than the average firm.
    RECOMMEND: Increase figure by 10% OR Keep old figure."
ELSE B23 = VALUE
DISPLAY"
    LAST YEAR: Your firm had HIGHER R&D QUALITY than the average firm.
    RECOMMEND: Reduce by 10% OR by 20%."
;

RULE 24
IF A[3] <= (A[116])
THEN B24 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LESS BRANCHES than the average firm.
    RECOMMEND: Keep old figure."
ELSE B24 = VALUE
DISPLAY"
    LAST YEAR: Your firm had MORE BRANCHES than the average firm.
    RECOMMEND: Keep old figure."
;

RULE 25
IF A[4] <= (A[119])
THEN B25 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LESS SALESMEN than the average firm.
    RECOMMEND: Keep old figure."
ELSE B25 = VALUE
DISPLAY"
    LAST YEAR: Your firm had MORE SALESMEN than the average firm.
```

```

    RECOMMEND: Keep old figure."
;

RULE 26
IF A[24] <= (A[123])
THEN B26 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LOWER COMMISSION than the average firm.
    RECOMMEND: Increase figure by 20% OR by 10%."
ELSE B26 = VALUE
DISPLAY"
    LAST YEAR: Your firm had HIGHER COMMISSION than the average firm.
    RECOMMEND: Keep old figure OR Increase figure by 10%."
;

RULE 27
IF A[10] <= (A[8]*0.8)
THEN B27 = VALUE
DISPLAY"
    LAST YEAR: Your firm had CAPACITY LESS than 80% of Production.
    RECOMMEND: Keep old figure if last round ELSE increase by 10%."
ELSE B27 = VALUE
DISPLAY"
    LAST YEAR: Your firm had CAPACITY MORE than 80% of Production.
    RECOMMEND: Keep old figure."
;

RULE 28
IF C7 <= '(-5)
THEN B28 = VALUE
DISPLAY"
    THIS YEAR: Your firm decided to drop Price by more than 5%.
    RECOMMEND: Increase Production by 30% OR by 20%.
    NOTE: Stock carried over from last year will then be deducted."
ELSE B28 = VALUE
DISPLAY"
    THIS YEAR: Your firm decided to have little change in Price.
    RECOMMEND: Increase Production by 20% OR by 10%.
    NOTE: Stock carried over from last year will then be deducted."
;

RULE 29
IF A[19] <= (A[17]*0.8)
THEN B29 = VALUE
DISPLAY"
    LAST YEAR: Your firm had CAPACITY LESS than 80% of Production.
    RECOMMEND: Keep old figure if at last round ELSE increase by 10%." ..
ELSE B29 = VALUE
DISPLAY"
    LAST YEAR: Your firm had CAPACITY MORE than 80% of Production.
    RECOMMEND: Keep old figure."
;

RULE 30
IF C20 <= (-5)
THEN B30 = VALUE
DISPLAY"

```

```

    THIS YEAR: Your firm decided to drop Price by more than 5%.
    RECOMMEND: Increase Production by 30% OR by 20%.
    NOTE:      Stock carried over from last year will then be deducted."
ELSE B30 = VALUE
DISPLAY"
    THIS YEAR: Your firm decided to have little change in Price.
    RECOMMEND: Increase Production by 20% OR by 10%.
    NOTE:      Stock carried over from last year will then be deducted."
;

RULE 31
IF A[102] <= (0.2)
THEN B31 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LESS than 20% R.O.I.
    RECOMMEND: Do no invest."
ELSE B31 = VALUE
DISPLAY"
    LAST YEAR: Your firm had MORE than 20% R.O.I.
    RECOMMEND: Do not invest."
;

RULE 32
IF A[102] <= (0.2)
THEN B32 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LESS than 20% R.O.I.
    RECOMMEND: Do not invest."
ELSE B32 = VALUE
DISPLAY"
    LAST YEAR: Your firm had MORE than 20% R.O.I.
    RECOMMEND: Do not invest."
;

RULE 33
IF A[89] >= (0.5)
THEN B33 = VALUE
DISPLAY"
    LAST YEAR: Your Debt/Asset Ratio => 0.5.
    RECOMMEND: No trading."
ELSE B33 = VALUE
DISPLAY"
    LAST YEAR: Your Debt/Asset Ratio < 0.5.
    RECOMMEND: Buy back all shares sold if last round ELSE No trading."
;

RULE 34
IF A[1] > (0)
THEN B34 = VALUE
DISPLAY"
    LAST YEAR: Your firm had PAID OUT Dividends.
    RECOMMEND: Pay 30% Profit as Dividends."
ELSE B34 = VALUE
DISPLAY"
    LAST YEAR: Your firm had NOT PAID Dividends.
    RECOMMEND: Pay 20% Profit as Dividends."
;

```

```
RULE 35
IF A[102] <= (0.2)
THEN B35 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LESS than 20% R.O.I.
    RECOMMEND: Do not invest."
ELSE B35 = VALUE
DISPLAY"
    LAST YEAR: Your firm had MORE than 20% R.O.I.
    RECOMMEND: Do not invest."
;

RULE 36
IF A[102] <= (0.2)
THEN B36 = VALUE
DISPLAY"
    LAST YEAR: Your firm had LESS than 20% R.O.I.
    RECOMMEND: Do not invest."
ELSE B36 = VALUE
DISPLAY"
    LAST YEAR: Your firm had MORE than 20% R.O.I.
    RECOMMEND: Do not invest."
;

ASK C7:"
DECIDE: What is the CHANGE of your new PRICE from last year ?";

ASK C8:"
DECIDE: What is the CHANGE of your new UNIT COST from last year ?";

ASK C9:"
DECIDE: What is the CHANGE of your new ADVERTISING from last year ?";

ASK C10:"
DECIDE: What is the new R&D QUALITY as % of Last Year's Revenue ?";

ASK C11:"
DECIDE: What is the CHANGE of your new BRANCH NO. from last year ?";

ASK C12:"
DECIDE: What is the CHANGE of your new SALESMEN NO. from last year ?";

ASK C13:"
DECIDE: What is the CHANGE of your new COMMISSION from last year ?";

ASK C20:"
DECIDE: What is the CHANGE of your new PRICE from last year ?";

ASK C21:"
DECIDE: What is the CHANGE of your new UNIT COST from last year ?";

ASK C22:"
DECIDE: What is the CHANGE of your new ADVERTISING from last year ?";

ASK C23:"
DECIDE: What is the new R&D QUALITY as % of Last Year's Revenue ?";
```

ASK C24:"
DECIDE: What is the CHANGE of your new BRANCH NO. from last year ?";

ASK C25:"
DECIDE: What is the CHANGE of your new SALESMEN NO. from last year ?";

ASK C26:"
DECIDE: What is the CHANGE of your new COMMISSION from last year ?";

ASK C27:"
DECIDE: What is the CHANGE of your new CAPACITY from last year ?";

ASK C28:"
DECIDE: What is the CHANGE of your new PRODUCTION from last year ?";

ASK C29:"
DECIDE: What is the CHANGE of your new CAPACITY from last year ?";

ASK C30:"
DECIDE: What is the CHANGE of your new PRODUCTION from last year ?";

ASK C31:"
DECIDE: What is the CHANGE of your new TECH. INVESTMENT from last year?";

ASK C32:"
DECIDE: What is the new TECH. INVESTMENT as % of Last Year's Revenue ?";

ASK C33:"
DECIDE: What is the CHANGE of your new STOCK TRADED ?";

ASK C34:"
DECIDE: What is the new DIVIDENDS as % of Last Year's Profit ?";

ASK C35:"
DECIDE: What is the new R&D COST as % of Last Year's Revenue ?";

ASK C36:"
DECIDE: What is the new R&D COST as % of Last Year's Revenue ?";

ASK C37:"
DECIDE: What is the LOAN (x1000) you want to Repay to the Bank ?";

CHOICES C7,C20: 10%,5%,0,-5%,-10%;
CHOICES C8,C21: 0,-5%,-10%,-15%,-20%;
CHOICES C11,C12,C24,C25: 2,1,0,-1,-2;
CHOICES C10,C13,C23,C26,C27,C29: 20%,10%,0,-10%,-20%;
CHOICES C31,C32: 8%,6%,4%,2%,0;
CHOICES C35,C36: 4%,3%,2%,1%,0;
CHOICES C9,C22,C28,C30,C34: 40%,30%,20%,10%,0;
CHOICES C33: 0,-10%,-20%,-30%;
CHOICES C37: 2000,1500,1000,500,0;

APP.11: POST-VALIDATION QUESTIONNAIRE

NAME: _____

QUALI./DISCIPLINE: _____
 INSTITUTE: _____

WORKING EXPERIENCE: _____ years

LAST JOB: COMPANY _____
 PLACE _____

 TITLE _____

 DURATION _____

MODULES TAKEN SO FAR: _____

=====

1. ES-MIS

1.0 Manufacturing / Services *

1.1 Score of the Company consulted: _____

[Please circle your choice.]

1.2 Ease of use -3 -2 -1 0 1 2 3

1.3 Adequacy of information -3 -2 -1 0 1 2 3

1.4 Value as aid for installing MIS -3 -2 -1 0 1 2 3

1.5 Value as learning tool -3 -2 -1 0 1 2 3

1.6 Major merit(s) : _____

1.7 Major drawback(s) : _____

1.8 Other comments : _____

2. ES-CASE [Please circle your choice.]

2.1 Industry code: M1 M2 M3 M4 M5 S1 S2 S3 S4 S5 S6 S7

2.2 Ease of use -3 -2 -1 0 1 2 3

2.3 Adequacy of information -3 -2 -1 0 1 2 3

2.4 Value as aid for installing MIS -3 -2 -1 0 1 2 3

2.5 Value as learning tool -3 -2 -1 0 1 2 3

2.6 Major merit(s) : _____

2.7 Major drawback(s) : _____

2.8 Other comments : _____

=====

3. STRATPLAN [Please circle your choice.]

3.1 Ranking of your firm: _____

3.2 Ease of use -3 -2 -1 0 1 2 3

3.3 Adequacy of information -3 -2 -1 0 1 2 3

3.4 Value of spreadsheet as aid -3 -2 -1 0 1 2 3

3.5 Value of game as learning tool -3 -2 -1 0 1 2 3

3.6 Major merit(s): _____

3.7 Major drawback(s) : _____

3.8 Other comments : _____

*** THANK YOU FOR YOUR HELP ***