AUTOMATION OF THE MANAGEMENT SCIENCE TECHNIQUE OF REPLACEMENT ANALYSIS (A CASE STUDY OF SUDDEN FAILURE ITEMS)

BY

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A PROJECT SUBMITTED TO THE DEPARTMENT OF MATHEMATICS COMPUTER SCIENCE.
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DEDICATION

I dedicate this work to the almighty God for giving me the ennoblement to write these project also to my husband Ezekiel Goje and my Son Sylvanus Goje.

ACKNOWLEDGEMENT

I wish to acknowledge my sincere appreciation to my supervisor, Prince R. Badmus for his cooperation, encouragement and above all his objectives, constructive criticisms and meaningful significant contributions toward making this work of high academic standard.

To the head of Department, I wish to salute your concern and courage to other staff in the deportment I am indebted for the knowledge imparted on me. Thank you all.

Other people who h . e also contributed to this work, they are numerous and cannot all be mentioned by names, I say thank you. I assure full responsibility for any error identified.

ABSTRACT

Management science (the application of a scientific approach to solving management problems in other to help managers make better decisions) encompasses a number of mathematically oriented techniques, like linear mathematical programming techniques, network techniques, probabilistic technique etc.

These techniques can be applied to solve problems in a variety of different types of organizations including government, military, business and industry, and health-care, though they a predominantly used in business. The success rate in situations where these techniques are used have been quite high.

In teaching these techniques emphasis has always being an manual solutions to the techniques both in the classroom and in textbooks. Where there are computerised solutions they are limited to linear mathematical programming techniques and a few others.

In this project, an attempt is made to provide a computerise solution to the management science technique of replacement analysis with emphasis on replacement problems involving sudden failure items.

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CHAPTER ONE

1.0 INTRODUCTION

Management science, operations research, quantitative methods, quantitative analysis, quantitative techniques, decision sciences, by whatever by whatever name it may be called refers by whatever name it may be called refers to the same discipline. It is a scientific approach to solving management problems in order to help managers make decisions. It encompasses a number of mathematically oriented techniques like linear programming techniques, inventory control techniques, network techniques, probabilistic techniques, replacement analysis techniques etc. these techniques have either been developed within the field of management science or adapted from other disciplines like mathematics (calculus), statistics (probabilistic techniques) to mention a few.

The application of management science techniques is widespread. Though [predominantly used in business, they are not restricted to business but also in government, military and healthcare. They have also being credited with increasing the efficiency and productivity of business., today management science is studied as either a course on its own or part of the curriculum of business courses, computer science etc.

Management science technique do not actually make decisions but provide information that can aid the manager in making decisions. This information is the results or solutions of management science techniques models. The manager uses his skill and experience

together with the information from management science techniques to make decisions.

As indicated earlier management science encompasses a logical; systematic approach to problem solving. This approach follows the steps below.

1. Observation- The system is closely observed so that problems can be identified as soon as they occur ort are anticipated.
2. Definition of the problems- The problem identified must be clearly and concisely defined. An unidentified problems can easily result in no solutions or an inappropriate solution.
3. Model construction- It is an abstract representation of an existing problem situation. It can be in the form of a graph or chart or mostly frequently as a set of mathematical relationship.
4. Model Solution- A management science techniques solution usually applies to a specific type of model. Thus the model type and solution are both part of the management science techniques.
5. Implementation of results-The manager combines the information (model solution /results) with his own experience and expertise in making the ultimate decision.

   Most organizations have a formalized information system to accumulate organise and distribute information for decisions making purposes called a management information system (mis). A management information system, is designed to channel through an organization. Data is collected, organized, processed and made conveniently accessible to the manager so that the

information can be of assistance in the manager's daily operations. The components of a management information system are; the database, the computer system and the form in which the data is distributed/. Most of the information is often in the form of reports or management science techniques results /solutions. The database contains items such as prices, production output and rates available resources, number of orders, capacities and Labour rates, for an efficient and effective management information system the database must contain relevant and quality information. the right type and should be enough/. The information in the database must be properly organised. Since most modern organizations have access to such a large quality and variety of information that, the use of properly organized. Since most modern organizations have access to such a large quantity and variety of information that the use of computer is required.

A decision support system (ASS) -a subsystem of a management information system-supports the manager in the decision making process. In a decision support system the manager acts as an internal components. In otherworlds the manager interacts with the computer based information system such that decisions are reached by an interactive process. A decision support system ferquently interates management science models within its framework. The computer generates the results of a management science model and the manager might ask the computer what if something were changed in the model. The manager might then ask the computer for new results

based on this change. Such experimentation with possible changes educates the manager regarding possible courses of action, that can be taken as a result of occurrences in the future. The manager can also test the possible decisions to see their potential results before actually making them.

1.1 STATEMENT OF THE PROBLEM

In management science textbooks and classes where students are taught management science techniques emphasis is on how to use the techniques manually. Computerised techniques are few and usually limited to linear programming.

The lack of computerised techniques limits our taking advantage of the attributes of a computer which include the ability to do calculations faster than human beings, ability to store and retrive in formation, accurately and less human effort.

The lack of computerised techniques limits our ability to have an efficient and effective decision support system, since it limits our degree of interaction with the system because much efforts will be required in providing results based on changes made.

The lack of computerised techniquesalso limits our ability to have an efficient and effective management information system. or ability to channel large quantities and numerous types of information through the organization will be limited.

1.2 OBJECTIVE OF THE STUDY

1. The purpose of this study, is to computerise replacement analysis techniques (a management science techniques for solving replacement problems involving sudden failure items or components to form port of a management information system or a decision support system.
2. It is believed that this work could be an important tool to be used curtailing all these wasteful spending which drain the limited resources.
3. It is also shows the needs for the total embracement of the technological advancement.
4. In addition, the study of replacement analysis could aid individuals and corporate bodies in minimizing cost benefit.

1.3 ASSUMPTIONS OF THE STUDY

In this study the following assumptions are made:-

1. The data required for the use of the techniques is readily available.
2. A peresonal computer will be used in processing the date
3. The user of the technique is a management scientist or someone with the knowledge of management science techniques and is computer literate.
4. The techniques is already in use (manually) or about to be introduced.
5. The computerised technique will be used either in a classroom, business or Industry.

place hence only those controls and security measures required for this technique will be considered in this study.

1.4 SCOPE AND LIMITATION OF THE STUDY

The scope of this study will include:-

1. An overview of replacement problems generally, what an optimum replacement strategy is, how to use replacement analysis to solve replacement problems involving sudden failure items and the data required for the technique.
2. A look at how the computerise technique of replacement analysis for sudden failure items could form part of a management information system or decision support system
3. A look at what management information system and decision support system are, their components, the attributes required to make them effective and efficient and how to do the work.
4. A look at how the data required for the technique will be collected, entered into the computer system and how it will be processed. The control and security measures necessary for the integrity of the data used and information produced will be looked into.
5. A program containing instructions on how the computer will produce the results of the technique will be written with a justification of the programming language used, how the program will be implemented and maintained and report that will be produced.

1.5 DEFINITION OF TERMS

APPLICATION PROGRAM:- In general a program that is designed to perform a specific user function.

AUTHORISED USER:- A person or organization authroised to use a system

BACK UP:- The hand ware and software resources available to recover after a degradation or failure of one or more system components or to copy files into a second storage device so that they may be retrieved if the data on the original source is accidentally destroyed.

COMPUTER:- An electronic system which in accordance with its programming will store and process information as well as perform high-speed mathematical or logical operations.

DATA:- Any material which is represented in a formulized manner so that it can be stored, manipulated and transmitted by machine.

DATA BASE:- a collection of data stored electronically in a predefined format and according to an establish set of rules.

DOCUMENTATION:-	A written description of a program that includes its name, purpose, how it works and frequently operating instructions.
HARDCOPY:_	Equipment (as opposed to a computer programe or a method of use) such as mechanical, electrical, magnetic or electronic devices.
INPUT:-	The data to be processed. The device or collective set of devices. The process of transferring data form an external storage to an internal storage.
MANITAINANCE:-	An activity intended to eliminate faults or to keep hardware or programs in satisfactory working condition.
PASSWORKD	A word or character string that when accurately presented permits a user access to a system or computer program.

CHAPTER TWO

2.0 INTRODUCTION TO REPLACEMENT ANALYSIS

At one time in our lives, we have had cause to replace some of the assets or items we have e.g clothes because of fashion, one celebration (Christmas, Sallah, weddings or birthdays) or the ones we have, have been destroyed. We change our cars because it is either giving us problem or we want to get a new model or another brand of car. A house because the one we have has been destroyed by a catastrophe, we have need for a bigger one, or a new design. Bulbs in our homes because the one we have failed, fan belts in our cars because the have failed too or fuses I.C's in appliances that suddenly fail and have to be replaced.

Just as we have Items, components or assets as individuals that we need to replace from time to time, so are companies businesses, factories, industries and organizations that have assets that they need to be replaced. Machinery because they are worn-out, destroyed or an improved version is needed. Buildings because there is need for a bigger one, a new design or the old one has been destroyed. Some of the components of the machinery in industries could also fail and need replacement, so also company vehicles.

The cost of replacing these assets could be enormous talkless of the incouineninces they could cause, because of their failure of a conveyor belt in a factory could stop production completely.

Because of these cost and inconveniences some organizations embark on a deliberate policy of the time interval to take before replacing their assets after taking into consideration certain factors.

Replacement analysis techniques assist organizations in making their replacement policies. It will be good to note that it is not all replacement problems stated above that replacement analysis helps us to solve.

Replacement analysis involves the study of the various costs associated with each time interval, which we are considering as the possible time interval to choose as our replacement cycle. The cycle with lowest cost is chosen as the optimum replacement cycle.

2.1 LITERATURE REVIEW

According to Professor R. Adeboye Stated thus:-

"many systems deteriorate as time goes on unless some corrective action is taken. In some cases parts of a system fail suddenly and unpredictably and the only corrective action possible is to replace them. For example a labour force deteriorates as people leave and hence replacement may be necessary". He goes on to say "once the data about the deteriorates have been collected the time when it becomes economical to replace the system with an associated capital cost can be calculated". When giving an example of a system that fails he wrote, "A classic example of this kind of a system that fails he wrote, the case of the light bulbs".

Accountancy Tutors (Nig) Ltd., a tutorial school in accountancy based in Kaduna in its tutorial notes on the subject financial management defined replacement analysis thus "must items of equipment (i.e. components, parts, vehicles, machinery e t c) need replacement of sometime or the other. Replacement analysis is the

process by which the various cost consequences involved are studied so that the optimum replacement decision can be taken".

Mayo/BPP Icon study text an financial management corites "The major problem with replacement is not so much" 'should the asset be replaced? But rather 'when or how frequently should the asset be replace?'

Accountancy Tutors (Nig) Ltd. While writing about the types of replacement problems wrote "the two most common replacement problems relate to: -

(a) Sudden failure:-

There are various parts or components that work adequately up to a point and then fail e.g.

- Fan belts
- Electric bulbs
- Fuses
- Tyres e t c

(b) Gradual Deterioration

These are usually relatively expensive items which could be kept functioning with increasing amounts of maintenance e.g.

- Vehicles
- Boilers'.

They wrote this again about sudden failure items, "often these items are inexpensive in themselves but the cost consequences of their failure and/or the installation costs involved in replacing them can be considerable. It is therefore necessary to estimate the various

costs involved and choose the least cost position. The three categories of cost are:-

(I) The replacement cost of the item: usually the purchase price at the time of replacement.

(II) The consequential costs of failure which night be trivial say, if an electric bulb failed, but could be substantial of a small component failure caused on assembly line stoppage.

(III) The costs involved in the actual replacement of the item because of location and/or accessibility problems consideration often given to group replacement at interval or on the failure of one item. For example, If a single electric bulb failed in an overhead lamp cluster in a factory then all the bulbs night be replaced at the same time even if many are still functioning.

As a result of the need to minimize the various costs involved several decisions alternatives are usually explored and the least cost alternative chosen".

2.2 TYPES OF REPLACEMENT PROBLEMS.

The two common replacement problems solved by replacement analysis relate to: -

(a) Assets that deteriorate gradually and

(b) Assets, items or components that suddenly fail.

GRADUAL DETERIORATION OF ASSETS

These are assets that because of usage with time they wear their functioning capability deteriorate. To keep them functioning

increasing amounts have to be spent on operating and maintaining them. A good example is a car, as it grows older it gives more problems and more is spent to maintain it, and it functions less than when it was new. Please note that my concern is not with this type of replacement problem as one is faced with the problem of what it will be economical to replace this type of asset.

SUDDEN FAILURE ITEMS

These type of item work adequately, but at a certain stage, that fail to function completely. A good example is an electric bulb, it provides light up to a certain point, then it fails and has to be replaced. Other examples include fuses and belts. These are items that are inexpensive at times but their failure could disrupt our activities like a bulb not providing light, a car's fan belt not turning the car fan to cool the radiator e t c Replacement analysis is also concerned in helping to choose the optimum time to replace this type of items (which of course is my main concern).

2.3 THINGS TO CONSIDER IN CHOOSING A REPLACEMENT STRATEGY FOR SUDDEN FAILURE ITEMS.

This management science technique of replacement analysis helps in choosing the most economical or optimum replacement strategy for replacing items that suddenly fail. Just as it is defined as a study of the cost consequences involved in the decisions or alternatives being considered, various costs are included in the things to consider. These include:-

(I) The replacement cost of the item-usually it is the purchase price of the item to replace the one that has failed.

(I) The consequential costs of failure – it could be small like when an electric bulb fails, but many ifs the failure of a conveyor belt disrupts. Production.

(iii) The costs involved in the actual replacement of a the item e.g. labour cost, cost of machinery or equipment to be used were necessary n doing the replacement. Sometimes because of the location or accessibility of the item concerned, consideration is often given to group replacement of intervals or an the failure in an overhead lamp cluster in a factory then all the bulbs might be replaced at the same time even though many are still functioning.

(iv). The life span of the item, asset or component: This could be known with certainty or Experience which will have shown the number of items on average that survive a particular time interval and on average the maximum life span of the item knowing the life-span enable one when considering the alternative replacement cycles to know the member of items that could fall in each cycle and the associated cost of replacing them.

(v). The total number of components under consideration.

2.4 OPTIMUM REPLACEMENT STRATEGY

After gathering the data on the various cots and life span of item comes the question of how these could be used to arrive at the optimum replacement strategy. In choosing a replacement strategy in choosing a replacement strategy various alternative strategies are

considered., for each strategy these costs (if the cost applies to that strategy) are added up, the strategy with the lowest total cost is the optimum replacement strategy i.e the item should be replaced after the interval in the premium strategy. For example, assuming a machine contains 50 components whose maximum life span is 4 weeks, the various alternatives are:-

(a) Replace on Failure only

(b) Replace on failure and all components after 1 week

(c) Replace on failure And all components after 2 weeks

(d) Replace on failure And all components after 3 weeks

(e) Replace on failure And all components after 4 weeks

The total costs in each alternative are found and the alternative with the lowest cost is the optimum then the components will be replaced everytime any fails and all components to be replaced after 2 weeks, even of it was replaced within the two weeks or it did not fail at the end of the 2 weeks.

2.5 CHOOSING A REPLACEMENT STRATEGY FOR SUDDEN FAILURE ITEMS MANUALLY.

An example will be used to illustrate how replacement analysis is used in the choice of an optimum replacement strategy.

EXAMPLE

The authorizes of the Aminu Kano International Airport in Kano are considering a replacement strategy for its illuminating bulbs at the airport. The following data have being collected on the illuminating bulb life span relating to normal operations.

Month after replacement	1	2	3	4	5
Percentage of original bulbs Which have failed by the and of that month cumulative.	10%	25%	50%	80%	100%

That is to say the bulbs have a maximum life span of 5 months.

One thousand bulbs are in use at any given time. They could be replaced by new bulbs on a mass replacement basis for N30.00 per bulb. Alternatively, they may be replaced individually as they fail at a cost of N120.00 per bulb. In each case the actual cost of the bulb itself is N15.00 the remainder representing Labour and overhead. At present the organization replace bulbs as they fail.

SOLUTION

Step 1: Alternatives involved include:-

1. Replacement on failure only
2. Replace on failure and all bulbs at the end of month 1
3. Replace on failure and all bulbs at the end of month 2
4. Replace on failure and all bulbs at the end of month 3
5. Replace on failure and all bulbs at the end of month 4
6. Replace on failure and all bulbs at the end of month 5

STEP 2: Calculation of average life span of Bulbs

Months (n)	Percentage of Original Bulbs failing (cumulative)	Percentage of Original lead failing at the end of each month	Expected value
n	Pn	P9p0n-Pn-1)	np
1	10%	10%	0.1
2	25%	15%	0.3
3	50%	25%	0.75
4	80%	30%	1.2
5.	100%	20%	1.0
			Enp =8.35

That is an average after 3.35 months all 1000 bulbs fail, therefore for 1 month 1000 =299 bulbs fail.

8.35

Step 3 Composition of number of bulbs that fail.

Alternative 1 $=\frac{1000}{8.85}$ = 2999 bulbs monthly

Alternative 2-6

Month	1	2	3	4	5	Total	Cumulative Total
Percentage Of Failure	10%	15%	25%	30%	20%	-	-

Months

1	100	100									100	100
2	100	10	1000	150							160	260
3	160	16	100	15	1000	250					281	541
4	281	28	160	24	100	250	1000	300			377	918
5	377	88	281	42	160	40	100	30	1000	200	350	1268

STEP 4: COMPUTATION OF AVERAGE MONTHLY COST OF EACH ALTERNATIVE REPLACEMENT CYCLE.

1 Alternative	2 Replacement On failure and all bulbs at the end of month.	3 Number of bulbs failing	4 Individual Cost	5 Group Cost	6 Total Cost	7 Average Cost
1	On Failure only	299	299 x120 =35880	-	35880	35880
2.	1	100	100 x 120 = 12000	30,000	42,000	42,000
3.	2	260	260 x 120 =31200	30,000	61,200	30,600
4.	3	541	541 x 120 = 64920	30,000	94,920	31,640
5.	4	918	918 x 120 = 110160	30,000	140,160	35,040
6.	5	1268	1268 x120 = 152160	30,000	182,160	36,432

Based on the average cost of each alternative, alternative 3 (Replacement on failure and all bulbs at the end of months 2) has the lowest average cost (N30,600) Therefore alternative 3 is the optimum replacement cycle.

CHAPTER THREE

3.0 SYSTEM ANALYSIS AND DESIGN

In this chapter one will look at two types of information systems, management information system and decision support and how the management science techniques of replacement problems involving sudden failure items can be incorporated or form part of a management information system or decision support system.

3.1 INTRODUCTION TO MANAGEMENT INFORMATION SYSTEM AND DECISION SUPPORT SYSTEM

For the running of an organization those charged with the responsibility of running that organization need information on the activities carried out by the organization need information on the activities carried out by the organization to whether they are doing well or not, whether they are going according to plan or not, about decisions to be taken and about their outcome of decision taken.

Most at times, a formal system of where and how the information is to be generated and channeled through the organization and the form the information systems could be manual (mostly for very small organizations) or computerised modern day information system.

There are different types of information systems but I will be concerned with management information systems and decision support systems.

A management information system (Mis) is a system specifically designed to channel different amounts and different types of infermatter through an organization Data is normally collected about the activities of the organization or any decision that is to be taken, processed, organized to be meaning and made available to the decision maker or the person changed with the responsibility of running the organization or carrying out the activity.

A modern management information system is made up of a data base, computer system and the form in which the information is to be distributed . the database consist of relevant numerical and non-numerical information about the activities of the organization properly organized. The computer system consist of the hardware and the software. In a management information system, software package as well as programs written by programmes internally are combined to form the management information system. The computer processes data as per the instructions in the program, to generate information system. The computer processes data as per the instructions in the program to generate information and this information is distributed through the organization in whatever form the organization decides. The information could be in the form of reports or the results of management science techniques. It could be on request or scheduled to be produced periodically or after a certain activity.

The diagram below shows an illustration of a management information system.

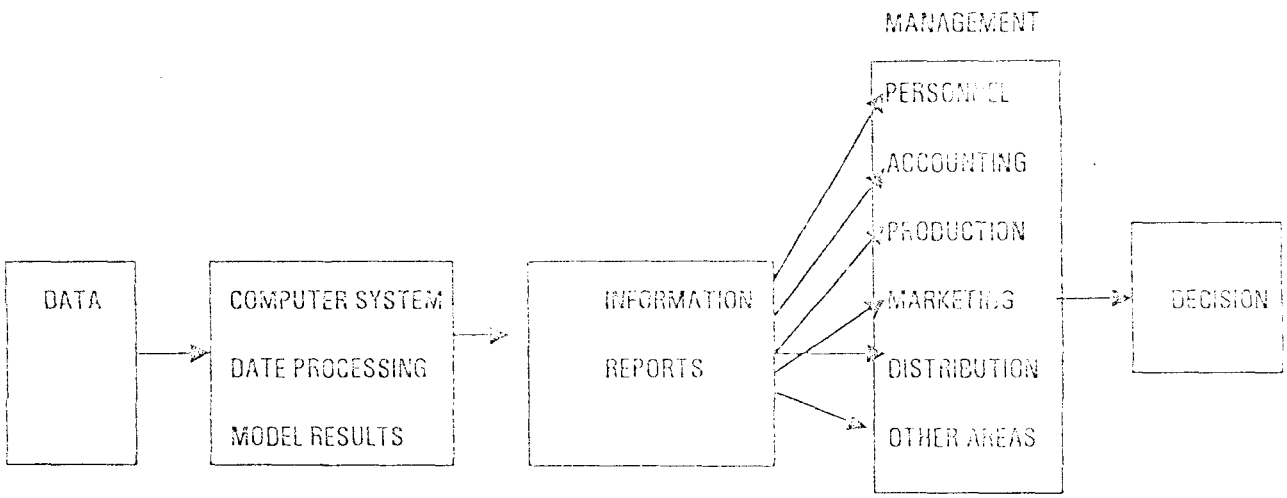

Fig. 1

Fig. 1 Illustration of a management information system.

In the diagram, data is collected and organised then processed through or by the computer system, to generate information in form of reports or management science model results which are distributed to management for decision making. Decisions affect many departments in an organization hence the flow of information between departments.

In a decision support system the information system support the manager in the decision making process. The manager intercats with the computer based information system such that a decision is reached by an interactive process. A decision support system frequently integrates management science models within its framework. Below is a general framework of a decision support system.

Fig 2. Illustration of a decision support system

With the decision support system, it can be seen from the diagram that its framework include that of the management information system with the addition of what if analysis. The computer generates the results of management science models, the manager then introduces changes to the model by asking question inform of what if analysis so and so changes are introduce what the results of decisions taken will be. By so doing, the manager is well informed before making an actual decision. The decision taken provide a feedback to the database hence it is an ongoing process. The interactive nature of the decision support system is achieved through programs written to ask for data in an interactive way. The interactive nature of decision support makes the information generated to be on request only. Software's like latus 123, excel, lindo support the manager in his interaction with information system.

3.2 MANAGEMENT INFORMATION

The computer in a management information system or decision support system process data and generates information for use by the different units of the organization in question. The information can take several forms e.g reports or the results of a management science model . for reports data is summarized and organized in a useful and easy interpretable manner. Reports can be about accounts receivable (debtors) workforce, inventory level or production output. It can be about recent information or historical information, they can be at the request of management or on a regular basis as a matter of

policy e.g the manager in charge of personnel might request for the number of vacancies available in the organization during a particular month, while a report on monthly salaries paid will be provided on a regular basis.

Information can take the form of management science model results or solutions. Like reports, this information can be generated on a regular basis or an request of the manager who wants the solutions to a specific problem. It is to be noted that the management information cannot formulate the management science model itself, this must be accomplished by the Manager, a management scientist or a management science staff skilled in management science techniques. The computer system can only provide the solution to the model that represents the problem.

3.3 INTEGRATION OF REPLACEMENT ANALYSIS IN A MANAGEMENT INFORMATION SYSTEM, OR DECISION SUPPORT SYSTEM.

The aim of the management science technique of replacement analysis for replacement problems involving sudden failure items is to help the manager in making decision as to the optiman replacement strategy to us in replacing items. Components or asset that sudden fail in the organization various strategy are considered and their associated costs in that the strategy with the least cost is taken. The technique provides information to the manager about the cost of each strategy and the manager to make his decision based on the information provided by the technique to form part of the management information system, data has to be collected for

inclusion in the database, processed by the computer system and made available i.e the results, to the manager for him to make his decision. Hence data collection entry and processing will be considered along Side the management of data file and files controls. And security measurers, the reports of the system, the cost and benefits of computerising the technique and the position of the management solentist in the organisaiton.

3.4 DATA COLLECTION DATA ENTRY AND DATA PROCESSING.

DATA COLLECTION.

This state involves the collection of all relevant data required for the replacement analysis model. The data include, the number or quantum of items involved, the purchase price of the item, how long the item will last, the personal and equipment cost to be used or incurred in the replacement process and the replacement periods under consideration. It is important that the data above is accurate. Inaccurate data will result in accurate Information (Model results) Leading to inaccurate decision. The number of items, the life span of the item, the personnel and equipment and other direct and indirect cost could be gotten from the works department. The price of the item could also be from the works department or purchase department, depending on how the organization is structured. The replacement periods under consideration could be agreed upon between the works and management science personnel.

DATA ENTRY

The data collected at the data collection stage is now entered into the system i.e the computer for processing. The data is read from documents by the person doing the entry and entered using the keyboard a print-out of the data entered is made for comparison with data on the source documents to see that it is the correct data that is entered. It is assumed that the data entry staff will be prompted by the computer 10 enter the data required for the solution of the model.

DATA PROCESSING

This stage involves the arithmetic calculations carried out by the computer in accordance with the program instructions to solve the replacement analysis model. The program is called using the keyboard by entering the data and program file name. The program now prompts the data entry staff for the data required then goes ahead to carryout the rest of the instructions contained in the program and finally brings out the solution to the model. The results of the model now form the information to be used by the manager in making his decision.

3.5 REPORTS FOR OPERATION AND DECISION MAKING.

The computer generates the results or solution of the replacement analysis model showing the replacement analysis periods under consideration, the number of items falling during the period and the number replaced, the total cost of the items replaced during the period and the average cost of replacement for the period. This is

displayed on the computer screen and printed copies made for filing or for onward delivery to the person to make the decision based on the results., the decision taken is communicated to the various departments affected for necessary action.

3.6 FILE AND DATA MANAGEMENT

Apart from the normal files that contain source documents with the data used in solving the model all correspondences and any document relevant to the making of the decision need to be documented and filed for future reference. This files need to be protected and maintained while in sue. Other documents might be added in future, and policy be set on when or why it might be destroyed and responsibility assigned for its upkeep. Apart from the files above, computer files are kept for the data, program and reports. Appropriate names need to be given to the files for easy access. A directory could be created to contain all files that have to do with replacement analysis and may be sub-created for each data, program and report files. Back-up copies should be made of these files. The operating system a st any manipulation that will be do the files as well as access con rol and protection Adequate protection should be given to the storage medium containing these files.

3.7 CONTROLS AND SECURITY MEASURES

These include all measures taken or introduced to ensure the accuracy, total recording of all data relevant to the solving of the model, to avoid loss of data or improper entry and processing of data entered, and the program correctly solve the replacement analysis model and all the safeguard put in place to protect the assets of the information system. The measures include:-

a. Ensure the accuracy of all data relevant to the solving of the model through:-

i. The organization has an approved and up to date categories of price list of items or a secured up to date computer file of the price list of items.

ii. Assign responsibility to ensure that price list is accurate

iii. Formally request for the number and life span of item from the unit, and ensure that the head of the unit signs the documents containing the information.

iv. Some for cost of personnel and equipment to be used fin the replacement process.

v. Educate and stress the importance of the accuracy of data required vis-à-vis the decision that is to be taken to all parties involved.

b. A print out of data entered is compared with that of source document.

c. The program is well tested before implementation

d. Back up copies of all computer files and put in file proof cabinets

e. Restricted access to the computer

f. The computer-housing environment should be cool and burglary proof.

g. The intergrity of staff should not be mortgaged.

3.8 THE POSITION OF THE MANAGEMENT SCIENCE STAFF IN THE ORGANISAITON.

The location of management science within an organisation structure, the size of the management science staff the Existence of a staff at all and the status of the management scientist are all factors affecting the degree of implementation of management science results. Many large and medium size business firms have management science departments or staffs concerned exclusively with problem solving and model department. These staffs can be quite large but their success is primarily dependent on quality.

The management science staff can exist at several locations within the organization structure. It can be contained at the management level, the corporate level or the operational level. Some firms have management science groups at each level of the organization. The officer to whom the management science staff reports is basically determined by the location of the staff in the organization. However there seems to be no organisational location for a management science staff.

The above should not indicate that management science does not exist in firms where there is no management science staff or department in many instances a member or several members of the

management staff will be well versed in management science and apply management science techniques to their problems.

3.9 COST AND BENEFIT ANALYSIS

Most at times this aspect is always overlooked. The cost in time and resources should not be overlooked. The financial cost, man power requirements, staff skill and computer cost required to develop the model are cost that should be considered. The easiest cost to estimate are the direct cost, such as cost of purchasing the system. These are the breakdown of items and cost implication in acquiring the system.

I. COST OF EQUIPMENTS

a. Two units of computer sets at N150,000 per set =N300,000.00

b. Printer 1 Dot Matrix printer and 1 Laser jet printer Dot matrix printer cost N70,000 and 1 set of Laser Jet Printer N100,000.00

c. UPS=N25,000.00

d. Softwares 4 sets of CPT at N100,000=N400,000.00

I Word perfect =N10,000 2 sets of CPT at N 0,000 =N200,000.00

ii. D base iv at III Plus =N10,000.00

iii. Installation cost N15,000.00

TOTAL COST = N530,000.00

2. OPERATING COST

i. Two Computer operators at N60,m000 monthly =N120,000.00

ii. Training for four weeks at N5,000.00 per week =N20,000.00

iii. Stationeries, Diskette, Ribbons =N30,000.00

TOTAL = N61,000.00

GRAND TOTAL =N530,000 +N61,000 =N591,000

Benefits derived from acquiring the system are enumerated below:-

i. Data and information are going to be easily accessed and well coordinated

ii. Prompt dictation of derivation from set objectives

iii. Effectiveness in policy formation and information are readily available

iv. It saves stationaries

v. It Saves time for planning and evaluating performance

vi. Records stored in the computer are well kept

vii. It can be used to dictate areas of wasting spending

viii. Increase in profit

ix. Manpower strength can be ascertained easily

x. Cost saved.

CHAPTER FOUR

4.0 CHOICE AND JUSTIFICATION OF PROGRAMMING LANGUAGE

The programming language chosen in writing this computer application is DBASE which will be used in solving replacement problems involving sudden failure items, using replacement analysis (a management science techniques), the subject of this project.

Through other programming languages like basic, Pascal, Fortran, etc could be used, we feel more at home with the characteristics of DBASE which make it have an upper hand over others.

With DBASE is easy to state the exact spot we want data entered or displayed on the screen unlike Basic that you will have to use a series of comas or semicolon to achieve that, if ever. With DBASE you just state the row and column of the screen (the screen is divided into columns (80) and 25 rows) where you want your data entered or displayed.

With DBASE on can control the environment where the program can be with the use of the various SET commands available in DBASE. One van set the colour of the screen, make the status bar or scoreboard be retained or disappear, set talk on or off among other set commands when the program is run.

The use of menus where a list of items or activities the program or application can perform are stated, and what the user need to do to activate the carrying out of the activity. This is not available in other programming language will be different to achieve.

DBASE is associated with data base management applications. It can also be used in non-data and Pascal among other that cannot be used in a database management environment.

However, Dbase has the disadvantage of not begin run i.e its applications directly from the Das prompt. This is because its files do not have the extension unlike other language that have and thus can be directly from the Das prompt.

4.1 PROGRAM AND PROGRAM DOCUMENTATION

The program to carry- out the computer application of replacement analysis management science of technique for sudden failure items with its associated documentation is included as an appendix. The documentation is made internally in the program.

4.2 PROGRAM IMPLEMENTATION

After installing this program on your personal computer which is better made on the hard disk in the dbase management package (Dbase v) it is advise that copies of the program be made as a back-up.

Implementation can be direct without problem because it has been tested and found working perfectly. However it can be implemented in conjunction with a manual solution to the problem at hand both results compared only when satisfied then will the manual solution be done away with.

4.3 PROGRAM MAINTAIN ACE

Program maintenance is the term given to the changes made to a software system after it has been put into operation. It

might be due to rectification of errors, adapting the software to changes in the environment it operates e.g new hardware, new operating system etc. it might be due to recommendations from users for new capabilities general enhancement and modification to existing functions. It might also be to improve future maintainability or reliability or to provide a better basic for future enhancement.

Research has shown that cost of maintenance is always high as 60% of the software development budget hence it is an important aspect.

Depending on the organization a maintenance department is at times created differently from a software development to carryout program maintained. A very important aspect of software maintenance is an understanding of program to be maintained. If the program is not understood instead of correcting errors more errors will be involved and the aim of maintenance will be defeated.

This program has been written in a simple enough format for easy understanding and internal documentation tries to explain each line of code in the program apart from a heading explaining what a particular segment is supposed to be performing. Hence in the absence of the producer or this program maintenance can be easily carried out.

4.4 CHOICE OF SOFTWARE PACKAGE AND LANGUAGE

In selecting a software package certain needs are to be considered. The criteria used for the choice of software packages and programming language for the project work are:-

a. The effectiveness and efficiency of the package with regards to the functions of the developed programmers.
b. The facilities for different types of files processing.
c. The security of the records in the files.
d. The facilities for maintaining the files, e.g. adding new records, easy retrieval of records and modifications.
e. The flexibility of the package and user friendly of the package. Based on the above outlined criteria and the type of files that will be required for processing. The application software package will be used for this project. These are the Microsoft wards 2000 Dbase v windows 2002.

4.5 FEATURE OF DBASE V FOR WINDOWS

Dbase v for window is similar to Dbase all the in Dos. In addition to other facilities, it has all the facilities that are available in Dbase iii plus in Dos. Dbase v is on organized, integrated relation Dbase management software package. This is complex and flexible software, which constructs, expands and maintains the database. It also provides a full maintenance program, which allows the DBMS to maintain the data in the pool by adding new records it provides an interface with user's program. This means that with Dbase programming language will be Dbase programming language. Another advantage of this software package is that a large number of built

functions are provided including mathematical functions and storing manipulation functions. The programming language includes command to perform conditional branching,

CHAPTER FIVE

5.0 IMPLEMENTATION SUMMARY AND CONCLUSION.

5.1 IMPLEMENTATION

The application of information (i.e results) form solving management science techniques models (Replacement Analysis technique inclusive) is referred to as implementation. The result of or solution of a management science technique is used in taking decisions as regards the problem under consideration. Some times the result or solution is used in taking decisions, sometimes it is not. If it is not used then the effort in using the technique is defeated more so when cost is incurred in using the technique, then it is just cost with out benefits. In this section we will look at some of the causes of non implementation of management science techniques results.

5.2 CAUSES OF NON IMPLEMENTATION

Many causes have been adduced to the non implementation of the information generated by management science models. These causes lie in the relationship of the management science staff and surrounding organization. These include:-

1. The support for management science in the organization.
2. The success of prior uses of management science.
3. The amount of influence the management science staff has in the organization.
4. The size of the management science staff and the amount of resources it commands.

5. The climate for innovation and change within the organization.
6. The time frame for decision-making.
7. The location of the responsibility for implementation.
8. Management's experience with management science techniques, among other

5.3 STRATEGIES FOR ACHIEVING SUCCESSFUL IMPLEMENTATION

As we can see there is no one cause or set of causes for implementation failure as a result is difficult to propose a specific strategy for ensuring implementation hence an implementation strategy must be tailored to fit the particular organization. However one common thing about all strategies is that implementation should be continuous on going process i.e implementation includes not only the final decision but also problem formation model development and construction and model testing. By this, the experience gained from implementation depends on success at each stage of the modeling process. If the management problem is not formulated property, if the model is constructed improperly, if the result are not realistic or applicable then implementation will never occur. If management is involved in the management process i.e active participation in the development and use of the management science model, then there is a better chance that the model will be designed with the proposed used closely in mind and the model will not be sophisticated for user. If a situation is crested in which the management is conducive to change then we could achieve successful implementation. This is based on the fact that for the manager, lack of change promotes

stability and continuity leading to feelings of comfort and safeness when change become imminent it is resisted since it is perceived as a threat to normal safe routine of the manager. In this scenario the management science technique is a potential change (more so it is computer based) since it after represents a new and deferent way of doing things. Therefore an organized process must be established to over come resistance to change and to create a new feeling of routine that will reinforce the use of the model.

5.4 CONCLUSION

Though an attempt has be made to provide a computerized solution to replacement problems using replacement analysis (a management science technique for solving replacement problems) because of the benefits of computerization all this implemented. Hence effort should be made to see that results of the technique are implemented and not just incurring cost without benefit.

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```
**********************************
* REPLACEMENT STRATEGY
* YUNANA HADIZA GARBA
* PGD/SSCE/2001/2002/1090
**********************************
SET TALK OFF
SET SAFETY OFF
SET SCORE OFF
SET CONFIRM ON
SET ESCAPE ON
SET MESSAGE TO ""
SET DEVICE TO SCREEN
SET STATUS OFF
CLEA ALL
SET COLOR TO GR+, G. G
CLEAR
DECLARE ALTER[10], NFAIL[10], MAVE[10], MFAIL[10]
DECLARE CUMFAIL1[10,10], CUMFAIL2[10,10]
DO MAINBUD
STOPPER = ' '
DO WHILE STOPPER = ' '
DO DEFIN
DO MAIN
CLEAR
ENDDO
RETURN

PROCEDURE DEFIN
IF ISCOLOR()
  SET COLOR OF BOX TO GR+/BG
  SET COLOR OF NORMAL TO W+/B
  SET COLOR OF HIGHLIGHT TO GR+/BG
  SET COLOR OF MESSAGES TO W+/N
  SET COLOR OF TITLES TO W/B
  SET COLOR OF FIELDS TO N/BG
  SET COLOR OF INFORMATION TO B/W
ENDIF

SET BORDER TO DOUBLE

*  SET BORDER TO DOUBLE
DEFINE POPUP MAINMENU FROM 1,25
DEFINE BAR 1 OF MAINMENU PROMPT " M A I N   M E N U " SKIP
DEFINE BAR 2 OF MAINMENU PROMPT "====================" SKIP
DEFINE BAR 3 OF MAINMENU PROMPT "ADD RECORD(s)";
  MESSAGE "Addition of record(s) to the database file"
DEFINE BAR 4 OF MAINMENU PROMPT "DELETE RECORD(s)";
  MESSAGE "This option allows deletion of record(s)"
DEFINE BAR 5 OF MAINMENU PROMPT "MODIFY RECORD(s)";
  MESSAGE "This option allows modificatio of record(s)"
DEFINE BAR 6 OF MAINMENU PROMPT "VIEW RECORD(s)  ";
```

```
  MESSAGE "This option allows you to view records"
DEFINE BAR 7 OF MAINMENU PROMPT "COMPUTATIONS ";
  MESSAGE "This option allows Computations & Generation of reports"
DEFINE BAR 8 OF MAINMENU PROMPT "E X I T ";
  MESSAGE "You want to Shutdown"
ON SELECTION POPUP MAINMENU DO MAIN_PARA

*-----------> Popup for Report
DEFINE POPUP REPOM FROM 6,45
DEFINE BAR 1 OF REPOM PROMPT " R E P O R T   M E N U" SKIP
DEFINE BAR 2 OF REPOM PROMPT "======================" SKIP
DEFINE BAR 3 OF REPOM PROMPT "CALCULATION OF AVERAGE LIFE SPAN ";
  MESSAGE "Generate report of Average Life Span "
DEFINE BAR 4 OF REPOM PROMPT "CALCULATION OF NUMBER OF FAILURES ";
  MESSAGE "Generate report of Number of Failures "
DEFINE BAR 5 OF REPOM PROMPT "CALCULATION OF AVERAGE MONTHLY COST ";
  MESSAGE "Generate report of Average Monthly Cost "
ON SELECTION POPUP REPOM DO REPO_PARA

*-----------> Popup for Exit
DEFINE POPUP EXITM FROM 7,45
DEFINE BAR 1 OF EXITM PROMPT " E X I T   M E N U" SKIP
DEFINE BAR 2 OF EXITM PROMPT "==================" SKIP
DEFINE BAR 3 OF EXITM PROMPT "EXIT TO PROMPT";
  MESSAGE "Return to the Dbase Prompt"
DEFINE BAR 4 OF EXITM PROMPT "EXIT TO DOS ";
  MESSAGE "Shutdown and return to DOS"
ON SELECTION POPUP EXITM DO EXIT_PARA


PROCEDURE MAINBUD
* ----------------> This section design the screen
DEFINE WINDOW MAINSC FROM 1,1 TO 22,78 NONE COLOR W+/B
DEFINE WINDOW WORK_IN FROM 7,5 TO 21,75 DOUBLE COLOR W+/B
ACTIVATE WINDOW MAINSC
@1,20 to 3,60 double
@2,21 say "R E P L A C E M E N T   S T R A T E G Y" COLOR W*
ACTIVATE WINDOW WORK_IN
RETURN

PROCEDURE MAIN
ACTIVATE POPUP MAINMENU
RETURN


PROCEDURE MAIN_PARA
DO CASE
  CASE BAR() = 3
     DO ADDREC
  CASE BAR() = 4
     DO DELREC
```

```
  CASE BAR() = 5
     DO MODREC
  CASE BAR() = 6
     DO VIEWREC
  CASE BAR() = 7
     ACTIVATE POPUP REPOM
     DEACTIVATE POPUP
  CASE BAR() = 8
     ACTIVATE POPUP EXITM
     DEACTIVATE POPUP
ENDCASE
RETURN


PROCEDURE REPO_PARA
DO CASE
  CASE BAR() = 3
     DO REPONE
  CASE BAR() = 4
     DO REPTWO
  CASE BAR() = 5
     DO REPTRE
ENDCASE
RETURN

PROCEDURE EXIT_PARA
DO CASE
  CASE BAR() = 3
     STOPPER = 'Q'
     CANCEL
  CASE BAR() = 4
     QUIT
ENDCASE
RETURN

Procedure ADDREC
 store 'Y' to ans
 set stat off
 use repstr
 do while ans ='Y'
  clear
  store space(6) to mitem_code
  @1,10 Say "Enter Item Code: " get mitem_code Pict "999999"
  read
  locate all for item_code = mitem_code
  if found()
    @8,20 say 'Record already exist'
  else
  store 0 to mper1, mper2, mper3, mper4, mper5
  store 0 to ind_cost, grp_cost, mtot_num
  store space (25) to mitem_name
```

```
  DO GETDATA
  READ
   clear
   append blank
   replace item_code with mitem_code
   replace item_name with mitem_name
   replace per_1 with mper1
   replace per_2 with mper2
   replace per_3 with mper3
   replace per_4 with mper4
   replace per_5 with mper5
   replace tot_num with mtot_num
   replace grp_cost with mgrp_cost
   replace ind_cost with mind_cost
endif
  @10,10 to 12,50
  store 'N' to ans
  @11,12 say 'Are there more records? (Y/N)' get ans pict '!'
            valid ans $ 'YN' error 'Invalid entry !!!'
  read
enddo
CLEAR
close databases
return


Procedure DELREC
  store 'Y' to ans
  use repstr
  do while ans= 'Y'
    clea
    @2,15 to 4,55
    @3,20 say 'Deletion of record'
  store space(6) to mitem_code
  @1,10 Say "Enter Item Code: " get mitem_code Pict "999999"
  read
    locate all for  item_code = mitem_code
    if found()
  @10,10 to 12,50
    store 'N' to reply
  @11,12 say 'Are you sure? (Y/N)' get reply pict '!'
       valid reply $ 'YN' error 'Invalid entry!!!'
   read
   if reply = 'Y'
      dele
      pack
   endif
else
   @8,20 say 'Record does not exist'
   endif
   @10,10 clea to 12,50
```

```
  @10,10 to 12,50
  store 'N' to ans
  @11,12 say 'Delete more records? (Y/N)' get ans pict '!'
  read
enddo
CLEAR
close data
return


Procedure MODREC
  use repstr
  store 'Y' to ans
  do while ans = 'Y'
    clea
  store space(6) to mitem_code
  @1,10 Say "Enter Item Code: " get mitem_code Pict "999999"
  read
    locate all for item_code = mitem_code
    if found()
       store per_1 to mper1
       store per_2 to mper2
       store per_3 to mper3
       store per_4 to mper4
       store per_5 to mper5
       store tot_num to mtot_num
       store item_name to mitem_name
       store grp_cost to mgrp_cost
       store ind_cost to mind_cost
    DO GETDATA
    READ
    clear
     replace item_code with mitem_code
     replace item_name with mitem_name
     replace per_1 with mper1
     replace per_2 with mper2
     replace per_3 with mper3
     replace per_4 with mper4
     replace per_5 with mper5
     replace tot_num with mtot_num
     replace grp_cost with mgrp_cost
     replace ind_cost with mind_cost
  else
     @8,20 say 'Record does not exist'
  endif
     @10,10 to 12,50
     store 'N' to ans
     @11,12 say 'Modify more record? (Y/N)' get ans pict '!'
            valid ans $ 'Y/N' error 'Invalid entry!!!'
     read
  enddo
```

```
CLEAR
close databases
return

Procedure VIEWREC
 use repstr
 store 'Y' to ans
 do while ans = 'Y'
  clea
 store space(6) to mitem_code
 @1,10 Say "Enter Item Code: " get mitem_code Pict "999999"
 read
  locate all for item_code = mitem_code
  if found()
    store per_1 to mper1
    store per_2 to mper2
    store per_3 to mper3
    store per_4 to mper4
    store per_5 to mper5
    store tot_num to mtot_num
    store item_name to mitem_name
    store grp_cost to mgrp_cost
    store ind_cost to mind_cost
  DO GETDATA
  WAIT
  clear
else
   @8,20 say 'Record does not exist'
endif
   @10,10 to 12,50
   store 'N' to ans
   @11,12 say 'View more record(s)? (Y/N)' get ans pict '!';
          valid ans $ 'Y/N' error 'Invalid entry!!!'
   read
enddo
CLEAR
close databases
return

Procedure REPONE
define window user from 1,1 to 22,78 none color W+,B
activate window user
set stat off
set alternate to 'one.out'
set device to screen
 use repstr
 store 'Y' to ans
do while ans = 'Y'
 clea
 store space(6) to mitem_code
 @1,10 Say "Enter Item Code: " get mitem_code Pict "999999"
```

```
 read
  locate for item_code = mitem_code
  if found()
    set alternate on
    set space on
     DO HEADING
     ?
     ? 'CALCULATION OF AVERAGE LIFE SPAN OF '+item_name
     ?
     ? 'MONTHS | % OF FAILURE | % OF FAILURE AT   |   EXPECTED '
     ? '       | CUMMULATIVE  | END OF EACH MONTH |   VALUE '
     ? '*************************************************'
     i = 1
     cumm = 0
     mtot = 0
     do while i <= 5
       mmm1 = 'PER_'+str(i,1)
       cumm = cumm + &mmm1
       mtot = mtot + (i*(&mmm1/100))
       ? '  ',str(i,2),'    |    ',str(cumm,3),'%    |         '
       ?? str(&mmm1,3),'%      | ', str(i*(&mmm1/100),5,2)
       i = i + 1
     enddo
     ? space(34),'TOTAL = ',str(mtot,6,2)
     ? 'That is an Average after ',str(mtot,6,2),' months all ',str(tot_num,6)
     ? rtrim(item_name), ' fail.'
     ?
     ? 'Therefore for 1 month ',str(ceiling(tot_num/mtot),5)
     ?? ' ',rtrim(item_name),' fail'
     ? 'i.e. ',str(tot_num,6),'/',str(mtot,6,2)
     ?
    set alternate off
    wait
   endif
   @10,10 to 12,50
   store 'N' to ans
   @11,12 say 'More record(s)? (Y/N)' get ans pict '!';
          valid ans $ 'Y/N' error 'Invalid entry!!!'
   read
enddo
CLEAR
close databases
deactivate window user
return

Procedure REPTWO
define window user from 1,1 to 22,78 none color W/+,B
activate window user
set stat off
set alternate to 'two.out'
set device to screen
```

```
use repstr
store 'Y' to ans
do while ans = 'Y'
clea
store space(6) to mitem_code
@1,10 Say "Enter Item Code: " get mitem_code Pict "999999"
read
 locate for item_code = mitem_code
 if found()
   set alternate on
   set space on
   DO HEADING
   i = 1
   cumm = 0
   mtot = 0
   do while i <= 5
     mmm1 = 'PER_'+str(i,1)
     cumm = cumm + &mmm1
     mtot = mtot + (&mmm1/100))
     i = i + 1
   enddo

   i = 1
   do while i <= 5
     mmm1 = 'PER_'+str(i,1)
     fails = CEILING((&mmm1/100) * tot_num)
     mfail[i] = fails
     cumfail1[i,i] = tot_num
     cumfail2[i,i] = fails
     if i > 1
       j = 1
       cumm = 0
       do while j < i
         k = i-j
         mmm1 = 'PER_'+str(k,1)
         cumfail1[i,k] = mfail[j]
         cumfail2[i,k] = (&mmm1/100) * mfail[j]
         cumm = cumm + ((&mmm1/100) * mfail[j])
         j = j + 1
       enddo
       mfail[i] = mfail[i] + cumm
     endif
     i = i + 1
   enddo
   i = 2
   nfail[1] = mfail[1]
   do while i <= 5
     nfail[i] = nfail[i-1] + mfail[i]
     i = i + 1
   enddo
```

```
      ?
      ? 'COMPUTATION OF NUMBER OF ',rtrim(item_name),' THAT FAIL '
      ?
      ? 'Alternative 1 = ',str(tot_num,6),'/',str(mtot,6.2),
      ? '              = ',str(ceiling(tot_num/mtot),5), item_name
      ?
      ? 'Alternative 2 - 6 '
      ?
      ? 'MONTHS |     1     |     2     |     3     |     4     |'
      ?? '     5     |     |     '
      ? '       |   ',str(per_1,3),'%   |   ',str(per_2,3),'%   |   '
      ?? str(per_3,3),'%   |   '
      ?? str(per_4,3),'%       ',str(per_5,3),'%   | Total| Cumm. '
      ? replicate ('*',99)

      i = 1
      do while i <= 5
        mmm1 = 'PER_'+str(i,1)
        cumm = cumm + &mmm1
        mtot = mtot + (i*(&mmm1/100))
        ? ' ',str(i,2),'  |',
        j = 1
        do while j <= i
          ?? str(cumfail1[i,j],5),'  ',str(cumfail2[i,j],3),' |'
          j = j + 1
        enddo
        j = i+1
        do while j <= 5
          ?? '             |'
          j = j + 1
        enddo

        ?? str(mfail[i],4),' | ',str(nfail[i],5)
        i = i + 1
      enddo
      ?
     set alternate off
     wait
    endif
    @10,10 to 12,50
    store 'N' to ans
    @11,12 say 'More record(s)? (Y/N)' get ans pict '!'
           valid ans $ 'Y/N' error 'Invalid entry!!!'
    read
enddo
CLEAR
close databases
deactivate window user
return

Procedure REPTRE
```

```
alter[1] = '1 - Replacement on failure only'
alter[2] = '2 - Replacement on failure at the end of month 1'
alter[3] = '3 - Replacement on failure at the end of month 2'
alter[4] = '4 - Replacement on failure at the end of month 3'
alter[5] = '5 - Replacement on failure at the end of month 4'
alter[6] = '6 - Replacement on failure at the end of month 5'
define window user from 1,1 to 22,78 none color W+/B
activate window user
set stat off
set alternate to 'TRE.out'
set device to screen
 use repstr
 store 'Y' to ans
do while ans = 'Y'
 clea
 store space(6) to mitem_code
 @ 1,10 Say "Enter Item Code: " get mitem_code Pict "999999"
 read
  locate for item_code = mitem_code
  if found()
    set alternate on
    set space on
    DO HEADING
    i = 1
    cumm = 0
    mtot = 0
    cumfail = 0
    do while i <= 5
      mmm1 = 'PER_'+str(i,1)
      cumm = cumm + &mmm1
      mtot = mtot + (i*(&mmm1/100))
      fails = CEILING((&mmm1/100) * tot_num)
      mfail[i] = fails
      if i > 1
        j = 1
        cumm = 0
        do while j < i
          k = i-j
          mmm1 = 'PER_'+str(k,1)
          cumm = cumm + ((&mmm1/100) * mfail[j])
          j = j + 1
        enddo
        mfail[i] = mfail[i] + cumm
      endif
      i = i + 1
    enddo
    i = 2
    nfail[1] = mfail[1]
    do while i <= 5
      nfail[i] = nfail[i-1] + mfail[i]
      i = i + 1
```

```
  enddo
  nfail1 = ceiling(tot_num/mtot)
  mave[1] = nfail1*ind_cost
  ?
  ? 'CALCULATION OF AVERAGE MONTHLY COST OF EACH '
  ? 'ALTERNATIVE REPLACEMENT CYCLE OF '+item_name
  ?
  ? 'Alter- | After No.  | No. of | Indivdual | Group  |  Total  | Average '
  ? 'native | of months  | failures| Cost     |  Cost  |  Cost   | Cost '
  ? '*****************************************************************************'

    ? '   1  | failure only | ',str(nfail1,5),' |'
    ?? str(nfail1*ind_cost,10,2),' |     -    '
    ?? ' |',str(nfail1*ind_cost,10,2)
    ?? ' |',str(nfail1*ind_cost,10,2)
  i = 1
  do while i <= 5
    ? '  ',str(i+1,2),' |     ',str(i,2),'     | ',str(nfail[i],5),' |'
    ?? str(nfail[i]*ind_cost,10,2),' |', str(grp_cost,10,2)
    ?? ' |',str((nfail[i]*ind_cost)+grp_cost,10,2)
    ?? ' |',str(((nfail[i]*ind_cost)+grp_cost)/i,10,2)
    mave[i+1] = ((nfail[i]*ind_cost)+grp_cost)/i
    i = i + 1
  enddo
  i = 2
  low = 1
  lowval = mave[1]
  do while i <= 6
    if mave[i] < lowval
      lowval = mave[i]
      low = i
    endif
    i = i + 1
  enddo
  ?
  ? 'Based on the average cost of each alternative '
  ? alter[low]
  ? 'has the lowest average cost. '
  ? 'Therefore, Alternative',str(low,2),' is optimum replacement cycle '
  ?
  ? 'ALTERNATIVES '
  ? '------------'
  i = 1
  do while i <= 6
    ? alter[i]
    i = i + 1
  enddo
  ?
 set alternate off
 wait
endif
```

```
   @10,10 to 12,50
   store 'N' to ans
   @11,12 say 'More record(s)? (Y/N)' get ans pict '!'
          valid ans $ 'Y/N' error 'Invalid entry!!!'
   read
enddo
CLEAR
close databases
deactivate window user
return

PROCEDURE GETDATA
CLEAR
@ 3,5 SAY "Item Code :" + Mitem_code
@ 3,35 SAY "Item Name :" get mitem_name pict "@!"
@ 5,5  SAY "% after Month 1 :" get mper1 pict "999"
@ 5,45 SAY "% after Month 2 :" get mper2 pict "999"
@ 7,5  SAY "% after Month 3 :" get mper3 pict "999"
@ 7,45 SAY "% after Month 4 :" get mper4 pict "999"
@ 9,5  SAY "% after Month 5 :" get mper5 pict "999"
@ 9,45 SAY "Total Items :" get mtot_num pict "999999"
@ 11,5  SAY "Individaul Cost :" get mind_cost pict "999999.99"
@ 11,45 SAY "Group Cost :" get mgrp_cost pict "999999.99"
RETURN

PROCEDURE HEADING
? space(10),"*************************************************************"
? space(10),"* R E P L A C E M E N T  S T R A T E G Y  S Y S T E M *"
? space(10),"*************************************************************"
?
?
RETURN
```

REPLACEMENT STRATEGY SYSTEM

CALCULATION OF AVERAGE LIFE SPAN OF FAN BELTS

MONTHS	% OF FAILURE CUMMULATIVE	NO. OF FAILURE AT END OF EACH MONTH	EXPECTED VALUE
1	10	1	0.10
2	25	1.5	0.37
3	43	1.8	0.81
4	68	2.5	1.7
5	100	3.2	3.2
		TOTAL :	6.57

That is an Average after 6.57 months ... 200 FAN BELTS fail.

Therefore for 1 month 57 FAN BELTS fail
i.e. 200 / 3.57

****
* R E P L A C E M E N T S T R A T E G Y S Y S T E M *
****

COMPUTATION OF NUMBER OF FAN BELTS THAT FAIL

Alternative 1 = 200 / 3.57
= 57 FAN BELTS

Alternative 2 = 6

MONTHS	1		2		3		4		5			
	10 -		15 -		18 -		22 -		35 -		Total	Cumm.
1	200	20									20	20
2	30	2	200	30							32	52
3	32	3	20	3	200	36					42	94
4	42	4	32	5	30	4	200	44			57	151
5	[illegible]	6	42	6	36	6	30	4	200	[illegible]	62	213

```
**********************************************************
*  R E P L A C E M E N T   S T R A T E G Y   S Y S T E M  *
**********************************************************
```

CALCULATION OF AVERAGE MONTHLY COST OF EACH
ALTERNATIVE REPLACEMENT CYCLE OF FAN BELTS

Alternative	After No. of months	No. of failures	Indivdual Cost	Group Cost	Total Cost	Average Cost
1	failure only	57	11400.00	-	11400.00	11400.00
2	1	20	4000.00	20000.00	24000.00	24000.00
3	2	52	10400.00	20000.00	30400.00	15200.00
4	3	94	18840.00	20000.00	38840.00	12946.67
5	4	151	30164.00	20000.00	50164.00	10032.80
6	5	243	48584.40	20000.00	68584.40	11430.73

Based on the average cost of each alternative
1 - Replacement on failure only
has the lowest average cost.
Therefore, Alternative 1 is optimum replacement cycle.

ALTERNATIVES
----

1 - Replacement on failure only
2 - Replacement on failure at the end of month 1
3 - Replacement on failure at the end of month 2
4 - Replacement on failure at the end of month 3
5 - Replacement on failure at the end of month 4
6 - Replacement on failure at the end of month 5

REPLACEMENT ACTIVITY SYSTEM

CALCULATION OF AVERAGE LIFE SPAN OF LIGHT BULBS

MONTHS	NO. OF FAILURE CUMMULATIVE	NO. OF FAILURE AT END OF EACH MONTH	EXPECTED VALUE
1	10	10	0.10
2	25	15	1.[illegible]
3	50	25	1.[illegible]
4	90	[illegible]	1.[illegible]
5	100	[illegible]	1.[illegible]
		[illegible]	[illegible]

That is an Average after [illegible] months all [illegible]
LIGHT BULBS fail.

Therefore for 1 month [illegible] LIGHT BULBS fail
i.e. 1000 / 3.35

```
****************************************************************
* R E P L A C E M E N T   S T R A T E G Y   S Y S T E M *
****************************************************************
```

COMPUTATION OF NUMBER OF LIGHT BULBS THAT FAIL

Alternative 1 = 1000 / 3.35
= 299 LIGHT BULBS

Alternative 2 - 6

MONTHS	1	10	2	15	3	25	4	[illegible]	5	20	Total	Cumm.
1	1000	100										
2	100	10	1000	150							[illegible]	[illegible]
3	160	16	[illegible]	15	[illegible]	250					[illegible]	[illegible]
4	291	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	200	[illegible]	[illegible]

```
**********************************************************************
*  R E P L A C E M E N T   S T R A T E G Y   S Y S T E M  *
**********************************************************************
```

CALCULATION OF AVERAGE MONTHLY COST OF EACH
ALTERNATIVE REPLACEMENT CYCLE OF LIGHT BULBS

Alternative	After No. of months	No. of failures	Individual Cost	Group Cost	Total Cost	Average Cost
1	failure only	299	35880.00	-	35880.00	35880.00
2	1	100	12000.00	30000.00	42000.00	42000.00
3	2	260	31200.00	30000.00	61200.00	30600.00
4	3	361	43320.00	30000.00	73320.00	31440.00
5	4	918	110178.00	30000.00	140178.00	36043.63
6	5	1264	152155.20	30000.00	182155.20	32431.54

Each [illegible] average cost [illegible] monthly.
[illegible] - Replacement on failure at the end of month 2
has the lowest average cost.
Therefore, Alternative [illegible] is optimum replacement cycle

ALTERNATIVES

1 - Replacement on failure only
2 - Replacement on failure at the end of month 1
3 - Replacement on failure at the end of month 2
4 - Replacement on failure at the end of month 3
5 - Replacement on failure at the end of month 4
6 - Replacement on failure at the end of month 5