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DECISION SUPPORT SYSTEM: DEVELOPMENT AND APPLICATION USING OFF-THE-SHELF APPLICATION PACKAGES AND MICROCOMPUTER IN A MANUFACTURING COMPANY

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A thesis presented in fulfilment of the requirements for the degree of Master of Philosophy in Production and Quality at Massey University

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ABSTRACT

This research was aim to apply the decision support systems and quality costs concepts to build a Quality Costs Management Information System/Decision Support System (QC MIS/DSS) using off-the-shelf application packages and a microcomputer for the system development. To achieve these aims, a survey was conducted to find out the extent of computer applications in industries in the Manawatu region. Application packages was evaluated to select two suitable packages for the development of a QC MIS/DSS project in Company A.

Survey on the application of computers in the Manawatu region showed that about 47.4% of respondents were using microcomputers. The majority of the respondents used computer programs for finance, invoicing and stock control. Decision support was not yet a major usage.

The Prototype of QC MIS/DSS has the features of easy to use, simple to understand, user controlled, adaptive and easy to communicate with. The mangers/ users were satisfied with the prototype demonstrated. Interest in the possibility of expanding the system to other existing products and for detailed information on quality costs were raised.

Two main factors which contributed to the success of the project were - the prototyping approach used for system development.
- the management support during the system development process.
- the software used.

There were some significant changes after the concept of QC MIS/DSS was introduced to Company A which included improvement on data collection and records for rework, rejects, scraps on the assembly line, increasing the awareness of the quality costs and their significance, as well as the

process efficiency, As a result, work study and time study were carried out on the assembly line.

The project has met the predetermined objectives and the users' requirements. It has also proved that it is feasible to apply the decision sypport system theories and prototyping system development methodology by using the costs and time saving tools- Application packages for their model building.

To further improve and enhance the effectiveness of the system, it would be very useful to develop the DSS to a semi-expert system which would provide users with warning and some guidelines on what actions to be taken. This could be used as a consultancy device which would further improve the efficiency of the managers and decision makers in decision making.

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TABLE OF CONTENTS

Page

CHAPTER 1. INTRODUCTION.....1 - 4

CHAPTER 2. DECISIONS AND DECISION MAKING.....5 - 29

2.1. Introduction.....5

2.2. Definition Of Decision.....5 - 6

2.3. Classification Of Decisions.....6 - 11

2.3.1. Managerial Activities.....6 - 7

2.3.2. Types of Managerial Decisions.....8 - 9

2.3.3. Programmed and Non-programmed Decisions....9 - 10

2.3.4. Structured, Semi-structured and Unstructured Decisions.....10 - 11

2.4. Approaches Of Decision Making.....11 - 15

2.4.1. The Rational Manager View.....12

2.4.2. The "Satisficing" Process-oriented View....12

2.4.3. The Organizational Procedures View.....12

2.4.4. The Political View.....12 - 13

2.4.5. The Individual Differences Perspective.....13

2.4.6. Quantitative And Qualitative Approach.....13 - 15

2.5. Models Of Decision Making.....15 - 21

2.5.1. Normative Model.....15

2.5.2. Descriptive Model.....15

2.5.3. Quantitative Model.....16

2.5.4. Decision - Centred Model.....16 - 21

2.6. Techniques For Making Decisions.....21 - 26

2.6.1. Traditional Techniques For Programmed Decisions.....22

2.6.2. Modern Techniques For Programmed Decisions.....22 - 26

2.7. Conclusion.....26 - 29

Page

CHAPTER 3. DECISION SUPPORT SYSTEMS (DSS).....30 - 53

3.1. Introduction.....30
3.2. Current Research And Opinions.....30 - 32
3.3. Definition Of Decision Support Systems.....33
3.4. Decision Making, Information And Managerial Judgement Within A DSS Environment.....34 - 35
3.5. Framework Of Decision Support Systems.....35 - 37
3.6. Relationships Of Decision Making And Development Of Decision Support Systems.....37 - 39
3.6.1. The Rational Manager View.....37
3.6.2. The "Satisficing" Process-oriented View....38
3.6.3. The Organizational Procedures View.....38
3.6.4. The Political View.....38
3.6.5. The Individual Different Perspective.....39
3.7. Decision Support System Development Methodology...39 - 45
3.7.1. Conventional Design Approach.....40 - 41
3.7.2. Prototyping Approach.....41 - 43
3.7.3. User- developed Systems Approach.....43 - 44
3.7.4. Factors For Determining The Development Approach.....44 - 45
3.8. The Design Of Decision Support Systems.....45 - 49
3.8.1. The Components Of Decision Support Systems.....45 - 48
3.8.2. The Success Factors For Design Of Decision Support Systems.....48 - 49
3.9. Conclusion And Further Development.....49 - 50

Page

CHAPTER 4. SURVEY ON COMPUTER APPLICATION IN MANAWATU REGION.....54 - 83

4.1. Introduction.....54 - 55
4.2. The Objectives Of The Survey.....55
4.3. Methodology.....55 - 57
4.3.1. The Population.....55
4.3.2. The Sample.....56
4.3.3. Survey Procedure.....56 - 57
4.4. Questionnaire Design.....57
4.5. The Results Of The Survey.....58 - 81
4.5.1. Respondent Characteristics.....58
4.5.2. Survey Bias.....58
4.5.3. Interpretation Of Tables.....59 - 60
4.5.4. The Results.....60 - 81
4.6. Conclusions.....81 - 83

CHAPTER 5. MICROCOMPUTER APPLICATION PACKAGES' PERFORMANCE EVALUATION : SOME GUIDELINES FOR THE MANAGER.....84 - 104

5.1. Introduction.....84
5.2. Types of Application Package.....84 - 85
5.3. Performance Evaluation Criteria .....85 - 88
5.3.1. Basic requirements of the package for the Quality Costs MIS/DSS.....86
5.3.2. Software evaluation criteria.....86 - 88
5.4. Evaluation of Application Software.....89 - 103
5.4.1. Brief introduction of the package selected for evaluation.....90 - 91
5.4.2. Methodology for evaluation of packages.....91 - 101
5.4.3. Evaluation results.....102 - 103
5.5. Conclusion.....103 - 104

Page

CHAPTER 6. DEVELOPMENT OF QUALITY COSTS MANAGEMENT INFORMATION SYSTEM /DECISION SUPPORT SYSTEM (QC MIS/DSS) IN A MANUFACTURING COMPANY.....105 - 149

6.1. Introduction.....105 - 106
6.2. The Objective Of The Project - Development Of A QC MIS/ DSS For Product P.....106 - 107
6.3. Problems And Difficulties Encountered During System Development Process.....108 - 109
6.4. Concept Of Quality Costs.....110
6.4.1. Quality Costs Category.....110 - 111
6.4.2. Model For Optimum Quality Costs.....111 - 112
6.4.3. Analysis Techniques Of Quality Costs.....112 - 114
6.5. Developing The QC MIS/DSS.....114
6.5.1. The Benefits Of Using Quality Costs MIS/DSS.....115
6.5.2. The System Development Process Of The QC MIS/ DSS.....115 - 130
6.6. The System Output.....131 - 144
6.7. Future Development.....145 - 146
6.8. Concusions.....146 - 149

CHAPTER 7. CONCLUSIONS AND RECOMMENDATIONS.....150 - 155

7.1 Reviewing The Survey Finding.....150 - 151
7.2. Review On development of Quality Costs MIS/ DSS Project.....151 - 152
7.3. The Benefits And Success Factors Of The Project...153 - 154
7.4. The Effects Of The Project.....154 - 155

Page

APPENDIX -A. SURVEY QUESTIONNAIRES AND INFORMATION ON COMPUTER, AND PROGRAMS.....156 - 173

APPENDIX -B. COMPARISON OF INTEGRATED APPLICATION PACKAGES.....174 - 183

APPENDIX -C. DATA NEEDED FOR QUALITY COSTS MIS/DSS.....184 - 188

APPENDIX -D. QUALITY COSTS DATA BASE MIS SCREENS.....189 - 199

APPENDIX -E. QUALITY COSTS MIS/DSS PROTOTYPE SUMMARY.....200 - 201

BIBLIOGRAPHY.....202 - 233

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

This research project is associated with the increasing use of microcomputers in industry. This increasing popularity could be linked to the more competitive business environment, rapidly changing and advancing technology, the development of cheaper, high speed, low cost and larger capacity microcomputers with easier to use application programs.

The purpose of this research is to:-

1. Survey the application of computers in the manufacturing industry in the Manawatu region.
2. Evaluate certain application packages- data base management packages for data base and integrated packages for modelling purposes.
3. Investigate the methodologies used in developing Decision Support Systems by developing as an example, a management tool - Decision Support System to support managerial decision making for strategic planning (using a microcomputer and off-the-shelf application packages - dBASE III and Lotus Symphony). This will also give experience in the development of a decision support system along with the concept and methodology established by the researchers.

From the study of the available literature and case studies of Decision Support Systems it showed that there was a gap in the use of technical tools in building DSS. Mainframe or minicomputers and programming language (e.g. BASIC, COBOL) were mainly being used. This research study is an attempt to use an easily available application package and a fourth generation package which run on an IBM PC to build a Quality Costs Management Information System/ Decision Support System. The system could be used to assist and support managers in their strategic planning in quality assurance and indirectly in marketing, production, and purchasing.

This research was initiated firstly because of the popularity of microcomputers and the vast variety of application packages on the market which are lower in costs than mainframe packages, easy to use and will enable a non-computer specialist to build his own models within a short period of time. A second factor was the increasing awareness of the usefulness and benefits of quality costs control.

There were many models for decision support systems in the academic literature. They were mainly complex models built by using computer programming languages - eg. COBOL, FORTRAN, BASIC and other programming languages. These decision support systems were costly to build and need a long time span for system development by information system(IS) specialists. The effectiveness of the data processing function has been significantly hampered by a variety of problems, e.g. behind schedule, system maintenance requirements that absorb a large proportion of staff resources; and computer application which failed to meet the user's requirements [1].

Recently, it has been suggested that applications development by users themselves can provide solutions to both problems, firstly by relieving the IS professionals of some of their workload; and secondly by alleviating some of the DP user communication problems [3].

The growth in the use of microcomputers in the United States between 1983- 1984 was around 150 per cent [4]. The study carried out on the use of microcomputers in New Zealand over the first six months of 1985 suggested that approximately 70 per cent of managers of large companies in New Zealand will be using microcomputers by 1987 [2].

A very recent survey done by Arthur Hoby Associates on the New Zealand Computer Market [3] showed that personal computers have increased their penetration substantially with a total of 77.2 per cent of the user community running personal computers internally, compared to 47.9 per cent

in 1985 in New Zealand. The study also showed that application packages are considerably more popular than application programs developed inhouse. Moreover, fourth generation language software tools, e.g. dBASE II, dBASE III are becoming increasingly popular - accounting for 17.6 per cent of all application development done. (Up 91% from 1985)

This research was carried out by :

1. Reviewing the literature on the nature of decisions and the decision making process.
2. Reviewing literature on Decision Support Systems(DSS) and the methodologies of building decision support systems.
3. Surveying the extent of computerization in industry in the Manawatu region.
4. Studying and comparing the functions and capabilities of certain popular application packages on the market.
5. Reviewing the literature on Quality Costs.
6. Identifying the needs of users in a local manufacturing company which we shall call Company A.
7. Based on 6 above, building a Quality Costs MIS/ DSS by using a fourth generation package - dBASE III and an integrated package - Lotus Symphony for Company A.
8. Evaluating and drawing conclusions from the above.

Heavy emphasis has been put on current thinking about decision making process theories and decision support system building methodologies in the project development process. The first three chapters of the report discuss decisions, the decision making theories and decision support systems. Chapter 4 , analyses the results of the survey. Chapter 5 studies and compares certain application packages on the market and selected two suitable packages for project development. Chapter 6 describes the decision support system project at Company A. ie. model building process, problems and difficulties encountered. The last chapter is the conclusion and summary of the research.

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CHAPTER 2

DECISIONS AND DECISION MAKING

CHAPTER 2 DECISIONS AND DECISION MAKING

2.1. INTRODUCTION

Finding solutions to a problem is commonly asserted to be the heart of executive activity in business. Competence in making good and effective decisions differentiates the good manager from the mediocre manager. Hence, the success of the manager depends on his problem solving and decision making abilities. Unfortunately, there is a lack of universal agreement as to what constitute really good problem solving and decision making procedures that would result in favourable consequences.

Problem analysis and decision making are closely related to each other. Decision making is part of the problem solving process. Before a manager can make any decision, he has to know what is wrong. Therefore he needs to have a systematic approach to problem analysis and decision making in order to produce the best result.

Decision support requires a good understanding of the various decision making processes in organization. In this chapter, we will look into what is decision and decision making. (the different approaches of decision making and how it relates to problem solving and decision support systems).

2.2. DEFINITION OF DECISION

Decision is defined as a (conscious) choice of a move (or action) from among a well- defined set of alternatives [19].

A concise description of a decision is given by Ofstad [13], who said:
"To say that a person made a decision may mean:-
(1) he has started a series of behavioral reactions in favour of

something, or

(2) he has made up his mind to do a certain action, which he has no doubt that he ought to do.

(3) to make a judgement regarding what one ought to do in a certain situation after having deliberated on some alternative courses of action.

According to Dr. Kepner and Tregoe [9], "A decision is always a choice between various ways of getting a particular thing done or an end accomplished." They added, " A decision will be a compromise between what the manager wants and what can actually be done.

These imply that making decisions is connected with problems and problem solving, present or future, so that many of the difficulties are eliminated. Every decision has two or more possible outcomes attached with importance or value which will affect the effectiveness and variation of the outcomes. Evaluation and analysis on the alternatives should be made carefully before a decision is reached.

2.3. CLASSIFICATION OF DECISIONS

Decisions differ in a number of ways. The formulation of alternatives, choices and the design of information system support for decision alternatives are affected by the differences in decisions, problems, the organization's objectives, environment and the personality of the decision maker. Different researchers view decisions from different perspectives:-

2.3.1. Managerial Activitives

Anthony [1] views managerial activities as falling into three categories, and argues that each is sufficiently different in kind to require distinctive planning and control systems. These are :-

(i) Strategic Planning:

"The process of deciding on objectives of the organization, on changes in these objectives, on the resources used to attain these objectives, acquisition, use, and disposition of resources." [2] The planning process requires innovation, creativity and intuitive judgement to handle these non-routine decisions.

(ii) Management Control:

"The process by which managers assure that resources are obtained and used effectively and efficiently on the accomplishment of the organization's objectives." [2]

Figure- 2.1. Information Characteristics by Area of Decisions

Task Variables	*Strategic Planning*	*Management Control*	*Operational Control*
Accuracy	*Low*	←	*High*
Level of detail	*Aggregate*	←	*Detailed*
Time horizon	*Future*	←	*Present*
Frequency of use	*Infrequent*	←	*Frequent*
Source	*External*	←	*Internal*
Scope of information	*Wide*	←	*Narrow*
Type of information	*Qualitative*	←	*Quantitative*
Age of information	*Older*	←	*Current*

(Adapted from: Keen and Scott Morton. Decision support system: An organization perspective. Addison- Wesley. 1978)

For management control activities, the sources of information come from both external and internal sources used by both top and middle management. eg. top management would be concerned about the overall financial performance of their organization - internal source on sales and external source on competitors.

(iii) Operational Control:

This is the process of assuring the specific tasks are effectively and efficiently carried out. It is concerned with performing activities according to some predefined criterion. It is also concerned with information about operational control activities, so that the day to day operation of a specific department can be controlled.

These three types of decisions have no clear boundaries and often overlap. However, the classification is useful for analyzing information system needs and activities because the information required by the manager for each category would be different, as shown in Figure- 2.1.

2.3.2. Types of Managerial Decisions

At different management levels managers are concerned with different types of managerial activities. Ansoff, H. I. [2] suggests using the three managerial activities levels for classifying types of decisions into:- (Refer to Figure- 2.2)

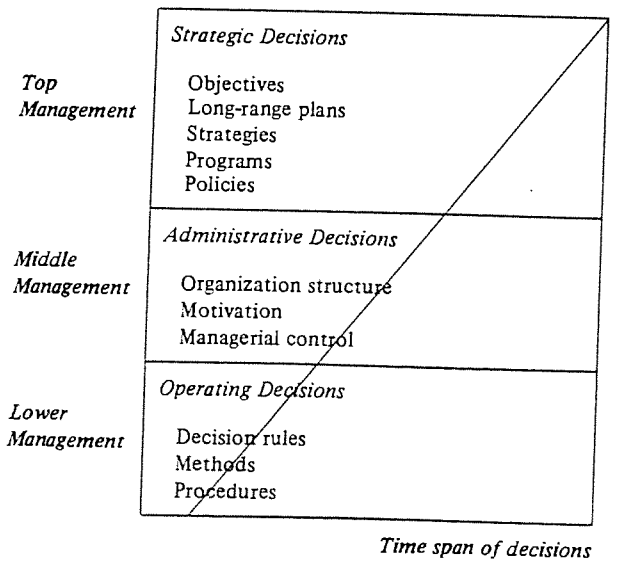
(i) Strategic Decisions:

These are top-management oriented and primarily concerned with the external problems of the firm and specifically with the selection of the product mix that the firm will produce and market.

(ii) Administrative Decisions:

These are mainly middle management oriented concerned with structuring the firms resources to create maximum performance potential.

Figure -2.2. Multi- level Decision Making Within A Typical Business Organization.



(Adapted from: Thierauf, R. J. Decision support systems for effective planning and control: A case study approach. Prentice- Hall, Inc., Englewood. Cliff, NJ. 1982. 536p.)

(iii) Operating Decisions:

These are primarily lower management decisions concerned with maximizing the profitability of current operations.

2.3.3. Programmed And Non-programmed Decisions

According to Simon, H. A. [16] decisions are classified as programmed and non- programmed.

Programmed decisions are decisions which are repetitive and routine, to the extent that a definite procedure has been worked out for handling them, so that they don't have to be treated de novo each time they occur. Non-programmed decisions are decisions whcih are novel, unstructured and usually consequential. There is no cut and dried method for handling the

problem because it hasn't arisen before, or because its precise nature and structure are elusive or complex or it is so important and unique that it deserves a custom- tailored treatment.

2.3.4. Structured, Semi-structured And Unstructured Decisions

Two of the major contributors of decision support systems, writers Keen and Scott Morton, classified decisions according to the nature of the problem- solving activities as structured, semi-structured and unstructured decisions.

(i) Structured decisions:

"Decisions that do not involve a manager, they are decisions that are well enough understood to have been given to clerks or to have been automated through the computer." [8] ie. inventory recording, credit scoring, airline reservations.

(ii) Semi-structured decisions:

This is the area where Decision Support Systems can be most effective. "These are decisions where managerial judgment alone will not be adequate, perhaps because of the size of the problem or the computational complexity and precision needed to solve it. Or on the other hand, the model or data alone are also inadequate because the solution involves some judgement and subjective analysis." [8] In this situation, the manager plus the system can provide a more effective solution.

(iii) Unstructured decisions:

Decisions that are either not capable of being structured or that have not yet been examined in depth and so appear to the organization as unstructured.

Keen and Scott Morton combined both Simon's concepts of programmed and non-programmed decisions and Anthony's work on the taxonomy of decisions into their "Framework for information systems".

Figure- 2.3. A Framework for Information Systems

		MANAGEMENT ACTIVITY			
Tpye of Decision/Task		Operational Control	Management Control	Strategic Control	Support Needed
Programmed	Structured	1 Inventory recording	4 Linear programming for manufacturing	7 Plant location	Clerical, EDP or MS models
Non-programmed	Semistruct-ured	2 Bond trading	5 Setting market budgets for consumer products	8 Capital acquisition analysis	DSS
Non-programmed	Unstructured	3 Selecting a cover for Time magazine	6 Hiring managers	9 R & D Portfolio development	Human intuition

The framework for information systems contributed by Keen and Scott Morton [8] has had a great impact on the development of decision support systems. It has become the major decision support system concept for decisions that DSS specialists use. Figure- 2.3 combines the frameworks of the decision theories of Keen and Scott Morton and Simon.

2.4. APPROACHES OF DECISION MAKING

Decision making is a complex and multi-dimensional activity with little agreement among the various disciplines. Each discipline approaches decision making differently in its purpose, but no discipline is "right" or "wrong". Each has something to offer [19]. Below are summaries of some of the different approaches:

Keen and Scott Morton classified the literature of decision making into five main schools of thought [8].

2.4.1. The Rational Manager View:

This concept of decision making in organization is based on the assumption of a rational, completely informed, single decision maker. It is appropriate for decisions dominated by economic factors, where an analytic definition of the variables involved in the decision is needed together with a precise, objective criterion for choice.

2.4.2. The "Satisficing" Process - Oriented View:

Simon [16] presents the satisficing process-oriented view which focuses on how a decision maker can most effectively use limited knowledge and skills. The notion of satisficing is contingent upon certain attributes of the decision maker. eg. his aspiration levels, his persistence and his perceptions. Simon emphasizes heuristic rules of thumb and searching for solutions that are good enough and highlights the constraints imposed by "bounded rationality".

Simon defines "bounded rationality" [16] as the capacity of the human mind for formulating and solving complex problems as being very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world or even for a reasonable approximation of such objective rationality.

2.4.3. The Organizational Procedures View:

This concept of decision making seeks to understand decisions as the output of standard operating procedures evolved by organizational subunits. It stresses the importance of identifying organizational roles, channels of communication, and relationships. The emphasis on design is to discover what these procedures are and how some or all of them might be supported and improved.

2.4.4. The Political View:

The decision making for the political view is seen as a personalized bargaining process between organizational units. It emphasizes

understanding the realities of power and the compromises and strategies necessary to mesh the interests and constraints of the factors in the decision process.

2.4.5. The Individual Differences Perspective:

This perspective emphasizes the individual manager and his problem-solving and information processing behavior.

2.4.6. Quantitive And Qualitative Approaches

Thierauf, R. J. [18] suggested viewing the decision -making process from two perspectives: the quantitative approach and the qualitative approach.

The quantitative approach determines specific values or a range of values for all parameters of the problem. It states the factors in general terms and solves the problem on that basis. Three different views are presented here:-

(i) Systematic - Intuitive Appraoch

James McKenney and Peter Keen [11] view problem solving and decision making in terms of the process through which individuals organize the information. This model is based on information gathering and information evaluation.

(ii) Thinking - Feeling Approach

C. G. Jung's [12] view on decision making is the Thinking and Feeling approach. Thinking types base their decisions on logical models of reasoning. They rely on analytical tools for their decision making. Feeling types, make their decisions based on extremely personal consideration - their feeling about a particular situation.

(iii) Normative -Descriptive Approach

The normative framework describes the traditional situation in which a decision maker faces a known set of alternatives and selects a course of action by a rational selection process. The decision procedures followed are those that will optimize output, income, revenues, costs or utility. The descriptive framework incorporates adaptive or learning features and the act of choice spans many dimensions of behaviour, rational as well as non-rational.

Keen and Scott Morton pointed out that there seems to be no self evident right way to look at the decision process. It is critical to diagnose which aspect is the most pivotal in any situation as the nature of the decision making is multi-dimensional. The decision maker is influenced by his or her personal values, the time available for the decision, the uncertainity of the outcomes, the importance of the decision and the comparability of these variables. The manager's intuitive decision making approach relies heavily on accumulated experience. The combination of a systematic problem solving approach and experience encompassing the systematic approach together with creativity is what the "Professional manager" should have to enhance his decision making process.

The concept of the decision process largely predetermines both one's response to other peoples logical behavior and opinions, and the strategy chosen for the design and implementation of any support aid to "improve" the quality of decisions.

The development today of high speed and larger memory microcomputers (with a lower cost of hardware and software and a large variety of application software) has made Simon's assumption on the theory of the satisficing process oriented view -" solutions...we can not within practical computational limits, generate all the admissible alternatives...", come closer to a possibility. Now we can use a computer to do tedious calculation work, exploring various alternatives and reach a

satifactory decision with greater speed and lower costs. This is what we will be discussed in the next chapter- Decision Support System.

2.5. MODELS FOR DECISION MAKING

Davis and Olson classified the decision making into normative or perscriptive and descriptive models [5].

2.5.1. The Normative Model :is a model of decision making which tells the decision maker how to make a classification of decisions - what ought to be done?

The normative models have generally been developed by economists and management scientists. eg. Linear programming, game theories, budgeting and statistical theories.

2.5.2. The Descriptive Model :is a model of decision making which describes how the decision maker actually makes decisions - what is done?

Descriptive models attempt to explain actual behavior and therefore have been developed largely by behavioral scientists.

The criterion of decision making in the normative model is the maximization or optimization of either utility or expected values. This is in quantitative terms, and is referred to as the objective function for a decision. It assumes that a rational decision maker, will always select the optimal alternatives and the decision making (under stable environment) will be based on maximing profit or utility.

In the descriptive, behavioral model, the criterion for decision making is satisficing. A decision support system attempts to combine these criteria of the decision making process. It uses the Normative model to find out or to generate all the alternatives with different inputs and uses decision maker's judgement and insight to make decisions.

Decision making activity is often associated with making a choice among alternatives. From the management view point, Churchman says: "The manager is the man who decides among alternative choices. He must decide which choice he believes will lead to a certain desired objective or set of objectives [4]. He viewed the decision making process from two perspectives- quantitive and decision centred.

2.5.3. Quantitive Model

The quantitive model of decision making are oriented more towards the systematic approach set forth above for solving structured problems faced by the managers. This is the "Classical" problem solving approach for Management Information System(MIS). This approach is an extension of the scientific method which was originally formulated by Francis Bacon in the sixteenth century and elaborated by John Stuart Mill in the nineteenth century [15].

The decision making consists of six steps :-

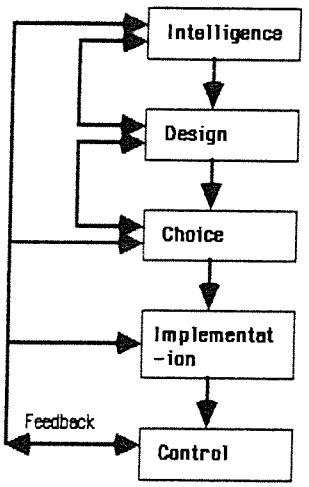
1. Observation.
2. Definition of the real problem.
3. Development of alternative solutions.
4. Selection of optimum solution.
5. Vertification of optimum solution.
6. Establishment of proper controls over solution.

This model is similar to Davis & Olsen's Normative model. It is primarily for solving structure problems such as, in accounting, inventory control and invoicing, etc.

2.5.4. Decision -Centred Model:-

The decision- centred approach is oriented towards solving semi-structured and unstructured problems. This approach combines intuitive and systematic approaches. It is based on Simon's model of decision making which was proposed in "The new science of management decision". It consists of three major phases :- [16] (Refer to Figure- 2.4)

Figure- 2.4. Flowchart Of Decision Making Process



Phase 1. Intelligence: Searching the environment for conditions calling for decisions. Data inputs are obtained, processed and examined for clues that may identify possible problems.

Phase 2. Design : Inventing, developing and analyzing possible course of action. This involves processes to understand the problem, to generate solutions and to test solutions for feasibility.

Phase 3. Choice : Selecting an alternative or course of action from those available. A choice is made and implemented.

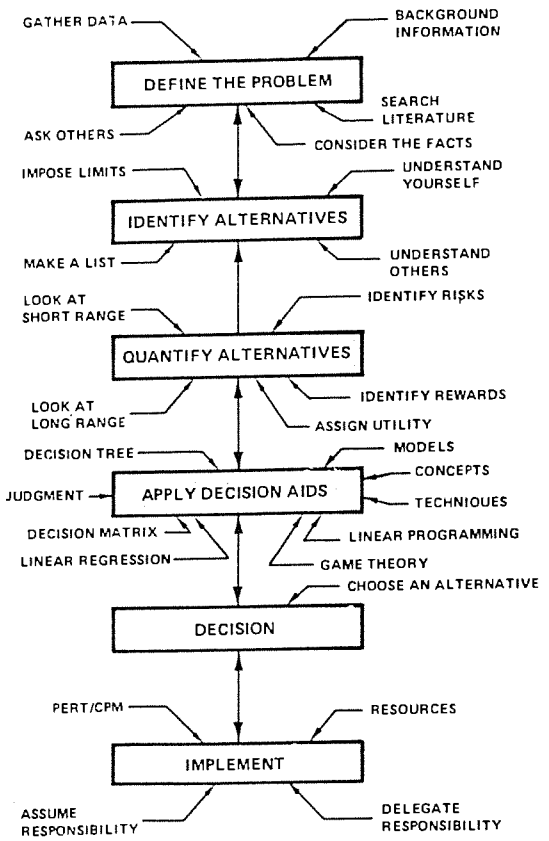
Additional steps in the decision making process:-

Phase 4. Implementation: Place the chosen solution into effect.

Phase 5. Control : Monitor the outcome and make the necessary adjustment.

There is a flow of activities from intelligence to design and to choice, but at any phase, there may be a return to a previous phase. Simon's model for decision making consists of the first three phases. It does not go beyond the choice phase. Two additional phases have been appended- implementation and feedback to complete the decision making process.

Figure- 2.5. The Decision- Making Process



(Adapted from: Hill, P. H. et al. Making decisions: A multi- disciplinary introduction. Addison- Wesley Publishing Co. 1979.)

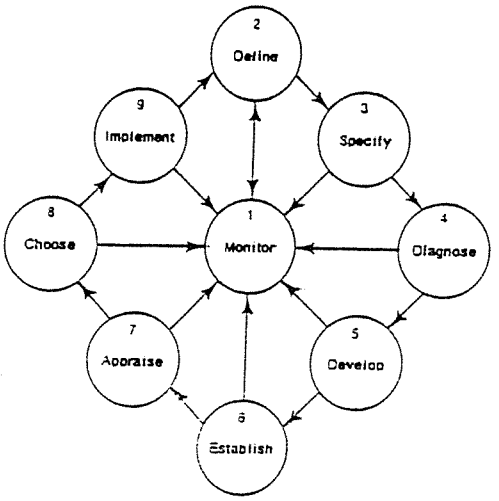
Hill, P. H. [6] views an ideal decision making process as one which would be a logical sequence of events which, if followed, may increase the likelihood of reaching a satifactory decision. The ideal decision making process begins with problem definition. Iteration of steps occurs when there is insufficient information to complete a given step. The previous step must then be repeated until the necessary data are in hand.

Managers often try to make the most logical decision they can, but they are limited by inadequate information and by their ability to utilize the information. Thereby, they are constrained by the environment, the personality, the organization objectives and the social pressure.

Professor of management at Winthrop College USA, Ernest Archer [3] examined over 2,000 managers, supervisors and executives. He found that they used steps which had been identified by well known decision experts over the years. Archer compared the decision steps or phases accross a variety of approaches. These included the work of Herbert Simon, Peter Drucker, Chester Barnard and others. He concluded that all these methods shared certain similarities, but there remained a lack of consensus about definitions and in some cases key steps seem to be missing. He therefore synthesized the various methods to produce an integrated nine step decision framework. Refer to Figure- 2.6.

This framework emphasized the interrelated nature of the process. At the core of Archer's framework there is the decision maker's need to monitor the environment constantly. Thus the job involves obtaining adequate feedback on any deviations from preplanned, normal, acceptable or expected states. The nine step procedure shown has been found to work well in practice. It is important to note that decision objectives should be broken down into those which are essential and those which are desirable and ranked according to the degree of importance.

Figure- 2.6. The Nine Phase Decision Making Process



(Adapted from: Archer, E. R. How to make a business decision, an analysis of theory and practice. Management Information Review, Feb, 1980. p. 58.)

The systematic problem solving and decision making framework suggested by Kepner and Tregoe [9], has the essence of Simon, Hill and Archer's decision making framework. The important feature of Kepner and Tregoe's decision making framework is that they emphasized the importance of the managers' problem analysis procedure, put objectives into prospective and ranked the objectives according to the importance - as "Must" and "Wants". Alternatives are then developed to achieve the objectives accordingly. Furthermore, they also look into the potential problems resulting from action taken. This step is often neglected by the managers and decision makers. The results of this negligence can be disastrous.

The seven concepts suggested by Kepner and Tregoe for making the best decisions are:-

(1) The objectives of a decision must be established first.

(2) The objectives are classified as to importance:

Must : a requirement that cannot be compromised.

Wants: are not requirements but are open to bargaining as to their

importance and the possible effects on the decision. The wants are then to be ranked and weighted.

(3) Alternative actions are developed.

(4) The alternatives are evaluated against the established objectives.

(5) The choice of the alternative best able to achieve all the objectives represents the tentative decision. The best alternative must meet all the "Must" requirements.

(6) The tentative decision is explored for future possible adverse consequences - future problems resulting from an action taken.

(7) The effects of the final decision are controlled by taking other actions to prevent possible adverse consequences from becoming problems and making sure the actions decided on are carried out.

The processing of managerial decision making is to gather all the facts and information, putting these together with experience to produce a better judgement and decision. In a changing environment, we need a more flexible and effective decision making model which allows the decision makers to use their experience and knowledge, combining the systematic problem solving approach to make more effective decisions. The decision centred Model and the Krepner and Tregoe problem solving approach would be most suitable. Simon has suggested using man and machine to perform this activity. The popular and lower costs of computer hardware and software has enabled the manager of the 80's to put this theory and concept into practice.

2.6. TECHNIQUES FOR MAKING DECISIONS

Different types of decisions use different techniques for decision making. According to Simon, the techniques used for decision making can be classified into traditional and modern for programmed decisions and non-programmed decisions.

2.6.1. Traditional Techniques For Programmed Decisions

Specific processes have been developed to handle routine, repetitive decisions. The decision making technique for making programmed decisions is Habit, which is most widely used. e.g. a standard operating procedure for clerical routing, common expectations in the organization with well defined information channels.

2.6.2. Modern Technique for Programmed Decisions

The modern techniques included in Table- 2.1, use the word heuristic, which needs to be defined. Unlike most of the techniques used by operational researchers, heuristic problem solving requires no formal problem definition. Heuristics are just like rules of thumb. They are reasoned aids to decision analysis.

Table- 2.1. Traditional and Modern Techniques of Decision Making

Types of decisions	*Decision-making techniques*	
	Traditional	*Modern*
Programmed: Routine, repetitive decisions Organization develops specific processes for handling them	1. Habit 2. Clerical routine: Standard operating procedures 3. Organization structure: Common expectations A system of subgoals Well-defined informational channels	1. Operations Research: Mathematical analysis Models Computer simulation 2. Electronic data processing
Non-programmed: One-shot, ill-structured novel, policy decisions Handled by general problem-solving processes	1. Judgement, intuition and creativity 2. Rules of thumb 3. Selection and training of executives	Heuristic problem-solving technique applied to: (*a*) training human decision makers (*b*) constructing heuristic computer programs

(Adapted from: Simon, H. A. The shape of automation for men and management. Haper and Row. 1965.)

The complexity of real world phenomena suggests the use of a systematic approach. Model building is not mentioned in the Table. Model building is important to decision analysis and is useful to incorporate in an explicit manner with some of the concepts described in the various classification of decisions.

(i) Model and decision making

A model is a representation of a real or a planned system [16]. It is usually simpler, easier to manipulate than the thing it represents. Managers often have to rely on surrogate systems of contrived models to study a real world system. The models are approximate, uncertain and incomplete and is a representation of a real or planned system.

(ii) Tools for model building

Most of the models were written by using computer language or command language. Recently, there have taken two commonly used model building and programming facilities - Spreadsheet and Fourth Generation Language Packages. Spreadsheet packages are available for the user on most personal computers. The first of these that came on the market was VisiCalc, but there are many similar packages with more complex modelling and powerful facilities such as integrated packages - Lotus 1-2-3, Lotus-Symphony, SuperCalc 3, IFPS, Framework, etc. These integrated packages have the spreadsheet, word-processor, data base, graphic and data conversion facilities. (not all the integrated packages have all the facilities listed)

The Fourth Generation Language(4GL) package is an English like modelling language. e.g. dBASE II, dBASE III, Knowledgeman, Dataflex, etc. These modelling facilities offer the non-DP personnel another approach to modelling and is lower in cost, more flexible, user friendly and time-saving in programming.

(iii) Models in decision making environment

Models are important to a manager in deciding which problem to identify and to address in the decision support system environment. Pounds [14] classified models into quantitative models and behavioral science models.

a) Quantitative Models

The successful marriage of a computerized system with mathematical and statistical models has produced a rapid growth in the number of quantitative techniques for solving business problems. The principle mathematical and statistical models that have been used to solve business problems are:-

Allocation	Routing	Searching Theory
Assignment	Combine Models	Competition
Sequencing Models	Decision Theory	Heuristic Methods
Statistical Techniques	Inventory	Transportation
Queuing	Replacement	

Managers must have the ability to recognize the right model or the right information to use to solve their problem. They must also develop an ability to spot patterns in data outputs that suggest hypotheses worthy of futher exploration.

b) Behavioral Science Models

Behavioral science models are used from a different perspective in DSS from the quantitative models. These models are designed to handle the human element within a changing situation. These are complementary to quantitative models. The two main behavioral science models are the Lewin-Schein Model and the Kolb-Frohman model.

The Lewin- Schein view the behavioral and organizational change as a three stage process:-

1) **Unfreezing** - An environment for change is created and some type of reason for change is applied to bring about a change in the individual's attitudes or habits. This stage is critical to the change process, as inadequate acceptance of change can prevent movement toward a desired state.
2) **Moving** - In this stage, attitudes or habit are moved towards a desired state.
3) **Refreezing** - Attitudes or habits are refrozen in the desired state.

Change needs to have the backing of the top management and to be self motivated.

The Kolb- Frohman model of the consulting process in organizational development extends the Lewin- Schein model. This involves working through a series of stages - presented to managers by systems analysts in terms of outside consultants. Their strategies for action can be viewed as follow:-

1) **Scouting** - Matching the systems analyst to the needs of the organization.
2) **Entry** - The systems analyst defines those key indicators that can be used to measure progress and accomplishment.
3) **Diagnosis** - Identification of the forces that impede movement toward current goals.
4) **Planning** - The initiation of the planning process to answer the question of what, who and how.
5) **Action** - Successful implementation of the plans set forth in the previous step.
6) **Evaluation** - Utilization of appropriate procedures to elicit feedback about progress.
7) **Termination**- A means by which the relationship can be terminated that is agreeable to all parties.

The systems analyst is a change agent or a facilitator of organizational change in terms of a new decision support system. The change agent must be able to diagnose the situation and identify the change factors. Modern techniques for programmed decision making which consists of quantitative and qualitative models can also apply to unprogrammed decision making to a certain extent. The combination of mathematical and statistical models to test various alternatives and make judgements of the manager's intuitive feeling and experience will enhance the effectiveness of the decision making.

2.7. CONCLUSION

From the literature, we can conclude that there are many approaches to decision making . The formulation of alternatives, choices and the design of information system support for decision alternatives are affected by the difference in types of decisions and problems, the organization's objectives, environment and the personality of the decision maker. There are many decision alternatives due to the complexity in some of the problems and analysis could become very difficult. As a result, careful evaluation has to be done. The decision makers cope with uncertainity by searching or acquiring relevant information using their intuition, then use a systematic problem solving approach for decision making. There is no "right way" for problem solving and decision making. They differ from individual to individual according to personal and cultural values [17] the environment he is in and the knowledge, skill and experience he has. These are the determinants of effective decision making.

Churchman's decision centred model for decision making would be suitable to use in a changing environment where there are changing elements involved in decision making. These include the human, social and economic factors and organizaional objectives and constraints. The model incorporates adaptive or learning features, intuitive judgement of the user, and combining it with Krepner and Tregoe's systematic problem solving

approach would be a suitable model for the development of DSS.

The view of DSS is to "support and enhance the manager's decision making ability", and "shifts attention from the level of operation towards the issues of managerial problem solving" [8]. The support that DSS provides varies from tailored to a particular problem or even to a specific individual's view of a particular problem. At the other extreme, DSS can provide support to multiple decision makers in relation to the context of the problem. The designer must observe, understand and identify the decision makers world and meet their needs. He and the users must also look into the aspect of predicting adverse consequences for the decisions made. This is the most important aspect that affects the success of the DSS system which is always neglected by both the user and designer.

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CHAPTER 3

DECISION SUPPORT SYSTEMS (DSS)

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3.1. INTRODUCTION

In the era of advanced technology, there are continuing pressures from the internal and external environment to improve the efficiency and effectiveness of the organizations. These lead managers to seek help from information technology, to aid their decision making.

Researchers are trying to find a tool for the strategic decision makers in organization to supplement where other computer-based information systems have failed. They have recognized the potential of decision support systems as a remedy for the failure of other computer based information systems.

The concepts involved in DSS were first articulated in the early 1970s by Michael Scott Morton, when he used the term 'Management Decision Systems' (Morton 1971). From then on 'Decision Support Systems' has been used by some firms and scholars in research. Decision Support Systems became characterized as "interactive computer-based systems which help the decision maker utilize data and models to solve semi-structured and unstructured problems" [26].

The use of a computer at all stages of decision making- from problem identification to decision making (in an iteration fashion) is a merging of computer outputs with the subjective feeling and judgment of the decision maker to reach a sounder decision.

3.2. DEFINITION OF DECISION SUPPORT SYSTEM

The term "decision support" appears to be an outgrowth of the management information system(MIS) area which has its roots in file

management.

Decision support system(DSS) refers to a class of systems which is designed to support managers' decision making. Keen and Morton define decision support systems as the use of a computer to :- [14]

- Assist managers in their decision process in semi-structured tasks.
- Support, rather than replace, managerial judgement.
- Improve the effectiveness of decision making rather than its efficiency.

The emphasis is on direct support for managers to enhance the professional judgment required in making decisions on semi-structured problems. DSS allows the decision maker to retrieve models and data and test alternative solutions, ask "What if" questions during the process of problem solving. It helps the manager in the decision making process and does not make the decisions for the managers. DSS incorporates features found in management information systems, and sometimes mathematical models used in operations research.

Baxter [3] defines DSS as a learning tool that helps a manager get hands on what is happening in his particular area of responsibility. It helps to interpret what is going on behind the numbers. It is evolutionary- as a manager learns more of his job and the way he makes decisions, he changes and improves the systems.

Sprague [26] suggests that decision support systems :-

- Combine the use of models and analytic techniques with traditional data access functions,
- Focus on features which makes them easy to use by non-computer people in interactive mode and,
- Emphasize flexibility and adaptability to accommodate changes in the environment and the decision making approach of the user.

The other recent definitions of DSS are offered by Moore and Chang(1980), Bonczek, Holsapple and Whinston(1980) and Keen and Morton(1980). They define DSS as:-

- Extensible systems.
- Capable of supporting ad hoc data analysis and decision modeling.
- Oriented towards future planning.
- Used at irregular, unplanned intervals.

A very likely reason for this change in emphasis is the difficulty of measuring the output of a DSS(ie. Decision quality).

Wagner(1981) [28] concluded that based on the results of a survey conducted with the users of a modeling language for building and using DSS "the real substance of DSS is Executive Mind Support". The basic assumption is that, in its most general sense, DSS refers to any computer software designed primarily to support the decision makers in thinking about the various aspects of the decision problems facing them.

It is important to emphasize that the decision support systems must be built from the managers or users' perspective and based on their decision making process and organizational context. From the above literature, we can conclude that the decision support system is a computer based system which helps the decision makers utilize data and models to solve semi-structured problems. It incorporates features found in the area of management information systems, management science and operation research. DSS emphasizes direct support to decision makers in decision making instead of replacing them. It is an interactive, simple and easy to use system which is designed for non-computer people, is flexible and adaptable to the user's changing environment and decision making process and is under the user's control.

3.3. CURRENT RESEARCH AND OPINIONS

Keen and Morton, McCosh and Scott Morton and Sprague all suggest that decision support systems should be utilitized at all managerial levels of the organization [14, 20, 26]. In a survey of organizational users, Naylor [23] found that most of the users were from middle and upper management. Simon [28] divides the decision making process into phases of intelligence, design and choice.

DSS should be used to support individual and group decision making, as Keen and Scott Morton and Sprague stated. They have indicated a greater likelihood for a general improvement in communication as many decision makers utilize similar systems for decision making.

One potential threat to interaction and communication between individuals concerns the use of a "personalized DSS". Davis [7] and Hackathorn and Keen [11] dichotomize DSS into "institutional" and "ad hoc" depending on whether or not they are used on a regularly scheduled basis.

As a general level, the roles of the managers and others may be expanded as a result of using DSS. Some writers simply observe that changes have taken place, while Ginzberg [9] states that the DSS generates a change in the definition of the manager's task and Nash [23] observes that the use of DSS led to an "expansion of decision process of users" in a major bank.

The literature suggests the importance of evaluating the success of a DSS. Sprague and Carlson [27] have provided an overall framework for evaluating a DSS. Welsh [29] has also conducted a comprehensive investigation of the measurement of DSS success.

3.4. INFORMATION DECISION MAKING, AND MANAGERIAL JUDGMENT WITHIN A DSS ENVIRONMENT

Decision situations have been viewed as a range from structured to unstructured. [10,14] Structured situations occur when the decision is completely automatable and there is no need for managerial involvement. In unstructured situations virtually no aspect of the situation is amenable to computerizable form. In between these extremes are "semi-structured" decisions which are amenable to analytic, computerisation techniques, portions of which require human judgment and intuition to deal with the unstructurable portion.

An observation on decision making which was found useful is that different types of decisions have different data processing requirements [2,6,10,14,20,24,26].

Information is a major resource of an organization, it supports the decision making process within a DSS environment. As managerial judgement is critical in the decision making process, a decision support system must be designed that allows combining managerial judgment for producing meaningful effective decisions.

Cognitive psychologists suggest that perception is a major component of the decision making process. A decision maker perceives information will substantially influence how decisions are made and will impact their quality [8,18]. If decision makers' perceptions of information are able to influence the decision process, the information system designer need an understanding of the way in which perception affect that process. It is vital to note that the information for one individual will not be the information for another [15,16,17,19,22].

Bonczek and co-authors [5] also indicate that a decision support system should address at least the three topics of data management:-

modeling (computation management); the user's interface (ie. user language) and data management. These three are interwined and interdependent. It should be designed with a unified database, easy to use, flexible enough to meet all types of information requirements at all levels, and dynamic enough to meet all changes in the future.

3.5. FRAMEWORK OF DECISION SUPPORT SYSTEMS

The specific decision support system will depend entirely on the task, the organizational environment, and the decision maker(s) involved. The following objectives collectively represent a set of capabilities which characterize the full value of the DSS concept from the manager/user point of view.

The characteristics of DSS which have evolved from the work of Alter, Keen and others include:-

(1) They tend to be aimed at the less well structured, under specified problems that managers typically face. These are the types ofdecisions that have had little or no support from EDP, MIS or management science/ operation research in the past.

(2) They attempt to combine the use of models or analytic techniques with traditional data access and retrieval functions.

(3) They specifically focus on features which make them easy to use by non-computer people in an interactive mode. It must learn its users' allegiance by being convenient and valuable.

(4) They emphasize flexibility and adaptability to accommodate changes in the environment and the decision making approach of the user.

(5) They provide decision- making support for managers at all levels, assisting in coordination between levels whenever appropriate.

(6) Decision support system should support all phases of the decision making process. A popular model of the decision making process has been given by Herbert Simon. He characterized the process in terms of three main steps.

a. Intelligence: Searching the environment for conditions calling for decisions). Raw data is obtained, processed, and examined for clues that may identify problems.
eg. - A list of quality costs.
- Quality costs at the individual department.

b. Design : (Inventing, developing and analyzing possible courses of action). This involves processes to understand the problem, to generate solutions and to test solutions for reasonableness. eg. - A bar chart of quality costs occurring in the production department.

c. Choice : (Selecting a particular course of action from those available). A choice is made from the alternatives.
eg. - Evaluate the quality costs by report.
- Evaluate the quality costs by chart.

Simon's [24] model also illustrates the role of MIS and MS/OR in decision making. EDP and MIS have made major contributions to the intelligence phase, but there has been no substantial support for the design phase. This seems to be one of the primary potential contributions of DSS.

(7) DSS should support a variety of decision-making processes, without being dependent on any one. It provides the decision maker with a set of capabilities to apply in a sequence and from that fits his/ her cognitive style, is processed independently and is user- driven. ie. the DSS must be designed in modules, so that the user can get the required information and be able to process the information easily.

The DSS framework is described as an extensible system with an intrinsic capability to support ad hoc extraction, analysis, consolidation and reduction as well as decision making activities and reporting. It is used for future planning orientation as opposed to the extraction of

"Historical" data. The goal is to improve managerial effectiveness as opposed to improving the operational efficiency of data processing. The major difference between DSS and other systems is the extent to which the information processing task can be prespecified by the user of the system.

Gorry and Scott Morton stated that " as we improve our understanding of a particular decision, we can make it more structured and allow the system to take care of it, freeing the manager for other tasks" [10].

3.6. RELATIONSHIPS OF DECISION MAKING AND DEVELOPMENT OF DECISION SUPPORT SYSTEM

In the DSS literature, Joyce and Oliver describe how a planning group changes its way of defining and managing projects as a result of its use of a DSS. Ginzberg postulates that changes in the manager's approach to the necessary tasks are intrinsic to successful DSS adoption. Haseman [12] notes that the real problem in implementing GPLAN(A planning DSS) was not in teaching the users how the system worked, but rather in getting them to make the role change from programmer/ analyst to decision maker.

Keen [14] stresses that decision making requires a detailed understanding of decision making in organization. He presents a diagnostic approach to the study of decision making. In the previous chapter, we discussed the literature of decision making, which was classified into five main schools of thought. We will now look into the different implications of these five schools of thought on DSS design and implementation.

3.6.1. The Rational Manager View:

The implementation process in this situation requires technical competence and educating those involved to adopt a rational perspective and to be explicit and consistent in their assessments. Game theory and decision analysis have exploited the rational framework. They analyse the logic of choice in competitive situation and maximize expected utility

respectively.

3.6.2. The "Satisficing" Process-oriented View:

This view focuses on how a decision maker can most effectively use limited knowledge and skills. The application of it to DSS involves building a descriptive model of the decision process. The design goal is then to improve the existing solution and not to vainly seek for an optimum.

Simon says that most problem- solving strategies for satisficing are based on heuristic rules of thumb that give good enough solutions most of the time. He added that building a DSS, one must understand the manager's decision process and know the heuristics he or she uses. Heuristics reflect "bounded rationality" - these are a compromise between the demands of the problem and the capabilities and committment of the decision maker.

3.6.3. The organizational Procedures View:

This concept of decision making emphasizes the design on discovering what the decision making procedures are and how some or all of them might be supported and improved. It stresses the importance of identifying organizational roles, channels of communication, and relationships. The organizational decision making involves bargaining among their own priorities, goals and focus of attention. Each develops its own standard "program" which constitutes its memory and store of learning.

3.6.4. The Political View:

Design based on this view emphasizes understanding the realities of power and the compromises and strategies necessary to mesh the interests and constraints of the factors in the decision process. The political viewpoint is very important for DSS because it is so seldom expressed and most analysts and designers are surprised that it should be seen as relevant. It is an important constraint and opportunity if one is interested in building a system to be used.

3.6.5. The Individual Differences Perspective:

The design and implementation strategy for building a DSS are seen as contingent on the decision making style. The DSS should mesh with the cognitive structures of its users. Mintzberg [21] suggests the cognitive style approach by looking at how the decision makers are, not how they ought to be.

There is no right way to look at the decision process. In reality, the nature of the situation is quite often multi-dimensional. From the project, there were two types of decision making approaches, ie. the organizational procedures view and the political view existing in Company A. Therefore during the design system development process, the following considerations were taken into account:-

- Identifying the organizational roles, channel of communications and relationships.
- Understanding the realities of power and arranging interviews with the managers involved. Discussions and meetings were held to gain feedback from the managers about their opinions and needs of the system.

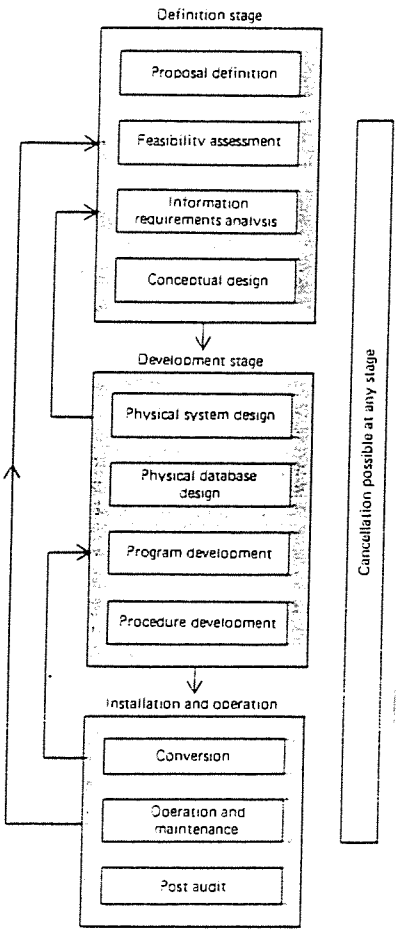
3.7 DECISION SUPPORT SYSTEM DEVELOPMENT METHODOLOGY

A decision support system does not solve problems, it lets individuals exploit their own skills in problem solving. The initial system must be close to the users' current procedure to be both attractive and easy to use. The traditional system design methodology is system life cycle approach.(Refer to 3.7.1. Convention design approach) Keen [14] views a DSS as an adaptive development strategy applicable only to situations where the final system can not be predefined. John Bennet suggested up the middle out approach in his "Building decision support system". Sprague and Calson illustrate the importance and need for flexibility in DSS - because the environment, the tasks and the users are subject to frequent changes. Here we will take a closer look at the different approaches of DSS development methodologies.

3.7.1. Conventional Design Approach

This approach emphasizes the stages of systems analysis and design, the division of responsibilities between the information services department and users. User and staff members reccommend the development of a system in some particular functional area of the organization. The EDP staff conduct the feasibility study, analysis, design, documentation, testing and implementation. Refer to Figure- 3.1.

Figure- 3.1. Conventional Design Approach



(Adapted from: Davis, G. B. and Olson, M. H. Management information systems: Conceptual foundations, structure and develpment. McGraw Hill Book Company, 1985. p571.)

There are three major stages of system development:

Phase 1. Definition Stage

- Proposal definition
- Feasibility assessment
- Information requirements analysis

Phase 2. Development Stage

- Physical system design
- Physical database design
- Physical development
- Procedure development

Phase 3. Installation and Operation

- Conversion
- Operation and maintenance
- Post audit

This approach is a troublesome, complex, costly and time consuming process. Problems arise when there is very little user involvment in the system development process which leads to lack of use and dissatisfaction with the system.

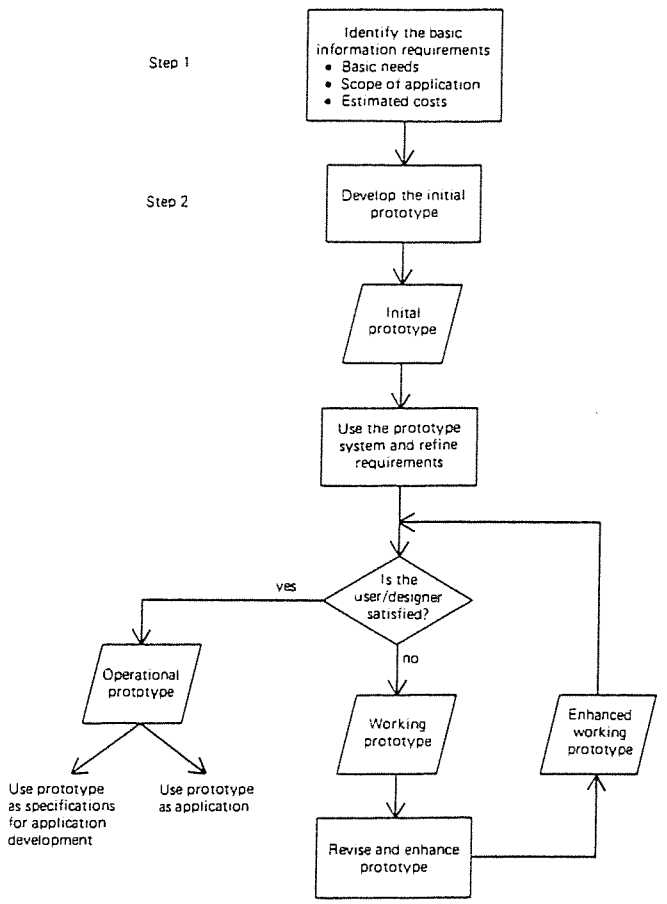
3.7.2. Prototyping Approach

The early framework of prototyping approach is the so-called middle out approach [4] which attempts to quickly establish a working model or prototype of a system. This design strategy is found under several terms such as adaptive design or evolutionary design or prototyping. A prototyping approach assumes that the final system must evolve through usage and learning. Refer to Figure- 3.2. The designer relies on a prototype system to :-

- find out quickly what is important to the user as opposed to what the designer thinks ought to be important.

- provide something concrete for the user to react to and to experiment with, and
- define a clear architecture for the DSS, so that it can be easily modified and in line with user's needs.

Figure- 3.2. Prototyping



(Adapted from A. Milton Jenkins, Prototyping: A methodology for the design and development of application systems, Working Paper, School of Business, Indiana University, 1983)

a) The features of the prototyping approach

(1) User learning is explicitly integrated into the design process- it is accomplished in an iterative fashion between designer and user.

(2) The feedback or iterations must be relatively fast- this is to support learning, as good timely feedback is prequisite to effective learning processes.

(3) User involvement - prototyping assumes that the user must actively participate in the design effort as well as recognizing that successful implementation will be more easily achieved with active involvment.

(4) Low cost - the initial prototype must be "low cost". It must fall below the minimum threshold for capital outlay justification.

(5) Evolves requirements via the user learning process.

This approach assumes that requirements are only partically known and attempts to clarify needs by actively involving the user in a low cost, fast feedback development process. It is a strategy for determining requirements wherein user needs are extracted, presented and refined by building a working model of the ultimate system- quickly and in context.

3.7.3. User-developed System Approach

A new system approach arises as a result of the rapid development in computer technology. The appearance of more powerful microcomputers and the abundance of application software allows the end-user an opportunity to develop their own system, instead of depending on the system professional. The term "user" in this context refers to any person other than a system professional whose primary activity is the development/ or management of computer- based systems.

The user-developed systems range from simple programs written by manager to run on their personal computers to the use of a data base query language to draw information from the corporate data base. The technical tools for this approach are :-

- Computer programming languages- eg. BASIC, FORTRAN, COBOL;
- Application packages- off-the-shelf packages such as spreadsheet, database and integrated packages.
- Fourth generation language packages- a high level programming language which can perform complex mathematical operations by using very few statement.

This approach is becoming more popular, hence, attention needs to be concentrated on the improvement of system problems. such as security, data transfer and net- working.

3.7.4. Factors for Determining the Development Approach

All systems development approaches, even the conventional design approach, have their users. To determine the appropriate method to use the following factors must be taken into account:-

(i) Commonality: The extent to which other organizations might use the system solution for a given problem. If it is a common problem, software packages are probably already available on the market. If the problem is unique, or the company's requirements dictate a unique approach to solve it, some sort of in-house development is indicated.

(ii) Impact : The degree to which a system will affect the company largely determines the roles the information system professional should play in the systems development. In general, the wider spread the impact, the more important to the company.

(iii) Structure: How well we understand the problem and its probable solution. The less certainty about what the proposed system should do, the more attractive prototyping becomes, because of its iterative, participative development process.

The user must be very cautious when they decide to develop a system, special attention needs to be put on the type of problem to be solved, the software and hardware used and the development approach to be adapted for the system. All these factors determine the success of the system development.

3.8. THE DESIGN OF DECISION SUPPORT SYSTEMS

The design of effective DSS requires application of a wide range of skills and attitudes. In addition to technical proficiency, the following skills and attitudes are required:-

- Understanding the decision making process in the organization.
- Appreciation of the complexity of empirical DSS design tasks.
- Awareness of and willingness to accommodate the DSS design to variation in decision environments and diverse tasks of managers.
- Sensitivity to the interpersonal and organizational dimensions of the relationships between decision-makers and DSS designers.

3.8.1. The Components of Decision Support Systems

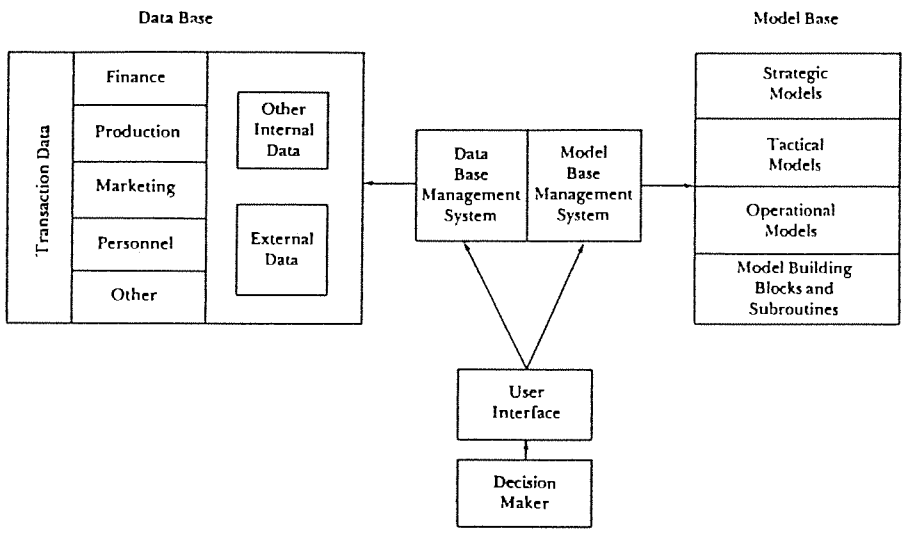
Decision support systems focus on the support of the manager's decision making rather than making decision for them. These systems consist of three major subsystems: [25] - a data base, a model base and the decision maker

The data base and model base are managed by software (e.g. command language) that work closely together to facilitate and manipulate the flow of data. It is done through a terminal that provides the mechanisms by which the decision maker gains access to both data and models, and manipulates them to support decision making.

(i) Data Base Sub-system

The data base system consists of a data base and a software system. It serves as a data gathering device. The sources of raw data are from the basic data processing activities of the organization - transactions processing, budgets, standards and plan. It must have a variety of logical structures to perform data retrieval, sorting, inquiry and reporting.

Figure- 3.3. Components Of A Decision Support System



(Adapted from: Sprague, R. H. Jr. "Bit by bit: Towards decision support systems". California Management Review, p64. Vol. XXII. No. 1. Fall, 1979.)

(ii) Model Base System

The model comprises the model base subsystems of strategic, tactical and operational models, model building blocks and subroutines. The strategic models are wide in scope. It could include company,s top management's strategic planning and are usually custom built for a particular organization. The tactical models are commonly used by middle management to assist in allocating and controlling the use of the organization's resources. The operational models are usually used to

support the short term horizon decision which are commonly found at lower organizational levels.

The model base also contains model building blocks and subroutines from which other models can be constructed. eg. linear programming and capital budgeting.

(iii) The Decision Maker System

The primary components of man-machine interface are the terminal device and the command language the user used to interact with the system. The common visual display is the graphic and color capabilities. It is a potent element in aiding the decision maker in interacting with the DSS. The command language which allows the decision maker to access and manipulate data and models in DSS must be flexible, robust, and easy to use.

Table- 3.1. Characteristics Of Different Classes Of Decision Support Systems

Type	*Type of Task*	*Hands-on User*	*Decision Maker*	*Key Role*	*Key Usage Problem*
File drawer system	Operational	Nonmanagerial line personnel	Nonmanagerial line personnel	Hands-on user	User motivation and training
Data analysis system	Operational or analysis	Nonmanagerial line personnel or staff analyst	Nonmanagerial line personnel, manager, or planner	Hands-on user	Can people figure out what to do wit the system?
Analysis information system	Analysis	Staff analyst	Manager or planner	Intermediary	How effective is the intermediary?
Accounting model	Planning	Staff analyst or manager	Manager or planner or line personnel	Intermediary, feeder	Integration into planning process
Representational model	Planning	Staff analyst	Manager	Intermediary	Understanding
Optimization model	Planning	Staff or nonmanagerial line personnel	Manager or nonmanagerial line personnel	Intermediary	Understanding
Suggestion model	Operational	Nonmanagerial line personnel	Nonmanagerial line personnel	Hands-on user	User motivation and understanding

(Adapted from: Alter, S. L. Decision support systems: Current practice and continuing challenges.Addison- Wesley, Reading, MA. 1980. p90-91)

Existing systems have generally focused on one type of problem [13]. The various types of decision support systems summerized by Alter [1] are shown in Table -3.1. Alter classified 56 systems then available by the way the output determined the decision. His taxonomy is severely limited because he only reviewed and classified large, corporate- wide DSS. Furthermore, he included the file drawer systems (for simple inquiries) and optimization models as decision support systems. These two systems were aimed at solving structured problems, therefore, we should not include them as decision support systems.

3.8.2. The Success Factors for Design of Decision Support Systems

Studies on decision makers' activities related to DSS and approach to DSS design reveals the following observations on the success factors of designing DSS:-

(1) User interaction:-

The decision makers sometimes have trouble describing a decision making process, but they seem to rely on conceptualization, such as pictures and charts. Therefore the decision support systems should help the decision maker to conceptualize a problem visually through interaction during the design process.

(2) Organization support:-

The support of the organization is critical to the sucess of DSS. The organization must recognize that the problem is important and must provide the resources necessary for its solution.

(3) Continual change:-

Changes happen continuously throughout the whole life-cycle of DSS. These include the changes in users, technical tools, organizational needs, etc. All these changes should be a positive force in the adoption of DSS in the decision making situation.

(4) Integrating agent or intermediary:-

A DSS is not an off-the-shelf product. Building it requires close involvement with the user. Keen believes that there is a need for an intermediary and Bennett commented that an integrating agent who can act as a crusader, teacher and even confidants are needed.

(5) Hardware and software:-

The hardware and software used play a vital role in DSS design. The designer must take into consideration the limitation, and power of the hardware, and make full use of it.

There are many types of software for modelling, such as programming languages, spreadsheet packages, data base packages, integrated packages. The selection of the right software for designing DSS to meet the user requirements is an important but not an easy task.

3.9. CONCLUSION AND FURTHER DEVELOPMENT

Timely and accurate business information is a resource: an asset that has been generally understood, underestimated and underused. After the human element, it is the manager's most important resource. Good planning over operations via effective decision making must be based on good quality up-to-date information. DSS will become an extension of the manager's mind and a "silent partner" for supporting more effective decision making. It is an interactive, ad hoc analytical capability that permits managers to simulate or model their problems as completely and accurately as possible, and test the impact of different assumption or scenairos.

To further enhance the effectiveness of the technology in developing decision support systems, it is vital that the DSS designer understands the user's decision making process, selects and defines the problem to be solved, information and ouputs required by the users. DSS is used for future planning orientation as opposed to the extraction of "Historical

Data". The objective is to improve managerial effectiveness instead of improving the operational efficiency of data processing.

The system development approach has moved from the traditional system approach to prototyping and user-developed approach. These changes are largely due to the advance of microcomputer technology, abundance of microcomputer hardware and software, the lack of information system professionals, and the cost and time factos involved.

The quality of the user-developed approach is an area which needs further research. Problems such as guidelines for documentation, file and data security, need to be paid special attention. The move towards using fourth generation language and application packages for building decision support system is inevitable, but, evaluation and development guidelines of systems documentation must be introduced to ensure the quality of the system.

The prototyping system development methodology for decision support system has proved to be more successful than other types of system development methods [7]. In effect, it combines the traditional steps of analysis, design, programming and testing into one interactive flow chart with the user controlling the entire process. Prototyping was adapted for the Quality Costs MIS/DSS project in Company A because the users were uncertain about their needs initially and what they could get out of the system. Using Prototyping enabled the system to get into operation quickly, thus saving time and cost. It also increased the likelihood that the final design met the user's needs and evolved over time through user learning.

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CHAPTER 4

SURVEY ON COMPUTER APPLICATION IN MANUWATU REGION

CHAPTER 4 SURVEY ON COMPUTER APPLICATION IN MANAWATU REGION

4.1. INTRODUCTION

The increasingly volatile and competitive environment stimulates the organizations of the 80's to demand for better information, higher productivity, efficiency and more effective planning tools. The decreasing costs of computer hardware and software that are available in New Zealand has resulted in widerspread acceptance of computerization in the New Zealand industry. They are used as a management tool for planning, forecasting and controlling.

In 1982, Mr. Martin Kaiser of the DSIR's Physics and Engineering Laboratory conducted a survey of production control applications using computers. An analysis of the results showed that among the 107 companies that responded, 19% of companies had mainframe computers, 70% had minicomputers and only 6% had microcomputers. Two years later, Arthur Hoby & Associates Ltd carried out a survey on the New Zealand microcomputer industry, which showed that 1984 was a year of considerable change for the New Zealand microcomputer industry. The market size was 8,934 units valued at NZ $89.2m in end- user or retail pricing. The bulk of microcomputers installed continue to be stand alone systems (51.5%) with just over 20% being multi-user systems.

A mail survey of 200 managers and executives from the largest companies in New Zealand was conducted in June 1985 by Steve Hodgkinson and Drew Bone of Otago University, to study the use of microcomputers for managerial purposes. The result shows that 45% of managers used microcomputers to support their work and 24% planned to start using computers within the next year. This suggests that approximately 70% of the managers of large companies in New Zealand will be using microcomputers by 1987.

The survey conducted in New Zealand on computer applications were mainly concentrated on a particular area. e.g. "Computer usage in Hamilton" by Cherie King and Colin Beardon; "Managerial use of microcomputer in large New Zealand companies" by Steve Hodgkinson. The present survey done on the computer applications in the Manawatu region attempted to look into the extent of the computerization in the region, the experience of the user, the computer hardware and software use, the training needed and attemped to establish relationship between computerization and the size of the organization and the type of industry in New Zealand.

4.2. THE OBJECTIVES OF THE SURVEY

a. To explore the extent of computerization in the Manawatu region.
b. To investigate the range of computer programs being used by local companies.
c. To investigate what tasks the programs are performing.
d. To find out the training needs for computer applications.
e. To establish a relationship between computerization and the size of organizations.
f. To establish a relationship between computerization and the type of industry.

4.3. METHODOLOGY

4.3.1. The Population:

A complete up to date list of companies in the Manawatu region was not available. However the "New Zealand Business Who's Who" and the "Yellow Pages" provided information on the companies in the Manawatu region. The estimated population size was 3052 units in June, 1985. (Statistics obtained from Ministry of Labour)

4.3.2. The Sample:

Two hundred samples were taken from 2 sources- 1984 New Zealand Business Who's Who and the "Yellow Pages". A stratified random sampling method was used to ensure that there was a good representation of the population. The industries were stratified according to the groups classified in the Statistics Year Book Of New Zealand. The companies were categorized into eight categories:-

1). Manufacturing.
2). Trading, restaurant, hotels.
3). Engineering.
4). Finance, insurance, business services.
5). Construction.
6). Transport and storage.
7). Primary product.
8). Others.

Samples were then randomly selected according to the proportion of the strata within the population.

4.3.3. Survey Procedure

Due to time and financial constraints, a mail survey was used. A survey questionnaire was designed to obtain a wide range of factual information about the company and to assure people of anonymity. A questionnaire was sent to 200 randomly selected samples in the Manawatu region, along with a covering letter, (see Appendix-A.) explaining the research project, directions for completing the questionnaire and a postage paid return envelope. A copy of the questionnaire is included in Appendix-A.

A pilot test on the draft of the survey questionnaire was carried out by asking those who had no or limited computer knowledge to fill out the form.

The questionnaires were despatched on the first of August 1985 and expected to be returned by the end of August. Due to cost, time constraints and the anonymity design of the questionnaire, no follow-up mailing was sent.

4.4. QUESTIONNAIRE DESIGN

The designed questionnaire contains 22 questions (Refer to Appendix-A). It consists of four sections:-

Section A. Background information about the company.

Section B. Information on the extent of computer application in the industry.

Section C. Information on the computer packages/programs currently used by the company- the models, the application,the funtions, subjective rating of the packages/ programs and the reasons for purchasing them.

Section D. Future plans of the company on computerization and training on the application of computer needed.

A flow chart on "How to fill the Questionnaire" and a glossary on special computer terms were attached with the questionnaire. The computerized companies were requested to answer all questions, while the non-computerized companies were requested to answer Section A and Section D. (Refer to Appendix-A. for more detail)

4.5. THE RESULTS OF THE SURVEY

In this section, I will discuss the points of interest drawn from the analysis of the information gathered from the survey.

Sample	: 200
Total Questionnaires Received	: 79
Total Usable Response	: 76
Response Rate	: 38.6%

4.5.1. Respondent Characteristics

Of the 200 questionnaires despatched, 79 were returned, three returned questionnaires could not be used for the following reasons:-

a. The firm had gone out of business and returned a blank questionnaire.
b. The firm was not at the stated address and the post office returned the questionnaire.

These unuseable questionnaires were deducted from both the total sample size and the total response rate was then calculated as 38.6%. Out of the 76 respondents' companies, 53.9% were computerized and 46.1% were non-computerized.

5.5.2. Survey Bias

The generality of the results should be accepted with caution. While little, if any, bias is evident in the responding sub- population, this cannot be concluded in relation to the non-responding sub-population. As no follow-up survey was done, we cannot conclude that there is an uniformity of characteristics and problems for both the responding and non-responding population. It is vital to aware that the existence of the two extreme possibilities- difference and no difference in the sub-population, enables a more complete assessment to be made of

prevailing characteristics, problems and needs in the sector.

The non-response may be symptomatic of several factors, ie. 1. Those companies which are not computerized. 2. Those companies which have no one in charge of the computer. 3. Due to time constraints, the company was unable to reply.

4.5.3. Interpretation Of Tables

The questionnaire was designed to allow the respondents to give multiple answers, therefore the total frequency of the answers were not equal to the total number of respondents.

a. Frequency Table

i. COUNT -- No of responses, the number of 'COUNT' will be larger than the number of valid cases due to multiple answers for one question.

ii. PCT OF RESPONSES -- This is the number of 'COUNT' divided by the 'TOTAL COUNT' multiplied by 100 to give a percentage.

iii.PCT OF CASE -- This is the number of 'COUNT' divided by 'VALID CASES' multiplied by 100 to give a percentage.

b. Crosstabulation

The crosstabulation is used to find the relationship between two variables through combining the results of the two variables.

i. COUNT -- The number of 'COUNT' is the same as the frequency table.

ii. ROW PCT -- The row percentage is calculated by using the individual cases for the particular category divided by the total number of cases for that category multiplied by 100 to give a percentage.

iii.COL PCT -- The column percentage is calculated by the individual case for the column divided by the total cases of that column multiplied by 100 to give a percentage.

iv. ROW TOTAL -- There are two numbers in the row total. The first number is the total number of cases. and the second number the case for the category divided by total cases multiplied by 100.

v.COL TOTAL -- There are two numbers in the column total. the first number is the total cases of that column and the second number is the percentage of the column total divided by the total cases multiplied by 100.

4.5.4. The Results

i. The Industry Background Of Surveyed Companies

a. Company's Activity

Table- 4.1 indicates the number of respondents in each industry category. All the companies surveyed were grouped into eight categories as shown in Table -4.1. The sample were grouped according to the classification of industry groups in the Statistics Year Book Of New Zealand. The major groups were manufacturing (35.7%), trading, restaurant & hotel(27.1%), engineering (12.9%) and finance, insurance, business services(10.0%). There were seventy companies giving details of their company's activity and there were six firms involved in two industries. (Refer to Figure- 4.1 in Appendix-A)

Table- 4.1. Company Activity

INDUSTRY	COUNT	PCT OF RESPONSES	PCT OF CASES
MANUFACTURING	25	32.9	35.7
TRADING,REST,HOTELS	19	25.0	27.1
ENGINEERING	9	11.8	12.9
FINANCE,INSURANCE,BUSINESS SERVICE	7	9.2	10.0
CONSTRUCTION	4	5.3	5.7
TRANSPORT & STORAGE	3	3.9	4.3
PRIMARY PRODUCTS	1	1.3	1.5
OTHERS	8	10.5	11.4
TOTAL RESPONSES	76	100.0	108.6

b. Company Size

In New Zealand, 80% of the companies are small businesses (The small business section in New Zealand By Martin H. Devlin). The definition of small business is given as a business having 1 to 25 employees. But there is no definitioin of medium and large businesses. Hence the following definitions were used in order to present this survey report:-

	No of Employee
1) Small Business	1 - 25
2) Medium Business	26 - 200
3) Large Business	201 and above

In Table- 4.2, 58.2% of the respondents' companies were small businesses, 28.3% were medium businesses and 13.4% were big businesses. (Also refer to Figure- 4.2. in Appendix-A)

Table - 4.2. Company Size

NUMBER OF EMPLOYEES	COUNT	PCT OF RESPONSES	PCT OF CASES
1 - 5	14	20.9	20.9
6 - 10	11	16.4	16.4
11 - 25	14	20.9	20.9
26 - 50	7	10.4	10.4
51 - 100	5	7.5	7.5
101- 200	7	10.4	10.4
201- 500	8	11.9	11.9
> 500	1	1.5	1.5
TOTAL RESPONSES	67	100.0	100.0

ii. The Respondent's Computer Application

a. Extent of Computerization

Out of 76 respondents, 41 of the respondents' companies were computerized. (Refer to Table- 4.3) The overall picture presented has shown an extensive computerization in manufacturing, trading, restaurant and hotels, finance, insurance and business services, primary products, construction, and transport and storage industries. Refer to Table- 4.4. for details.

Table- 4.3. COMPUTERIZATION

CATEGORY LABEL	COUNT	PCT OF RESPONSES	PCT OF CASES
COMPUTERIZED	41	53.9	53.9
NOT COMPUTERIZED	35	46.1	46.1
TOTAL RESPONSES	76	100.0	100.0

Table-4.4. Company Activity By Computerization

COMPANY ACTIVITY	COUNT / ROW PCT / COL PCT	COMPUTERIZED 1	NOT COMPUTERIZED 2	ROW TOTAL
MANUFACTURING	25	17	8	25
		68.0	32.0	32.9
		37.8	25.8	
TRADING, RESTAURANT HOTELS	19	13	6	19
		68.5	31.6	25.0
		28.9	19.4	
ENGINEERING	9	4	5	9
		44.4	55.6	11.8
		8.9	16.1	
FINANCE, INSURANCE BUSINESS SERVICE	7	3	4	7
		42.9	57.1	9.2
		6.7	12.9	
PRIMARY PRODUCTS	1	1	0	1
		100.0	0.0	1.3
		2.2	0.0	
CONSTRUCTION	4	3	1	4
		75.0	25.0	5.3
		6.7	3.2	
TRANSPORT & STORAGE	3	2	1	3
		66.7	33.3	3.9
		5.5	3.2	
OTHERS	7	2	6	8
		25.0	75.0	10.5
		5.5	19.4	
COLUMN TOTAL	76	45	31	76
		59.2	40.8	100.0

There were six companies which did not give information on their company activities. And there were six companies which had two activities in the company. Hence the total computerized companies and non-computerized companies does not equal the total in Table- 4.3. ie. 41 companies computerized and 35 companies non-computerized. (Refer to Figure- 4.3. in Appendix -A)

Table- 4.5. Company Size By Computerization

COMPANY SIZE	COUNT / ROW PCT / COL PCT	COMPUTERIZED 1	NOT COMPUTERIZED 2	ROW TOTAL
1-5	14	2	12	14
		3.0	17.9	20.9
		14.3	85.7	
6-10	11	5	6	11
		7.6	9.0	16.4
		55.5	55.5	
11-25	14	10	4	14
		15.2	6.0	20.9
		71.5	28.6	
26-50	7	2	5	7
		3.0	7.5	10.4
		28.6	71.5	
51-100	5	3	2	5
		5.5	3.0	7.6
		60.0	50.0	
101-200	7	7		7
		10.6		10.4
		100.0		
201-500	8	8		8
		12.1		11.9
		100.0		
> 500	1	1		1
		1.5		1.5
		100.0		
COLUMN TOTAL		38	29	67
		56.7	43.3	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE
26.56123	7	0.0004

Table- 4.5. used Crosstablation and Chi-square to carry out a hypothesis test on whether there is a relationship between computerization and a company's size. A Null hypothesis (Ho) where there is no relationship between computerization and a company's size was set at a 5% significant level.

The Chi-square was used to test the hypothesis, the Chi-square value shown at the bottom of Table- 4.5. is 26.56123 with 7 degrees of freedom.(D. F.= 7) at a significant level of 0.0004. This is far lower than the accepted level of significance.(i.e. P=0.05) Hence, we rejected the null hypothesis that there are no differences between computerization and a company's size, and concluded that the computerization is affected by the size of the company. The ratio of computerization increases as the company size increases. Table-4.5 showed that there were more non- computerized companies in the 1 to 100 groups. There was 100% computerization in the medium and large size companies, ie. company size from 101 to above 500 groups. (Also refer to Figure- 4.2. in Appendix -A)

b. Types Of Computer Use

The types of computer used ranges from mainframe to microcomputer and external computer bureau. The major type of computer used were microcomputers(47.5%), mini-computers(35.2%), mainframes(26.3%) and external computer bureaus(26.3%). (Refer to Table- 4.6.)

Table- 4.6. Types Of Computer Used

TYPE OF COMPUTER	COUNT	PCT OF RESPONSES	PCT OF CASES
MICROCOMPUTER	18	35.3	47.4
MINICOMPUTER	13	25.5	34.2
MAINFRAME	10	19.6	26.3
EXT.COMPUTER BUREAU	10	19.6	26.3
TOTAL RESPONSES	51	100.0	134.2

Table- 4.7. Crosstabulation Of Companies' Activities And Type Of Computer Used

COMPANY ACTIVITY	COUNT TOT PCT	COMT1 MAINFRAME 1	MINICOMPUTER 2	MICROCOMPUTER 3	EXT.COMP BUR 4	ROW TOTAL
MANUFACTURING	25	4	5	6	1	16
		10.5	13.2	15.8	2.6	42.1
TRADING,REST,HOT	19	4	3	2	1	10
		10.5	7.9	5.3	2.6	26.3
ENGINEERING	9	1		2	1	4
		2.6		5.3	2.6	10.5
FIN,INS,BUS.SER	7			1		1
				2.6		2.6
CONSTRUCTION	4		2	1		3
			5.3	2.6		7.9
TRANSPORT & STOR	3	1	1			2
		2.6	2.6			5.3
OTHERS	8		1	1		2
			2.6	2.6		5.3
COLUMN TOTAL		10	12	13	3	38
		26.3	31.6	34.2	7.9	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE
11.17001	18	0.8870

The type of computer used did not vary with the company nor with the size of the company. Chi-squre was used to test the level of sigificance for the hypothesis that there was no relationship between the company activity, company size and type of computer used. The results from Table-4.7 and Table- 4.8. show that the significance level for both hypotheses

were smaller than the 5% signifiance level(p= 0.05). Therefore, we accepted the hypothesis that there was no relationship between the company activity, company size and type of computer used.

Table- 4.8. Crosstabulation Of Companies' Size And Type Of Computer Used

COMPANY SIZE	COMT1 COUNT TOT PCT	MAINFRAME 1	MINICOMPUTER 2	MICROCOMPUTER 3	EXT.COMP BUR 4	ROW TOTAL
1-5	14	2				2
		5.3				5.3
6-10	11	2	2	1		5
		5.3	5.3	2.6		13.2
11-25	14		2	7	1	10
			5.3	18.4	2.6	26.3
26-50	7	1		1		2
		2.6		2.6		5.3
51-100	5		2		1	3
			5.3		2.6	7.9
101-200	7	2	3	1	1	7
		5.3	7.9	2.6	2.6	18.4
201-500	8	3	3	2		8
		7.9	7.9	5.3		21.1
> 500	1			1		1
				2.6		2.6
	COLUMN TOTAL	10	12	13	3	38
		26.3	31.6	34.2	7.9	100.0

CHI-SQUARE	D.F.	SIGNIFICANCE
25.11242	21	0.2423

From Table- 4.9, about 37.8% of the computerized companies had been using computers for 5- 10 years. Refer to Table- 4.9. and Figure- 4.5. in Appendix -A. (For more details on the Types of Computer Used - Makers, refer to Appendix -A.)

Table- 4.9. No Of Years Computerized

NO OF YEARS	COUNT	PCT OF RESPONSES	PCT OF CASES
0 - 1	5	13.5	13.5
1 - 2	4	10.8	10.8
2 - 5	9	24.3	24.3
5 - 10	14	37.8	37.8
ABOVE 10	5	13.5	13.5
TOTAL RESPONSES	37	100.0	100.0

c. Person In charge Of Computer

Table- 4.10 shows that the Data processing manager was the major person who was in charge of the computer, the others were the finance manager and managing director. 61.1% of the computerized companies have 1-2 staff members specially employed for doing computer work. And 19.5% have employed 3-5 staff members. The DP manager and finance manager are the two major persons in charge of the computer in the repondents' company. Also refer to Figure- 4.6. in Appendix -A.

Table- 4.10. Person In charge Of Computer

POSITION	COUNT	PCT OF RESPONSES	PCT OF CASES
DP MGR	11	26.2	29.7
FINANCE MGR	10	23.8	27.0
MANAGING DIR	7	16.7	18.9
MANUFACTURING/PRODUCTION MGR	5	11.9	13.5
ENGINEER	1	2.4	2.7
OTHERS	8	19.0	21.6
TOTAL RESPONSES	42	100.0	113.5

iii. Design Of Models And Use Of Packages And Programs

a. Model Construct

The models currently used by the respondents' companies were constructed using language(53.3%), using spreadsheet(33.3%) and using integrated packages(26.7%) (Refer to Table- 4.11). The Spreadsheet package used were Multiplan, VisiCalc. Integrated packages used were SuperCalc, Lotus 1-2-3, Symphony. The Data base packages used were dBASE II and dBASE III.

Table- 4.11. Model Construction

MODEL CONSTRUCTED BY	COUNT	PCT OF RESPONSES	PCT OF CASES
A LANGUAGE	8	34.8	47.1
INTEGRATED PACKAGES	6	26.1	29.4
SPREADSHEET	5	21.7	35.3
DBASE PACKAGE	3	13.0	17.6
COMMAND LANGUAGE	1	4.3	5.9
TOTAL RESPONSES	23	100.0	135.3

Table- 4.12. Programming Language Used for Modelling

TYPE OF LANGUAGE	COUNT	PCT OF RESPONSES	PCT OF CASES
COBOL	6	50.0	66.6
BASIC	5	41.7	55.6
FORTRAN	1	8.3	11.1
TOTAL RESPONSES	12	100.0	133.3

The major languages used for constructing the models in the respondents' companies were Basic(41.7%), Cobol(33.3%) and Fortran (8.3%). Refer to Table- 4.12.

b. Areas The Models Used In

The models were used in the following areas:- Refer to Table- 4.13.

Table- 4.13. Model Use Area

MODEL USE AREA	COUNT	PCT OF RESPONSES	PCT OF CASES
FINANCIAL	24	37.5	64.9
PRODUCTIONN/MANUFACTURING	16	25.0	43.2
STATISTICAL	12	18.8	32.4
MARKETING	9	14.0	24.3
OPERATION RESEARCH	3	4.7	8.1
TOTAL RESPONSES	64	100.0	172.9

From Table- 4.13, we notice that models were predominantly used in the financial and production areas. Also refer to Figure- 4.7 in Appendix - A.

c. Who Uses The Models

Finance department personnel were the major computer users in the respondents' companies. The rest were data processing department, manufacturing and marketing department personnel. (Refer to Table- 4.14 and Figure- 4.8 in Appendix -A)

Table- 4.14. Persons Using Computers

DEPARTMENT	COUNT	PCT OF RESPONSES	PCT OF CASES
FINANCIAL DEPT	23	27.1	63.9
DP DEPT	14	16.5	38.9
MANUFACTURING/PRODUCTION DEPT	13	15.3	36.1
MARKETING DEPT	12	14.1	33.3
MD/GEN.MGR	9	10.6	25.0
QA/QC DEPT	3	3.5	8.3
ENGRG DEPT	2	2.4	5.6
OTHERS	9	10.6	25.0
TOTAL RESPONSES	85	100.0	236.1

There were an average of two departments' personnels using computers in the respondents' companies.

d. Packages Or Programs Used

There was a wide variety of packages and programs used by the respondents' companies. (Refer to Appendix -A. for the name of the packages/programs used by the respondents' companies) The survey analysis shown that the application of the package/ programs averaged five. They were primarily used in the financial areas, ie. accounting and invoicing. And less emphasis were placed on the decision support, planning forecasting and production control.

Most of the respondents' companies were quite satisfied with their packages or programs.

e. Functions For Which Packages/Programs Currently Used

Table- 4.15. shows the analysis of package usage in the companies surveyed. The major functions were Accounting(69.4%), Invoicing(61.1%), Stock control(47.2%). There were 30.6% of the respondents' companies using the packages for production control, most of whom were quite satisfied with the packages or programs they were using.

Table- 4.15. Functions Of The Packages/Programs Used

FUNCTION	COUNT	PCT OF RESPONSES	PCT OF CASES
ACCOUNTING	25	17.5	69.4
INVOICING	22	15.4	61.1
STOCK CONTROL	17	11.9	47.2
PLANNING	14	9.8	38.9
FORECASTING	12	8.4	33.3
JOB COSTING	12	8.4	33.3
DECISION SUPPORT	11	7.7	30.6
PRODUCTION CONTROL	11	7.7	30.6
FILING CABINET	7	4.9	19.4
PROJECT PLANNING	7	4.9	19.4
PROCESS CONTROL	2	1.4	5.6
OTHERS	3	2.1	8.3
TOTAL RESPONSES	143	100.0	397.2

Table- 4.16. attempted to use crosstabulation to find out what area or functions the packages were being used in the respondent's company. The result shows that the packages were being used in most areas, especially accounting, invoicing, stock control, planning and job costing. The results shown here may not be very accurate due to the fact that some word processor and other mainframe packages/ programs were included in the answers.

Table- 4.16. Crosstabulation of Package Used And The Area Program Was Used In

PACKAGE USE	COUNT / ROW PCT / COL PCT	PACKAGE APPLICATION DECISION SUPPORT	PLANNING	FORECASTING	PROJECT PLANNING	FILING CAB	INVOICING	ACCOUNTING	PROCESS CONTROL	PRODUCTION CONTROL	STOCK CONTROL	JOB COSTING	OTHERS	ROW TOTAL
		1	2	3	4	5	6	7	8	9	10	11	12	
WORDSTAR	5	2	2	2	0	2	4	3	0	1	3	1	0	20
		10.0	10.0	10.0	0.0	10.0	20.0	15.0	0.0	5.0	15.0	5.0	0.0	12.3
		13.3	11.8	13.3	0.0	25.0	16.7	11.5	0.0	9.1	15.0	6.3	0.0	
CAD/CAM	4	1	1	0	1	1	2	2	0	1	1	2	0	23
		7.7	7.7	0.0	7.7	7.7	15.4	15.4	0.0	7.7	7.7	15.4	0.0	14.1
		6.7	5.9	0.0	11.1	12.5	8.3	7.7	0.0	9.1	5.0	12.5	0.0	
MULTIPLAN	4	4	2	2	1	1	3	4	0	2	3	1	0	18
		17.4	8.7	8.7	4.3	4.3	13.0	17.4	0.0	8.7	13.0	4.3	0.0	11.0
		26.7	11.8	13.3	11.1	12.5	12.5	15.4	0.0	18.2	15.0	6.3	0.0	
LOTUS 1-2-3	4	1	3	2	2	0	2	2	0	2	2	2	1	13
		5.6	16.7	11.1	11.1	0.0	11.1	11.1	0.0	11.1	11.1	11.1	7.7	8.0
		6.7	17.6	13.3	22.2	0.0	8.3	7.7	0.0	18.2	10.0	12.5	100.0	
SUPERCALC	3	0	1	1	0	1	3	2	0	0	1	1	0	10
		0.0	10.0	10.0	0.0	10.0	30.0	20.0	0.0	0.0	10.0	10.0	0.0	6.1
		0.0	5.9	6.7	0.0	12.5	12.5	7.7	0.0	0.0	5.0	6.3	0.0	
DBASE II	3	1	1	1	2	1	2	1	0	1	2	0	0	12
		8.3	8.3	8.3	16.7	8.3	16.7	8.3	0.0	8.3	16.7	0.0	0.0	7.4
		6.7	5.9	6.7	22.2	12.5	8.3	3.8	0.0	9.1	10.0	0.0	0.0	
SYMPHONY	2	0	1	1	0	0	0	0	0	1	0	0	0	3
		0.0	33.3	33.3	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0	1.8
		0.0	5.9	6.7	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	
DBASE III	2	0	1	1	0	0	1	0	0	0	0	0	0	3
		0.0	33.3	33.3	0.0	0.0	33.3	0.0	0.0	0.0	0.0	0.0	0.0	1.8
		0.0	5.9	6.7	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0	
VISCALC	1	0	0	0	0	0	0	1	0	0	1	1	0	3
		0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	33.3	33.3	0.0	1.8
		0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	5.0	6.3	0.0	
XY WRITE	1	0	0	0	0	0	0	1	0	0	1	1	0	3
		0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	33.3	33.3	0.0	1.8
		0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	5.0	6.3	0.0	
OTHERS	13	6	5	5	3	2	7	10	1	3	6	7	0	55
		10.9	9.1	9.1	5.5	3.6	12.7	18.2	1.8	5.5	10.9	12.7	0.0	33.7
		40.0	29.4	33.3	33.3	25.0	29.2	38.5	100.0	27.3	30.0	43.8	0.0	
	COLUMN TOTAL	15	17	15	9	8	24	26	1	11	20	16	1	163
		9.2	10.4	9.2	5.5	4.9	14.7	16.0	0.6	6.7	12.3	9.8	0.6	100.0

Table- 4.17. Length Of the Current Packages/Programs Being Used

NUMBER OF YEARS	COUNT	PCT OF RESPONSES	PCT OF CASES
1-2	23	60.5	104.5
2-3	10	26.3	45.5
3-4	4	10.5	18.2
4-5	1	2.6	4.5
TOTAL RESPONSES	38	100.0	172.7

The length of the current packages/ programs being used was rather short. 60.5% of the packages had been used for between 1-2 years. (Refer to Table- 4.17)

f. Reasons For Purchasing The Current Packages/Programs

The reasons for purchasing the current packages/programs are illustrated in Table- 4.18.

Table- 4.18. Reasons For Purchasing The Current Packages/Programs

REASONS FOR PURCHASE	COUNT	PCT OF RESPONSES	PCT OF CASES
TIME SAVING	21	16.9	61.8
INFORMATION CONTROL	20	16.1	58.8
IMPROVE PRODUCTIVITY	18	14.5	52.9
FORECAST,PLANNING	15	12.1	44.1
DECISION MAKING	12	9.7	35.3
INVENTORY CONTROL	12	9.7	35.3
REDUCE COST	9	7.3	26.5
PROBLEM SOLVING	8	6.5	23.5
REDUCE MANPOWER	4	3.2	11.8
ALL	1	0.8	2.9
OTHERS	4	3.2	11.8
TOTAL RESPONSES	124	100.0	364.7

Table- 4.18 shows that time saving, information control, improving productivity, forecasting/planning, decision making and inventory control were the six major reasons given by the respondents' companies for purchasing the current packages/ programs. Surprisingly reducing cost and manpower were not considered as a major factor for computerization. However, the time saving and improved productivity has indirectly implied that there were costs saved as a result of computerization.

g. Difficulties And Problems Encountered During Application

The three major difficulties or problems faced by the respondents were poor user manuals(41.7%), slow processing speed(30.6%) and poor user support(25%). (Refer to Table- 4.19)

Table- 4.19. Difficulties And Problems Faced While Using The Program

DIFFICULTY, PROBLEM	COUNT	PCT OF RESPONSES	PCT OF CASES
POOR USER MANUAL	15	33.3	41.7
SLOW PROCESSING SPEED	11	24.4	30.6
POOR USER SUPPORT	9	20.0	25.0
ERROR CONTROL	4	8.8	11.1
TEDIOUS DATA ENTRY	2	4.4	5.6
HIGH COSTS	1	2.2	2.8
OTHERS	3	6.6	8.3
TOTAL RESPONSES	45	100.0	125.0

It is evident that the areas where there is a higher frequency of problems are those of the supporting element on the application of the program.

h. How Experience And Knowledge Of Computer Gained

The experience and knowledge of the users in the respondents' companies were mainly gained from self training, company training and from a software vendor. Universities were not playing an important role in this area. Refer to Table- 4.20.

Table- 4.20. How Experience And Knowledge Gained From

EXPERIENCE AND KNOWLEDGE GAINED FROM	COUNT	PCT OF RESPONSES	PCT OF CASES
SELF TRAINING	23	31.9	60.5
COMPANY TRAINING	17	23.6	44.7
SOFTWARE VENDOR	13	18.1	34.2
ATTENDING COURSES	9	12.5	23.7
UNIVERSITY	5	6.9	13.2
MODEL DESIGNER	1	1.4	2.6
ALL	1	1.4	2.6
OTHERS	3	4.2	7.9
TOTAL RESPONSES	72	100.0	189.5

v. Respondents' Companies' Future Plan On Computerization

Table- 4.21 shows that out of the 41 respondents' companies who were already computerized, 31 of them answered this question. 31.9% of them were planning to increase the use of computers, and 22.2% planned to introduce them to other departments. 12.5% planned to acquire new programs and 11.1% planned to acquire new computers. (Refer to Appendix -A. New Package/Programs, New Computers)

As for the non-computerized respondents'companies, out of 35 companies, 28 of them answered this question. 11 respondents' companies (39%) intended to computerize and 25% did not intend to computerize. We can expect an increase in computerization in the near future. The "DO NOT KNOW" group mainly belongs to subsidary companies whose computerization decisions were decided by the head office.

Table- 4.21. Future Plan For Non-computerized And Computerized Companies

FUTURE PLAN	COMPUTERIZATION COUNT ROW PCT COL PCT	COMPUTER NOT COMPUTERIZED 1	 2	ROW TOTAL
ACQ.NEW PROGRAM	9	9 100.0 12.5	0 0.0 0.0	9 9.0
ACQ.NEW COMPUTER	8	8 100.0 11.1	0 0.0 0.0	8 8.0
INCREASE COMPUTER USE	23	23 100.0 31.9	0 0.0 0.0	23 23.0
INTRODUCE TO OTHER DEPT	16	16 100.0 22.2	0 0.0 0.0	16 16.0
PROVIDE TRAINING	12	11 91.7 15.3	1 8.3 3.6	12 12.0
INTEND TO COMPUTERIZE	10	0 0.0 0.0	11 100.0 39.3	11 11.0
DO NOT INTEND TO COMPUTERIZE	7	0 0.0 0.0	7 100.0 25.0	7 7.0
DO NOT KNOW	13	5 30.8 5.6	9 69.2 32.1	13 13.0
OTHERS	1	1 100.0 1.4	0 0.0 0.0	1 1.0
COLUMN TOTAL		72 72.0	28 28.0	100 100.0

vi. Computer Training

There was a great interest in the training on spreadsheet and integrated packages. eg. SuperCalc, Multiplan, Lotus 1-2-3, Symphony and Knowledgeman.

Table- 4.22. Computer Training

PACKAGE NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
SUPERCALC	17	37.0	41.5
MULTIPLAN	9	19.6	22.0
DBASE III	6	13.0	14.6
LOTUS SYMPHONY	5	10.9	12.2
KNOWLEDGEMAN	4	8.7	9.8
LOTUS 1-2-3	4	8.7	9.8
CAD/CAM	1	2.2	2.4
TOTAL RESPONSES	46	100.0	112.2

The day and time suitable for the respondents' companies were 1-2 days in the weekday evenings or weekend daytimes. There were only ten respondents companies who gave information on a suitable time for training.

Table- 4.23. Day For Training By Suitable Time

DAY FOR TRAINING	COUNT / ROW PCT / COL PCT	TIME: WKDAYS-EVENINGS (2)	WKENDS-DAYTIME (3)	WKENDS-EVENINGS (4)	ROW TOTAL
0-1	26	6	1	0	7
		85.7	14.3	0.0	50.0
		85.7	20.0	0.0	
1-2	15	1	4	2	7
		14.3	57.1	28.6	50.0
		14.3	80.0	100.0	
COLUMN TOTAL		7	5	2	14
		50.0	35.7	14.3	100.0

4.6. CONCLUSIONS

The key points from the survey results were:-

i. About 54.9% of the respondents' companies were computerized, and 39% of the non-computerized companies intended to computerize.

ii. The respondents companies were mainly small businesses(58.2%) having 1-25 employees. 28.3% were medium businesses and 13.4% were big businesses.

iii. Computerization did not vary with the type of industry. However there was a high significant difference between the company size and computerization. The ratio of computerization increases as the company size increases. For the company size of 1-5 employees, there was only 16.7% computerized, but for the company size of 100 or more employees, there was 100% computerization.

iv. Microcomputers were quite popular, with about 47.4% of the respondents' companies using microcomputers, (this number is expected to increase in the near future). 34.2% of the respondents' companies were using minicomputers, 26.3% were using mainframes and external bureaus. There were some companies using two types of computers. The types of computer used did not vary with the company activity nor with the company size.

v. Most of the computerized companies have been computerized for more than two years.

vi. The models used by the computerized companies were constructed by languages and application packages such as spreadsheet, integrated packages and database packages which were mainly used in the financial and production areas.

vii. Programs were mainly used for accounting, invoicing and stock control purposes. Only 33.3% of them were using the program for decision support.

viii. The main reasons given by the respondent for purchasing the packages/ program were time saving, information control and improving productivity.

ix. A wide range of packages/programs were used by the respondent companies for the mainframe, minicomputer and microcomputer. The most popular packages used for microcomputer were:-

a. Integrated Package- Lotus 1-2-3, Lotus symphony.

b. Spreadsheet Package- Multiplan, SuperCalc.

c. Database Package - dBASE II, dBASE III.

d. Word Processing Package- Wordstar.

The packages/programs used were rated highly by the respondents.

x. Poor user menu, slow processing speed and poor user support were the three major problems and difficulties faced by the respondents companies.

xi. The experience and knowledge of the respondent companies were mainly gained from self training, company training or from a software vendor.

xii. Increasing the computer usage, training and acquiring new computers and programs were the main future plans for the computerized companies. As for the non-computerized companies, 39.3% of them intended to computerize, and 25.0% of them did not intend to computerize. The reasons given by those companies that did not intend to computerize were:-

- the company is too small to computerize.
- they have no confidence in computers.

The result of the survey shows that the application of the microcomputer in industry is becoming more popular than the mainframe and mini-computer in the 1980's. From the estimate made from the result of the survey, we are expecting about 83% of companies in Manawatu region to be computerized in the near future.

It is apparent from the survey that the use of the computers for decision support and production control in the industry is still not as common as the accounting application. However, the application of computer has broadened from mainly an accounting application in the 70's to production control, decision making, marketing, statistical, engineering,

and process control. The increasing availability of application packages in the market for various applications will also stimulate the increasing use of computers and broaden the application of computers in the organization.

A follow-up on the non-reponse questionnaires and further research on the extent of the use of application packages and microcomputers in the manufacturing industry in New Zealand would be quite valuable to the thesis, as we are looking into using application packages for building decision support system in the manufacturing industry.

The survey shows that the respondents' knowledge and experience on the use of computers and packages were mainly gained from self training, company traning and from vendors. Universities have not been playing an important role in providing new technology and knoledge to the industry. There is a great demand in this area as the computer is becoming more popular as it is becoming more powerful and cheaper. New Zealand universities can take the lead and contribute to the industry by providing training, using computers as a teaching tool, and offering courses to the public.

CHAPTER 5

MICROCOMPUTER APPLICATION PACKAGES' PERFORMANCE EVALUATION : SOME GUILDELINES FOR THE MANAGER

CHATPER 5 MICROCOMPUTER APPLICATION PACKAGES' PERFORMANCE EVALUATION: SOME HELPFUL GUIDELINES FOR THE MANAGERS

5.1. INTRODUCTION

Today's managers and decision makers are confronted with an overwhelming range of choices for computer software to develop decision support systems. The problem is how do we go about selecting a suitable package ? In this chapter, we are going to look into the types of application packages available on the market, criteria for evaluating a package's performance, provide some guidelines on how to evaluate a software package, compare some of the most popular integrated packages and data management packages for the development of our DSS.

5.2. TYPES OF APPLICATION PACKAGE

The type of application packages that would be useful to the project could be grouped into the following groups:

(1) **Spreadsheet Package** - is an electronic blackboard divided into rows and columns to create a vast field of cubby holes called cells. It calculates a formula or a function automatically.

(2) **Data management Package** - program that organizes data into three basic units, ie. files, records and fields.A card catalog in a library is an example of a nonautomated data base. The catalog itself is the file, which contains a record for each book in the library. In an electronic card catalog, or data base, only one copy of each card is kept on disk. You use the software to organize the data

in any order. A Data management program exists to fill any data management need, from a simple electronic box of index cards for random notes to a complex inventory system for a small factory.

(3) **Integrated package** - program that provides or allows a number of applications such as word processing, spreadsheets, data base management, graphics and communications, to share data and work in a similar and consistent manner.

(4) **Communication package** - program that organizes data and sends it out through the serial port. There the data encounters a modem which translates digital signals into analog waves so the informaton can travel through the phone lines. On the receiving end, another modem translates the analog waves back to digital signals and a second communications program directs incoming data to the screen, printer or to disk.

(5) **Graphics package** - program that converts data from a spreadsheet or data base into an easily comprehensible chart and graphs for analysis and business presentations.

However, according to the system and user requirements, we shall only look into two types of application packages - data base management and integrated packages.

5.3. PERFORMANCE EVALUATION CRITERIA

The objectives of the software evaluation were:- firstly, to set a guideline for software selection. Secondly, to examine the various

facilities offered by the package. Thirdly, to select suitable packages for the Quality Costs MIS/DSS system development.

5.3.1. Basic requirements of the package for the Quality Costs MIS/DSS

Basic requirements of the package for the system were identified as follow:-

a. Be able to transfer data to other packages.
b. Have a powerful data base.
c. Have a powerful spreadsheet.
d. Have graphic facilities.
e. Be able to generate reports.
f. Have mathematical, statistical and logical functions.
g. Be able to build in security system.
h. User friendly.
i. Flexible.
j. Available at Massey University and can be run on IBM PC or compatible.

The above requirements were identified in accordance with the user requirements for the system and the available resource at Massey for system development. Hence the last basic requirement was an important "Must" factor.

5.3.2. Software evaluation criteria

Choosing the appropriate software was one of the vital success factors for the system development. Evaluation criterion were developed to compare the packages on a stardard basis. The evaluation criteria were developed in such a way as to identify packages that would be suitable for developing a decision support system or modeling from the view of non-programmer. This was adapted from "The evaluation criteria for financail modelling" by Mr. E. L. Loo. Two major criteria were identified :-

i. Criteria for powerful, flexible and useful model.

Powerful, flexible and useful models must have the following characteristics:-

a) The package should be expandable - ie. can it communicate with other packages, e.g. exchanging data with other packages.
b) The integration function provided by the package should be adequate- ie. the integration between spreadsheet, data base, graphics, word processing, report generator and communication should be sufficient for the job.
c) Size of model/ memory requirements should be miminised - this includes the memory required by the program and model.
d) Hardware required for the package - type of computer, monitor, printer, plotter and modem required should be available at Massey University.
e) Consolidations - can it consolidate selected parts of different files, or files from the same or different disk drives.
f) Versatile report writing - can the results of modelling be formatted into table or schedules easily. Does it have word processing and graphics available.
g) Networking - would it allow for transfer of data over a network for modelling.
h) Continual update of package - are there updates produced by the distributor at a minimum service charge.
i) Templates availability - are there useful program templates at a reasonable price.

ii. Criteria for user friendliness.

A system is user friendly when the user is comfortable in using the system, and its characteristics matches the user's. The elements of "User friendly" includes:-

(1) Relevance - The system should satisfy the user.
(2) User's information processing sequence - A computer system matches

the user's information processing sequence. It should not require the user to change his strategy.

(3) User's limitations - Human beings have cognitive and physical limitations. The system should not expect the user to operate beyond those limitations.

(4) User compatibility - Compatibility means that the computer system acts in the same way as the user expects it to act.

(5) User's model - Each individual approaches a machine with some idea of what the machine does and how it works. Matching the computer system to the user's model of that system provides a "User friendly" system.

(6) Minimum Risk - A computer system that exposes a user to unnecessary risk is unfriendly. A "User friendly" system keeps the user from making catastrophic mistakes by requiring a greater effort for entering crucial commands or by asking the user to confirm critical action requests.

The elements of the user friendliness shows the level of tolerance built into a system that enables the user to cope with complexity, e.g. a user error would not result in freezing the screen and can be corrected. The criteria of ease of use includes:-

a) Type of facilities provided - spreadsheet, graphics, data base, communications, etc.

b) Documentation, help and tutorial provided.

c) Human engineering considerations- easy to learn system , easy to understand reference, easy cursor movement, the screen does not scroll too fast, does not do unexpected things, has abbreviated inputs commands and macro functions.

d) System security - ie.security for the program, formulae and file.

5.4. EVALUATION OF APPLICATION SOFTWARE

The popular application packages used by New Zealand managers were Lotus 1-2-3, Multiplan, Lotus-Symphony. Based on the basic requirements of the Quality Costs MIS/DSS, two integrated packages - Lotus Symphony and IFPS and two data management packages - Knowledgeman and dBASE III were selected for evaluation.

Information on the packages were obtained from various sources:-

- Software package reviews in magazines, such as Datamation, Bytes, New Zealand Interface, Creative Computing, PC World, Dr. Dobb's Journal, Data Processing, Nibble, PC Week and Absoluate Reference (Journal for Lotus 1-2-3 and Symphony)
- Software manuals.
- Books on specific software packages.
- Running and reviewing the packages.

Software manuals provide detailed information of the packages, from the experience of the users reviews on the package which expressed their feeling of the packages and problems encountered. Combining the above knowledge and the actual running of the program, gives us a good idea and indication of the capability and suitability of the packages.

5.4.1. Brief Introduction Of the Packages Selected for Evaluation

1) Lotus Symphony

It is an enhancement of Lotus 1-2-3. Five functions are contained in Symphony: word processing, communications with other computers and data bases, a spreadsheet, a form- oriented data base manager and graphics. The word processer provides windows for simultaneously viewing several documents or different parts of the same documents.

The spreadsheet has up to 8192 rows and 256 columns. Features over 70 text manipulations, financial, date and time, statistical, mathematical, logical and special functions. The data base allows wild card paramenters and compound search criteria using up to 32 fields. Graphics functions include eight graph types, a zoom capability to let you temporarily view a graph at full screen and has multiple windows.

Symphony is open-ended, allowing expansion with specialized add-in applications. The command language lets you automate any program process and supports hidden cells, password protection, input validation, and error detection. High level language commands include subroutines for parameter passing. FOR ...NEXT Loops, direct access to named ranges, array- oriented assignment statements, delay and beep control. It requires at least 320K RAM and two disk drives to run the program.

2) IFPS

IFPS is an interactive financial planning system. It is a planning and modeling language which was developed to provide for the tabular presentation of information in the form of spreadsheet type reports. It has financail and budgeting languages, a planning system generator, a decision support system generator, a spreadsheet calculator, and a corporate planning system. IFPS has facilities such as "What If" capabilities, a report generator, consolidation from detailed models, sensitivity - impact analysis, financial, data smoothing and projection functions.

3) dBASE III

A relational data base manager, dBASE III has a mode with menus and prompts to assist novices with commands. The program could accommodate 1 billion records per data base, 128 fields per record, and 4000 bytes per fixed- length record or 512 kilobytes per variable- length record. You can use ten data base files simultaneously. With the English- like command designed specifically for 16-bit computers, dBASE III offers quick sorting and indexing of data with context sensitive help available at any time. The program includes report and mailing- label facilities that can be modified.

4) Knowledgeman

An integrated data management program, Knowledgeman includes spreadsheet analysis and application development. You can create data base files with read and write access codes specified for a particular file or its record fields. A query language lets you select data by logical and conditional operators or by wild- card strings.

The spreadsheet feature lets you enter formulae for data entry which includes error checking, special effects such as inverse video, and free form field placement, "For" language for creating and executing procedures including arithmetic and logical operations and IF...Then...Else control structures. It requires 192K RAM and two disk drives to run.

5.4.2. Methodology for evaluation of packages

Based on the results of the survey on the application of computers in industry in the Manawatu region, we found out that Lotus 1-2-3, Lotus-Symphony, dBASE II and dBASE III were the popular integrated and data base packages respectively. A preliminary survey on the integrated packages and data base management packages has been carried out identify the packages available on the market and at Massey University. The Methodology used for evaluation can be divided into two stages:-

Stage 1. Comparison of the integrated packages.

Comparison of popular integrated packages - Lotus 1-2-3, Symphony, IFPS, SuperCalc and Framework were made to have a better idea what the integrated packages offered. (Refer to Appendix -B) After the premilinary screening, it was discovered that there was no packages that had both a powerful and flexible spreadsheet and a data base. Hence, we decided to use two packages - an integrated package for the powerful spreadsheet and graphics and a fourth generation language(4GL) package for the data base facilities. Two integrated packages and two 4GL packages that met the basic requirements stated in 5.3. and were available at Massey were chosen for detailed evaluation.

Stage 2. Evaluating selected packages according to the Criteria estabilished.

The evaluation process can be divided into four steps:-

Step 1. Determine the criteria that the package must fullfil, and the important features for a powerful and flexible package.

Step 2. Assign weights to each criterion. A score of 0 to 10 was assigned to the criteria according to the importance of the criterion.

Weight assigned : 0 (No information)
1 - 5 (Nice to have but not important)
6 - 10 (Need to have to obtain powerful, flexible and useful model)

The higher the weight assigned, the more importance is attached to the criteria.

Step 3. Fill in the score for the package according to how well one feels that criterion or feature has been met.

Step 4. Expand and total all the subtotal scores, obtain a grand total. The higher the grand total, the more favourable the package is.

The criteria tables for package evaluation were divided into two parts according to the two main criteria:

Part 1. Criteria for powerful, flexible and useful model.
Part 2. Criteria for ease of use, user friendly.

Weights were given to each criteria to meet the user requirements and perceived needs in future for the system.

Table- 5.1. Criteria Table For Integrated Packages- Part 1.1

Criteria For Powerful, Flexible and Useful Model	Must(M)			SYMPHONY			IFPS	
	Weight	Score	Total	Comments	Score	Total	Comments
(1) The package should be expandable.							
- Can communicate with other packages	M	M	M	dBASE III,Lotus 1-2-3, VisCalc	M	M	To Mainframe only EPS-FCS
* Exporting	8	10	80		5	40	
* Importing	M	M	M		M	M	
(2) Integration of functions and capabilities provided.							
- Spreadsheet	M	M	M		M	M	
- Data Base	7	9	63		0	0	
- Graphics	10	9	90		8	80	
- Word processing	7	8	56		0	0	
- Report generator	M	M	M		M	M	
- Foresting	8	10	80		10	80	
- Statistical analysis	9	10	90		10	90	
- Communication	10	10	100		10	100	
- Are the main capabilitites you want integrated ?	10	9	90		0	0	
- Do modules use the same command language ?	8	10	80		10	80	
- Does the package provide the mathematical, logical operation you require ?	10	10	100		10	100	
(3) Maximum size of model memory requirements							
- Size of matrix provided for modelling	8	9	72	8192X256 (Row X Col)	7	56	Need confirmation
- Size of data base	8	8	64	8192 rows	0	0	
- Your computer memory size				640K			
- Kbytes available if possible to extend memory				284K			
- Program memory required				265K			

Table- 5.2. Criteria Table For Integrated Packages- Part 1.2

Criteria For Powerful, Flexible and Useful Model	Must(M)	SYMPHONY			IFPS		
	Weight	Score	Total	Comments	Score	Total	Comments
(4) Hardware Requirements							
- Hardware	10	7	70	IBM PC,AT,XT, or equ	7	70	IBM PC, XT or equiv
- Memory RAM	10	7	70	320K min	6	60	512K
(5) Consolidations							
- Package can consolidate selected parts of different files into any new format	M	M	M		M	M	
- Consolidate files from same disk drive	10	10	100		10	100	
- Consolidate files from different disk drive	10	8	80		9	90	
(6) Versatile Report Writing							
- Results of modelling could be formatted into tables or schedules easily	8	10	80		8	64	
- Word processing available	8	10	80		0	0	
- Word processing with capability to extract information from other modules	8	9	72		0	0	
- Color graphics hardcopy output	8	9	72	Line,bar,stack-bar, open-close	9	72	
(7) Networking							
- Would it allow for transfer of data over a network for modelling ?	4	10	40		9	36	

Table- 5.3. Criteria Table For Integrated Packages- Part 1.3

Criteria For Powerful, Flexible and Useful Model	Must(M)	SYMPHONY			IFPS		
	Weight	Score	Total	Comments	Score	Total	Comments
(8) Continual Update of Package							
- Are there updates produced by the distributor at a minimum service charge ?	9	9	81		8	72	
- Are there updates, extensions produced by either the distributor or others at the market rate ?	9	7	63		7	63	
(9) Template Availability							
- Are there useful program templates ?	3	8	24		6	18	
- Are these reasonably priced ?	3	7	21		6	18	
TOTAL SCORE			1818			1289	

Table- 5.4. Criteria Table For Integrated Packages- Part 2.1

Criteria For Ease of Use And User Friendly	Must(M)	SYMPHONY			IFPS		
	Weight	Score	Total	Comments	Score	Total	Comments
(1) Type of facilities							
- English type command language	10	10	100		10	100	
(2) Help/ Tutorial							
- Help available at the stroke of a key	4	10	40		10	40	
- Tutorial programe available	5	10	50		10	50	
- Good clear detailed manual	8	8	64	3 menuals	6	48	manuals
- Prompts available	4	8	32		6	24	
- Function keys	9	10	90	20 function keys	7	63	
(3) Human Engineering Considerations							
- Easy to understand cell references	5	8	40		4	20	
- No obscure keys	4	7	28		5	20	
- Easy cursor movement	4	10	40		7	28	
- Goto function for fast cursor movement	6	10	60		8	48	
- Does not scroll screen too fast	4	9	36		8	32	
- compatibility, commands, features appear "natural"	4	8	32		5	20	
- package does not do unexpected things	4	7	28		5	20	
- Abbreviated inputs/ commands allowed	4	7	28		7	28	
- Does the package explain itself and easy to learn	9	7	63		4	36	
- Does the package provide more than one way to accomplish the same thing ?	7	7	49		5	35	
- Does the package allow backing out of a command before completion ?	7	9	63		8	56	
- Inform user of current status	9	8	72		7	63	

Table- 5.5. Criteria Table For Integrated Packages- Part 2.2

Criteria For Ease of Use And User Friendly	Must(M)	SYMPHONY			IFPS		
	Weight	Score	Total	Comments	Score	Total	Comments
(4) Other Features							
- Data protection, confirmation procedure for deleting files	9	10	90		10	90	
- Can "Un-delete" a record or file	4	0	0		0	0	
- Package does not fail or "freeze" if wrong keys are hit	10	9	90		7	70	
- Window protection	3	10	30		10	30	
TOTAL SCORE			1125			921	

Table- 5.6. Criteria Table For Data Base Management Packages- Part 1.1

Criteria For Powerful, Flexible and Useful Model	Must(M)	KNOWLEDGEMAN				dBASE III			
	Weight	Score	Total	Comments		Score	Total	Comments	
(1) Expandable and Communication									
- Can communicate with other packages	M	M	M	Kpaint, Kgraph,Ktext		M	M	Delimited files	
* Exporting	10	10	100			10	100	Delimited text	
* Importing	10	10	100			10	100		
(2) Capability Of the Package									
- No of records	10	7	70	Limited by memory		9	90	1 billion /per file	
- No of fields	9	9	81	255 fields		8	72	128 fields	
- No of active memory variables	6	0	0			7	42	256	
- Total no of bytes for memory variables	6	0	0			7	42	6000	
- Minimum memory required	10	9	90	192K RAM		8	80	256K RAM	
(3) Hardware Requirement									
- Hardware	10	9	90	IBM PC		10	100	IBM PC, AT, XT	
(4) Integrated Facilities									
- Data management	M	M	M			M	M		
- Spreadsheet analysis	10	5	50	Has spreadsheet, but not bug free		0	0		
(5) Operational Facilities									
- Have methematical, logical operation you required	10	8	80			9	90		
- Versatile Report Writing	10	9	90			9	90		
(6) Networking									
- Would it allow for transfer of data over a network for modelling ?	8	0	0			0	0		

Table- 5.7. Criteria Table For Data Base Management Packages- Part 1.2

Criteria For Powerful, Flexible and Useful Model	Must(M) Weight	KNOWLEDGEMAN Score	KNOWLEDGEMAN Total	KNOWLEDGEMAN Comments	dBASE III Score	dBASE III Total	dBASE III Comments
(7) Continual Update of Package							
- Are the updates provided by the distributor at a minimum service charge ?	9	8	72		8	96	
- Are there update extensions provided by either the distributor or others at market rates ?	9	4	48		6	72	
TOTAL SCORE			871			974	

Table- 5.8. Criteria Table For Data Base Management Packages- Part 2

Criteria For Ease of Use And User Friendly	Must(M)	KNOWLEDGEMAN			dBASE III		
	Weight	Score	Total	Comments	Score	Total	Comments
(1) Type of facilities available							
- Spreadsheet	5	7	35		0	0	
- English type command language	M	M	M		M	M	
(2) Help/ Tutorial							
- Help available at the stroke of a key	9	3	27		9	81	Function key 1
- Tutorial programe available	9	5	45		9	81	
- Good clear detailed manual	10	5	50		9	90	
- Prompts available	9	0	0		9	81	
- Menu- driven programming	8	0	0		8	64	
(3) Human Engineering Considerations							
- package does not do unexpected things	9	5	45		8	72	
- Abbreviated inputs/ commands allowed	4	7	28		8	32	
- Does the package explain itself and easy to learn	9	4	36		8	72	
- Does the package provide more than one way to accomplish the same thing ?	8	7	56		8	64	
- Does the program stop at error out of a command before completion ?	10	0	0		8	80	
- Does the error message indicate the fault ?	8	0	0		7	56	
(4) Other Features							
- Data protection, confirmation procedure for deleting files	9	8	72		7	63	
- Can "Un-delete" a record or file	7	8	56		8	56	
- Package does not fail or "freeze" if wrong keys are hit	10	6	60		8	80	
TOTAL SCORE			510			972	

5.4.3. Evaluation Results

This method of evaluating packages is subjective due to the variation of personnel requirements and knowledge about the package. Therefore the weights and scores given to the criteria varies with the user's requirements and his perceieved needs.

The "Ideal Score" was calculated according to the assigned weight multiplying the highest score by 10. The ideal score for integrated packages was 3300 points and 2510 points for 4GL package. The grand total of the results for the Integrated packages and the 4GL packages were as follow :-

	INTEGRATED PACKAGE Ideal Score = 3300 points		4 G L PACKAGE Ideal Score = 2510 points	
	SYMPHONY VS	IFPS	KNOWLEDGEMAN VS	dBASE III
Part 1	1818	1289	871	974
Part 2	1125	921	510	972
GRAND TOTAL	3744	2725	1709	2290

Comparing the ideal score with the actual score, Symphony and dBASE III were the two favourable packages for the system development. From the user review and experiences and the running of the programs, we found out that there were some features that made these two packages preferable to other packages for they were powerful, versatile, flexible packages and simple to operate with.

The major problem of Symphony is that because the program requires 256K of RAM, there is not much memory left for working, if you are using a 320K computer, it would be more suitable to run it on a harddisk computer.

Users' comments on dBASE III are that it is a programmer's delight which has menu- driven facilities. It has a good on-line help and tutorial which is very easy to use for those with no programming experience, yet it offers powerful data handling capability.

Comparing dBASE III to Knowledgeman(Kman), although Kman has spreadsheet facilities, it is a user-unfriendly package, the manual is difficult to follow, there are bugs in the program which do unexpected things, it has no menu-driven facilities to help the users, and most importantly, the program does not stop when there is an error. The diagnoistics of the program error were not very helpful. And the Slowness in processing speed was a major disadvantage.

Decisions on using the two best features of the two packages were made based on the above information. dBASE III would be used for data base management information system, and Lotus Symphony 's spreadsheet and graphics for the decision support system to meet the user requirments.

5.5. CONCLUSION

The most critical step in the development and implementation of an effective DSS is the evaluation and selection of appropriate software for system development. Today's user has to face the problem of the profusion of software product on the market. As the software is intended for DSS system development used by non-programmers, the selection process should reflect this end-user orientation. The criteria for selection of software must emphasize satisfying the end-user needs.

The performance evaluation criteria here is trying to select the most appropriate software to fullfil the users' needs. This evaluation method gives you a guideline as to how to evaluate a package. It is subjective to what the user requirements are and what is their perception and weight on different criteria. Therefore, it is very flexibile as different users have

different needs and perceptions on what is powerful, useful and what is user friendly. It would help you in evaluating the package and assist you in assessing how far have your requests have been met. Based on these facts, you would be in a position to make a decision on what is the best buy.

Finally, I would like to stress again that the selection of an appropriate package is an important success factor. for model building or system development An inappropriate package used for model building and system development would be a pain in the neck and a waste of money.

CHAPTER 6

DEVELOPMENT OF QUALITY COSTS MANAGEMENT INFORMATION SYSTEM/ DECISION SUPPORT SYSTEM (QC MIS/DSS) IN A MANUFACTURING COMPANY

CHAPTER 6. DEVELOPMENT OF QUALITY COSTS MANAGEMENT INFORMATION SYSTEMS/ DECISION SUPPORT SYSTEM(QC MIS/DSS) IN A MANUFACTURING COMPANY

6.1. INTRODUCTION

In mid 1985, a postal survey of NZOQA members on the practice of quality costs control was conducted as part of a Quality Management Control project. The results of the survey showed that there was increasing awareness of the importance of quality and the benefits of quality costs control practice [12].

The usefulness of quality costs control practice identified by the members of NZOQA are as below:-

- Alerts senior management and others to problems.
- Problems and opportunities identification for improvement.
- Measures quality and monitoring improvement.

Modern planning activities focus on integrating functional activities - marketing, finance, design and production into a coherent business strategy. Strategic planning in its simplest sense is the integration of the resources available, ie. capital, time and human talent to achieve effectively, a specified business objective - "Profit".

A Quality Costs Control System involves every department in the organization. It is a tool used to collect and to analyse quality costs data for planning and control. The philosophy of quality costs management is to reduce failure costs by attacking the problems causing these costs, reducing appraisal costs in accordance with the results achieved, and investing in preventive activities to the extent necessary to achieve maximum overall costs effectiveness.

It is an excellent tool in the management of a business. It can provide a measure of the overall management health of a business in terms of quality, by providing priority for corrective actions in needed areas. It can also be used to force the integration of all the separate quality activities into the mainstream of the product cycle. It focuses the entire organization in the context of the total quality costs.

From the above, it was deemed to be a benefical area in which to carry out a project to develop a QC MIS/DSS. The project was carried out in Company A, an international company which specializes in plastic products. Recently, the company has diversified production from simple plastic products to more sophicated high-tech dairy equipment (e.g. product P) This change in manufacturing has forced the management to focus on their product quality and productivity. Quality is therefore becoming a focus point and an important factor to success. The main objective of Company A is to maintain the leading role in their plastic products and product P in the market. Thus improving Quality and productivity are the first priorty of Company A. The company has no quality costs control system at present, it would be a new management tool for the managers to monitor their product performance.

6.2. THE OBJECTIVES OF THE PROJECT - DEVELOPMENT OF A QC MIS/ DSS FOR PRODUCT P

From the literature on decision support systems for the past two decades, we can see that most of the systems were built by Information Systems professionals using programming or command languages and ran on mainframe or minicomputers [1,4,5,7,9,10,11]. There were only a small number of systems which were built by using application packages. Most of them were not complete DSS but only the model component of the DSS (ie. without any data bases attached).

The increasing popularity of microcomputer software and hardware affects the system development pattern. The system development pattern had been changing from the traditional system design approach to prototyping and end-user system design approach using off-the-shelf application packages. The off-the-shelf application packages offer "user friendly", easy to learn, easy to use and powerful programs for modelling. The advantages of the user-friendly package enable the end-user to build his own model within a short period of time.

This project was an attempt to put QC and DSS theories into practice by building a QC MIS/DSS using microcomputer and two popular and powerful application packages - dBASE III and Lotus Symphony. The purpose of using the application packages is to establish the feasibility of using off-the-shelf application packages for the development of decision support systems. In the process we also get exposed to the problems of the conversion and transfer of data from one package to another, when they are produced by different software houses.

We can summarize the objectives of the project as follow:-

i. To build a quality cost management information system and decision support system using microcomputer and application packages based on DSS concepts and building techniques and concepts of cost of quality.

ii. To establish the feasibily of using two off-the-shelf application packages for the systems development and also the feasibility of transferring and converting data from one package to another.

iii. To provide a management tool to support the manager in planning and decision making in quality assurance. This tool would also have an indirect impact on engineering, production and purchasing.

iv. To assist the manager in monitoring, controlling and evaluating quality programs for cost reduction.

6.3. PROBLEMS AND DIFFICULTIES ENCOUNTERED DURING THE SYSTEM DEVELOPMENT PROCESS

The introduction of the concept of a Quality Costs MIS/DSS tool to company A was a new idea and would be a new management tool for the managers if it was implemented. Good support from the management was the major success factor of the prototype development. However, the prototype development process was not a smooth one. There were some problems and changes during the system development process, e.g.

a. The sensitive issue of the company's financial information

The initial prototype did not include detailed financial information due to the sensitive issue of the information. Some dummy figures were used for the prototype demonstration. Whatever actual data information was given by the company was treated as highly confidential.

b. Lack of standards on the assembly line

At the initial stage of the project, the product P's assembly line was a one man operation line. There was no proper record. The standard time for the process was an estimate. No time or method study has been carried out. Moreover, the rejects from the assembly line were set aside temporarily(without recording), repair work was carried out when there was no parts supply and assembly had to stop. The rework job done would then be recorded as normal production. Therefore, the accuracy of the daily production record was in doubt.

The situation had improved after the interview. A Rework record was introduced to the assembly line. A time and method study was carried out after a Product P assembly manager was appointed to be in charge of the Product P assembly. They discovered that there were considerable differences between the estimated standard time and the actual time taken for the job - this led to the problem of accuracy of product costing.

c. The existing accounting system did not include all the quality costs information.

The information for the quality costs were scattered around in different departments . They were often overlooked by the managers and were not always included in the existing accounting system. It was then suggested that Charge codes be assigned to the quality costs, so that the costs could be identified, as to which component and department they belonged to. The introduction of QC MIS/ DSS helped to pinpoint these costs and to implement a proper recording system to facilitate the data gathering. This became an unwelcome extra workload for the staff concerned.

d. The selection of computer hardware and software to be used for system development.

The existing computer system used in the company is HP-3000. As many computer terminal hours would be required, it was decided that the project was to be developed using Massey University- Department of Production Technology's facilities. Agreement on using the IBM PC and two application packages which run on IBM PC or compatible - dBASE III and Lotus Symphony were reached. A copy of the relevant parts of the report and documentation will be given to the company after the project has finished.

This arrangement was acceptable because of the confidentiality of the company's data information. A system which runs on a separate microcomputer also allows the manager to have easy free access to the system and prevents corruption to the main data base system.

Despite the various difficulties and problems encountered, with the help, support and cooperation of the managers and staff of Company A, the project had successfully achieved its objectives and the users were satisfied with the system.

6.4. CONCEPT OF QUALITY COSTS

"Quality is free", [6] but it is not free when one does the wrong thing. Quality cost is the price of non- conformance and the price of maintaining conformance. The price of non- conformance is every cost incurred because things were not done right the first time. The price of maintaining conformance is the cost involved in making certain that things were done right the first time.

In short, any costs that would not have been expended if quality was perfect contributes to the costs of quality. Such costs are often overlooked or unrecognized simply because most accounting systems are not designed to identify them. This is one of the main reasons that the system of QC MIS/ DSS was created. It was designed to demonstrate that the cost of "doing things over" is a significant addition to the cost of the product, and also to show that these costs collectively offer an otherwise hidden opportunity for profit improvement.

6.4.1. Quality Costs Category

Quality costs are customarily divided into four categories. They are prevention costs, appraisal costs, internal failure costs and external failure costs. (Refer to Appendix -C)

a. Prevention Costs: These are costs in an effort to prevent discrepancies. eg. Quality planning, supplier quality survey, training programs etc.

b. Appraisal Costs: These are costs incurred in the evaluation of product quality and in the detection of product quality and discrepancies. eg. Inspection, testing and calibration of equipment.

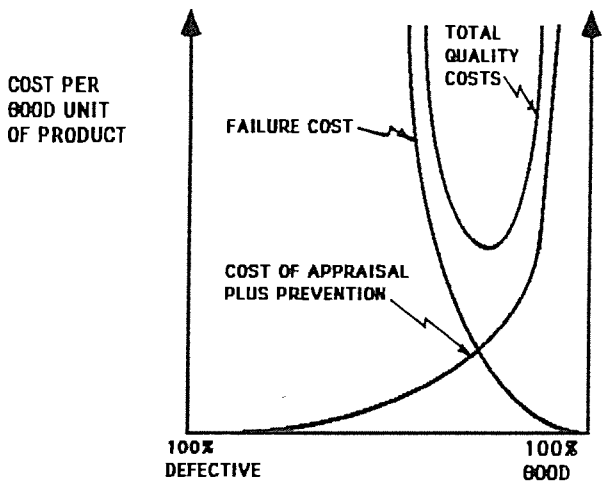
c. Internal Failure Costs: These are costs resulting from discrepancies found prior to delivery of the product to the customer, eg. rework, scrap and material review.

d. External Failure Costs: These are costs resulting from discrepancies found after delivery of the product to the customers. eg. Customer complaints, customer returns, field services and warranties.

6.4.2. Model For Optimum Quality Costs

A quality costs control system serves as a base for setting up the elements of a prevention oriented quality program.

Figure -6.1. Model Of Optimum Quality Costs



(Adapted from Juran, J. M. Quality control handbook. MacGraw- Hill Book Company. 3rd Edition, 1974)

When a manager looks at the quality cost report, he may face problems such as, "How can I use these data?", "What are the right quality costs", "How do they compare to other organization?" They would require standards

to compare with their actual quality costs, so that judgement and decisions can be made.

The amount of quality costs incurred can run from under 2% (Low tolerance industries) of sales to over 25% (High precision, complexity and reliability industries) of sales depending on the type of industry. [8] There are no useful guidelines on the variation of quality costs, total quality costs or the ratios of the various major categories to the total.

Juran [8] suggested a model for optimum quality cost- which gives the optimum total quality costs through analysis of the interrelationships among the costs categories. (Refer to Figure 6.1) The model shows the principle quality costs which enter the achievement of fitness for use. They consist of:

i) The costs of appraisal and prevention. When these costs are zero, the product is 100% defective. To improve conformance, prevention and appraisal costs are increased until perfection is approached.

ii) The failure costs due to the existence of defects. When the product is 100% good, there are no defects and zero failure costs. As nonconformance sets in, failure costs rise until at 100% nonconformance, the product is 100% defective.

Typically, prevention costs are about 10% of the total quality costs. Appraisal costs are about 25% and failure costs are about 50% -75% of the total quality costs. These ratios vary with the quality improvement stages and industry.

6.4.3. Analysis Techniques Of Quality Costs

The managers are constantly making decisions which affect the costs on the various segments in order to obtain the minimum quality cost at the outgoing quality level. Quality costs provide some basically sound "tools"

for arriving at such decisions.

The analysis of the quality costs process consists of examining each cost item in relation to other cost items and the total. Period to period comparison, i.e., comparing one month's operations with the previous month's operation. The comparison is more meaningful when the absolute dollars of quality costs for a period are related to the degree of total manufacturing activity for that period. The Comparison base commonly used are direct labour, net sales billed, contribution and total manufacturing cost. Techniques for analysing quality costs are as varied as those for any other quality problems in industry. They range from simple charting techniques to complicated mathmatical models of the program. The most common techniques used are as follows:-

a) Trend Analysis: This technique is simply comparing present cost levels to past levels. It is suggested that costs be collected for at least one year before attempting to draw conclusions or plan action programs.

b) Pareto Analysis: This technique involves listing the factors that contribute to the problem and ranking them according to the magnitude of their contribution. The 20/80 rule can be applied here; in most situations, a relatively small number of causes or sources will contribute a relatively large percentage of total costs.

c) Budgetary Analysis: This method has been used by companies to control various elements of quality costs. e.g. budget for inspection cost. It is based on history, which tends to perpetuate bad levels of performance because no alarm signals sound when current costs are no worse than prior costs.

These three methods have their own merits and demerits. Trend analysis requires a longer time period to be useful to the user. It could be used for budgeting purposes. Pareto analysis pinpoints the main contribution of the quality costs, but does not give the magnitude compared to other costs. The combination of the above techniques will give a better indication of the company performance to assist the managers in decision making. In this project, we used a combination of the three techniques. We started by using an arbitrary budgeted quality cost to demonstrate how the system works. Further adjustment would be made at later stages, in order to have a better budgeted quality cost.

6.5. DEVELOPING THE QC MIS/ DSS

A meeting was held with the Director of Corporate Planning, Quality Assurance Manager and New Product Development Manager. It was then agreed that the proposed system would be based on one new product - Product P - initially. If the project proved to be useful and beneficial to the company, they would consider fully developing and also expanding the system to include other existing products.

There was no quality costs control system in the company. The manager perceived the needs for the system as:-

i). To identify the quality problem areas for improvement.

ii). To analyse the product performance in production and in the market via failure costs and use it as a guide for planning and decision making.

iii).To monitor and evaluate the effectiveness of quality programs.

The quality assurance manager stated that he had plans to introduce a quality costs control system in the near future. The proposed system (a prototype) would be helpful to start the ball rolling.

6.5.1. The Benefits Of Using QC MIS/ DSS

The benefits of using the QC MIS/ DSS are as follow:-

i. In satisfying the stated needs above, the QC MIS/DSS would provide useful information for managers for decision making and strategic planning in quality and production.

ii. It would improve the efficiency and effectiveness of managerial decision making - all the manager has to do is to input the quality costs and DSS data, then the system will generate reports and graphs that he requires. He can then concentrate on the analysis to identify the important facts to be more effective.

iii. The manager can manipulate the data, use "What If" analysis to check out his decision with reports and graphic representations.

iv. Costs benefits - the system generates reports and graphs easily, saving managers' and clerks' time on tedious calculations, preparing reports and drawing graphs.

v. User friendly - the system is designed for those who have no computing knowledge. It is simple and easy to use, and menu driven.

vi. Flexibility - the system is built on a modular basis, new models can be added on to the system easily.

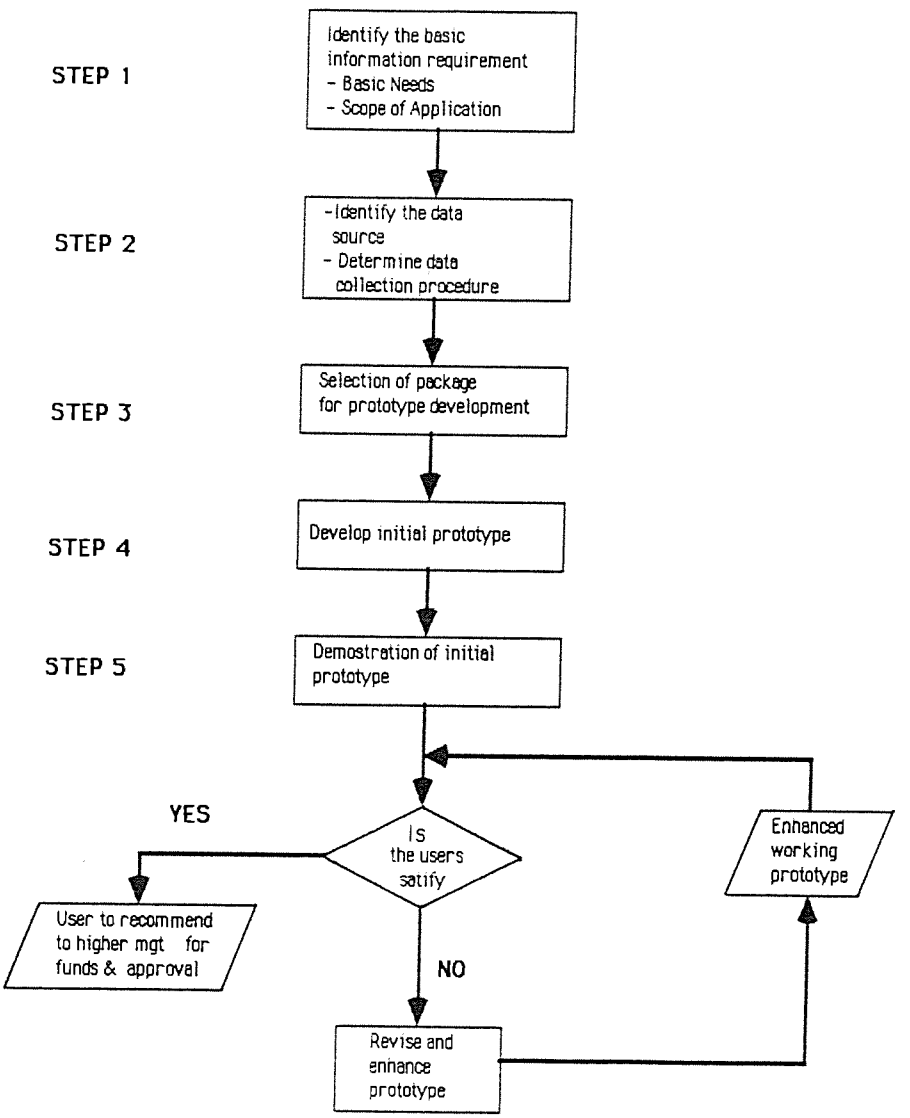
6.5.2. The System Development Process Of The QC MIS/ DSS

The system development methodology adapted for this project was prototyping. The method was based on building a simple yet realistic working system in a short period of time, trying out ideas with the user, without incurring large costs. The user expresses what he likes and dislikes about the system and the builder then evolves the system to suit

the user's decision making mental process.

The prototyping approach is a five step process. Refer to Figure 6.3. This project had reached the fifth step with an initial prototype, when the prototype was demonstrated to company A. The prototype also successfully transferred data from dBASE III to Lotus Symphony and met the users' requirements. Refer to Figure- 6.2.

Figure -6.2. Quality Costs MIS/DSS Prototyping Development Process



Step One - Identify the basic information requirements.

Interviews with the managers were conducted. A desire for a better information system on quality costs was expressed. The information output required by the user was discussed, and that the system provided fulilled the needs is shown in Table- 6.1.

The reports and graphics are on a monthly, quarterly and yearly basis. The quality costs elements included in the system were discussed and decided by the users. They were categorized according to the traditional quality costs categories, but not all elements were included. There were some quality costs elements not accounted in the company which were excluded. The reason for the exclusion of the quality costs, such as cost of downgrading, product rejected and returned by customer, loss on sales, was because the product P was at the introduction stage of the product life cycle. There was no competitor on the New Zealand market and the company planned to create a high quality image for the product. Therefore, there was no downgrading. The products rejected and returned from customers were zero. At this stage the marketing personnel found difficulty in estimating sales as well as the effect of quality on sales. (Please refer to the details of Quality Costs in Appendix -C)

Step 2 - Identify the source of data, determine the data collection and reporting procedure.

After determining the users' requirements, and what quality cost elements were to be included in the system, the next step was to decide how to collect these quality costs data for the system. Interviews with the personnel concerned were carried out to identify and determine the following:-

- the availability of quality costs data.
- the data gathering procedures.
- the person responsible for the data collection.
- method for data collection.
- time for submitting the data to accounting department for costing.

The sources of quality costs data were scattered around all departments ie. production, quality assurance, new product development, dairy equipment, purchasing and accounting department. A data collection and reporting system was set up (Refer to Figure -6.4.).

The following problems were discovered after interviewing the affected departments' personnel.

- In the current Production report, incoming inspection records, calibration records and scrap notes and time and cost data for Product P were not in the records.

- There was no record for rework and repairs on the shop-floor. The actual rework was set aside without any form of recording. The rework would be done when there were no parts supplied for normal production and these rework products would then be recorded as good products in the production report. There was no indication of rejects being recorded at Product P's assembly line at the time of interview.

- The costs of customer services complaints administration and warranties were estimates made by the manager.

- Prevention costs such as design, field performance test, training, etc were estimates made by the managers.

- Direct labour cost was an estimate.

Analyzing the results of the interviews, dicussions on the method of data collection with the personnel concerned were held. Suggestions made were as follows:-

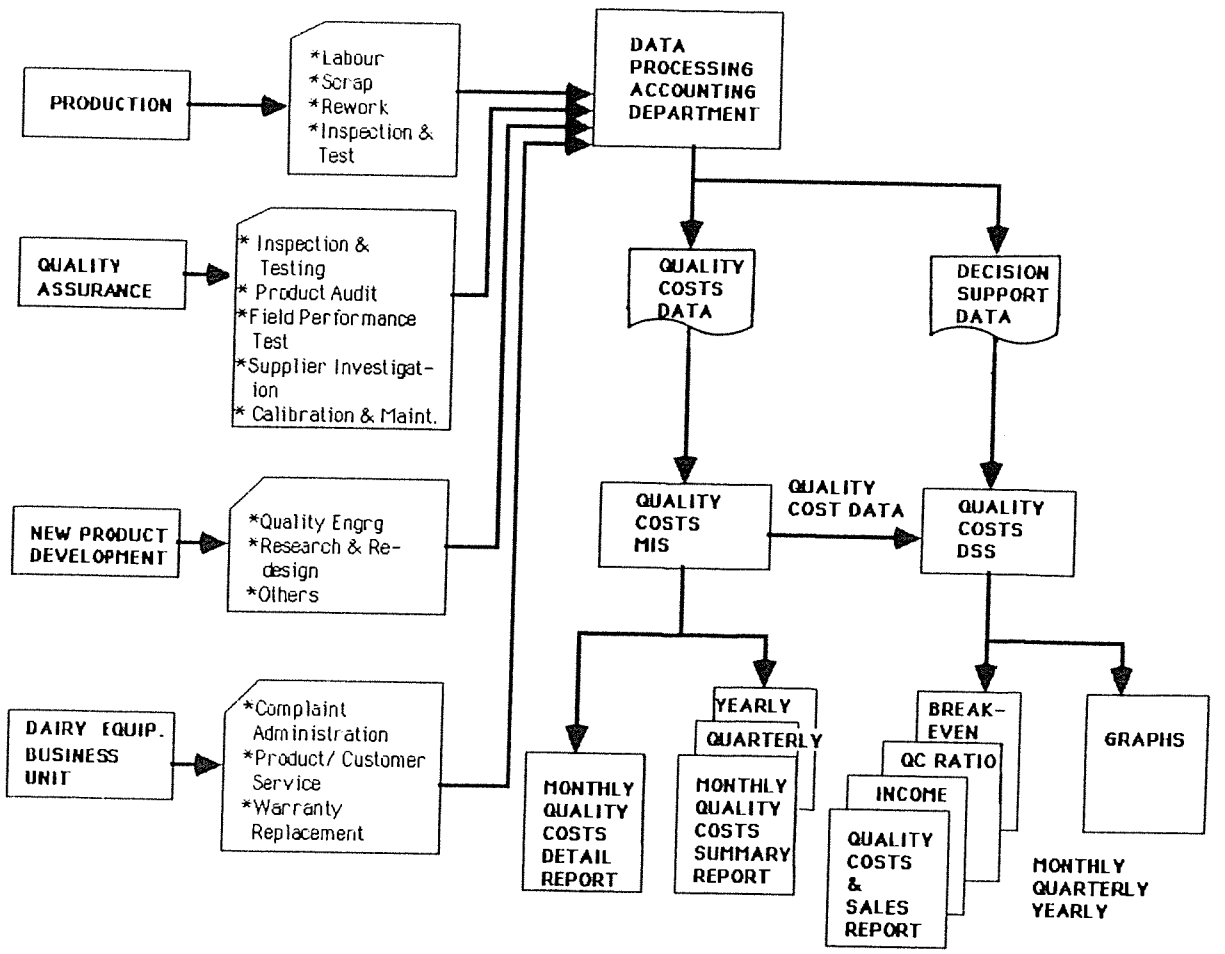
- Include the time and cost elements spent on work done on or for product P in the records.

- Introduce rework and repair record for the assembly line, clearly distingushing the rework and normal production. The rework record must have information on the date, type, faulty item, time taken for rework, parts and quantity of parts replaced.

- Charge Codes for the quality costs related data were suggested by the new product development manager. The purpose was to identify the quality cost elements and the departments responsible.

The accuracy and integrity of the data collected from various departments must be checked and verified by the person in charge before submitting to the accounting department for costing. Refer to Figure-6.3.

Figure -6.3. Quality Costs Data Collection And Reporting



Step 3- Selection Of Application Packages For The System Development

The information requirements of the users from the system were identified and software for the system was evaluated. The evaluation was based on the following criteria for system development. Essentially they should :-

- Be adequate for powerful, flexible and useful models.
- Enable user friendliness to be built into models.

The criteria are as follows:-

i) Ability to accommodate unique and variable requirements

Requirements from users were taken into account. Potential changes such as increases in volume of data, changes in types of data, conceptualization, type of analysis and output format were also taken into consideration to be flexible to suit users' needs.

ii) To have system security

Two levels of security have been built into the system to prevent unauthorized persons accessing the system.

iii) Should be user friendly

The system was designed for those who had no computing knowledge. Easy to use features such as menu driven, dialogue interface were built in. Minimum effort was required from the users to operate the system.

File access time was too long initially but was reduced to one third later on. Error messages and helpful instructions would appear to direct the users when they hits the wrong key.

iv) Should be flexible

The system was built on a modular basis, this gave the user the flexibility to change and to expand the system easily.

v) To provide modelling and analytical capabilities

The model base provides modelling and analytical capabilities which enables the users to ask "What If" and "What is " questions, subject to users' specified constraints and conditions.

vi) "User controlled"

The system allows users to have direct "control" over their system (In the sense that no complex mathematics was used). The models were those that the managers were familiar with, hence the managers felt they had control over the situation.

v) Has memory aids

The manual driven and simple to operate system provides the decision maker with a tool to assist their memory, to store information into the database, and to retrieve information easily at any time he wants.

Application packages were then evaluated based on the above criteria in addition to some specific features required as shown below: (Refer to the details in Chapter 5.)

- Be able to transfer data to other packages.
- Have a powerful data base.
- Have a powerful spreadsheet.
- Have graphic facilities.
- Be able to generate reports.
- Have mathematical, statistical and logical functions.
- Be able to build in a security system.
- User friendly.
- Flexibile.
- Available within Massey University and preferably could be run on IBM PC.

The decision making process varies with decision makers, the type of problem, the task and the environment. Prototyping the quality costs

MIS/DSS was trying to accommodate the users' needs for conceptualization, memory aids, information analysis and to allow the users to have direct control over the system. Taking the above into consideration, dBASE III and Lotus Symphony were chosen for this project after a considerable amount of time had been spent on evaluating the user requirements and the available suitable software.

Step 4 - Developing the initial prototype system

Taking into account the users' requirements, the existing computer system and future plans for expansion, the development of the initial prototyping was then undertaken using the chosen dBASE III and Lotus Symphony. An interactive application system was built to meet the user's basic stated information requirements.

a. The Components Of The QC MIS/DSS For Product P

There were three basic components in the system. ie. Quality costs data base, Quality costs model and User System Interface. Refer to Figure-6.4, 6.5, 6.6.

i) Quality Costs Data Base/MIS

The Quality Costs data base is built using dBASE III. It serves as a data gathering device, all quality costs data were stored in this data base. The managers or users can view, update, edit the data and generate reports from the system. (Screen format refers to Appendix -D) The reports generated by the MIS system are:-

- Quality Costs Detail Report.(Monthly Only)
- Quality Costs Summary Report. (monthly, quarterly and yearly)

Figure -6.4. The Components Of The Quality Costs MIS/DSS

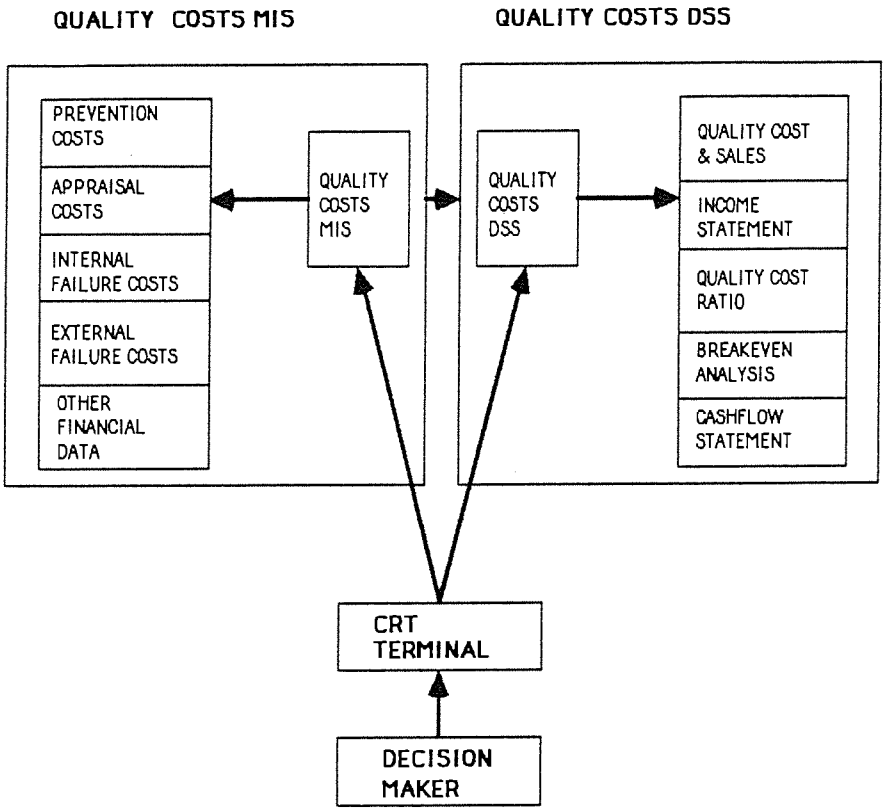


Figure -6.5. Quality Costs MIS/DSS Overview

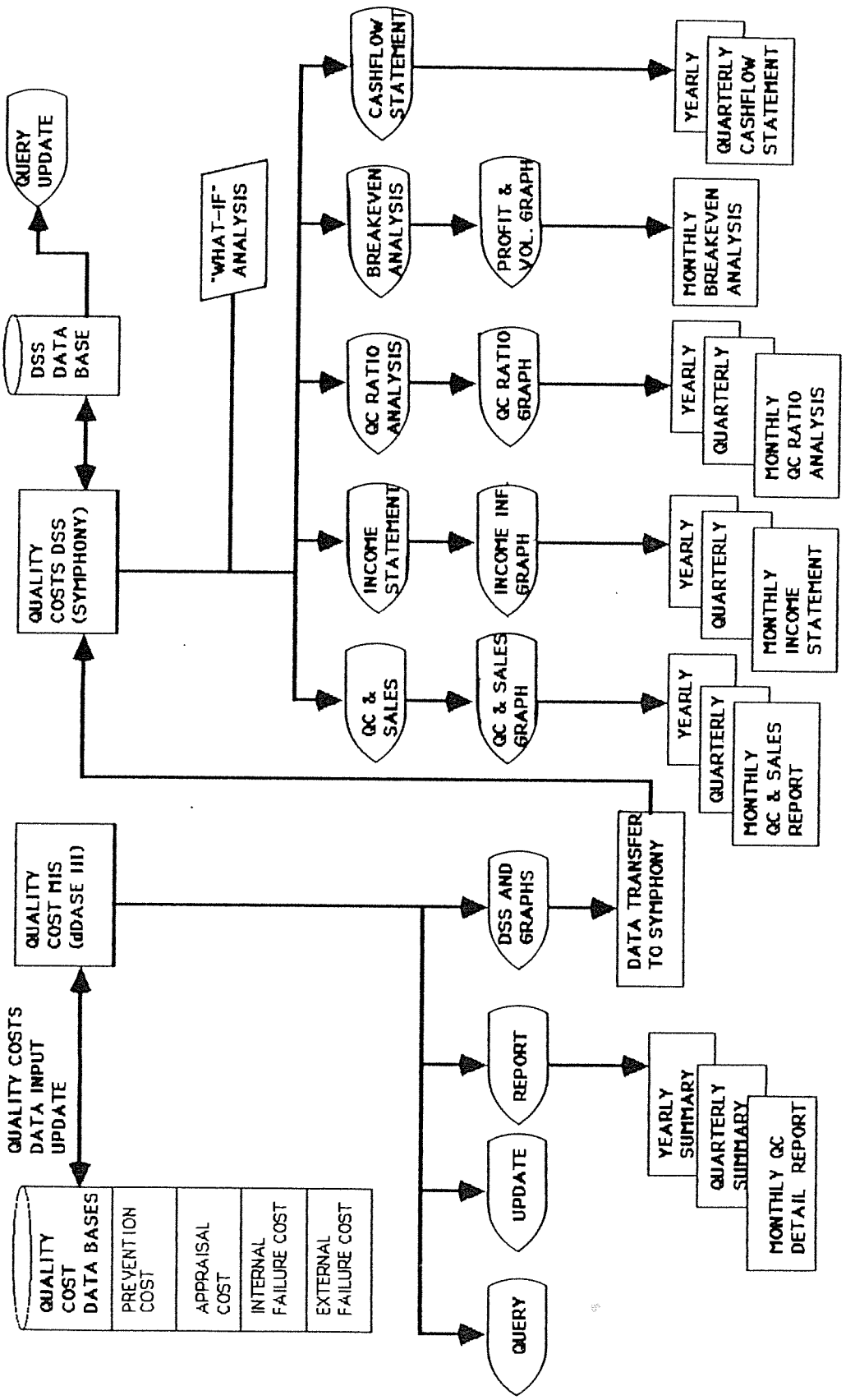
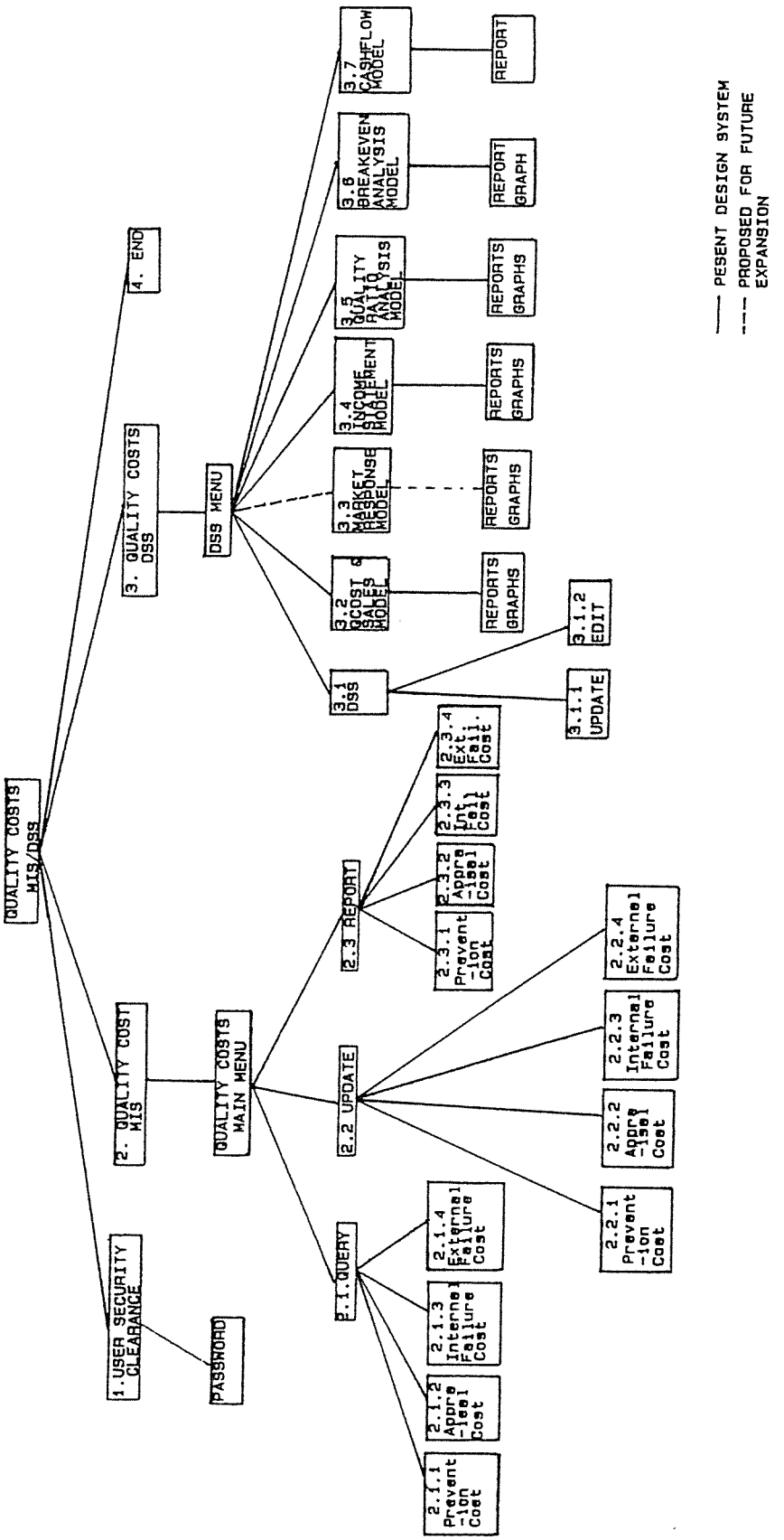


Figure -6.6. Quality Costs MIS/DSS Structure Diagram



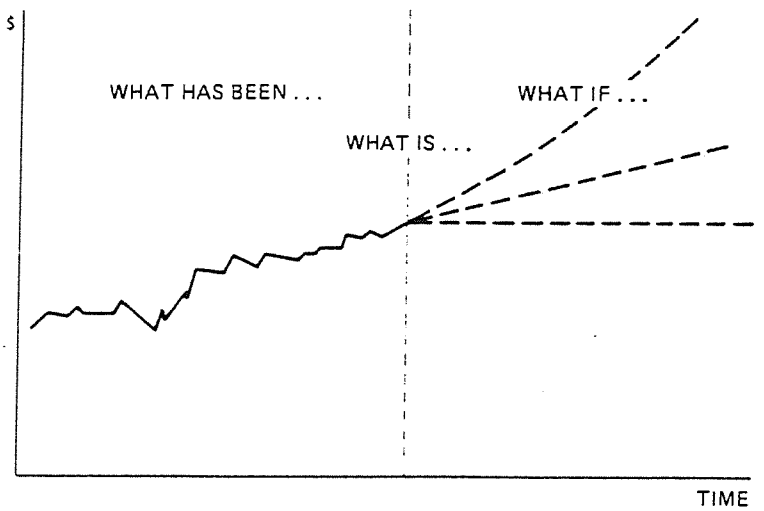
ii) Quality Costs DSS

QC DSS was built using Lotus Symphony. It consists of the following models:-

- Quality Costs and Sales Model.
- Income Statement Model.
- Quality Costs Ratio Analysis Model.
- Breakeven Analysis Model and
- Cashflow Model.

The quality costs data base and model base are managed by software systems that work closely together to facilitate the necessary flow of data. Both are directed by the command language of the packages through a terminal that provides the mechanisms by which the decision maker gains access to both data base and model base, converts and transfers data from the data base to the model base, to see "what has been" and "what is..." situations. The manager can also manipulate the data to do "What If" analysis. The DSS should be able to satisfy the planning situation as indicated in Figure 6.7.

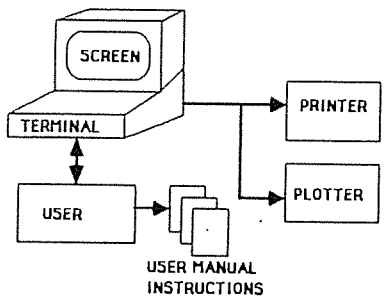
Figure -6.7. The Planning Situation



iii) The Decision Maker System

Much of the power, flexibility, and usability is characterised by the system interface which helps the decision maker in interacting with the DSS. The components of man-machine interface are the terminal device and the command language the user uses to interact with the system. The visal display would be the graphic and color capabilities (Screen, printer and plotter's output). Lotus Symphony command language would allow the decision maker to access and manipulate data and model in DSS. It is flexible, powerful and easy to use.

Figure -6.8. User System Interface



After three months of liaison, consultation, programming, etc. finally the prototype of the system was ready for demonstration. The prototype system demonstration was arranged and held at Company A on the 30th June, 1986. The managers that attended the demonstration were the Quality Assurance Manager, Chief Accountant, Information System Manager, Business Unit Manager and the Dairy Equipment Business Unit Manager.

The objectives of the demonstration of the Prototype system were:-

i) To demonstrate the usefulness, ease of use and flexibility of the system.

ii) To obtain feedback and comments from Company A on the prototype system.

The equipment used for the demonstration such as the computer, software and projector were provided by Massey University - Production Technology Department. Handouts on the prototype summary (Appendix -E) system overview and system output were given to the managers.

a. The demonstration

A brief introduction to the background of the project was given by the Quality Assurance Manager. The demonstration was then carried out in the following sequence:-

(1). Brief introduction of the objectives and the scope of Quality Costs MIS/DSS (Refer to Appendix -E)
(2). Explanation of the benefits of using QC MIS/DSS.
(3). Demonstration of the prototype system.
(4). Comments and discussions.

The session was carried out by demonstrating to the managers:-
- how the system works, screen by screen.
- explaining the function of each of the modules.
- explaining the information provided by each module.
- using system output example to give the managers more detailed information on the report and graphs provided by the system.
- explaining the easy to use, user friendly features of the system.

The users were very interested and satisfied with what they had seen. They enquired about the possibility of expanding the system and suggested some changes with the models. The suggested expansion of the system included:-
- The possibility of expanding the system to other products.

- The possibility of having more detailed information on quality costs. For example the failure costs- the possibility of including information on detail of the faulty product, which will enable the manager to trace back to the primary cause of the problem, so that corrective action can be taken easily. The above two problems can be solved quite easily by adding another module to the existing system.

- The possibility of linking the system to HP- 3000 was raised. The HP-VECTRA is compatible to IBM PC, HP- VECTRA which can link to the main system by using Office Share HP-LAN/3000 Link. Hence, there would be no problem in linking the system to the HP system in future.

6.6.THE SYSTEM OUTPUT

A). Quality Costs Data Base MIS

The system outputs from this module are (Refer to Table -6.2 to 6.5.):-

A1. Monthly Quality Costs Detail Report
A2. Monthly Quality Costs Summary Report
A3. Quarterly Quality Costs Summary Report
A4. Yearly Quality Costs Summary Report

B). Quality Costs DSS

The system outputs from this module are (Refer to Table -6.6. to Table -6.10. and Figure -6.10 to Figure -6.13):-

B1. Monthly Quality Costs and Sales Report
B2. Graph on Sales and Quality Costs
B3. Monthly Income Statement
B4. Graph on Income Statement Information
B5. Monthly Quality Costs Ratio Analysis Report
B6. Graph on Quality Costs Ratio Analysis
B7. Breakeven Analysis Report
B8. Graph on Profit and Volume Analysis
B9. Quarterly Cash Flow Statement

Table- 6.2. Monthly Quality Costs Detail Report

11/21/86

MONTHLY QUALITY COSTS DETAIL REPORT - PRODUCT P
FOR THE MONTH ENDED May 1986

QUALITY COSTS		AMOUNT(In Dollars)
A. PREVENTION COST		
A1. Quality Procedure Preparation		1234.00
A2. Research,Redesign for Q Improvement		500.00
A3. Calibration & Maintenance		
- Production Equipment		123.00
- Testing Equipment		114.00
A4. Other Prevention Cost		122.00
TOTAL PREVENTION COST	$	2093.00
B. APPRAISAL COST		
B1. Inspection & Testing		
- Process		671.00
- Setting Up for Insp.		90.00
- Incoming Inspection & Testing		342.00
B2. Product Quality Audit		412.00
B3. Field Performance Testing		76.00
B4. Investigation of Supplier		135.00
TOTAL APPRAISAL COST	$	1726.00
C. INTERNAL FAILURE COST		
C1. Scrap - Supplier Related		1135.00
Scrap - Production Related		562.00
C2. Rework & Repair		123.00
C3. Production Loss		45.00
TOTAL INTERNAL FAILURE COST	$	1865.00
D. EXTERNAL FAILURE COST		
D1. Complaint Administration		113.00
D2. Product/customer Service		4562.00
D3. Warranty Replacement		2345.00
TOTAL EXTERNAL FAILURE COST	$	7020.00
TOTAL QUALITY COSTS FOR VACUUM PUMP =>$		12704.00

Table -6.2. The Monthly Quality Costs Detail Report allows the managers to have detailed information on the quality costs of product P.

Table- 6.3. Monthly Quality Costs Summary Report

11/21/86

MONTHLY QUALITY COSTS SUMMARY REPORT - PRODUCT P
FOR THE MONTH ENDED May 1986

QUALITY COSTS CATEGORY	AMOUNT(In Dollars)	%
A. PREVENTION COST	$ 2093.00	16.48
B. APPRAISAL COST	1726.00	13.59
C. INTERNAL FAILURE COST	1865.00	14.68
D. EXTERNAL FAILURE COST	7020.00	55.26
TOTAL QUALITY COSTS	$ 12704.00	100.00%

Table- 6.4. Quarterly Quality Costs Summary Report

11/21/86

QUARTERLY QUALITY COSTS SUMMARY REPORT - PRODUCT P
FOR THE PERIOD OF 5 TO 7 1986

QUALITY COSTS CATEGORY	AMOUNT(In Dollars)	%
A. PREVENTION COST	$ 5438.00	18.80
B. APPRAISAL COST	2536.00	100.00
C. INTERNAL FAILURE COST	7024.00	24.29
D. EXTERNAL FAILURE COST	13923.00	48.14
TOTAL QUALITY COSTS	$ 28921.00	100.00

Table- 6.5. Yearly Quality Costs Summary Report

11/21/86

YEARLY QUALITY COSTS SUMMARY REPORT
FOR PRODUCT P ON FOR THE YEAR ENDED 4 1986

QUALITY COSTS CATEGORY		AMOUNT(IN DOLLARS)	%
PREVENTION COST	$	5438.00	18.80
APPRAISAL COST		2536.00	8.77
INTERNAL FAILURE COST		7024.00	24.29
EXTERNAL FAILURE COST		13923.00	48.14
TOTAL YEARLY QUALITY COSTS	$	28921.00	100.00%

Table -6.3, 6.4 and 6.5. provides monthly, quarterly and yearly quality costs summaries respectively. The managers can use these reports to identify quality problems, find out the cause, and take remedial actions against it.

Table- 6.6. Monthly Quality Costs And Sales Report

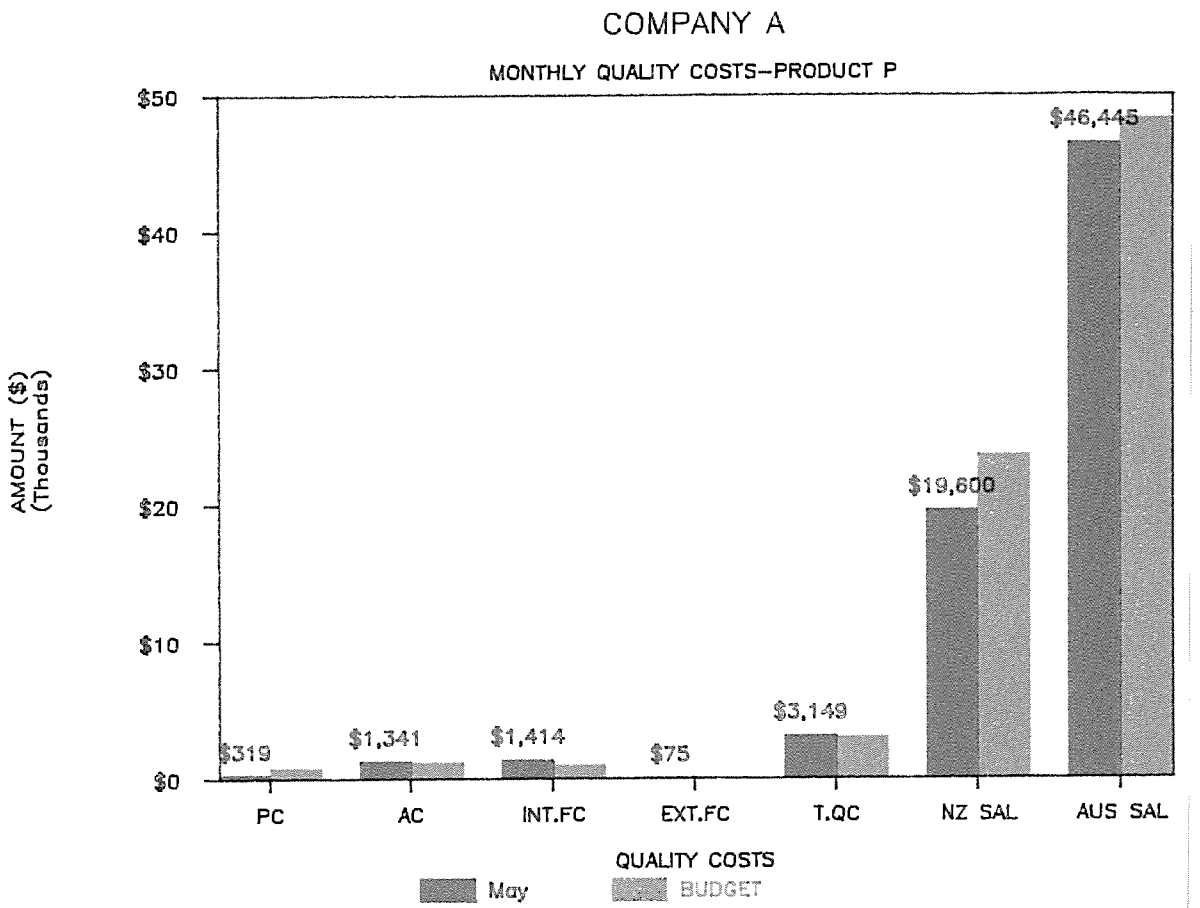
MONTHLY QUALITY COSTS AND SALES - PRODUCT P

FOR THE MONTH ENDED May 1986

SALES AND QUALITY COST	AMOUNT($)			BUDGETED TOTAL	VARIANCE BUDGET VS ACTUAL	% OF T.SALES
	Model -170	Model -240	Total			
Sales Price	$1,085.00	$1,470.00				
New Zealand Sales(Unit)	14	3	17			
Australia Sales(Unit)	13	22	35			
New Zealand Sales	15190.00	4410.00	$19,600.00	$23,625.00	($4,025.00)	29.68%
Australia Sales	14105.00	32340.00	$46,445.00	$48,300.00	($1,855.00)	70.32%
Total Sales	$29,295.00	$36,750.00	$66,045.00	$71,925.00	($5,880.00)	100.00%
PREVENTION COST			$319.00	$800.00	($481.00)	0.48%
APPRAISAL COST			$1,341.00	$1,200.00	$141.00	2.03%
INTERNAL FAILURE COST			$1,414.00	$1,000.00	$414.00	2.14%
EXTERNAL FAILURE COST			$75.00	$50.00	$25.00	0.11%
- New Zealand						0.00%
- Australia						0.00%
TOTAL QUALITY COSTS			$3,149.00	$3,050.00	$99.00	4.77%

Table -6.6 gives information on the sales and the percentage of quality costs over sales, the variance of sales and quality costs against the budget. The budgeted figures here are dummy figures. A Graph on quality costs and sales can be generated from this report.(Refer to Figure -6.9). A warning system can be built in, which would give warning to the managers if the variance is over 5% of the budgeted figure, indication on what other information to look for will be given to assist the manager in finding the problem if there is any.

Figure- 6.9. Graph On Quality Costs And Sales



The index of quality costs over net sales billed ((Quality costs/Net sales billed)*100) over a period of time, e.g. one year, will give the managers an indication of product performance in the market related to the quality.

Table- 6.7. Monthly Income Statement

MONTHLY INCOME STATEMENT - PRODUCT P

FOR THE MONTH ENDED May 1986

	AMOUNT($)			BUDGETED TOTAL	VARIANCE BUDGET VS ACTUAL	% OF T.SALES
	Model -170	Model -240	Total			
New Zealand Sales	15190.00	4410.00	$19,600.00	$23,625.00	$4,025.00	29.68%
Australian Sales	14105.00	32340.00	$46,445.00	$48,300.00	$1,855.00	70.32%
Total Sales	$29,295.00	$36,750.00	$66,045.00	$71,925.00	$5,880.00	100.00%
Cost Of Goods Sold						
- Direct Material	18748.80	21756.00	$40,504.80			61.33%
- Direct Labour	263.66	330.75	$594.41			0.90%
- Direct Factory Overheads	1054.62	1212.75	$2,267.37			3.43%
Cost of Goods Sold	$20,067.08	$23,299.50	$43,366.58			65.66%
GROSS PROFIT / LOSS	$9,227.93	$13,450.50	$22,678.43			34.34%
Indirect Factory Overheads			3000.00			4.54%
Assig. Marketing Cost			1000.00			1.51%
Total Fixed Costs			$4,000.00			6.06%
NET PROFIT/LOSS(BEFORE TAX/ DEPRECIATION-CAP.INVEST.)			$18,678.43			28.28%
Depreciation-Cap.Investment			$7,083.33			10.73%
Total Quality Costs			$3,149.00	$3,050.00	($99.00)	4.77%
Total Quality Costs / Net Profit Before Tax & Depreciation-Cap.Inv.(%)			16.86%			

Table -6.7, is the Monthly Income Statement for Product P. This statement provides infomation on sales, cost of goods sold, contribution, profit before tax and depreciation, ratio of quality costs and profit before tax and depreciation. Budgeted sales, and expenses were assigned by using dummy figures. Enhancing facility such

as warning system can be built in, i.e. if the variance between the budget and actual figures were greater than 5%, warning would be given to the manager.

The "What If" Table which consists of the variables such as sales price, sales quantity, raw material cost, labour cost allows the managers to make desired changes, do "What If" analysis to test out various alternatives and see the effects of their changes on the profit and cash flow. Figure- 6.10 is the graphic representation of the Income Statement.

Figure- 6.10. Graph On Income Statement

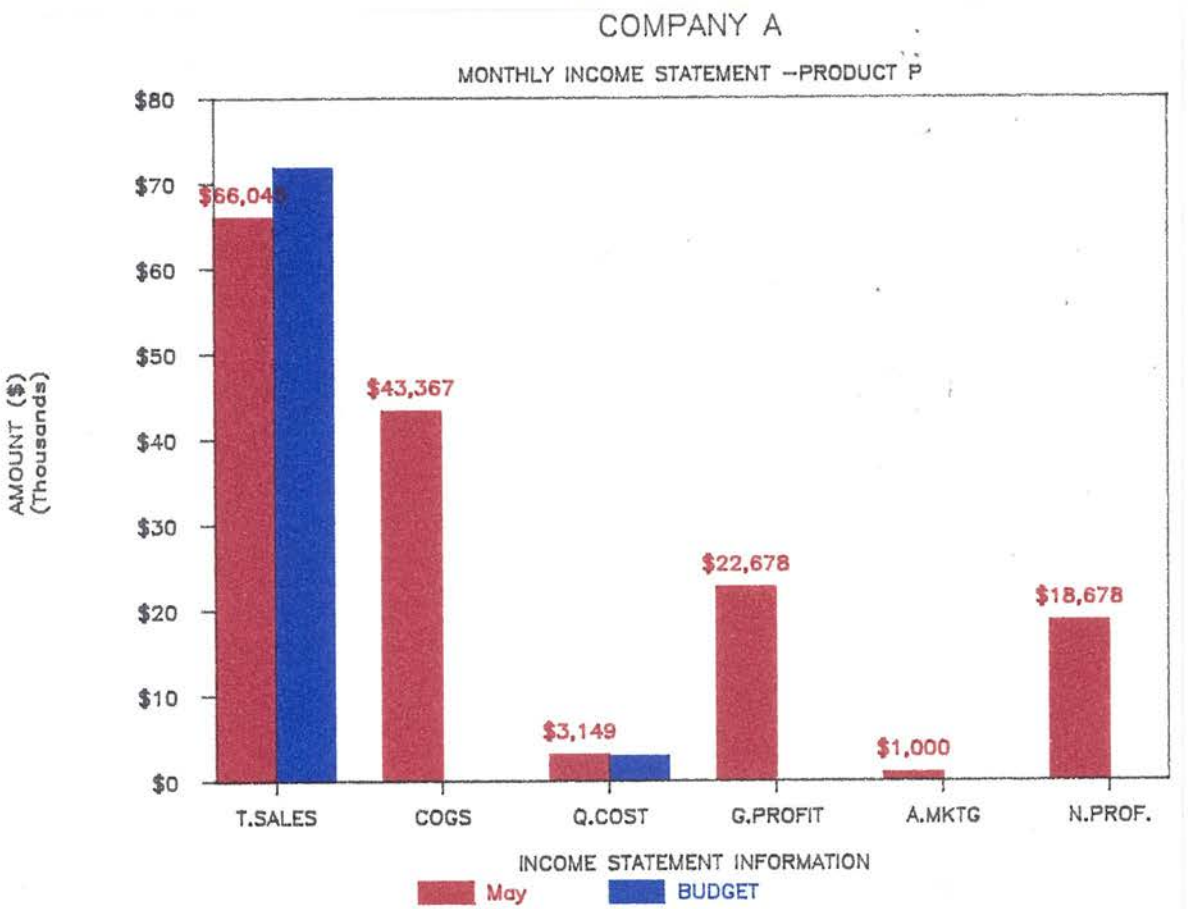


Table- 6.8. Monthly Quality Costs Ratio Analysis Report

MONTHLY QUALITY COSTS RATIO ANALYSIS - PRODUCT P

FOR THE MONTH ENDED May 1986

QUALITY COSTS AS A % OF	PREVENTION COST	APPRAISAL COST	INTERNAL FAILURE COST	EXTERNAL FAILURE COST	TOTAL QUALITY COSTS
SALES	0.48%	2.03%	2.14%	0.11%	4.77%
COST OF PRODUCTION	0.74%	3.09%	3.26%	0.17%	7.26%
OVERHEADS	6.06%	25.46%	26.84%	1.42%	59.78%
LABOUR COST	53.67%	225.60%	237.88%	12.62%	529.77%
NO. OF WORKERS	0.0	0.1	0.1	0.0	0.2

Table- 6.8. and Figure- 6.11. Quality costs Ratio Analysis is a summary of the Ratio of quality costs and sales, cost of production, overheads, labour cost and no. of workers. This table is very useful to the managers, since from here the manager would be able to see the significance of quality costs in comparison to sales, cost of production etc. e.g. If the ratio of quality costs to sales is 10%, that means that 10% of sales were spent on the quality costs. If this 10% can be reduced to 5%, the company would have a 5% or more increase in profit. The manager can then find on which category of quality costs the most was spent, and take action against it. The Trend of quality costs ratio would show the managers the results of the quality improvement program.

Figure- 6.11. Graph On Monthly Quality Costs Ratio Analysis

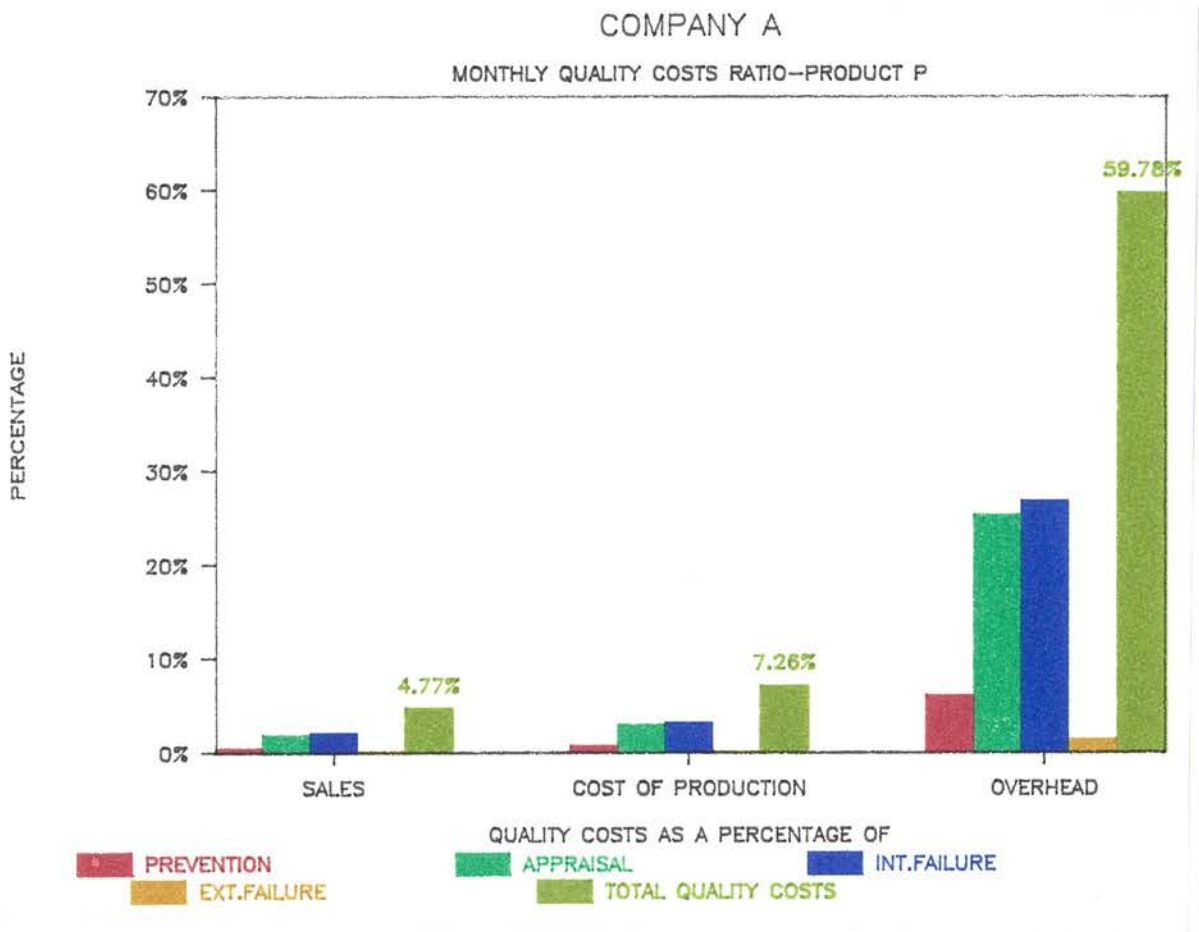


Table- 6.9. Breakeven Analysis Report

BREAKEVEN ANALYSIS - PRODUCT P

FOR THE MONTH ENDED May 1986

	Model -170	Model - 240	Combination
Unit Sales Price	1085.00	1470.00	1277.50
Unit Sales	27	25	52
Total Sales	$29,295.00	$36,750.00	$66,430.00
Unit Variable Cost			
Direct Materials	694.40	870.24	782.32
Direct Labour	9.76	13.23	11.50
Direct Overhead	39.06	49.98	44.52
Total Variable Cost	$743.23	$933.45	$838.34
UNIT CONTRIBUTION MARGIN	$341.78	$536.55	$439.16
Total Quality Costs	3149.00	3149.00	3149.00
Fixed Cost			
Indirect Overhead	3000.00	3000.00	3000.00
Ass. Marketing Cost	1000.00	1000.00	1000.00
Depreciation-Cap. Invest	7083.33	7083.33	7083.33
Total Fixed Cost	$11,083.33	$11,083.33	$11,083.33
Bef. Adding Quality Cost			
CONTRIBUTION RATIO	31.50%	36.50%	34.38%
BREAKEVEN SALES($)	$35,185.19	$30,365.30	$32,240.82
BREAKEVEN POINT (Units)	32	21	25
QUALITY COSTS EQUIVALENT NO OF UNIT SALES	3	2	2

Figure- 6.12. Graph On Profit And VOlume Analysis

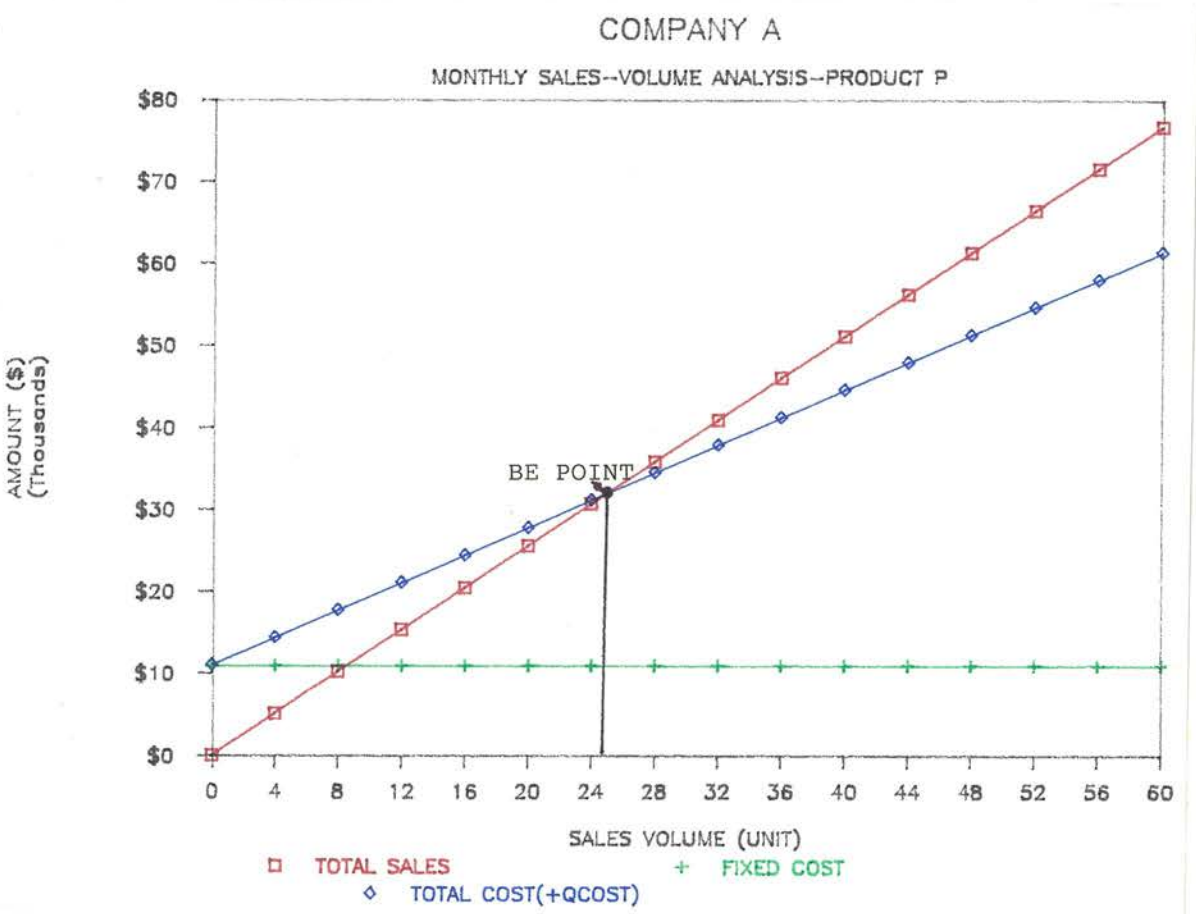


Table- 6.9. and Figure- 6.12. are the breakeven analysis and profit and volume analysis. The fixed and variable costs together constitute the total cost, which can be compared to the revenue to find the firms breakeven point. The table and graph sum up the profit structure for product P. The Profit and Volume graph protrays the "Profit wedge" showing the area of profitability. The total costs(PV) line shows the profit rate, the slope of the total costs line revealing the internal cost characteristics - the fixed and variable cost.

Table- 6.10. Quarterly Cashflow Statement

CASHFLOW STATEMENT - PRODUCT P

FROM May TOJuly 1986

	May	June	July
Cash Receipts			
Account Receivable			
First Month Collection-	0.00	55020.00	0.00
Second Month Collection-	0.00	0.00	36645.00
Third Month Collection-1	0.00	0.00	0.00
Other Income	0.00	0.00	0.00
Total	$0.00	$55,020.00	$36,645.00
Cash Disbursments			
Direct Material Purchase	6000.00	0.00	0.00
Direct Labour	1280.00	0.00	0.00
Manufacturing Overhead	20000.00	0.00	0.00
Assigned Marketing Cost	1000.00	0.00	0.00
Total Cash Disbursments	$28,280.00	$0.00	$0.00
Net Change In Cash	($28,280.00)	$55,020.00	$36,645.00
Beginning Cash Balance	$0.00	($28,280.00)	$26,740.00
Ending Cash Balance	($28,280.00)	$26,740.00	$63,385.00

Table -6.10. this table provides information on the company cashflow and liquidity in a quarterly statement. The manager can use this information to predict and improve company profitability and liquidity.

The system outputs from QC MIS provided the managers with detailed and summary reports for Product P quality costs. This information would assist the managers to identify the quality problem areas, to bring the problems to management's attention and support the managers in evaluating and planning the quality program.

The system outputs from the QC DSS provided the managers and decision makers with information on sales, profitibility, quality, profit-volume and cost of Product P. This information could be presented in two forms - report and graph. The Break-even chart could be used in analysing alternative decisions and unexpected situations which might arise in a future period. The Break-even chart reveals the estimate profit past the break-even point. It assists and supports the manager in planning the marketing mix, production, purchasing and quality.

The manager could use the "What If" Table to change some variables, such as sales price, sales volume, material and labour costs, quality costs etc. Using "what if analysis" to test out various alternatives, he could view the results of the changes he made on the screen and print out the report and graph that he wanted. These are all under his control.

A warning and direction pointing facility can be built into the system to warn and point directions to the managers when the actual expenses are exceeding the budgeted figures. e.g. if the quality cost is 5% over the budgeted value, (the budgeted figures used here are dummy figures) warning and direction for searching the cause would appear. This facility would warn the manager of problems and save the manager time in searching for the cause.

6.7. FUTURE DEVELOPMENT

From the response and feedback on the QC MIS/DSS prototype demonstration, it appears that it has met the preliminary requirements of the users, and the predetermined objectives. However, some of the decision makers have a very vague idea of what they want at the initial stage. Their requirements will gradually surface when they have their hands on the system to see what they can get out of the system. The system would evolve with users' understanding and learning.

When the system has evolved from a prototype system to an operating system through user's understanding and learning of the system, the system will then be expanded to other existing products. Additional sub-models for detailed information of the quality costs can also be built in.

A Market response model was not included in the model system due to lack of information from the business unit department. The reason for this was that the Business Unit manager felt that they have not had enough knowledge and experience about Product P's market as it is in its introduction stage of Product Life Cycle. They suggested they could look into a market response model at a later stage. A market response model would be very useful to the manager for market forecasting. It would be worthwhile to include it into the system in future.

The QC MIS/DSS can be linked to the main system. The system can be run on the HP-VECTRA (An IBMPC compatible), which can then be linked to the main data base by Office Share LAN/3000 Link. However, access to the main data base for micro users may present some problems - such as the security of sensitive information. Hence, in order to ensure that the data for the DSS are accurate and to save the manager's time in gathering and entering the data for DSS, and at the same time to have total control of their own computer environment, quality related data could be stored in a separate data base for the Quality Costs MIS/DSS use. This will solve the access and

security problem on the main data base.

A future development opportunity for the QC MIS/DSS would be the design of a semi-expert system. This is a problem solving program that achieves good performance in a specialized problem domain that requires specialized knowledge and skills. (The system would suggest what the decisions should be). Our DSS interfaces in DSS allows the users to do "What if" analysis, e.g. if I reduce the quality costs, what impact would there be on the cost of goods sold, sales and profit. The semi-expert system that I mentioned here is to move DSS up to be a little more active, to be run like a good consultant instead of just a software system, which would be very valuable.

6.8. CONCLUSIONS

The project has shown that it is possible to combine the two application packages for developing decision support system and the use of a decision support system and quality costs control concepts to develop QC MIS/DSS modelling to support the management in strategic planning qualtiy assurance and indirectly to marketing, purchasing and new product develpments.

The QC MIS/DSS prototype system had been accepted by the user and met the user requirements and achieved the predetermined objectives:-

i. To build a management information system and decision support system using microcomputer and application packages based on DSS concepts and building techniques.

ii. To establish the feasibily of using two off-the-shelf application packages for the system's development, and also the feasibility of transfer and conversion of data from one package to another.

iii. To provide a powerful management tool to support the manager in planning and decision making in quality assurance, and indirect support to marketing, engineering, production and purchasing.

iv. To assist the manager in monitoring, controlling and evaluating quality programs for cost reduction.

It is a powerful management tool which will enhance the managers task by :-

- Making timely decisions.
- Analysing some situations more thoroughly.
- Reviewing several courses of action before deciding what to do, rather than having only one recommended course to consider.
- Examining analyses of the impact that courses of action will have on the problem or opportunity identified.

The unique feature of the system would be the design of a warning and direction pointing facility to problem areas. This device would point out the problems and gives general guidelines to the managers on actions to be taken. Improvement would be made through user learning and experience, additional information would then be able to add in to improve the system to adapt to the user's environment. It is an evolutionary process through user learning.

The fourth generation package and the integrated packages proved to be a powerful tool for model building. They are versatile, easy to use and learn and most importantly, a time and cost saving for system development. The integrated packages provide facilities such as spreadsheet, data management, word processing, graphics and communication. These facilities enhanced the model by providing graphics, reports and they enabled the user to transfer data from other computers or other application packages which is an added flexibility for system development or model building.

In conclusion, the project has been a great and valuable experience for me. The building of a DSS using the decision support systems concepts and model building techniques in conjuction with quality costs control concepts, to actually put theories into practice was not an easy task. It involved knowledge in the areas of production, quality control, accounting, communication, management and programming. The sucess factor of the project depended greatly on:-

- the management support, cooperation of the managers and staff and user
- the type of software used
- the user/ designer interaction during the development process
- the cost benefit of using application packages and prototyping.

Finally, I must stress that regardless of the system's specific capabilities, decision makers do not rely on the DSS to make decisions for them. It is simply to support the decision making process. DSS support the managers decision making by providing the manager with accurate, timely information which support their decision making and assist the managers in designing alternative courses of action through a "What If" capability. The final judgement is still in the manager's hand.

The evolutionary nature of QC MIS/DSS is of central conceptual and practical importance. It is to simulate learning, encourages the managers to look for alternatives, experimenting and probing. The managers learning will lead to new ideas and willingness to try new methods. Hence, the Quality Costs MIS/DSS protoype system will evolve with the user's knowledge and experence of the system. Fine tuning and further development are needed to meet any change in user requirement and environment.

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CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 7. CONCLUSIONS AND RECOMMENDATIONS

Decision support systems have become more widely used since the last decade, partly due to a turbulant and rapidly changing environment and technology. The ability of an organization to adapt properly to the environment, both internal and external has become more critical in survival. Effective and efficient planning and decision making have become important success factors for managers and their companies.

This research was aimed at applying the decision support systems and quality costs concepts to build a Quality Costs Management Information System/Decision Support System using some of the popular, powerful off-the-shelf application packages and a microcomputer for the system development. To achieve these aims, a survey was conducted to find out the extent of computer applications in industries in the Manawatu region. Application packages was evaluated to select two suitable packages for the development of a Quality Costs Management Information System/ Decision Support System project in Company A. In conclusion, I would like to restate the findings of this research and to make recommendations about the implementation of the Quality Costs MIS/ DSS.

7.1. REVIEWING THE SURVEY FINDING

In New Zealand, it was estimated that approximately 70% of the managers of large companies would be using microcomputers in 1987. A survey on the application of computers in the Manawatu region was conducted in June, 1985. The results showed that about 47.4% of respondents were using microcomputers. The extent of computerization varied with the company size. Only 16.7% of small businesses were computerized but there was 100% computerization for the large businesses. (Company size of 100 or more employees) The majority of the respondents used computer programs for finance, invoicing and stock control. Decision support was not yet a major

usage.

Popular application packages used by the respondents were:-

a) Integrated Package - Lotus 1-2-3, Lotus Symphony.
b) Spreadsheet Package - Multiplan, SuperCalc 3.
c) Database Package - dBASE II, dBASE III.

The application of the microcomputer in industry was more popular than the mainframe and minicomputer. The area of computer application was expected to be broadened from the traditional accounting and stock control to decision making, marketing, engineering, statistical analysis and process control.

7.2. REVIEWING THE DEVELOPMENT OF QUALITY COSTS MIS/DSS PROJECT

The results of the survey of Quality Costs practice on NZOQA members which was conducted in 1985 showed that there was an increase in awareness about the benefits of quality costs control. The Quality Costs MIS/ DSS project attempted to combine two useful management tools using a time and costs saving technical tool - application packages which were powerful, flexible and easy to use for system development.

The evaluation of the application packages was carried out to select suitable application packages for QC MIS/DSS's system development, based on user requirements for Quality Costs MIS/DSS and the availability of the packages for the designer. The method for evaluating a package's performance could be subjective to users' and designers' view on the criteria of power, use, flexibility and user friendliness. It was not a perfect evaluation method but it gave a basic foundation for a comparison of the package's performance. dBASE III and Lotus Symphony were chosen for their power, flexibility and user friendly features on data base management and the latter for its spreadsheet, graphic and communications capabilities.

There were one or two hiccups during the system development process, where the Accounting personnel were concerned about the confidentiality of the financial information, and the Information System development were concerned about the linking of the system to their mainframe. These two problems were solved after ensuring that the confidentially of the data would be kept and documentation of the system would be provided if the system was accepted.

Prototyping was adapted for QC MIS/DSS system development. This method has been viewed as an "evolutionary" method that provides a quick and effective prototype to meet the users' requirements. It was an appropriate methodology to use for the project as there was a substantial uncertainity in the information requirements and managers/ users expectation on what information the system could provide. These uncertainties were mainly due to the lack of understanding, and experience on what the system could offer.

The Prototype of Quality Costs MIS/DSS has the features of easy to use, simple to understand, user controlled, adaptive and easy to communicate with. The mangers/ users were satisfied with the prototype demonstrated. Interest in the possibility of expanding the system to other existing products and for detailed information on quality costs were raised. A future link to the mainframe was also being discussed.

The system was built on a modular basis, new models can be added to the system. Symphony has a communication facility and there were IBM LINK products in the market. The system can also be run on HP-VECTRA(An IBM compatible), which can be linked to the main data base by office share HP-LAN/3000 Link. Hence, there would be no problem linking the system to the HP system in future.

7.3. THE BENEFITS AND SUCCESS FACTORS OF THE PROJECT

The concept of Quality Costs were new to some of the managers and users, since it was not practiced in the company. Therefore, initially there were doubts on the practicality and benefits of the system. However, the top management and the quality assurance manager had great interests in the information that the system could provide. The benefits of the system were identified as follows:-

(1) The system provides useful information on quality costs, its effects on costs of production, sales, profitability of the product. This information would assist the managers in effecive decision making and in strategic planning in production, quality assurance, sales and purchasing.

(2) It would help the managers to monitor, control and evaluate the product's quality and quality program.

(3) Costs and time saving on tedious calculation and reports or graphs preparation would be provided. The user can generate reports and graphs by a simple key stroke which is under his control.

(4) The system also allows the managers/ users to use "What If" analysis to test out different alternatives. He can then use his knowledge and experience to make more effective decisions.

(5) Flexibility, user friendly and easy to use were the main features of the system.

Two main factors which contributed to the success of the project were:-

a) The prototyping approach used for system development.

The approach taken effectively involved the managers/ users in the

definition development process. This was a quick approach to find out the users' need and provide somthing concrete for the users to work and experiement with. It could then be modified and evolved according to the users' needs. The project has stimulated the potential users and manager's interests which resulted in greater cooperation from management and staff.

b) Management support.

The support from the management was very encouraging throughout the system development process, especially, the suggestion and comments given by the managers during the system development process.

7.4. THE EFFECTS OF THE PROJECT

There were some significant changes after the concept of quality costs MIS/DSS was introduced to Company A.

a. Improvement on data collection and records for rework, rejects, scraps on the assembly line. It also led the sales, production, quality control, purchasing and finance managers to look into the control and management of rejected goods returned from customers.

b. It increased the awareness of the quality costs and their significance.

c. It increased the awareness of the process efficiency and as a result, work study and time study were carried out on the assembly line.

In conclusion, the Quality Costs MIS/ DSS was only at the prototying stage. There was some quality costs information that was not included as requested by the users, due to lack of information. Further investigation on this would need to be carried out.

Accuracy and integrity of the data input is another important area that needs special attention. The data required for the prototype were

input manually. Data transfer from the mainframe to the system would improve the accuracy and integrity of the data input.

The project has met the predetermined objectives and the users' requirements. It has also proved that it is feasible to apply the decision sypport system theories and prototyping system development methodology by using the costs and time saving tools- Application packages for their model building.

The expansion of the system to other products should be carried out only after the prototype has been improved and implemented successfully for product A. To further improve and enhance the effectiveness of the system, it would be very useful to develop the DSS to a semi-expert system which would provide users with warning and some guidelines on what actions to be taken. This could be used as a consultancy device which would further improve the efficiency of the managers and decision makers in decision making.

APPENDIX -A

SURVEY QUESTIONNAIRES AND INFORMATION ON COMPUTER, AND PROGRAMS

Massey University

PALMERSTON NORTH, NEW ZEALAND

TELEPHONES, 69-079, 69-089, 69-099.

In reply please quote:

Department of Production Technology

1 August 1985

The Manager

Dear Sir/Madam,

As part of a research project, we are conducting a survey on the use of computers, application programs and/or application packages (e.g. dBaseII, Lotus 1-2-3, I.F.P.S. etc.) in the Manawatu region. The research project is a major requirement of Miss S.W.Tan for her Master of Philosophy (Quality and Production).

The objectives of the survey are to determine:-

1. The range of computers and computer programs being used by local companies.

2. What tasks the programs are performing (e.g. modelling, decision support, accounting, stock control etc.).

The information will assist us to design better courses on the use of application programs for local industry.

We fully realise that it will take up precious time and may also inconvenience you to fill in this questionnaire, but we hope you will help us out and bear with us. Perhaps the questionnaire may provide an opportunity for you to review your own computerisation process.

Please retain this page, complete the questionnaire, enclose it in the stamped, self-addressed envelope and return it to us by 21 August so that it can be coded for computer analysis as soon as possible.

Thank you for your co-operation in completing the questionnaire.

Yours faithfully,

E L Loo

Lionel Loo
Senior Lecturer

The questions have been designed in such a way as to allow anonimity. However, if you wish to enquire about courses offered at Massey or application packages in general, please fill out the details below and return this page separately or with the questionnaire.

Name of Contact.....

Position .....

Phone .....

Address .....

.....

.....

MASSEY UNIVERSITY

DEPARTMENT OF PRODUCTION TECHNOLOGY

SURVEY ON APPLICATIONS OF COMPUTERS, COMPUTER PROGRAMS/PACKAGES IN MANAWATU REGION

I. GUIDELINES FOR ANSWERING THE QUESTIONNAIRE

1) Please circle the appropriate code.
2) More than one code may be circled for the same question.
3) Please give details where applicable.
   N/A is used when the question is "Not applicable".
4) If your company has not yet computerised, please answer Section A and Section D and
5) Please return the questionnaire as soon as possible.

GLOSSARY - to assist in clarifying some of the terms

1)	Mainframe -	Purchase cost from $250,000, used only by large organisations with large volume of data and large amount of computations. Usually require computer professionals and specialised staff to operate and maintain.
2)	Minicomputer -	Purchase cost from $50,000, suitable for small organisations or for decentralised units of large firms.
3)	Microcomputers-	Purchase cost from $1,500 onwards, can be used as personal computer at home or in a neighbourhood store.
4)	Application - Programs	Pre-written programs that can be bought or rented from consultants, software houses, computer manufacturers, e.g. accounting, stock control, scheduling programs etc.
5)	Application - Packages	Can be used to write application programs for various purposes, e.g. accounting, stock control, decision support, scheduling etc. Examples of application packages are multiplan, Visicalc, dBase II, Lotus 1-2-3 etc.
6)	Model -	Computer program written for problem solving and decision making in a specific area, e.g. Financial Model, Operational Research Model, Production Model, Statistical Model, etc.

HOW TO FILL THE QUESTIONNAIRE

IT IS VERY EASY, JUST CIRCLE YOUR CHOICES & FILL IN THE BLANKS

GENERAL INFORMATION

SECTION A
Q 1 TO Q 3

IF COMPANY ALREADY COMPUTERIZED, PLEASE FOLLOW THIS BRANCH

IF COMPANY HAS NOT YET COMPUTERIZED, PLEASE FOLLOW THIS BRANCH

SECTION B
Q 4 TO Q6

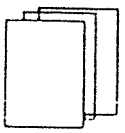
SECTION C
Q 7 TO Q 17

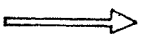
SECTION D
Q 18 TO Q 22

SECTION D
Q 18 TO Q 22

WELL DONE !
YOU'VE FINISHED

QUESTIONNAIRE





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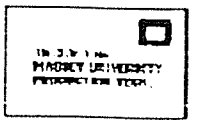


THANK YOU
VERY MUCH !

II. QUESTIONNAIRE

SECTION A: Company Details and Current Position of Respondent

Q1. Your current position

	Code
Managing Director	1
General Manager (Or manager)	2
Data Processing manager (or equivalent)	3
Finance Manager (Financial Director)	4
Manufacturing/Production Manager	5
Marketing Manager	6
Engineer	7
Other (please specify)	8

Details:_____

Q2. Company's Activities

	Code
Construction	1
Engineering	2
Financing, Insurance, Real Estate & Business Services	3
Manufacturing/Production, (Food, Textile, Paper Chemicals, etc.)	4
Primary products (Agriculture, Fishing, Oil, Mining)	5
Trading (Wholesale, retail), Restaurant, Hotels	6
Transport and Storage	7
Others (please specify)	8

Details:_____

Q3. Company size (Total no. of people employed)

	Code
1 - 5	1
6 - 10	2
11 - 25	3
26 - 50	4
51 -100	5
101 -200	6
201 -500	7
Above 500	8

SECTION B: Company's Computer Applications

Q4. Computer(s) currently used

	Code	Brand (e.g.IBM)
Mainframe	1	
Minicomputer	2	
Microcomputer	3	
External Computer Bureau	4	
No computer used yet	5	Go to Q18
Others (please specify) Details:_____	6	

Q5. How long since the company started its computerisation activities?

	Code
0 - 1 year	1
1 - 2	2
2 - 5	3
5 - 10	4
Above 10	5

Q6. Number of staff specially employed for computer applications.

	Code
0 - 2	1
3 - 5	2
6 - 10	3
11 - 15	4
Above 15	5

SECTION C: Computer Program(s), Application Packages currently used or being built

Q7. Areas where computer models are used to help decision making and problem solving.

	Code	
Financial	1	
Marketing	2	
Operational Research	3	
Production/Manufacturing	4	
Statistical	5	
None	6	Go to Q.10
N/A	7	
Others (please specify) Comments/details:_____	8	

Q8. Construction of Computer Models:-
Model in use (or being built) is constructed by using

	Code	
A language (e.g. Fortran, Cobol, Basic etc.)	1	→ Go to Q9
Command language (e.g. Foreight, IFPS etc)	2	
Data Base Package (e.g. dBase II,III, etc)	3	
Spread sheets (e.g. Multiplan, etc.)	4	
Integrated packages (e.g. Lotus 1-2-3 etc)	5	→ Go to Q10
Don't know details	6	
N/A	7	
Others (please specify)	8	

Comments/details:_____

Q9. Languages used for modelling

	Code
Fortran	1
Cobol	2
Basic	3
Pascal	4
Others (please specify)	5

Details:_____

Q10 Name of the computer program or application packages and no. of years used (Please enter no. of years used for the particular program or package).

Name of program/package	Years Used	Code
dBase II	( )	1
dBase III	( )	2
Multiplan	( )	3
Visicalc	( )	4
Supercalc	( )	5
Lotus 1-2-3	( )	6
XYWrite	( )	7
WordStar	( )	8
IFPS	( )	9
Foresight	( )	10
CAD/CAM	( )	11
Others (please specify)	( )	12

Details:_____

Q11. Reasons for purchasing the computer program or application packages.

	Code
To assist in forecasting and planning	1
Better information control	2
To assist in Decision making	3
To assist in problem solving	4
Reduce stock, Inventory & Work in progress	5
Improve productivity	6
Reduce manpower	7
Cost Reduction	8
Time Saving	9
Others (please specify)	10

Details:_____

Q12.Who is in charge of the computer system?

	Code
Managing Director/General Manager	1
Finance Manager	2
Data Processing Manager	3
Marketing Manager	4
Manufacturing/Production Manager	5
Operation Manager	6
Engineer	7
Others (please specify)	8

Details:_____

Q13.Who/Which department/s is/are using computers?

	Code
Managing Director/General Manager	1
Financial Department	2
Data Processing Department	3
Marketing Department	4
Manufacturing/Production Department	5
Quality Control/Quality Assurance Department	6
Engineering Department	7
Others (please specify)	8

Details:_____

Q14.What are the computer program(s) used for by the above personnel?

	Code	Package Name	Usefulness		
			Good	ok	poor
Decision Support	1	_____	1	2	3
Planning	2	_____	1	2	3
Forecasting	3	_____	1	2	3
Project Planning	4	_____	1	2	3
Filing Cabinet (e.g. records, specifications)	5	_____	1	2	3
Invoicing	6	_____	1	2	3
Accounting	7	_____	1	2	3
Process Control	8	_____	1	2	3
Production Control	9	_____	1	2	3
Stock Control	10	_____	1	2	3
Job Costing	11	_____	1	2	3
Others (Please specify)	12	_____	1	2	3

Details:_____

15. Experience or knowledge of computers of the users in the company was gained from:-

	Code
University	1
Attending courses	2
Software vendor	3
Model designer	4
Company training	5
Self training	6
Others (please specify)	7

Details:_____

Q16. Difficulties or problems encountered on using the computer programme or application package.

	Code
Poor user manual (descriptions are not clear)	1
Slow processing speed	2
Tedious data entry and operations (require several steps to perform a function)	3
High costs (need extra hardware)	4
Poor user support (training, after sales services & assistance)	5
Error control and recovery (unsatisfactory)	6
No comment	7
Others (please specify)	8

Details: _____

Q17. Subjective rating of computer program(s) or application package(s). (Please write the program or package name in the space provided, if it is not on the list.)

Name of Program/s or Application	Code	Ease of use or "User Friendliness"				
		Excellent	Good	Acceptable	Poor	Very Difficult
		1	2	3	4	5
dBase II	1	1	2	3	4	5
dBase III	2	1	2	3	4	5
Multiplan	3	1	2	3	4	5
Visicalc	4	1	2	3	4	5
Supercalc	5	1	2	3	4	5
Lotus 1-2-3	6	1	2	3	4	5
XYWrite	7	1	2	3	4	5
WordStar	8	1	2	3	4	5
IFPS	9	1	2	3	4	5
Foresight	10	1	2	3	4	5
CAD/CAM	11	1	2	3	4	5
Others (please fill in below)						
_____		1	2	3	4	5
_____		1	2	3	4	5
_____		1	2	3	4	5

SECTION D: Your Future Plan on Computerisation and Comments.

Q18. What are your future plans on Computerisation?

	Details	Code
Acquire new program: Name of Program	_____	1
Acquire new computer:Name of computer	_____	2
Increase the usage of computer		3
Introduce it to other departments which are not using computers		4
Provide training for staff on the use of computer		5
Intend to computerise		6
Do not intend to computerise		7
Do not know yet		8
Others (please specify)		9

Details:_____

Q19. What type of computer package training would you be interested in?

	Code
Multiplan	1
Supercalc	2
dBase III	3
Knowledgeman	4
Lotus 1-2-3	5
Lotus Symphony	6
Framework	7
CAD/CAM	8
None	9
Others (please specify)	10

Details:_____

Q20. How long could you afford to spend time away for training?

	Code
0 - 1 day	1
1 - 2 days	2
2 - 3	3
3 - 4	4
4 - 5	5
5 - 6	6

Q21. What time of the week would you be able to have time away for training. (Please circle the appropriate choices.)

	Code
Week days - day time	1
Week days - evenings	2
Week ends - day time	3
Week ends - evenings	4

Q22. Comments:_____

_____

_____

_____

_____

_____

THE END

APPENDIX -A. SURVEY OF COMPUTER APPLICATION IN THE MANAWATU REGION

A.1. NAME OF THE PACKAGES/PROGRAMS USED

The name of the packages/programs given in Q 10 and Q 17 in the questionnaire were only some packages/programs used for Personnel Computers. The following list are 45 different packages/programs used in the respondent companies.

	NAME OF THE PACKAGES/PROGRAMS	NO OF CASES
1.	AUCTIONEERING/ WHOLESALEING	1
2.	MAPICS	1
3.	IMAS 34	1
4.	IMAS	1
5.	PIPS	1
6.	SMALL BUSINESS SERVICES	1
7.	SPECIAL COSTING SYSTEM	1
8.	CREDITORS	1
9.	BELDS	1
10.	QMRP	1
11.	SOLUTION 6	1
12.	AUTOCOMP	1
13.	COBOL	1
14.	COMMAND	1
15.	LCALL	1
16.	OLDS	1
17.	PLAMCODE	1
18.	CPM	2
19.	TOGS	1
20.	UGEN	1
21.	CHARTER SERIES	2
22.	CHARTER STARS	1
23.	OPEN ACCESS	1
24.	APPLE STARS	1
25.	APPLE CHARTER	1
26.	APPLE WRITER	1
27.	SORDS(STOCK CONTROL)	1
28.	TRANSACT	1
30.	SORDS(WORD PROCESSOR	2
31.	HORIZON	1
32.	BPI	1
33.	VISIFILE	1
34.	PEACHCALC	1
35.	FCS-EPC	1
36.	LOTUS SYMPHONY	2
37.	DBASE II	3
38.	DBASE III	1
39.	MULTIPLAN	4
40.	VISCALC	1
41.	SUPERCALC	3
42.	LOTUS 1-2-3	4
43.	XY WRITE	1
44.	WORDSTAR	5
45.	CAD/CAM	3
	TOTAL CASES	64

A.2. TYPES OF COMPUTER USED BY THE RESPONDENT COMPANIES

MAINFRAME		MINI-COMPUTER		MICROCOMPUTER	
MAKER	NO	MAKER	NO	MAKER	NO
IBM	3	WANG	3	IBM	5
FACCOM	2	BURROUGHS	3	ICL	2
BURROUGHS	1	SORDS	2	SORDS	2
QANTEL	1	ICL	1	BURROUGHS	2
NOT		HP 3000	1	APPLE	2
SPECIFIED	3	CASIO	1	CANNON	1
		SYSTIMX	1	DATA	
		IBM	1	GENERAL	1
				COWERCEWNT	1
				NOT	
				SPECIFIED	2
TOTAL	10		13		18

NOTE:

1. "NOT SPECIFIED" : There were some respondent companies who did not specify the types of computer used in their company.

APPENDIX -A. SURVEY OF COMPUTER APPLICATION IN THE MANAWATU REGION

A.3. FUTURE PLANS OF THE RESPONDENT COMPANIES

A.2.1. Acquire New Computer

Eight out of 41 respondent companies intended to acquire new computers. There were seven respondents who gave details of the types of computer that they would like to acquire.

TYPE OF COMPUTER	NO OF CASES
IBM PC	2
EPSON	2
BURROUGHS B20	1
ALTOS	1
CANNON	1
TOTAL	7

APPENDIX -A. SURVEY OF COMPUTER APPLICATION IN THE MANAWATU REGION

A.2.2. Acquire new packages/ programs

Nine out of 41 respondent companies intended to acquire new packages/programs. Seven respondent companies gave details the packages/ program that they would like to acquire. These are as follow:-

NAME OF THE PACKAGE/PROGRAM	NO OF CASES
STOCK CONTROL	2
PAYROLL	2
GST	1
MULTIPLAN	1
MAIL MERGE	1
FCS-EPS	1
CREDITORS	1
TOTAL	9

APPENDIX -A. SURVEY OF COMPUTER APPLICATION IN THE MANAWATU REGION

Figure- 4.1. RESPONDENT COMPANY'S ACTIVITY

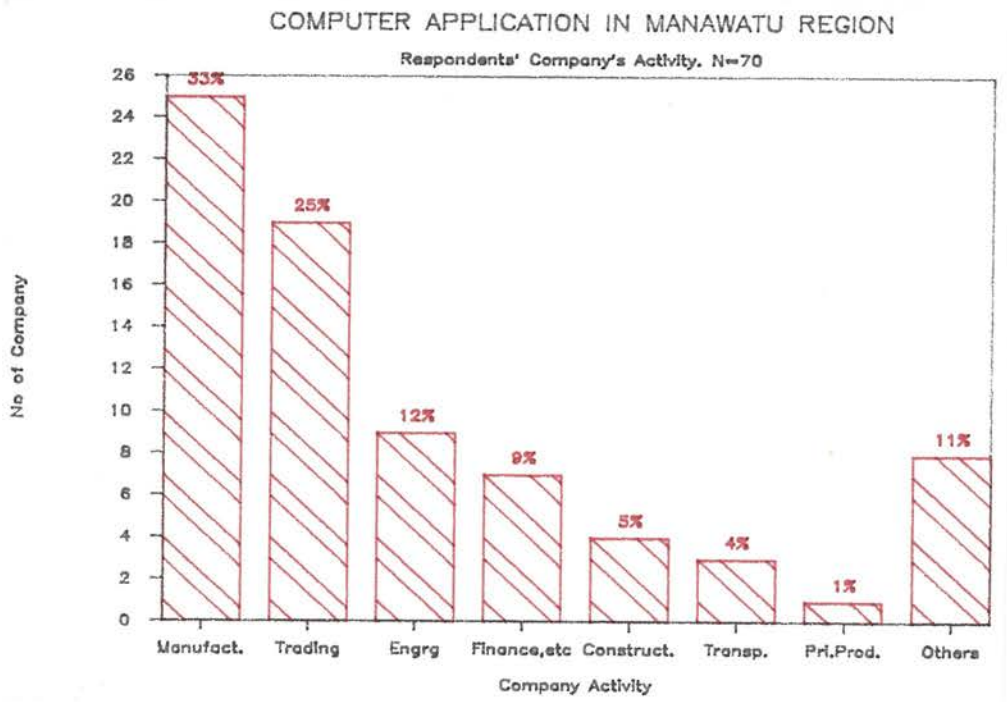
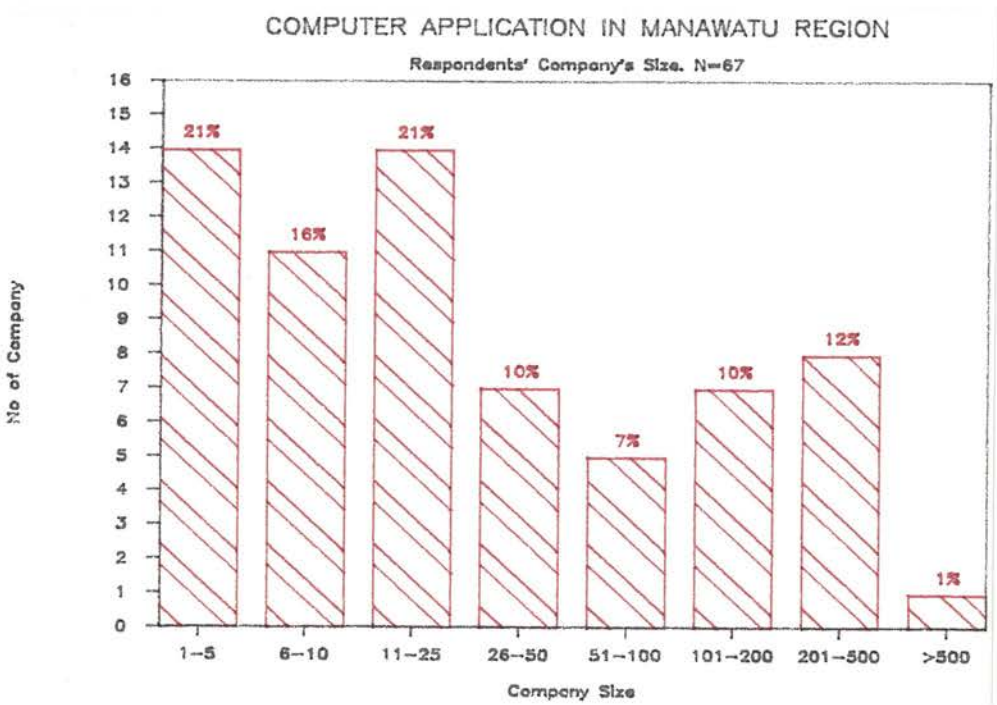


Figure- 4.2. RESPONDENT COMPANY SIZE



APPENDIX -A. SURVEY OF COMPUTER APPLICATION IN THE MANAWATU REGION

Figure- 4.3. RESPONDENT COMPANY ACTIVITY AND COMPUTERIZATION

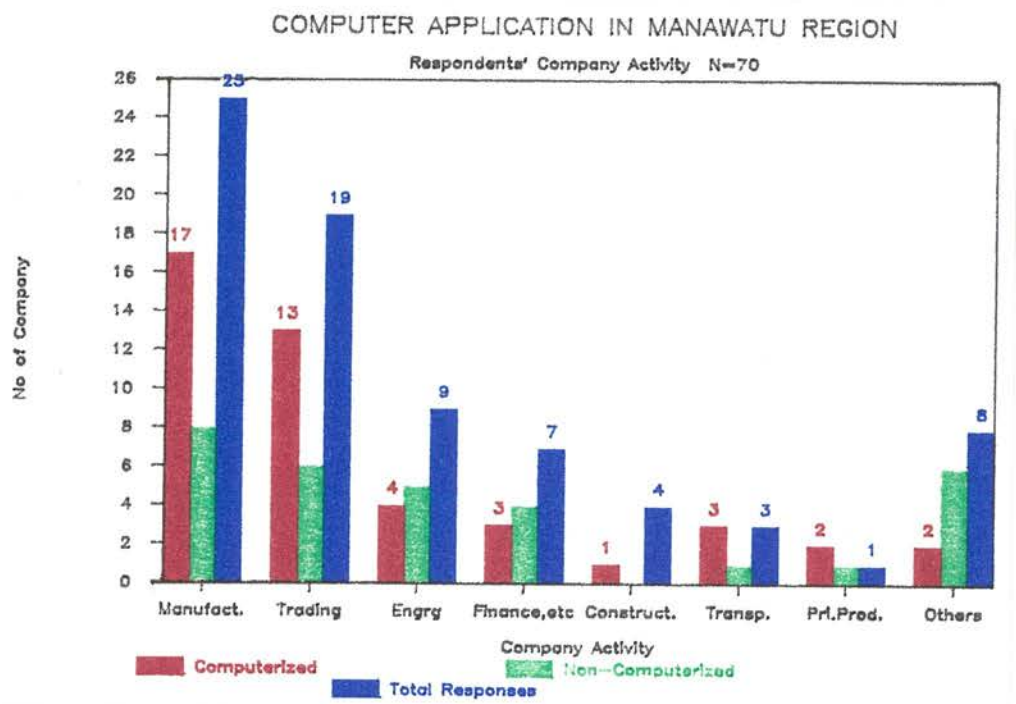
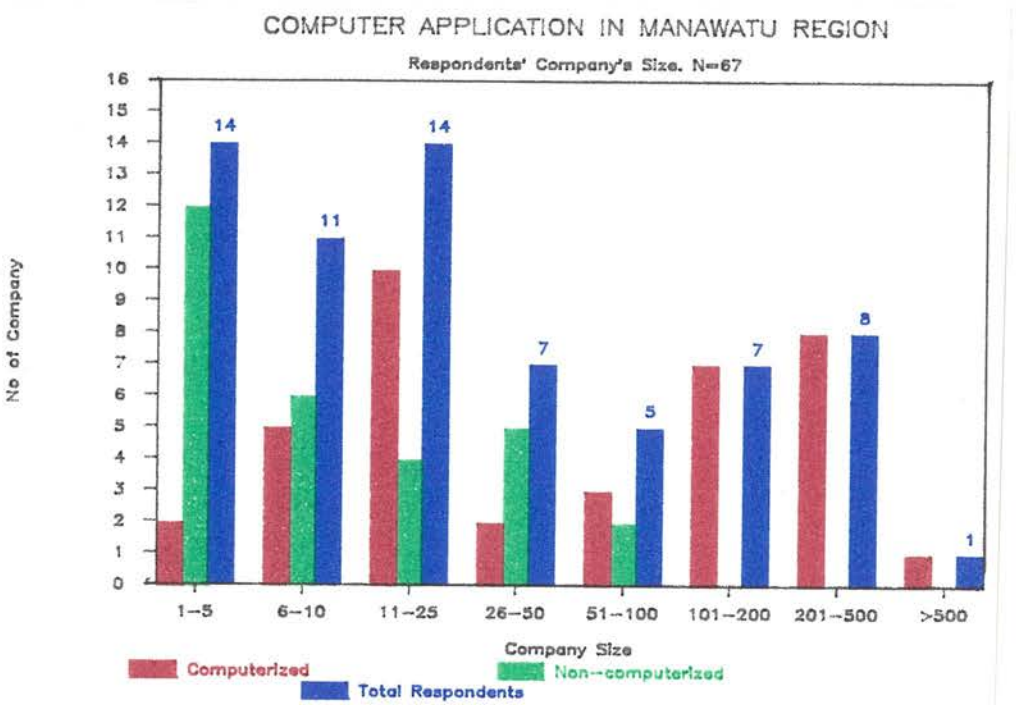


Figure- 4.4. RESPONDENT COMPANY SIZE AND COMPUTERIZATION



APPENDIX -A. SURVEY OF COMPUTER APPLICATION IN THE MANAWATU REGION

Figure- 4.5. YEAR OF COMPUTERIZATION

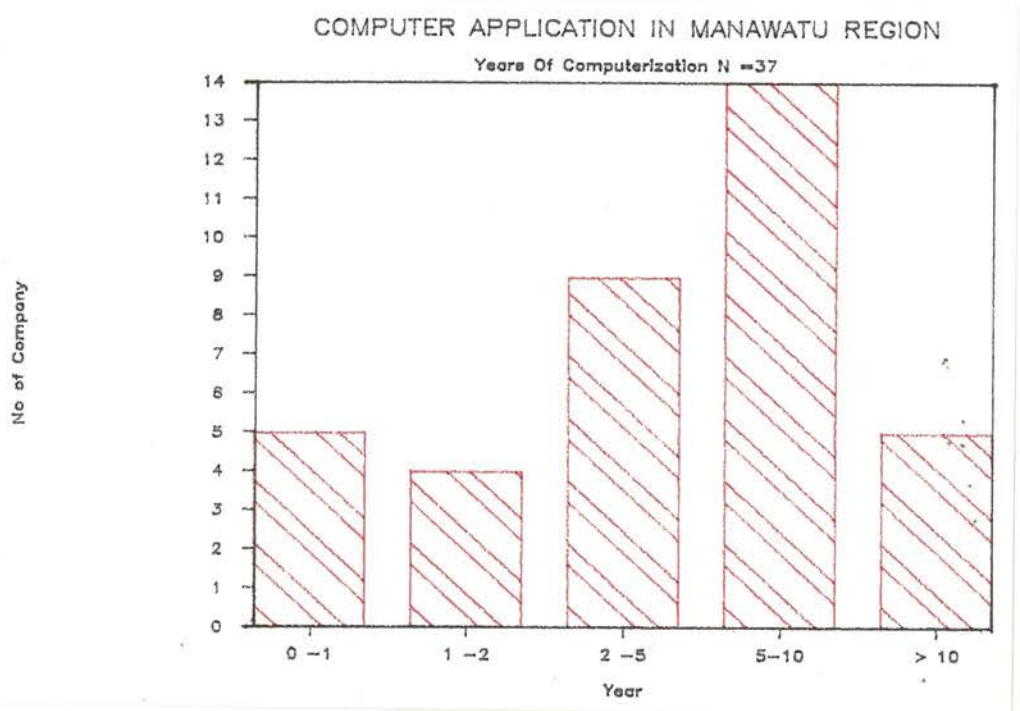
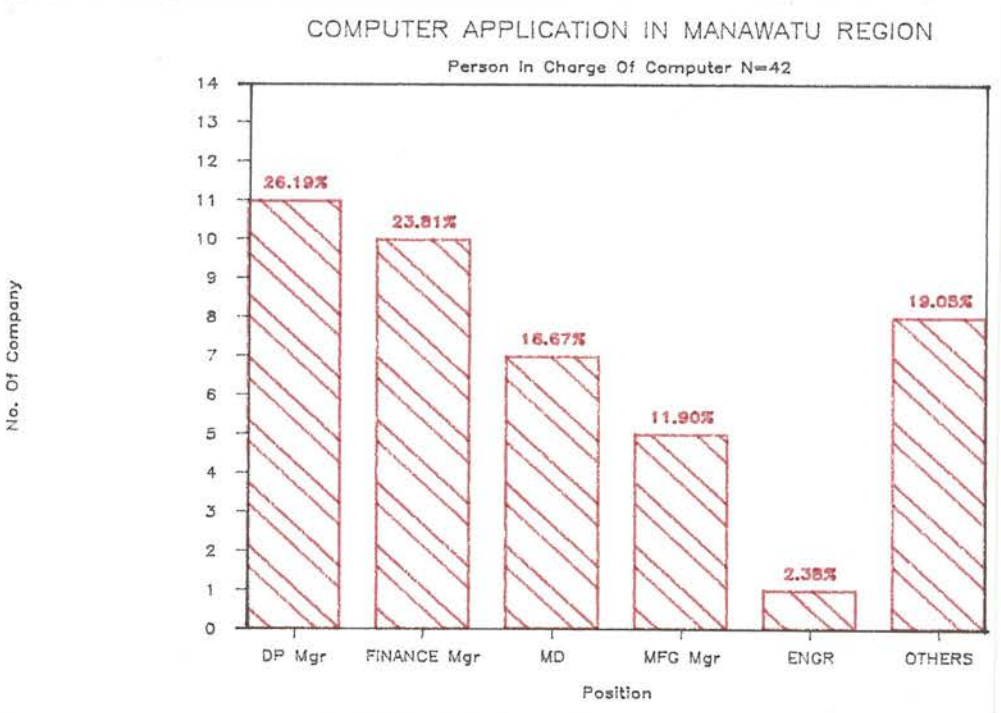


Figure- 4.6. PERSON IN CHARGE OF COMPUTER



APPENDIX -A. SURVEY OF COMPUTER APPLICATION IN THE MANAWATU REGION

Figure- 4.7. AREA THAT MODEL USE ON

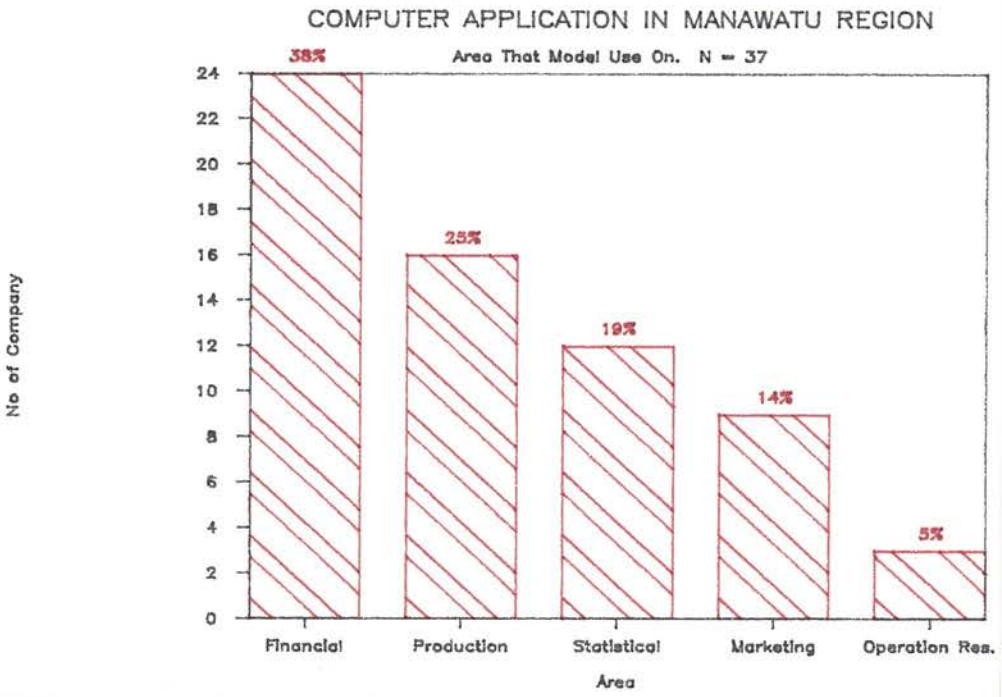
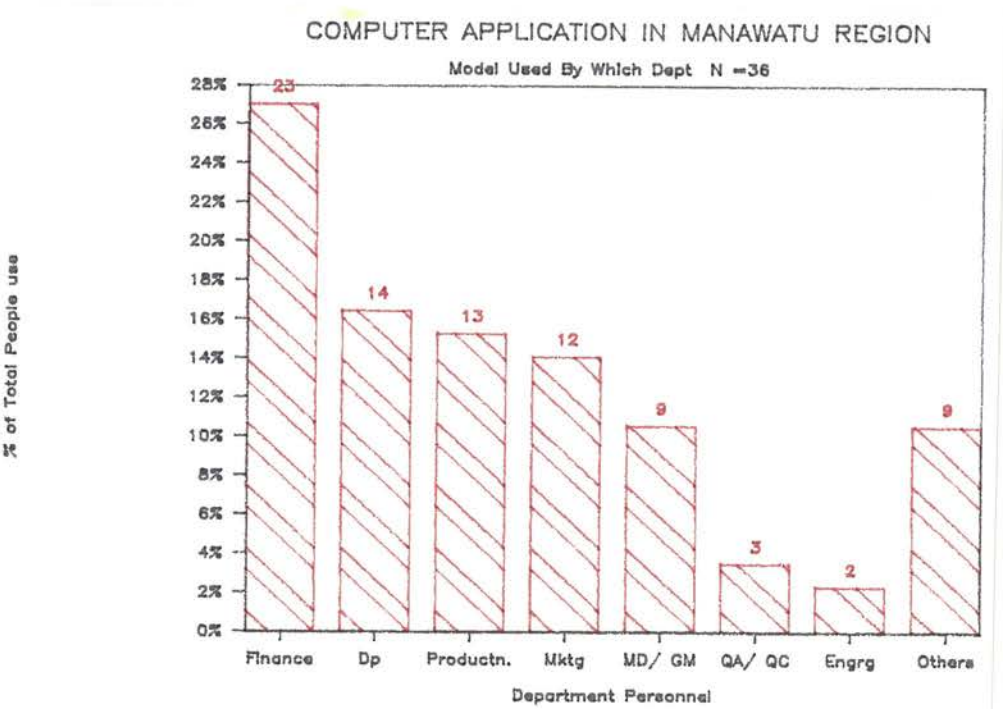


Figure- 4.8. MODEL USED BY WHICH DEPARTMENT



APPENDIX -B

COMPARISON OF INTEGRATED APPLICATION PACKAGES

COMPARISON OF LOTUS SYMPHONY, LOTUS 1-2-3, IFPS, FRAMEWORK AND SUPERCALC 3

NF - Need confirmation
NA - not applicable

	SYMPHONY	LOTUS 1-2-3	IFPS	FRAMEWORK	SUPERCALC3
A. HARDWARE REQUIREMENT					
Hardware	IBMPC, PERT™ or COMPAQ™ or equiv.	IBMPC, XT™ COMPAQ™ PC or equiv.	IBMPC,XT or equiv.	IBMPC, XT (384K ram) or equiv	IBMPC or equiv
Memory RAM (Random Access Memory or Main Memory)	320K	192K RAM	512K min.memory	384K min.memory	96K min.memory
Disk Drive	Double sided,double density, floppy disk drives	Double sided,double density, floppy disk drives	2 disk drive	2 disk drive	2 disk drive
Graphic Monitor	Yes	Yes	Yes	Yes	Yes
Modom	Yes	No	No	Yes	NF
B.DOCUMENTATION					
Tutorial	Yes	Yes	Yes	Yes	Yes
Sample Data	Yes	Yes	Yes	Yes	Yes
Manual	Yes	Yes	Yes	Yes	Yes
C.CAPACITIES					
Max rows	8192	2048	NF	NF	9999 (limited by memory)
Max columns	256	256	8000	NF	127 (limited by memory
Max cells	2097152 (18.8mill)	524,288	NF	32,000 (limited by memory)	16,002
Max windows	infinite	infinite	NF	NF	NF
Max.col.width	240 char	240 char	80 char	NF	NF
Memory for program	265K	112K	NF	NF	NF

	SYMPHONY	LOTUS 1-2-3	IFPS	FRAMEWORK	SUPERCALC3
D.FACILITIES AVAILABLE					
Spreadsheet	yes	yes	yes	yes	yes
Database	yes	yes	no	yes	yes
Word processor	yes	no	no	yes	no
Graphics	yes	yes	yes	yes	yes
Communications	yes	no	yes	yes	no
E.TRANSLATE UTILITY					
Source			Mainframe		
Visicalc	yes	yes	no	yes	yes
DIF (Data Interchange format)	yes	yes	no	no	no
D Base II	yes	yes	no	yes	no
D Base III	yes	NF	no	yes	no
IFPS Mainframe	no	no	yes	no	no
Lotus 1-2-3	yes	N/A	no	yes	yes
WordStar	no	no	NF	yes	no
F. LAYOUT AND LABELLING					
Variable Width columns	yes	yes	yes	yes	yes
Individual variable width	yes	yes	yes	yes	yes
Align Data					
- right	yes	yes	yes	yes	yes
- left	yes	yes	yes	yes	yes
- centre	yes	yes	yes	yes	yes
Underline	yes	yes	no	yes	yes
Dollar sign	yes	yes	yes	yes	yes
Minus sign	yes	yes	yes	yes	yes
Negative nos in Parentheses	yes	yes	yes	yes	yes
Commas in nos	yes	yes	yes	yes	yes
Protect cells, rows or columns	yes	yes	yes	yes	yes

SUMMARY OF OPERATIONAL DIFFERENCES

	SYMPHONY	LOTUS 1-2-3	IFPS	FRAMEWORK	SUPERCALC3
G. COMMANDS					
Provides adequate no. of commands	yes	yes	yes	yes	yes
Provides for alignment of characters	yes	yes	yes	yes	yes
- centre	yes	yes	yes	yes	yes
- right	yes	yes	yes	yes	yes
- left	yes	yes	yes	yes	yes
Provides commands for					
- copying from other sheets	yes	yes	yes	yes	yes
- naming of cells	yes	yes	yes	yes	yes
- sorting of results	yes	yes	yes	yes	yes
- moving range of data within sheet	yes	yes	yes	yes	yes
User friendliness	yes	yes	no	yes	yes
H.PRINTING					
- Margins	yes	yes	yes	yes	yes
- File	yes	yes	yes	yes	yes
- Prints/Suppresses	yes	yes	yes	no	yes
- Alternate Printers	yes	yes	no	yes	no
- Printer adjustment	yes	yes	no	no	no
Line advance	yes	yes	no	no	no
Page advance	yes	yes	no	no	
- Settings			yes	yes	yes
Page	yes	yes	yes	yes	yes
- length	yes	yes	yes	yes	yes
- spacing	yes	no	yes	yes	yes
- print no.	yes	no	yes	yes	yes
- header	yes	yes	yes	yes	
- footer	yes	yes	yes	yes	
Source	yes	yes	yes	yes	yes
Labels	yes	yes	yes	yes	
Top - label	yes	no	yes	yes	
Left - label	yes	no		yes	

	SYMPHONY	LOTUS 1-2-3	IFPS	FRAMEWORK	SUPERCALC3
SUMMARY OF OPERATIONAL DIFFERENCES					
I. SCREEN AND EDITING					
No. of windows	Infinite	Infinite	NF	yes	2
Name facility	yes	yes		yes	yes
Remove borders of the window	yes	no			yes
Change of window borders	yes	no		no	no
Change of environment	yes	no		yes	yes
Freezing of window	yes	yes		yes	yes
Window Splits					
Horizontal splits	yes	yes	yes	yes	yes
Vertical splits	yes	yes	yes	yes	yes
Both	yes	no	yes		no
Change of window Layout	yes	yes	NF	yes	no
- Delete a window	yes	no	yes	yes	yes
- Hide a window	yes	no	NF	yes	yes
Create Commands Outline	no	no	no	yes	no
J. DATA ENTRY					
- Provide English or coded prompts- codes	yes	yes	yes	yes	codes
- Provide easy to understand cell reference	yes	yes	yes	yes	yes
- No special procedures required to enter alphabetic characters	yes	yes	Space bar first		"first
- Special procedure to enter formulas	+ first	+ first	no	F2 first	no
-Provides for entry of text across adjacent cells without having to be concerned by cell column width	yes	yes	NA	yes	" first
K. COMMAND LANGUAGE					
Macro	yes	yes	yes	yes	yes
Learn Mode	yes	no	yes	no	no

	SYMPHONY	LOTUS 1-2-3	IFPS	FRAMEWORK	SUPERCALC3
Recalculation	yes	yes	yes	yes	yes
- Method	yes	yes		yes	yes
Automatic	yes	yes		yes	yes
Manual	yes	yes		yes	yes
-Order					
Natural	yes	yes		yes	yes
column by column	yes	yes		yes	yes
row-by-row	yes	yes		yes	yes
-Iteration	yes	yes		yes	yes
Titles (Freezing)	yes	yes		yes	yes
both	yes	yes			yes
hotizontal	yes	yes		yes	yes
vertical	yes	yes		yes	yes
Window					
Horizontal	yes	yes	yes	yes	yes
Vertical	yes	yes	yes	yes	yes
Sync	yes	yes	no	yes	yes
Unsync	yes	yes	no	yes	yes
Clear	yes	yes	yes	yes	yes

N. WORD PROCESSING

Word Processor					
Commands	yes	no	no	yes	no
Copy	yes			yes	
Move	yes			yes	
Erase	yes			yes	
Search	yes			yes	
Replace	yes			yes	
Justify	yes			yes	
Format	yes			yes	
Spacing	yes			yes	
Edit	yes			yes	
Auto-justify	yes			yes	
Page	yes			yes	

O.GRAPHICS

Graph Commands					
Preview	yes	yes	yes	yes	yes
Type	yes	yes	yes	yes	yes
- Line	yes	yes	yes	yes	yes
- Bar	yes	yes	yes	yes	yes
- Stacked-Bar	yes	yes	yes	yes	yes
- X Y	yes	no	no	yes	yes
- Pie	yes	yes	yes	yes	yes
- High Low-Close					
Open	yes	yes	no	no	yes
Data Labels	yes	yes	yes	yes	yes
Legend	yes	yes	yes	yes	yes
Titles	yes	yes	yes	yes	yes
Grid	yes	yes	yes	no	yes
Colour	yes	yes	yes	no	yes

COMPARISON OF OPERATIONAL FUNCTIONS

	SYMPHONY	LOTUS 1-2-3	IFPS	FRAMEWORK	SUPERCALC3
L. FILE COMMANDS					
Save	yes	yes	yes	yes	yes
Retrieve	yes	yes	yes	yes	yes
Combine	yes	yes	yes	yes	yes
Extract	yes	yes	yes	yes	yes
Formulas	yes	yes	yes	yes	yes
Values	yes	yes	yes	yes	yes
Erase	yes	yes	yes	yes	yes
Bytes	yes	yes	yes	yes	NF
Directory	yes	yes	yes	yes	yes
M. SPREADSHEET					
READ SHEET COMMANDS					
Copy	yes	yes	yes	yes	yes
Move	yes	yes	yes	yes	yes
Erase	yes	yes	yes	yes	yes
Insert					
- columns	yes	yes	yes	yes	yes
- rows	yes	yes	yes	yes	yes
Delete					
- columns	yes	yes	yes	yes	yes
- rows	yes	yes	yes	yes	yes
- global	yes	no	no	no	no
Width	yes	yes	yes	yes	yes
Format					
- currency	yes	yes	yes	yes	yes
- punctuated	yes	no	yes	yes	yes
- fixed	yes	yes	yes	yes	yes
- %	yes	yes	yes	yes	yes
- general	yes	yes	yes	yes	yes
- Date	yes	yes	yes	yes	yes
- Time	yes	yes	NF	yes	no
Range	yes	yes	yes	yes	NF
Protect	yes	yes	NF	yes	yes
Allow changes	yes	yes	NF	yes	yes
Prevent changes	yes	yes	NF	yes	yes
Fill	yes	yes	no	yes	no
Distribution	yes	no	no	no	no
What-if	yes	no	yes	yes	no
1-way	yes	no			
2-way	yes	no			
Graph	yes	yes	yes	yes	yes
Preview	yes	yes	yes	yes	yes
Setting	yes	yes	yes	yes	yes
Image save	yes	yes	yes	yes	yes
Setting					
Label -prefix	yes	yes	yes	yes	yes
left	yes	yes		yes	yes
centre	yes	yes		yes	yes
right	yes	yes		ys	yes

	SYMPHONY	LOTUS 1-2-3	IFPS	FRAMEWORK	SUPERCALC3
P. DATABASE					
Database Commands					
Record-Sort	yes	yes	yes	yes	yes
Sort-keys	yes	yes	N/A	yes	yes
Report	yes	no	N/A	yes	no
Max field	8190	32	N/A	NF	NF
Max field width	240 char	240 char	N/A	NF	NF
Records (640K RAM)	4000	NF	N/A	512	10000
COMPARISON OF AVAILABLE FUNCTIONS					
Q. FORMULAE AND FUNCTIONS					
1. Formulas					
@ ABS(x)	yes	yes	yes	yes	yes
@ ACDS(x)	yes	yes	NF	yes	yes
@ ASIN(x)	yes	yes		yes	yes
@ ATAN(x)	yes	yes		yes	yes
@ ATAN 2 (x,y)	yes	yes		yes	no
@ COS (x)	yes	yes		yes	yes
@ EXP(x)	yes	yes		yes	yes
@ INT (x)	yes	yes		yes	yes
@ LN(x) (log base)	yes	yes		yes	yes
@ LOG(x) (log base 10)	yes	yes		yes	yes
@ MOD (x,y)	yes	yes		yes	no
@ PI ( )	yes	yes		yes	no
@ RAND	yes	yes		yes	yes
@ ROUND (x,n)	yes	yes		yes	yes
@ SORT (x)	yes	yes		yes	yes
@ SIGN	no	no		yes	no
@ TAN (x)	yes	yes		yes	yes
@ SIN (x)	yes	yes		yes	yes

	SYMPHONY	LOTUS 1-2-3	IFPS	FRAMEWORK	SUPERCALC3
2. Statistical Functions					
@ AVG (list)	yes	yes	yes	yes	yes
@ COUNT (list)	yes	yes	no	yes	yes
@ MAX (list)	yes	yes	yes	yes	no
@ MIN (list)	yes	yes	yes	yes	no
@ STD (list)	yes	yes	yes	yes	no
@ SUM (list)	yes	yes	yes	yes	yes
@ VAR (list)	yes	yes		yes	no
Median	no	no	yes	no	no
Movave	no	no	yes	no	no
Trend	no	no	yes	no	no
Step	no	no	yes	no	no
Ceiling	no	no	no	yes	no
Flooring	no	no	no	yes	no
3. Special Features					
@ CELL	yes	no	NF	no	no
@ CELLPOINTER	yes	no		no	no
@ CHOOSE	yes	yes		yes	no
@ COLS	yes	no		no	no
@ ERR	yes	yes		no	yes
@ HLOOK UP	yes	yes		yes	yes
@ INDEX	yes	no		no	no
@ NA	yes	yes		no	no
@ ROWS	yes	no		no	no
@ VLOOKUP	yes	yes		no	no
@ FILL	no	no		yes	no
@ NEXT	no	no		yes	no
@ PUT	no	no		yes	no
@ RESET	no	no		yes	no

	SYMPHONY	LOTUS 1-2-3	IFPS	FRAMEWORK	SUPERCALC3
4. Financial Functions					
@ F V	yes	yes	NF	yes	yes
@ IRR	yes	yes	yes	yes	yes
@ NPV	yes	yes	yes	yes	yes
@ PMT	yes	yes	NF	yes	yes
@ P V	yes	yes	yes	yes	yes
CIRR	no	no	yes	yes	no
MDIRR	no	no	yes	no	no
NTV	no	no	yes	no	no
POLYFLT	no	no	yes	no	no
GROWRATE	no	no	yes	no	no
DECBAL DEP	no	no	yes	no	no
ST LINE DEP	no	no	yes	no	no
SUM DEP	no	no	yes	no	no
5. Logical Functions					
@ FALSE	yes	yes	NF	yes	yes
@ IF	yes	yes	yes	yes	yes
@ ISERR	yes	yes	NF	yes	yes
@ ISNA	yes	yes		yes	yes
@ ISNUMBER	yes	no		yes	yes
@ ISSTRING	yes	yes		yes	no
@ TRUE	yes	yes		yes	yes
@ AND	no	no		yes	yes

	SYMPHONY	LOTUS 1-2-3	IFPS	FRAMEWORK	SUPERCALC3
6. DATE & TIME FUNCTIONS					
@ DATE	yes	yes	yes	yes	yes
@ DATE VAL	yes	no	no	yes	yes
@ SUMDATE	no	no	no	yes	no
@ NOW	yes	yes	no	yes	yes
@ TIME	yes	no	yes	yes	no
@ TIMEVALF	yes	no	no	no	no

APPENDIX -C

DATA NEEDED FOR QUALITY COSTS MIS/DSS

APPENDIX- C. DATA NEEDED FOR QUALITY COST MIS/DSS FOR PRODUCT P

CATEGORY A: Prevention Cost -- costs expensed in an effort to prevent discrepancies.

** All data related to Quality Cost of Vacuum Pump Only **

ELEMENT	SOURCE	RECORD	REMARKS
A1. Quality Engineering			
A1-1. Time taken for preparing quality procedure	QA & Manufacting Staff		Estimate
A2. Research & redesign reqired to improve quality	Technical Div QA Staff Manufacturing Staff	Charge Code...	Estimate
A3. Calibration & maintenance			
A3-1. Production equipment	QA Staff Manufacturing	Charge Code...	Starts from April
A3-2. Test & inspection in QC Dept.	QA Staff	Charge Code...	Starts from April
A4. Other prevention cost			
- New tools & equipment	QA Staff	Charge Code...	

N.B. Quality Control = QC; Quality Project = QP

APPENDIX- C. DATA NEEDED FOR QUALITY COST MIS/DSS FOR PRODUCT P

CATEGORY B: Appraisal Cost -- costs incurred to determine the condition of the product and assure that it meets specifications.

** All data related to Quality Cost of Vacuum Pump Only **

ELEMENT	SOURCE	RECORD	REMARKS
B1. Inspection & testing			
B1-1.Process	Manufacturing staff	Daily production report No code is required	Estimation on time spent on 15 min per pump assembled.
B1-2.Setting up for inspection and testing	Manufacturing staff	Daily production report No code is required	Estimation on time spent on set-up 6 min per pump.
B1-3.Incoming inspection testing	QA staff	Incoming Insp -ection report No code is required	Add time spend on each item inspected
B2. Product Quality Audit	QA staff		Fixed cost
B3. Field Performance Test	Product development & QA staff	Charge code...	
B4. Investigation of supplier- fault, etc.	QC department	Charge code...	Include all costs

APPENDIX- C. DATA NEEDED FOR QUALITY COST MIS/DSS FOR PRODUCT P

CATEGORY C: Internal Failure Cost -- costs arising when product, components and materials fail to meet quality requirements prior to transfer of ownership to the customer.

** All data related to Quality Cost of Vacuum Pump Only **

ELEMENT	SOURCE	RECORD	REMARKS
C1. Scrap			Include labour,
C1-1. Scrap caused by supplier(RFC)	Accounting	Credit note	material loss.
C1-2. Scrap caused by production	Manufacturing staff	Scrap note	
C2. Rework & Repair Materials & Labour	Manufacturing Staff	Rework record	Startd from April
C3. Loss of production (due to parts delay etc.)	Manufacturing staff	Production report	Estimate

N.B. Quality Control = QC; Quality Project = QP

APPENDIX- C. DATA NEEDED FOR QUALITY COST MIS/DSS FOR PRODUCT P

CATEGORY D: External Failure Cost-- costs arising when product, components and materials fail to meet quality requirements after transfer of ownership to the customer.

** All data related to Quality Cost of Vacuum Pump Only **

	ELEMENT	SOURCE	RECORD	REMARKS
D1.	**Complaint Administration**	Business unit department	Charge code...	Estimate on time spent on adminstration. Data is not available now.
D2.	**Product/Customer Service**	Product Development Dept QP officer	Charge code... -	Base on product -wise % of sales.
D3.	Warranty Replacement	Business unit Department	Charge code...	

N.B. Quality Control = QC; Quality Project = QP

APPENDIX- C. DATA NEEDED FOR QUALITY COST MIS/DSS FOR PRODUCT P

Other data for management information system and decision support system

** All data related to Quality Cost of Vacuum Pump Only **

ELEMENT	SOURCE	RECORD	REMARKS
1. Cost of Goods Sold	Accounting Dept	Manufacturing A/c	
1-1. Direct materials			
1-2. Direct labour			
1-3. Factory overhead			
2. Assigned Marketing Fixed Cost	Accounting Dept		
3. Sales			
3-1. Total sales			
- Area			
-Distriburor			
3-2. Sales volume			
3-3. Sales price			
4. Cost of Production	Accounting Dept		Including overhead
5. Total Investment	Accounting Dept		

N.B. Quality Control = QC; Quality Project = QP

APPENDIX -D

QUALITY COSTS DATA BASE MIS SCREENS

SCREEN- 1

```
**************************************************
*  QUALITY COST MANAGEMENT INFORMATION SYSTEM/   *
*                                                *
*  DECISION SUPPORT SYSTEM FOR PRODUCT  P        *
*                                                *
*  Designed By : S. W. TAN (MASSEY UNIVERSITY)   *
**************************************************
```

A project presented in partial fulfilment of the requirements for the Degree of Master in Philosophy (Production & Quality) at Massey University

Any quries, please contact or write to:-

Miss S. W. TAN
c/o Department Of Production Technology
Massey University
Private Bag, Palmerston North
New Zealand. PH. No: 69-099

Please Press [RETURN] To Continue.
Please Enter Here ==>

SCREEN- 2

```
**************************************************

Security Clearance.

Please enter the Password

**************************************************
```

SCREEN- 3

```
************  QUALITY COSTS  MAIN  MENU  ************
   **************    ( LEVEL ONE )    **************

              1) QUERY

              2) UPDATING THE COSTS

              3) REPORT

              4) QUIT

*****************************************************

Please Enter A Number==>
```

SCREEN-4

```
*****************    QUERY        MENU    ********************
     *****************  (LEVEL TWO)  *****************

              1)   PREVENTION COST

              2)   APPRAISAL COST

              3)   INTERNAL FAILURE COST

              4)   EXTERNAL FAILURE COST

              5)   RETURN TO MAIN MENU

*****************************************************

 This Menu allows you to Update and Edit the Quality
 Costs Data base files.

Please Enter A Number ==>
```

SCREEN- 5

QUERY - PREVENTION COST

RECORD NO	MONTH TO DATE	QUALITY PROCEDURE PREP. ($)	RESEARCH REDESIGN TO IMPR.Q ($)	CALIBRATION & TESTING -PRODUCTION ($)	TESTING INSPECT.TEST ($)	OTHERS ($)
1	04/30/86	100.00	2000.00	3.45	123.00	1100.00
2	05/30/86	1234.00	500.00	123.00	114.00	122.00
3	06/30/86	1200.00	1100.00	200.00	500.00	345.00

Do you want to Edit the File ? (Y/N)
Please Enter ==>

SCREEN- 6

QUERY - APPRAISAL COST

ECORD D	MONTH TO DATE	INSPECTION AND TESTING PRODUCTION ($)	SETUP ($)	INCOM.QC ($)	PRODUCT AUDIT ($)	FIELD PERF ($)	INVEST SUPPLIE ($)
1	04/30/86	123.00	456.00	78.00	223.00	112.00	200.0
2	05/30/86	671.00	90.00	342.00	412.00	76.00	135.0
3	06/30/86	70.00	321.00	63.00	214.00	42.00	100.0

Do you want to Edit the File ? (Y/N)
Please Enter Here ==>

SCREEN- 7

QUERY - INTERNAL FAILURE COST

RECORD NO	MONTH TO DATE	SCRAP		REWORK	PRODUCTION LOSS
		SUPPLIER ($)	PRODUCT ($)	($)	($)
1	04/30/86	1120.00	2345.00	671.00	114.00
2	05/30/86	1135.00	562.00	123.00	45.00
3	06/30/86	1140.00	3451.00	456.00	112.00

Do you want to Edit the File ? (Y/N)
Please Enter ==>

SCREEN- 8

QUERY - EXTERNAL FAILURE COST

RECORD NO	MONTH TO DATE	COMPLAINT ADMINIST-RATION ($)	PRODUCT/ CUSTOMER SERVICE ($)	WARRANTY REPLACEMENT ($)
1	04/30/86	113.00	560.00	1370.00
2	05/30/86	113.00	4562.00	2345.00
3	06/30/86	112.00	4561.00	2230.00

Do you want to Edit the File ? (Y/N)
Please Enter ==>

SCREEN- 9

```
**************     UPDATE          MENU     ***************
  ***************    ( LEVEL   TWO )   ***************

          1)    PREVENTION COST

          2)    APPRAISAL COST

          3)    INTERNAL FAILURE COST

          4)    EXTERNAL FAILURE COST

          5)    RETURN TO MAIN MENU

*************************************************************

 This menu allows you to Update the Quality Costs Files

Please Enter A Number ==>
```

SCREEN- 10

```
********  MONTHLY UPDATING FORM - PREVENTION COST **********

     DATE (MM/DD/YY)                    :    /  /

A1. QUALITY PROCEDURE PREPARATION       :        .

A2. RESEARCH,DESIGN FOR 0 IMPROVEMENT:           .

A3. CALIBRATION & MAINTENANCE :-

     - PRODUCTION EQUIPMENT             :        .

     - TEST,INSP. EQUIPMENT             :        .

A5. OTHER  PREVENTION COST              :        .

*************************************************************

        Data Entry     - Press <RETURN>
        Data Correct   - Use Arrow Key To Move Around
        Data Update    - Press <RETURN>
Please Enter Your Choice ==>
```

SCREEN- 11

```
********  MONTHLY UPDATING FORM - APPRAISAL COST *********

     DATE (MM/DD/YY)                        :    /   /

B1. INSPECTION AND TESTING :-

     -PROCESS                               :         .
     -SET UP FOR INSP. & TESTING            :         .
     -INCOMING INSP. & TESTING              :         .

B2. PRODUCT QUALITY AUDIT                   :         .

B3. FIELD PERFORMANCE TEST                  :         .

B4. INVESTIGATION OF SUPPLIER               :         .

*************************************************************

          Data Entry       - Press <RETURN>
          Data Correction  - Use Arrow Keys to move around
          Data Update      - Press <RETURN>
Please Enter Your Choice ==>
```

SCREEN- 12

```
*******  MONTHLY UPDATING FORM - EXTERNAL FAILURE COST *******

     DATE (MM/DD/YY)                        :    /   /

D1. COMPLAINT ADMINISTRATION                :         .

D2. PRODUCT/CUSTOMER SERVICE                :         .

D3. WARRANTY REPLACEMENT                    :         .

*************************************************************

          Data Entry       - Press <RETURN>
          Data Correction  - Use Arrow Key To Move Around
          Data Update      - Press <RETURN>
Please Enter Your Choice ==>
```

SCREEN- 13

```
**********************    REPORT          MENU    **********************
    **********************    (LEVEL TWO)   **********************

                1)    MONTHLY QUALITY COSTS DETAIL REPORT

                2)    MONTHLY QUALITY COSTS SUMMARY REPORT

                3)    QUARTERLY QUALITY COSTS SUMMARY REPORT

                4)    YEARLY QUALITY COSTS SUMMARY REPORT

                5)    RETURN TO MAIN MENU

*************************************************************************

   This menu allows you to view and print the Quality Costs Report.

Please Enter A Number ==>
```

SCREEN- 14

```
This file gives you a Monthly Detail Report of the Quality Costs

  Enter  MONTH : MM    YEAR : YY

   Enter the month & year of report that you require
   Example : Month : 04     Year : 86
```

SCREEN- 15

11/21/86

MONTHLY QUALITY COSTS DETAIL REPORT- PRODUCT P
FOR THE MONTH ENDED May 1986

QUALITY COSTS		AMOUNT(In Dollars)
A. PREVENTION COST		
A1. Quality Procedure Preparation		1234.00
A2. Research,Redesign for Q. Improvement		500.00
A3. Calibration & Maintenance		
- Production Equipment		123.00
- Testing Equipment		114.00
A4. Other Prevention Cost		122.00
TOTAL PREVENTION COST	$	2093.00

See Next Screen - Press <RETURN>
** APPRAISAL COST **
Please Enter ==>

SCREEN- 16

B. APPRAISAL COST		
B1. Inspection & Testing		
- Process		671.00
- Setting Up for Inspection & Testing		90.00
- Incoming Inspection & Testing		342.00
B2. Product Quality Audit		412.00
B3. Field Performance Testing		76.00
B4. Investigation of Supplier		135.00
TOTAL APPRAISAL COST	$	1726.00

See Next Screen - Press <RETURN>
INTERNAL FAILURE COST & EXTERNAL FAILURE COST
Please Enter ==>

SCREEN- 17

C.	INTERNAL FAILURE COST		
C1.	Scrap - Supplier Related		1135.00
	Scrap - Production Related		562.00
C2.	Rework & Repair		123.00
C3.	Production Loss		45.00
	TOTAL INTERNAL FAILURE COST	$	1865.00
D.	EXTERNAL FAILURE COST		
D1.	Complaint Administration		113.00
D2.	Product/customer Service		4562.00
D3.	Warranty Replacement		2345.00
	TOTAL EXTERNAL FAILURE COST	$	7020.00

TOTAL QUALITY COSTS FOR VACUUM PUMP =>$ 12704.00

****

Do you want to print the report ?
Printing - Press "P"
Return to Report Menu - Press "M"
Please Enter Your Choice ==>

SCREEN- 18

11/21/86

MONTHLY QUALITY COSTS SUMMARY REPORT - PRODUCT P
FOR THE MONTH ENDED May 1986

QUALITY COSTS CATEGORY	AMOUNT(In Dollars)	%
A. PREVENTION COST	$ 2093	16.48
B. APPRAISAL COST	1726	13.59
C. INTERNAL FAILURE COST	1865	14.68
D. EXTERNAL FAILURE COST	7020	55.26
TOTAL QUALITY COSTS	$ 12704	100.00%

Do you want to print the report ?
Printing - Press "P"
Return to Report Menu - Press "M"
Please Enter Your Choice ==>

SCREEN- 19

11/21/86

QUARTERLY QUALITY COSTS SUMMARY REPORT - PRODUCT P
FOR THE PERIOD OF 5 TO 7 1986

QUALITY COSTS CATEGORY	AMOUNT(In Dollars)	%
A. PREVENTION COST	$ 5438.0	18.80
B. APPRAISAL COST	2536.0	8.77
C. INTERNAL FAILURE COST	7024.0	24.29
D. EXTERNAL FAILURE COST	13923.0	48.14
TOTAL QUALITY COSTS	$ 28921.0	100.00

Do you want to print the report ?
Printing - Press "P"
Return TO Report Menu - Press "M"
Please Enter Your Choice ==>

SCREEN- 20

11/21/86

YEARLY QUALITY COSTS SUMMARY REPORT
FOR PRODUCT P FOR THE YEAR ENDED 4 1987

QUALITY COSTS CATEGORY		AMOUNT(IN DOLLARS)	%
PREVENTION COST	$	5438.0	18.80
APPRAISAL COST		2536.0	8.77
INTERNAL FAILURE COST		7024.0	24.29
EXTERNAL FAILURE COST		13923.0	48.14
TOTAL YEARLY QUALITY COSTS	$	28921.0	100.00 %

Do you want to print the report ?
Printing - Press "P"
Return to Report Menu - Press "M"
Please Enter Your Choice ==>

APPENDIX -E

QUALITY COSTS MIS/ DSS PROTOTYPE SYMMARY

PROTOTYPE SUMMARY
QUALITY COSTS MANAGEMENT INFORMATION SYSTEM AND DECISION SUPPORT SYSTEM FOR PRODUCT P

A. Objective And Scope Of The Quality Costs MIS/DSS

1. The objectives of the system are :-

1.1. To provide a management tool to support the managers in planning and decision making in marketing, quality assurance, engineering, production and purchasing.

1.2. To assist the manager in monitoring, controlling and evaluating quality programs.

1.3. To estimate the effects of quality improvement on cost saving and profits.

2. The scope of the system:-
The system is built on a moduler basis, there are two modules in the system:-

2.1. Module One : Quality Costs Management Information System. - Quality Costs Data Base and Report Generator. The reports generated from this module are :- Monthly Quality Costs Detail Report.

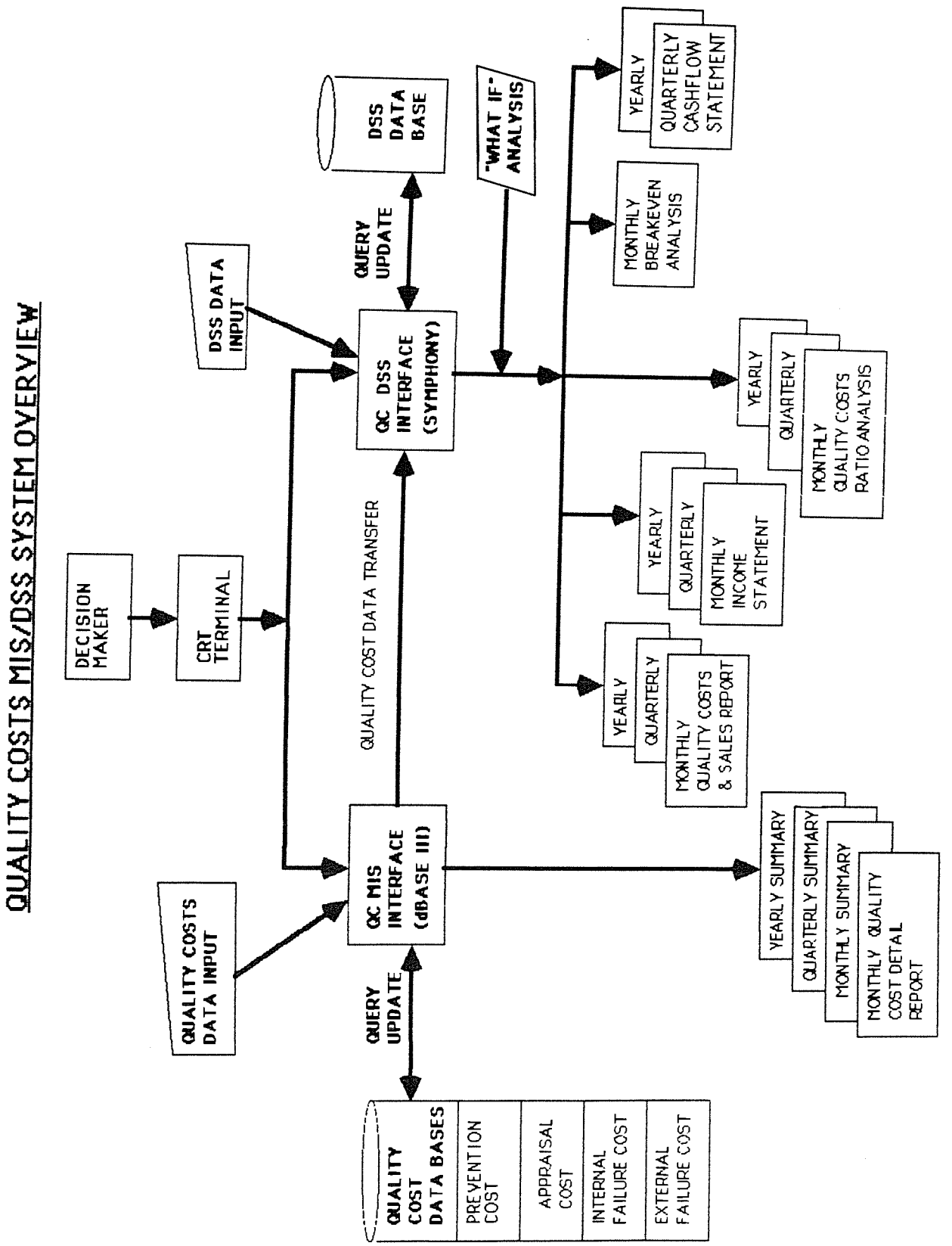
- Monthly Quality Costs Summary Report.
- Quarterly Quality Costs Summary Report.
- Yearly Quality Costs Summary Report.

2.2. Module Two: Quality Costs Decision Support System.- A Decision support system using the information from Sales, Production and Accounting, to generate reports and graphs on the quality costs effects on product's profitibility and sales revenue. The reports generated from this module include :-

- Quality Costs and Sales Report.
- Income Statement .
- Quality Costs Ratio Analysis Report.

B. The Benefits Of Using Quality Costs MIS/DSS

1. Provide useful information for managers for decision making and strategic planning.
2. Improve the effectivess and efficiency of managerial decision making: all the manager has to do is to input the quality costs and DSS data, the system will generate reports and graphs that he required.
3. The manager can manipulate the data, use "What If " Analysis to test various alternatives, and select the optimum alternative to support his decision with report and graphic representation.
4. Costs benefits: the system generate report and graphs easily, saving managers' and clerks' time on tedious calculation , preparing reports and drawing graphs.
5. User friendly : The system is designed for those who has no computing knowledge. It is simple, easy to use, and menu driven.


QUALITY COSTS MIS/DSS SYSTEM OVERVIEW
DECISION MAKER
CRT TERMINAL
DSS DATA INPUT
QUALITY COSTS DATA INPUT
QUERY UPDATE
QUERY UPDATE
DSS DATA BASE
"WHAT IF" ANALYSIS
QC DSS INTERFACE (SYMPHONY)
QC MIS INTERFACE (dBASE III)
QUALITY COST DATA TRANSFER
QUALITY COST DATA BASES
PREVENTION COST
APPRAISAL COST
INTERNAL FAILURE COST
EXTERNAL FAILURE COST
YEARLY
QUARTERLY CASHFLOW STATEMENT
MONTHLY BREAKEVEN ANALYSIS
YEARLY
QUARTERLY
MONTHLY QUALITY COSTS RATIO ANALYSIS
YEARLY
QUARTERLY
MONTHLY INCOME STATEMENT
YEARLY
QUARTERLY
MONTHLY QUALITY COSTS & SALES REPORT
YEARLY SUMMARY
QUARTERLY SUMMARY
MONTHLY SUMMARY
MONTHLY QUALITY COST DETAL REPORT

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