THE EXTENT OF USAGE OF FORECASTING METHODS IN KENYA:

A SURVEY OF LARGE MANUFACTURING FIRMS IN NAIROBI.

BY

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DECLARATION

This research project is my original work and has not been submitted for a degree in any other University.

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This research project has been submitted for examination with my approval as the University Supervisor.

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DEDICATION

In memory of my late father, Suter Yego Sirikwa (Arap Cheboi), for his unqualified love, undiminishing support, encouragement and more so, for his near perfect forecasting of events.

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ABSTRACT

This study analyzed the extent of utilization of formal subjective and and quantitative methods of Forecasting. The study also explored the reasons behind the use of various forecasting methods surveyed, the problems encountered in applying them and the situations in which forecasting is needed most. Also explored were the time horizon in which the various methods are applied and their level of familiarity among the respondents (firms).

The motivation of the study was the fact that the long-run success and survival of any organization, especially in a turbulent environment like the one that is currently experienced in Kenya, depends entirely on how well management is able to forecast the future events that will affect its operations and thereby make strategic plans and decisions to counter them well in advance. The study was a survey of large manufacturing firms based in Nairobi. The required data was collected using a semi-structured questionnaire and analyzed and presented using frequency tables and proportions or percentages.

It was found from the study that in the overall, subjective methods of Forecasting are very familiar and used more regularly than quantitative ones. Of all the methods included in the survey, customer expectations was indicated as the most commonly used, while Box-Jenkins was indicated as the least familiar and least used.

With respect to forecasting time horizon for the methods used by the firms, customer expectations and sales force composite are used more for short and medium-terms, while jury of executives opinion is used more for medium term. Moving averages and trend-line projection/ analysis is used most for medium-term and very less for short-term.

Concerning the reasons for using the various methods surveyed, most firms indicated that they use them mainly because they are easy to understand and less costly in development and application. The least important reasons were detailed analysis and enhancement of team spirit.

For the problems encountered in applying the methods used, rapid and ionconsistent environmental changes was mentioned as the most serious, followed by inaccuracy of the methods. Difficulty in understanding and expensiveness in development were cited as the least serious problems.

The findings also indicate that production planning is the decision making situation that requires forecasting most. Sales analysis and materials resource requirements planning are other heavy users of forecasting, while logistics planning was indicated as the least user of forecasting.

On the basis of the findings of the study, it was recommended that the departments of management science in every institution take active role in enlightening the public about the existence and importance of using quantitative methods of forecasting in combination with the subjective ones.

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CHAPTER 1

INTRODUCTION

1.1 Background to the Study

As a result of trade liberalization all over the world today, especially in the developing countries, the environment in which organizations (profit or non-profit making) operate is increasingly becoming turbulent, hostile and complex. This is because the Phenomenon causes various fundamental changes - social, political and economic- which occur continuously and simultaneously, making business life to be one of survival of the fittest. In such an environment, new technology is frequently being developed, government activity at all levels keep ir competition in all areas is increasingly becoming stiff, ir tiona trade (globalization) is stepping up in almost all industries, social help and service agencies are increasingly being created and customer needs are changing all the time. These changes are quite uncertain as they occur, are of varying magnitude and may lead to the collapse of an organization if effective corrective action is not taken well in advance. This means that the long-run success and survival of any organization depends entirely on how well management is able to predict the future events that will affect its operations and hence make sound strategic plans and decisions to counter them.

In order to achieve effective strategic planning and decision making, the most critical activities to any organization, organizations must, therefore, use operations research/management science (OR/MS)

techniques. This is because OR/MS techniques generate several alternative outcomes which aid organizations in making sound, rational and objective plans and decisions that will enable them to take advantage of emerging opportunities by using their scarce resources effectively and efficiently.

One of the OR/MS techniques that is currently considered as the most effective in aiding planning and decision making and, therefore, reduce the adverse effects of a turbulent, hostile and uncertain environment is forecasting. As pointed out by Makridakis (1981):-

> **".....the forecasting industry is flourishing and high interest is maintained as shown by recent books and articles published, the number of people attending conferences and the opportunities for consulting in business and government."**

A recent literature analysis of the use of OR/MS tools in strategicplanning by Clark (1992) showed that out of 766 abstracts/papers on OR/MS tools in journals, forecasting is the most frequent with 320 papers followed by Decision Support Systems with 119 papers. In this same analysis, forecasting was found to be the most frequently used tool in every functional area in all the industries surveyed. The same analysis found the number of publications on forecasting from 1980 to 1990 to be higher than any other OR/MS technique, which confirms Makridakis (1981) argument. This clearly demonstrates that the operations and strategies of any organization are absolutely dependent on forecasting.

Forecasting means looking into the future basing on the existing situation. It is an OR/MS technique of translating past experiences/data into prediction of things to come. It tries to evaluate the magnitude and significance of forces that will affect future operating conditions in an organization.

Forecasting is indispensable, central and an important prerequisite to any form of planning and decision making. Though it may be difficult, poor or unreliable, it is crucial and inevitable as plans and decisions cannot be made in total ignorance of what is likely to happen in the environment. For example, to reach a decision on whether or not to build a factory, forecasts concerning future demand, technological innovation, costs, competitors plans, labour, expected returns, legislation and many other factors are needed. If the forecasts are good, then the factory will be built, otherwise it will not. This means that investment and forecasting are inseparable.

A clear demonstration of the importance of forecasting is the daily weather forecasts undertaken by Meterological departments all over the world. Weather forecasts are very vital to farmers, businesses and even individuals as they use them in planning their activities. This is why every radio and TV station in the world broadcats weather forecasts almost every hour.

Barron and Target (1988) content that the rewards of good forecasting are extremely high and the penalties for bad forecasting or for no forecasting at all are greater than ever.

It is evident, therefore, that poor forecasting or lack of it results in missed opportunities and considerable opportunity cost because managers will not be able to identify and capitalize on emerging opportunities. It also leads to continued repeat of past mistakes and poor planning leading to inefficient operations and costs associated with attempts to compensate for inappropriate actions or failure to act, among other issues. Effective forecasting solves these problems.

From all the aforesaid, it is clear that organizations must apply the OR/MS technique of forecasting so as to plan effectively. The message

to managements of organizations, therefore, is that they must stay ahead of changes, that is, anticipate new actions that internal and especially others, before being forced, while there is still time, to exercise choice about how and what time to influence, shape and/or redirect the events themselves. This they must do if their organizations are to survive and others, before being forced, while there is still time, to exercise choice about how and what time to influence, shape and/or redirect the events themselves. This they must do if their organizations are to survive and succeed especially in a turbulent environment.

Whereas there are several methods of forecasting that have been introduced, accepted as reducing environmental uncertainties and are now taught in universities and colleges all over the world, little is known about their application in the industry, yet planning depends on forecasting. Although it is very important in managing and controlling the effects of a complex environment, forecasting and other OR/MS techniques in general have not been widely applied, not applied at all or poorly applied in the developing countries as in the developed (Western) ones, according to Gass (1991). This is likely to be the case as organizations in developing countries face problems that emanate from poor planning and decision making.

In reference to Kenya, a developing country, recent studies conducted in some of her organizations confirm the above argument. In his study, Chepkoit (1992) found that the problem of commodity shortages in Kenya National Trading Corporation depots is due to lack of statistical or informed judgemental forecasting method. Murage (1992) found that the Thomas Barnado Children's Home for the Needy and other similar homes do not forecast the donations they receive and hence faced cash flow planning problems. Irayah (1993) also found that the lack of effective planning and hence the long queues in the University of Nairobi clinics is due to

lack of a forecasting tool.

In addition to the findings of the above studies, there are other indicators of poor forecasting or lack of it in the country and hence poor planning and decision making. For example, it is common knowledge that electricity is currently in short supply despite the construction of more powergenerating stations from time to time, a situation that has led to power rationing by the Kenya Power and Lighting Company Limited every year since 1992 (Daily Nation, Thursday, June 1, 1995 and Sunday Nation, July 17, 1995). Water and other services are not adequately provided by the CityCouncil of Nairobi to the city residents yet it is its duty to do so. Also, students in all Kenyan state universities are well in excess of the facilities available.

The collapse of Trade Bank (The Standard, Monday, April 19, 1993), and many other banks in 1993, the closure of several textile and garment manufacturing firms and the remaining operating at low capacities (Daily Nation, Thursday, June 1, 1995) and the serious liquidity problems faced by Trans-National Bank and Sanyo Armco in 1993 (Business Week, Daily National, Tuesday, November 23, 1993), the frequent shortages of seed maize and medicine in Hospitals in the country, the virtual collapse of the Cotton Board of Kenya and Kenya Film Corporation as well as newspapers and magazines remaining unsold each day are also attributed to poor or no forecasting.

1.2 Statement of the Problem

All of the problems highligted above and many others seriously affect Kenya's economic performance and have occurred at a time when the business environment in the country changed from one that was relatively stable to one that has become increasingly turbulent and complex due to trade liberalization in the country in 1993. In this new, complex environment,

forecasting is now needed much more than before.

Given that the factors that hindered the application of forecasting methods in the past, such as unavailability of skilled manpower from universities and colleges across the world and computer software which can perform large, complex and tedious calculations, are no longer a problem, it is, therefore, expected that the several recommended methods already available are now widely applied so that the problem may be that they are not used effectively. But is this the case?

This study attempts to answer this question. It sets out to find the current state of the application and practice of forecasting in large Kenyan manufacturing firms.

Large manufacturing firms are expected to be using forecasting most, especially now, because they are the most hit by the effects of the recent trade liberalization in the country. Firstly, they face stiff competition from imported goods which have been increasing. Secondly, they encounter foreign exchange uncertainties and local currency value fluctuantions, both of which affect their operations, especially importation of raw materials. Thirdly and most importantly, the setting or opening up of regional markets such as Common Market for Eastern and Southern Africa (COMESA), Southern Africa Development Community (SADC), East African Co-operation (EAC) and other preferential trade areas (PTAs) present great challenge to them. As they are engaged in export trade, they will need to know much about the behavior and size of these market as well as the opportunities and threats they are likely to present before entering into them. Next, some of these firms manufacture perishable commodities that require quick disposal and therefore need accurate demand forecasts so as to avoid wastage. These firms also need forecasting most so as to avoid over-and under production, unneccesary plant expansion, huge stock holding costs as well as losing market to

their competitors. They also have enough resources to hire forecasting experts and/ or establish their own forecasting systems. Also, wholesale and retail business constitute their markets.

For these reasons, there is therefore a need to make these firms aware of the existing forecasting methods, if they are not using or already aware of, and how to use them effectively so as to improve their strategic planning and decision - making. This is why large manufacturing firms were chosen for the study.

1.3 Objectives of the Study

(i) To find out the most commonly used forecasting method(s) in large manufacturing firms in Kenya.

(ii) To find out the situations in which forecasting is used most.

(iii) To find out the reasons behind the use of the forecasting methods in practice.

(iv) To identify the problems encountered when using forecasting methods.

1.4 Importance of the Study

The outcome of the study will greatly help manufacturing firms and other organizations to know the existing forecasting methods, the situations in which they are best applied and how to select an appropriate method(s) so as to achieve effective planning and decision making and hence reduce the adverse effects of a turbulent environment.

The findings of the study will also enable universities and other centres of training for forecasting to know the most commonly used methods so that they place more emphasis on how these methods can be effectively used to improve planning and other forms of decision-making.

Forecasting consultants will also benefit very much from the findings of the study. They will be able to know the problems faced by firms in applying forecasting methods, if they do, so as to improve their consulting services.

The findings of the study will also be very useful to OR/MS researchers as they will be able to identify the issues to be addressed when developing new forecasting methods and how to modify the existing ones so as to achieve high degree of forecast accuracy.

1.5 Overview of the Study Report

This management research project report consists of five chapters. The foregoing introductory chapter discussed the background to the study, the statement of the problem, the objectives of the study and its importance. Chapter two provides a review of the literature that is relevant to the study. The issues considered in this chapter are the need for forecasting, forecasting application situations, review of forecasting methods, effective forecasting, efficiency of forecasting, and some studies on forecasting application and practice.

The third chapter discusses the research methodology used in the study. In this chapter, the population of the study, the sample and sampling design, the data collection method and the data analysis techniques are covered.

The fourth chapter covers data analysis and presentation of the research findings. It also discusses the findings of the study, while the final chapter, five, which is a conclusion, covers the summary of the findings, recommendations, limitations of the study and suggestions for further research.

CHAPTER 2

LITERATURE REVIEW

2.1 The Need for Forecasting

The need for forecasting arises from the fact that organizations operate in an environment that is surrounded by uncertainty, both internally and especially externally, so that the greater the amount of uncertainty, the more difficult it becomes for the organizations to formulate plans that will produce desired results. Organizations must, therefore, develop methods of predicting future outcomes, especially in uncertain environments. Such methods include the use of forecasting techniques which provide the organizations with good forecasts. Good forecasts:

i) provide decision makers with an improved picture of probable future events and hence be able to plan accordingly, thereby reducing some of the future uncertainties and avoid being caught unawares.

ii) enable organizations to study and analyze its past records/data and policies. This analysis will reveal good and bad courses taken by management and hence provide a basis for avoiding the same mistakes in the future.

iii) enable organizations to formulate strategies that will help them take advantage of future opportunities and avoid threats at the earliest time possible so as to gain competitive advantage.

iv) enable organizations to allocate their scarce resources effectively and efficiently and hence avoid unnecessary wastage and costs.

v) enable managements to look at all the outside factors affecting their organizations, including remote possibilities and therefore be aware of environmental changes.

Several scholars have emphasized the importance of forecasting. Hamburg (1983) points out that:

> **"Decisions in Private and Public Sector enterprises depend on perceptions of future outcomes that will affect the benefits and costs of possible courses of action. Not only must managers forecast these outcomes, but also they must plan and think through the nature of activities. Clearly, managerial planning and decision making are inseparable from forecasting."**

With the establishment of more and more organizations, competition for myriad opportunities become increasingly stiff. Under such circumstances, organizations will succeed only to the extent to which they are led by managements which have vision to see these opportunities and their ability to strategically position their organizations to harvest them. Harper (1991) asserts that:-

> **"Without vision, executives will continue to be hopelessly caught in a perpetual quicksand type of existence and they will be sealing their company's fate if they assume that what worked well today will work well tomorrow".**

Harper argues that managers who continue their perspective of trying to improve today's results rather than cultivating tomorrow's opportunities, are accelerating their company's demise.

Dilworth (1983) warns that even if it is a fact that we do not know exactly what will happen or occur in the future, it is no excuse for making decisions in total ignorance. Hanke and Reitsch (1992) argue that those organizations which cannot react quickly to changing conditions and that cannot foresee the future with any degree of accuracy are doomed to extinction. This calls for continuous environmental scanning and monitoring so as to be aware of emerging opportunities and threats and to deal with them at the earliest time possible.

In their study entitled, *"Anticipating the future"*, Wajeratne and Harris (1987) concluded that bankruptcies and liquidity crises show that to forestall trouble, it is necessary for an enterprise to plan and arrange adequate cash flow forecasts. Gaither (1983), while stressing the importance of forecasting, points out that:-

"When Managers plan, they determine in the present what courses their organizations will take in the future. The first step in planning is, therefore, forecasting or estimating the future demand for products and services and the resources necessary to produce these outputs."

Cohen (1987) points out that forecasting enables an organization to establish in a marketing plan more accurate goals and objectives and the strategies and tactics for reaching these objectives, and therefore succeeding under circumstances of poor forecasting would be a matter of luck. On his part, Leontief (1964) argues that, no matter how well a company schedules its internal operations, its plans will collapse if its sales forecasts are seriously in error.

From all the afforesaid, it is clear that forecasting is an exercise that cannot be avoided or ignored by any organization if it has to succeed and survive, especially in a turbulent environment, as it is central and prerequisite to any meaningful form of planning and decision making.

2.2 Forecasting Application Situations

Forecasting is an area of interest that cuts across all professions and is, therefore, required throughout all the major sections of an organization and at all levels of planning and decision-making. It is used both formally and informally by all organizations (profit or non-profit making, small or large, public or private), and even by individuals, because they must plan to meet the conditions of the future for which they have imperfect knowledge. Briefly, the principal planning and decision - making areas/situations in which forecasting is needed most, especially in the manufacturing sector are:-

(i) Finance and accounting; to determine future cashflows, investment project selections, and other future financial requirements and commitments;

(ii) Marketing; to determine and/or anticipate the likely volumes of sales (sales analysis) and demand for products, market share and prices so as to plan promotional efforts;

(iii) Personnel; to determine the number of employees and training needs required in future;

(iv) Production; to determine the volumes and mix of product demand and hence effectively plan for production schedules and inventories, materials requirements, labour scheduling, maintenance requirements, facility layout, location, transport, distribution scheduling and plant capacity;

(v) Inventory control; to determine stock holding levels, warehouse expansion, the quantity of raw materials to order and the time of ordering;

(iv) Purchasing; to determine the lead time for purchasing, monitor supplier's and competitor's moves, take advantage of discounts from bulk buying and negotiate forward contracts for buying raw materials ; and

(viii) Research and Development (R&D); to predict technological, social, political and economic conditions of the future as well as the effects of developing a new product.

In the service industry, forecasting also helps managers in their decision - making process. To achieve success in their operations, managers in the travel and tourism industry need seasonal forecasts of demand; university administrators need forecasts of student enrollment so as to ensure that facilities are adequate; city planners need forecasts of population trends to plan highways, mass transit systems, housing and other social amenities; restaurants need forecasts in order to be able to plan for food purchases; hospitals and health clinics need seasonal and average daily forecasts of diseases and patients in order to plan for drug purchases and job schedules. (Evans et al, 1987).

2.3 A Review of Forecasting Methods

This section reviews various methods of forecasting. It briefly discusses the history of forecasting, the process of forecasting and classification of various forecasting methods. It should be noted that each individual method is not described here and, therefore, the reader is advised to consult relevant text books.

2.3.1. A Brief History of Forecasting

The development of forecasting models has been over along period of time. For instance, P. Fermat (1601-1665) and B. Pascal (1623-1662) formulated some of the probability models in use today and used them in gambling problems. The probability theory that is used for forecasting presently was proposed in 1933 by A. Kolmogorov. However, many of the forecasting methods used today, such as regression analysis procedures, were developed in the 20th Century.

In the mid 1950s, the exponential smoothing methods were developed by a number of researchers led by Robert G. Brown. This method was first used by the military before being applied in the business world. As forecasting received more and more attention as one way of reducing uncertainties, new methods continued to be developed. Julius Shiskin (1957, 1961) developed the census II package and engineered the development of decomposition methods which gained significant intuitive appeal to practitioners.

The problems posed by the forecasting methods developed in the 1950s inspired researchers in the field of forecasting to look for more reliable methods. In 1976, professors George Box and Gwilym Jenkins managed to develop the Box-Jenkins methodology which provides a systematic procedure for the analysis of time series that is sufficiently general to handle virtually all empirically observed time-series data patterns.

The 1960s and 1970s also saw the development of technological forecasting methods with the cross-impact matrices method coming in use in early 1980s. With the realization that forecasts are of no use unless applied for planning and decision making and that quantitative techniques assume constancy in the pattern and relationships of data over time which may not always be true, judgemental (subjective) methods of forecasting were developed and were in use from as early as 1980s.
The Delphi method is one such judgemental or subjective method. Judgemental forecasting is greatly useful in changing circumstances.

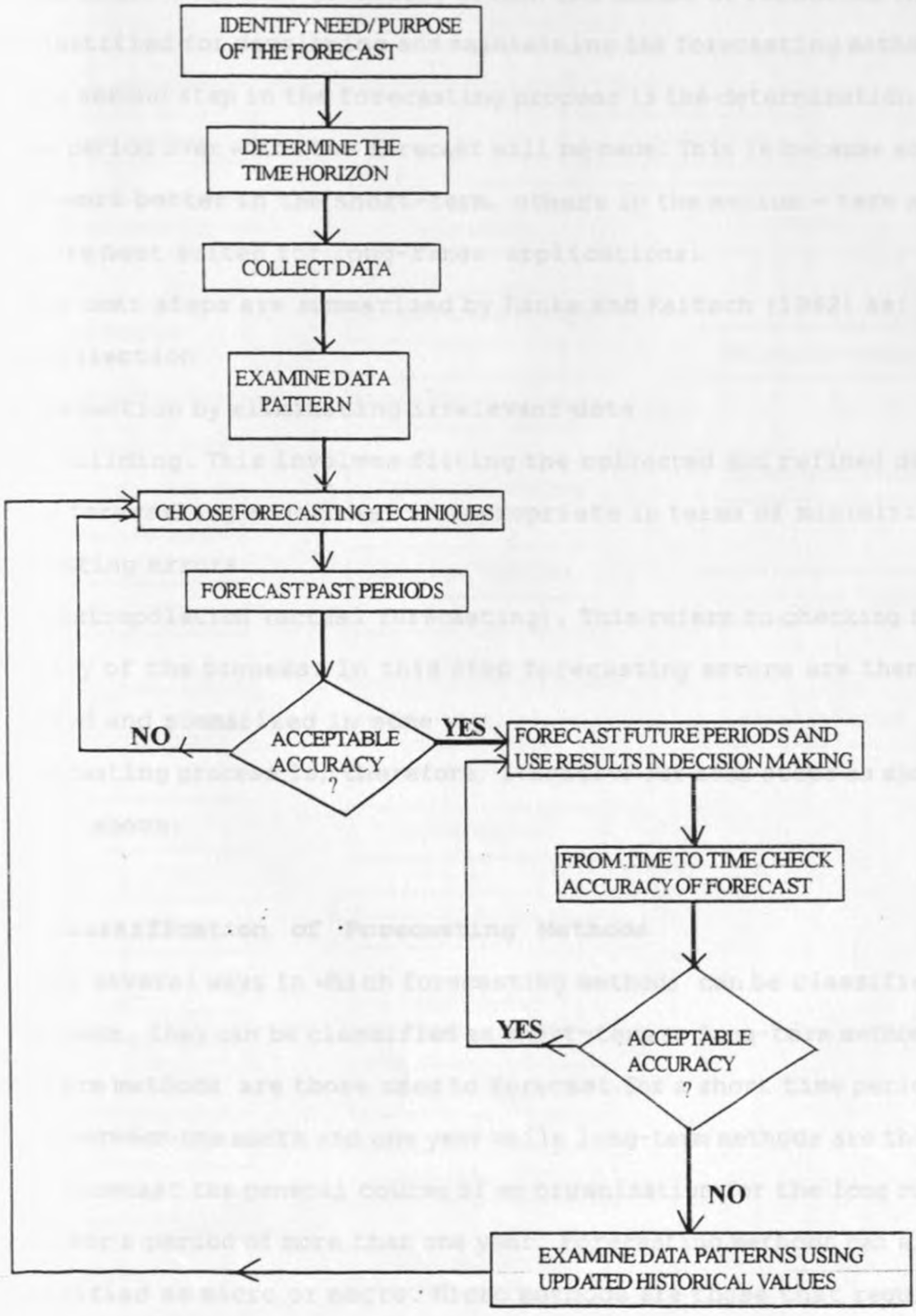
More and more sophisticated forecasting methods such as Parzens ARARMA models, Kalman Filters, and others continued to be developed. With several inconsistencies and problems inherent in the current methods (see Yego, 1995 for some of these inconsistencies) and as environmental complexities continue to increase, new forecasting methods will continually be developed or existing ones modified from time to time to meet these challenges.

Though quantitative methods of forecasting offer more benefits than judgemental methods - such as objectivity, high level of accuracy and generation of better alternative courses of action - they do not provide decisions. In this case, human judgement is required. It is for this reason that the modern trend has been to use a combination of quantitative and judgemental methods in order to benefit from the advantages of both. (Clemen, 1989; Armstrong, 1989).

2.3.2 The Process of Forecasting

The development of a forecasting method involves several steps that form a process. Dennis and Dennis (1991) suggest that the forecasting process begins when the need to obtain a forecast is identified at the appropriate managerial level. This involves analyzing all the decisions that will

Figure 1: The Process of Forecasting



SOURCE: Adapted from Hanke and Reistsch, *Business Forecasting*, 4th Edition, Allyn and Bacon, 1992.

be affected by the forecast so as to determine what the forecast is required to do. This will generally govern the amount of resources that can be justified for developing and maintaining the forecasting method.

The second step in the forecasting process is the determination of the time period over which the forecast will be made. This is because some methods work better in the short-term, others in the medium - term and others are best suited for long-range applications.

The next steps are summarized by Hanke and Reitsch (1992) as:

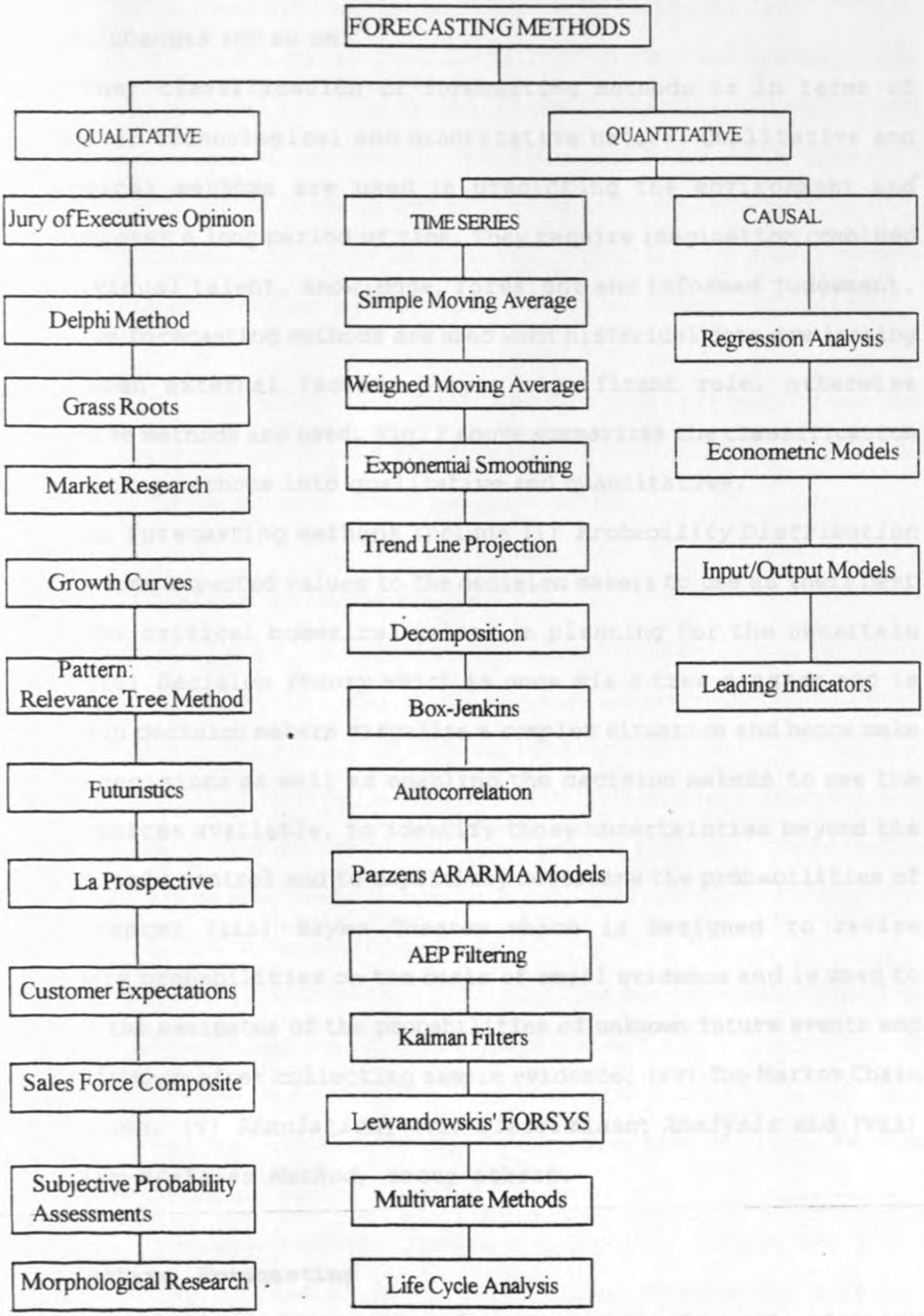
- Data collection
- Data reduction by eliminating irrelevant data
- Model building. This involves fitting the collected and refined data into a forecasting model that is appropriate in terms of minimizing forecasting errors.
- Model extrapolation (actual forecasting). This refers to checking the accuracy of the process. In this step forecasting errors are then observed and summarized in some way.

The forecasting process is, therefore, iterative for some steps as shown in Fig. 1 above.

2.3.3 Classification of Forecasting Methods

There are several ways in which forecasting methods can be classified. For instance, they can be classified as short-term or long-term methods. Short-term methods are those used to forecast for a short time period, usually between one month and one year while long-term methods are those used to forecast the general course of an organization for the long run, usually for a period of more than one year. Forecasting methods can also be classified as micro or macro. Micro methods are those that require small, specific details and are used to make forecasts for individual organizations, while macro methods are those that require large, general

Figure 2: Classification of Forecasting Methods



amount of data for forecasting the general situations of a country such as national economic growth and development, political events, social attitudes/changes and so on.

Another classification of forecasting methods is in terms of qualitative, technological and quantitative nature. Qualitative and technological methods are used in predicting the environment and technology over a long period of time. They require imagination combined with individual talent, knowledge, foresight and informed judgement. Qualitative forecasting methods are used when historical data are lacking such as when external factors play a significant role, otherwise quantitative methods are used. Fig. 2 above summarizes the classification of forecasting methods into qualitative and quantitative.

Other forecasting methods include (i) *Probability Distribution* which provides expected values to the decision makers to use as their best guesses for critical numerical values in planning for the uncertain future; (ii) *Decision Theory* which is done via a tree diagram and is used to help decision makers visualize a complex situation and hence make rational decisions as well as enabling the decision makers to see the various choices available, to identify those uncertainties beyond the organization's control and to explicitly determine the probabilities of future events; (iii) *Bayes Theorem* which is designed to revise preliminary probabilities on the basis of small evidence and is used to determine the estimates of the probabilities of unknown future events and then modify them after collecting sample evidence; (iv) The Markov Chain Distribution, (v) *Simulation,* (vi) *Discriminant Analysis* and (vii) *Percentage-of-Sales Method,* among others.

2.4 Effective Forecasting

As indicated earlier, forecasting plays a crucial role in the planning

and decision making processes in an organization. It is from forecasts that planning and decision-making are made. Good forecasts result in the preparation of sound plans and decisions which then improve the performance and growth of the organization. Successful planning and decision making, therefore, demands that forecasts be accurate. However, as the future is quite complex and full of uncertainties, absolute of forecasting accuracy can never be achieved. Nevertheless, a fair degree of forecasting accuracy can be achieved if the forecasting process is well managed.

This section examines the possible problems of forecasting and the management issues that should be addressed in order to overcome these problems and hence achieve effective forecasting.

2.4.1 The Problems of Forecasting

One of the Problems of forecasting emanates from the organizational environment. From time to time, organizational environment becomes more and more complex. The result of this increasing complexity is that the variables required for forecasting are also increasingly changing and hence facts about them become difficult to get. In addition, these facts, even if got, are distorted or incomplete and, therefore, unsuitable for preparing accurate forecasting methods.

Fluctuations in information resulting from the constant changes in environmental variables demand that sophisticated forecasting methods be used. These methods are sometimes hard to be understood by users. As a result, they will not use them or even if they use, they will not use them as required and hence create forecast errors.

When forecasting methods become difficult to understand, users leave the whole process of forecasting to the forecasting experts. However, more often than not, these experts do not understand the user

needs and specifications. As a result, they become unable to prepare forecasting methods that meet the specifications of all the management systems that they serve, hence poor forecasting results.

A large gap between the forecasting expert and the user of the forecasting methods also presents a problem in forecasting. This is because consultations are delayed resulting into production of ineffective forecasting methods.

Another problem is that accurate forecasting does not necessarily carry a high pay back. As much as forecasting accuracy is required, forecasting methods that do not yield forecasts which influence decision making are worthless no matter how accurate they may be. This presents a dilemma to forecast users.

Wheelwright and Makridakis (1985) in their discussion on achieving forecasting's full potential by improving existing application of forecasting, summarize the problems of forecasting by putting them into five categories as presented below:-

1. *Bias*. Bias problems are caused by personal, political or self serving organizational goals incorporated in the forecasts, hence manipulation by those in control of forecasting. These factors bias forecasting representation of future outcomes and decrease its accuracy considerably.
2. *Credibility and Impact*. Credibility and impact problems result from communication failure between forecasting experts and users of forecasts, organizational structures where forecasting is performed by top management which may have no much impact on decision making and also result from high concentration of stable situations at the expense of the more needed dynamic situations. The problem here is the forecasting methods' lack of relevance in terms of what, when, how and in what form such forecasting methods

are provided, hence no confidence in their use.

3. *Lack of Recent Improvements in forecasting.* Forecasting problems of this type arise when forecasting is no longer improving because of exhausted or few resources to maintain on-going forecasting procedures, and when there is little or no commitment by managers to attain the next level of substantial progress.

4. *Lack of a Firm Base on which to Build.* This type of problem arises due to indecision as to when to start the forecasting process, insufficient resources, lack of commitment, poor forecasting practice, lack of good forecasting methods, absence of strategy and insufficient database.

5. *Recognition of Major Opportunities in the Present Approach.* Wheelwright and Makridakis (1985) argue that organizations frequently describe their forecasting problems in terms of opportunities for substantial improvements. In this case, a problem exists if performance is not yet at the expected level or if the forecasting approach is extremely vulnerable to changes in the environment and so on.

2.4.2 Managing the Forecasting Function

The benefits of forecasting can only be realized if forecasting problems are eliminated or at least drastically reduced. This is possible only if effective management of forecasting methods is greatly enhanced, if the forecasting experts and the users of the forecasting methods participate jointly in the forecasting process and if both possess the necessary skills and abilities. The reasons for this mutual link are summarized by Barron and Targett (1988) who argue that users:

(i) Provide information and specify the results required.

(ii) Play the role of managing the forecasting process and ensuring that

the forecasting methods are linked with the decisions they are required to service and with the general needs of the organization.

(iii) Should also take the initiative in deciding the timing and level of detail required.

(iv) Are the only ones in a position to specify how the forecasting methods are to be used, to monitor them and to amend the forecasting process if this is required.

The importance of user involvement in the entire forecasting process and hence successful forecasting is further supported by research findings in other fields. Robey and Farrow (1982) content that the success of an information system depends on the involvement of the user in both designing and influencing the process. Clearly, the exclusion of users in the forecasting process will make even relevant forecasting methods to be misused or misunderstood. The forecasting expert/user interaction, therefore, ensures forecast credibility and systematic and effective use of forging such a link.

Production of good forecasts demand that users be aware of the range of forecasting methods available. Wheelwright and Makridakis (1985) argue that users should understand enough of the details of the forecasting methods in use so as to visualize new applications of them or make reasonable demands for modifications that will lead to greater usefulness. Given an understanding of the available forecasting methods and how they differ in what they can do, the user can make an initial judgement on those which best apply to his or her situation. This knowledge will increase the user's confidence and credibility in discussions with his or her forecasting expert and in using the methods developed.

Users also need to be aware of past forecasting errors so as not to repeat them. Barron and Targett (1988) stress that a review of the

mistakes made in the organization as well as in other organizations must be done since they will alert the users of possible blunders. In effect, therefore, users will be able to provide quality information to forecasting experts who will then prepare quality forecasting methods.

Successful forecasting requires that both users and forecasting experts possess the necessary skills and abilities. Users must be able to describe important issues in forecasting situations. They must also know how to use forecasting methods. Forecasting experts, on the other hand, must be able to work fully within the organization in obtaining forecasts. Besides , they should provide forecasting methods in new and on-going situations. They should also participate in identifying the most appropriate forecasting method(s) for a given situation.

Full organizational support ensures that good forecasting methods are prepared and used successfully. Management, and particularly users, must have the willingness and commitment to participate fully in forecasting development and implementation.

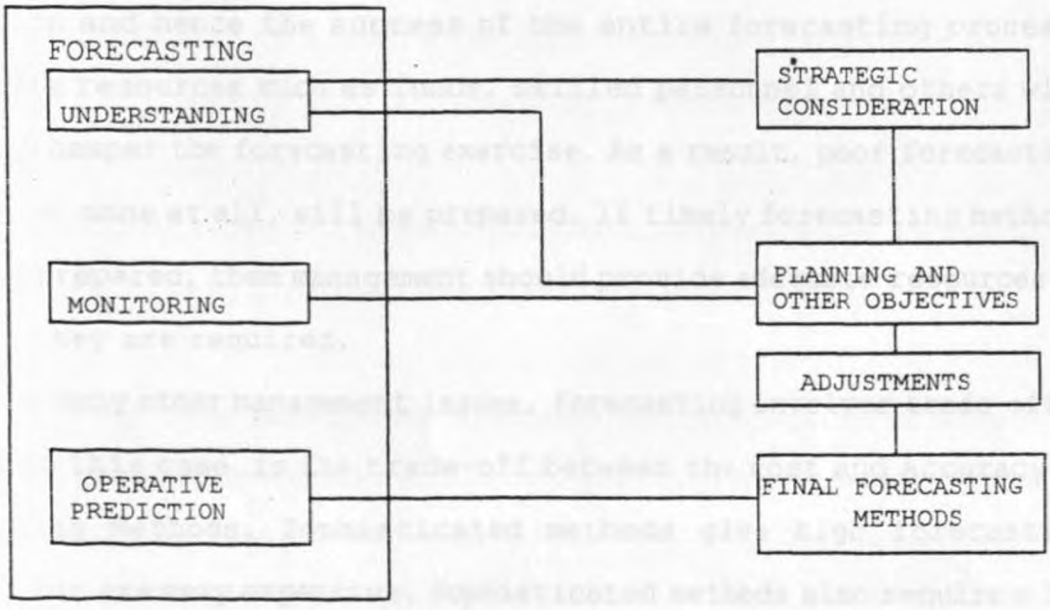
Organizational politics and too much redtape results in preparation of poor or inaccurate forecasting methods. This is because there will be manipulation of the methods to suit personal interest at the expense of the organizational goals. Redtape and politics also delay the forecasting process. To produce good forecasting methods, it is imperative that management reduce the level of bureaucracy in their organizations and introduce punitive measures to stop manipulations of the forecasting methods.

Coordination is another issue that users must address if forecasting is to be effective. Without coordination, the parties involved in the forecasting process will not get clear direction about their responsibility and where their emphasis should be placed.

Wheelright et al. (1985) advice that responsibility be given to one person to see that the forecasting methods are prepared and distributed accordingly, and to ensure that feedback is obtained from operating users about their usefulness. This eliminates confusion and conflicts.

Behind every organization's success is teamwork. It is important that all the staff of the organization be involved in the forecasting process. Through teamwork, elaborate ideas and needs that are required for preparing good forecasting methods can be obtained. Teamwork also makes implementation of forecasting methods quite easy as it lessens resistance from the organization's staff. Management should, therefore, encourage teamwork.With an appreciation of the interface of forecasting with other organizational systems, users will be able to ensure that good, comprehensive and workable forecasting methods are prepared. To facilitate this understanding, there must be a clear definition of the

Figure 3: The Major Functions of Forecasting



Source: Adapted from Makridakis, S., Forecasting Accuracy and the Assumption of Constancy, **Omega**,Vol. 9 (1981) No.3, PP. 307-311.

forecasting function. This will ensure that forecasting procedures are consistent with other procedures and with the objectives and strategies of the organization. The major functions of forecasting are summarized in the diagram above.

To further enhance forecasting effectiveness, both the forecasting experts and the users should be trained. Training enables them to acquire the required skills for forecasting, increase the levels of their innovation or creativity and acquire technical abilities to monitor and react decisively to changes in the environment. In addition to training, management should conduct on-going forecasting seminars in their organizations. If such seminars are conducted outside the organization by forecasting consultants, then management should, as much as possible, enable their forecasting staff to participate. The seminars will diversify their skills and hence improvement in forecasting methods.

The availability of the necessary resources greatly determines the completion and hence the success of the entire forecasting process. Inadequate resources such as funds, skilled personnel and others will obviously hamper the forecasting exercise. As a result, poor forecasting methods, or none at all, will be prepared. If timely forecasting methods are to be prepared, then management should provide adequate resources at the time they are required.

Like many other management issues, forecasting involves trade-offs. Notable in this case is the trade-off between the cost and accuracy of forecasting methods. Sophisticated methods give high forecasting accuracy but are very expensive. Sophisticated methods also require a lot of time to prepare and may then be less useful by the time they are ready. On the other hand, simple forecasting methods may not yield high forecast accuracy but are less costly and take a short time to prepare. To reap maximum benefits from forecasting, management must, therefore, ensure

that cost-effective forecasting methods are prepared.

In summary, a clear knowledge of the steps of the forecasting process and the resources and information required are prerequisites to effective forecasting. This is recognized by Hanke et al. (1992) who conclude that proper management of the forecasting process and hence effective forecasting requires that management, forecasting experts and the users of the forecasting methods have a clear knowledge of the following:

(i) the need for forecasting methods

(ii) the users of forecasting methods and their specific requirements

(iii) the level of detail required and proper time horizon.

(iv) the available data to see if it is sufficient to generate the needed forecasting method or not.

(v) the cost/benefit of the forecasting method.

(vi) the required level of accuracy.

(vii) the time taken to prepare the forecasting method.

(viii) the most appropiate forecasting method to be used in the organization.

(ix) the availability of feedback process to evaluate the forecasting method after it is made and adjust it accordingly.

2.4.3 The Time Span and Update Frequency of Forecasting Methods

As it has been mentioned elsewhere in this paper, the environment in which an organization operates is increasingly becoming turbulent so that from time to time, changes occur on the information that the organization uses to forecast its future prospects. This situation renders existing forecasting methods inappropriate and hence calls for the preparation of new ones, an exercise that is very costly.

To deal firmly with the problem of environmental turbulence,

management should be reviewing and revising their forecating methods so as to accommodate new changes. Dilworth (1983) argues that, at designated time periods, new activity records should be compiled and actual activity compared with forecasted activity for the period. By doing so, management will be able to know whether the forecasting method is working satisfactorily and, therefore, be in a poşition of deciding if any plans and strategies need to be revised due to unanticipated levels of activity. Gaither (1983) argues that as changes occur or are sensed, forecasting methods should be modified to allow users to change their systems.

Management is also advised to prepare different forecasting methods for different time horizons if it is to reduce the effects of a turbulent environment. This is because decisions made are different and focus on different time spans. Some decisions and plans are made for short-term, some for the medium-term while others for the long-term and therefore require different forecasting methods, hence the significance of preparing forecasting methods that are appropriate to different time spans.

It is therefore important to note that forecasting methods must be updated every time new relevant information surface from the environment, internal or external, if acceptable levels of accuracy are to be realized.

2.4.4 Monitoring and Controlling Forecasting Methods

It is of great importance for users to know whether or not the forecasting methods they use in their organizations are performing adequately . This is because methods which perform below expectation adversely affect the performance of the organization. Users should, therefore, monitor and control the forecasting methods they use so as to detect and control forecast errors as they occur. Forecasting is, therefore, a continuous process.

The significance of monitoring and controlling forecasting methods

is greatly emphasized. Dennis and Dennis (1991) point out that:

> **"It is frequently as important to measure and track forecast error as it is to maximize forecast accuracy."**

This suggests that forecasting errors should be monitored to ensure that the forecasting method used is performing as it is required and that it responds adequately to changes in data patterns.

Hanke et al. (1992) stress the necessity of pausing in the forecasting process from time to time so as to reconsider the procedures being used. They suggest the following steps in carrying out the monitoring exercise:

(i) Discard historical values and use the most recently available values.

(ii) Re-calculate the parameters used in the forecasting method.

(iii) Examine the forecasting method with the new parameters for accuracy. If the accuracy is seen to be sufficient, then the method is used until the next update but if not, then a new method can be used.

By monitoring the performance of forecasting methods, their weaknesses will be revealed. This will enable users to institute corrective actions. However, users should set realistic standards of performance for each forecasting method which will act as yardsticks against which forecast performance will be measured. They should also institute effective control measures and ensure continuous monitoring of forecasting so as to achieve good results from forecasting methods. By doing this, effective forecasting will be achieved.

How then can users of forecasting methods monitor forecasting errors? Some commonly used methods for this purpose include: (i) *Mean Absolute Deviation (MAD),* (ii) *Mean Square error (MSE),* (iii) *Tracking Signal and* (iv) *Control Charts.* These methods have upper and lower limits which define the range of acceptability of errors. Any forecast value beyond these limits signals the existence of systematic or nonrandom errors thereby calling for revaluation of the activity pattern and the forecasting method, identification of the causes of the

errors and a corrective action taken in effect. These methods of monitoring forecast accuracy are also used to measure forecasting accuracy and are, therefore, discussed in section 2.4.5.4 below.

2.4.5 Appraisal of Forecasting Methods

The availability of several alternative forecasting methods makes forecast appraisal or evaluation to be of great importance to managers. This is because different methods have different levels of accuracy yet they perform the same function. Since forecast accuracy, among other factors, is the most important in determining the selection and use of a forecasting method, forecast evaluation becomes necessary so as to know and rank the level of accuracy of each method. This exercise will facilitate the selection of an appropriate forecasting method.

2.4.5.1 The Accuracy of Forecasts

Ordinarily, accuracy means free from error, or more precisely, exact. From this ordinary definition, forecast accuracy can simply be defined as the equality between the actual (observed) value and the forecasted value of a variable, that is, no forecast error.

The prime objective of any forecasting process is to achieve forecast accuracy since accurate forecasts enable managers to make sound and effective plans and decisions. However, the question of perfect accuracy is one that any organization should never expect, even if it has the best forecasting experts. This is because of the dynamic nature of the environmental forces affecting the operations of the organization. Organizations should, therefore, be concerned with minimizing forecast errors so as to achieve a reasonable degree of accuracy. In support of this argument, Stevenson (1989) points out that:-

"In the real world, the important question is not: will the forecast be perfect?, but rather: How far off might the forecast be?"

In the same token, Dilworth (1983) argues that absolute accuracy in predicting the future is not achievable and, therefore, there is a limit to the benefits one should expect from forecasting methods and the effort one should put into it. Hanke et al. (1992) conclude that predictions as to the future outcomes rarely are precisely on the mark and so forecasting experts can only endeavour to make inevitable errors small.

It is, therefore, evident that forecasting methods have errors, with the degree of inaccuracy varying between them. This then brings us to the subject of forecast errors and their sources.

2.4.5.2 Forecasting Errors and their Sources

Forecast error is the numeric difference between the actual value and the forecast value. Mathematically, it is calculated as below:

Forecast Error = Actual Value - Forecast Value

Forecast error is a measure of effectiveness that is used to evaluate the success or failure of the method in use and other different methods. For decision making purposes, a method that results in large forecast errors is less desirable than one yielding fewer errors. The sources of forecast errors are outlined below:

1. Causes of projecting past trends into the future, that is deviations from predicted line on trend caused by the presence of extreme values or outliers.
2. Bias errors. They are caused by:
   (i) Failure to include the right variable(s),
   (ii) Using wrong relationships among variables,

(iii) Employing the wrong trend-line,

(iv) Consistently shifting seasonal variable(s) from where it (they) normally occur, and

(v) The existence of some undetected secular trends.

3. Existence of random variations in the data used in forecasting. Random errors (or variations) cannot be explained by the forecasting method being used and remain in the data after all causes of variation have been accounted for. They are attributes to measurement errors and other chance factors.

4. Irregular and unforeseen variations such as temporary shortages, electricity blackouts, change in government policy, prolonged and unexpected strikes, and so on.

5. The method being used may be inadequate due to the appearance of a new variable.

6. Improper or incorrect use of the forecasting method.

7. Misinterpretation of forecast results.

8. Undue optimism or pessimism which prejudice the forecasting expert's judgement.

9. Faulty and inaccurate assumptions from the data and information the forecasting expert has been using.

10. Forecasting expert's failure to include all managerial specifications.

11. Failure to update forecasting methods as soon as changes occur.

2.4.5.3 Improvement of Forecasting Accuracy

Since Perfect forecast accuracy cannot be attained, organizations should strive to achieve the highest possible degree of it. This can be achieved by reducing, as much as possible, forecast errors through effective improvement of forecasts. Managers should, therefore, control the sources or causes of forecast errors outlined above in addition to ensuring effective management of forecasts as discussed earlier.

Another way of increasing forecast accuracy is by using a

sophisticated forecasting method. Usually, the more sophisticated the forecasting method used, the higher the level of accuracy achieved and vice versa. Sophisticated methods are of high quality and are costly. This results into trade-offs between cost and quality and cost and accuracy. This is because managers would like to achieve high degree of accuracy by using quality forecasting methods and at the same time keep costs at minimum. Normally, there is a limit to which management can spend on forecasting methods so as to maximize benefits. According to Dilworth (1983), the values of perfect and imperfect information to an organization has a finite limit and yet the amount of money one can spend trying to predict the future is almost infinite, limited only to the amount of money available.

The level of forecast accuracy can also be increased by using combined forecasting methods. A considerable amount of research evidence in support of improving accuracy in this way exist. Clemen (1989) states:-

> **"Considerable literature has accumulated over the years regarding the combination of forecasts. The primary conclusion of this line of research is that forecast accuracy can be substantially improved through the combination of multiple individual forecasting methods".**

Armstrong (1989) conducted research from over 200 studies and found out that combining forecasting methods produces consistent, but modest gains in accuracy. Bates and Granger (1969)* , Newbold and Granger (1974)* and Bunn (1975, 1981) examined the principles behind the combination of forecasting methods from theoretical standpoint, while Makridakis and Winkler (1983)* empirically examined the effects of combining several statistical forecasting methods. Briefly, Makridakis and Winkler found

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* Information extracted from Lawrence et al. (1986).

i) Accuracy increases and variability in accuracy decreases as forecasting methods are combined. This tendency was also found to continue as more methods are included in the combination.

ii) These benefits are most pronounced for methods or combinations of methods which have errors associated with them.

Other researchers who agree that the accuracy of combination of forecasting methods is generally always greater than that of simple forecasting methods include Lawrence, Edmundson and O'Connor (1986), Reeves et al, (1992) and Dickinson (1975).

2.4.5.4 The Methods for Measuring Forecasting Accuracy

Several measures for analyzing forecast errors and hence the level of forecast accuracy of quantitative methods are available to forecasting experts and users. These measures are:-

1. *Mean Absolute Deviation (MAD)*. This is the average of the absolute deviations for all the forecast errors. It is calculated as below:-

$$MAD = \frac{\sum_{i=1}^{n} |\text{Actual Value} - \text{Forecast Value}|}{n}$$

Where: n = Number of periods for which errors may be determined. MAD is useful when the analyst wants to measure forecast error in the same units as the original values.

2. *Mean Squared Error (MSE)*. This is the average of all square forecast errors. It is calculated as below:-

$$MSE = \frac{\sum_{i=1}^{n} (\text{Actual Value} - \text{Forecast Value})^2}{n}$$

This method provides penalty for large errors because it squares each. Its importance is due to the fact that a method that produces moderate errors may well be preferable to one that usually has smaller errors but occasionally yields extemely large ones.

3. *Mean Percentage Error (MPE).* This method is used to determine whether a forecasting method is biased, that is, consistently forecasting high or low . If the forecasting method is unbiased, then the value of MPE is close to zero. A large negative value of MPE means that the forecasting method is consistently overestimating and if it is large and positive, then it is consistently underestimating. MPE is calculated as follows:-

$$MPE = \frac{\frac{\sum_{i=1}^{n} (\text{Actual Value} - \text{Forecast Value})}{\text{Actual Value}}}{n} X100$$

4. *Mean Absolute Percentage Error (MAPE).* This is the average of the absolute percentage errors for all forecasts and is found using the following formula:-

$$MAPE = \frac{\frac{\sum_{i=1}^{n} |\text{Actual Value} - \text{Forecast Value}|}{\text{Actual Value}}}{n} X100$$

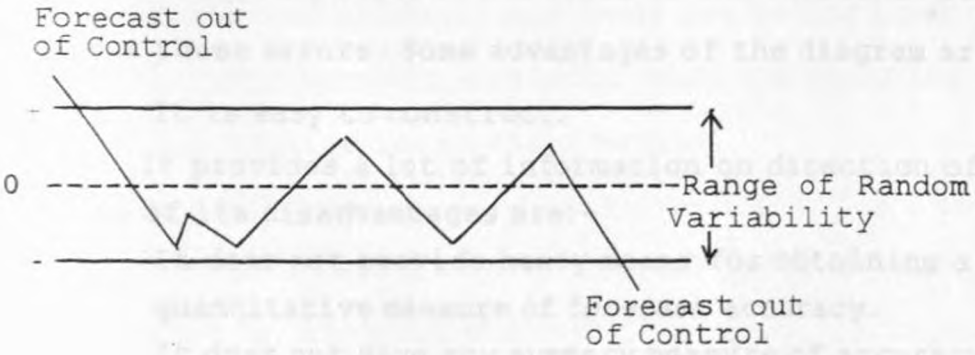
MAPE is a relative measure and is thus preferred to MAD. It is useful when the size or magnitude of the forecast variable is important in evaluating the accuracy of the forecasting method. It also provides an indication of how large the forecast errors are comparison to the actual values observed. it is a useful measure for comparing the accuracy of the same data or series.

5. *Tracking Signal.* This is the ratio of the "running sum of forecast errors (RSFE)" to the mean absolute deviation (MAD) and is derived as below:-

$$\text{Tracking signal} = \frac{\text{RSFE}}{\text{MAD}} = \frac{\sum_{i=1}^{n} (\text{Actual Value} - \text{Forecast Value})}{\text{MAD}}$$

6. *Control Chart.* This is a chart that defines the range of acceptability of forecast errors. It has lower (-) and upper (+) limits which serve as decision rules for each new error. A value beyond either limit is taken as probable evidence that errors are no longer random and hence a need for a corrective action. Figure A below illustrates a control chart.

Figure 4: A Control Chart



7. *The Prediction-Realization Diagram.* If forecasting methods were always perfect, then the predicted and the actual values would be equal all the time. This situation is represented in the diagram

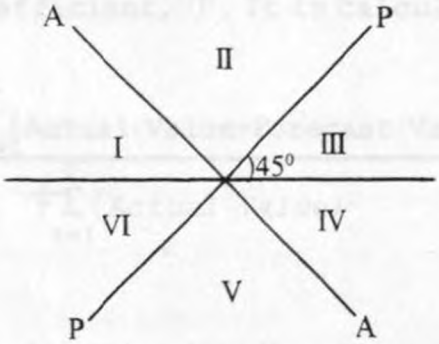


Figure 5: The Prediction-Realization Diagram

above by the straight line drawn through the origin at a slope of 45 degrees-line of perfect forecasts (PP). AA is the line of actual observed values. By transforming this line 45 degrees, the horizontal axis becomes the line of perfect forecasts while Perfect forecasts fall on the horizontal axis whereas any point above the horizontal axis (sections I, II and III) reflect actual changes which are smaller than predicted. Similarly, points below the line of perfect forecasts or horizontal axis (sections IV, V and VI) reflect actual changes which are larger than predicted. Thus, points above the line of perfect forecasts indicate over-estimates of the level of the series, and points below the line are under-estimates of the level of the series.

The Prediction-Realization diagram can be used to keep a running record or check of the distribution of forecast errors and as a flag to warn the forecasting experts and users of the existence of systematic pattern of these errors. Some advantages of the diagram are:

i) It is easy to construct.

ii) It provides a lot of information on direction of change.

Some of its disadvantages are:-

i) It does not provide handy means for obtaining a useful quantitative measure of forecast accuracy.

ii) It does not give any summary measure of accuracy that would permit a meaningful comparison with errors obtained using alternative forecasting methods.

8. *The Forecaster's Batting Average.* This method uses the Theil inequality coefficient, U^2. It is calculated as follows:-

$$U^2 = \frac{\frac{1}{T}\sum_{t=1}^{T}(\text{Actual Value}-\text{Forecast Value})^2}{\frac{1}{T}\sum_{t=1}^{T}(\text{Actual Value})^2}$$

Where:-

i) $U^2 = 1$ is the dividing line.

ii) $U^2 < 1$ indicates that the forecasts are "better" than those which would have been obtained using the naive alternative methods.

iii) $U^2 > 1$ Indicates the opposite of (ii) above.

9. *Naive Methods.* As quantitative measures of forecasting accuracy facilitate the comparison of the results of different procedures, a meaningful comparison of the results of different forecasting methods requires that the forecasts should have been made under the same conditions.
These conditions are unrealistic and therefore comparison may not be possible. It is, however, made possible by using naive mechanical methods which utilize little in the way of initial assumptions that might distort their performance and thus provide the basis for reasonably pure bench-marks for measuring the accuracy of the alternative forecasting method.

The most commonly used naive method is the autoregressive equation which imposes fewer initial restrictions on the bench mark, that is, they let the past data speak for themselves. They are usually preferred as a basis for the comparison of forecasting accuracy. In this method, current period changes are related to previous changes by a mathematical model as shown below:-

$$A_t = BA_{t-1} + M_t$$

Where :

A_t = Current period's change.

A_{t-1} = Previous period's change.

B = Constant estimated from data using the Least Squares Method.

M_t = Random error term

The Bench-Mark forecast for time period a head would then be found by using the estimated value of B times the most recent change. This is a first order auto-regressive equation.A second order auto-regressive equation can also be used.

$$A_t = B_1 A_{t-1} + B_2 A_{t-2} + M_t$$

Wheelwright and Makridakis (1985) define two very simple naive methods against which the performance of more sophisticated methods can be evaluated. They named them as naive Forecast 1 (NF1) and Naive Forecast 2 (NF2).

(i) *Naive Forecast 1 (NF1).* This method uses as forecast the most recent information available concerning the actual value. It is known as a random walk model in statistics. It assumes that no pattern in the data series to be forecast exists. It is calculated as follows:-

$$NF1_{MAPE} = \frac{\sum_{i=2}^{n} \left| \frac{x_i - x_{i-1}}{x_i} \right|}{(n-1)} \times 100$$

where :- x_i = The current actual value.

x_{i-1} = The latest actual value.

n-1 Means that Ram forecasting begins in year 2, not year 1.

(ii) *Naive Forecast 2 (NF2).* This method, unlike NF1, considers the possibility of seasonality in the series. It allows one to decide whether or not the improvement obtained from going beyond a simple seasonal adjustment of the data is worth the time and cost involved. It is calculated as below:-

$$NF2_{MAPE} = \frac{\sum_{i=2}^{n} \left| \frac{x'_i - x'_{i-1}}{x'_i} \right|}{(n-1)} \times 100$$

where x'_i = Seasonally adjusted value of x_i

10. *Mean Error (ME)*. This is the average of all forecast errors. It is derived as below:-

$$ME = \frac{\sum_{i=1}^{n} (\text{Actual Value} - \text{Forecast Value})}{n}$$

11. *Standard Deviation of Error (SDE)*:- This is the squareroot of the MSE. It assesses the reliability of the forecasting method used and serves as a basis for control of variability of forecast errors. It is mathematically expressed as follows:-

$$SDE = \sqrt{\frac{\sum_{i=1}^{n} (Actual\ Value - Forecast\ Value)^2}{(n-1)}}$$

12. *Percentage Error (PE)*. This is the percentage of forecast errors as at a particular time. It is calculated using the following formula:-

$$PE = \frac{(\text{Actual Value} - \text{Forecast Value})}{\text{Actual Value}} \times 100$$

13. *Bias*. This is the average of the sum of the algebraic forecast errors for all periods. It is expressed as:-

$$Bias = \frac{Sum\ of\ algebraic\ errors\ for\ all\ periods}{Total\ number\ of\ periods\ evaluated}$$

2.4.5.5 Criteria for Evaluating the Quality of Forecasts

As the main purpose of forecasts is to help formulate and improve managerial decisions, they ought to be assessed according to the degree to which they succeed in reducing errors in these decisions. Several factors must be taken into consideration so as to achieve effective measurement of forecast accuracy. These factors are:-

i) Study the average performance of a forecasting method over a sufficiently long stretch of time, including different environmental changes so as to know the power of accuracy of the forecast and its degree of reliability.

ii) Appraisals of forecasting methods should include predictions of various environmental developments or changes and diverse variables.

iii) The forecasting experts should clearly and carefully state the assumptions of using the forecasting methods and combine quantitative analysis of forecast errors with qualitative analysis and see how each prediction was derived.

iv) Distinguish forecasting errors of measurement that contribute to forecasting errors and those attributable to chance or are random.

v) Use large samples of comparable predictions to establish the presence of systematic errors.

vi) Establish realistic bench-mark values against which the values from forecasting methods are compared with.

vii) Accuracy must be concerned with post-sampling periods and how well statistical forecasting methods can do in the future, beyond the available data.

viii) Sophisticated statistical forecasting methods should always be compared with naive approaches (such as random walk models, equal weighing schemes or simply deseasonalizing data) to know if the

former is an improvement of the latter and by how much. This is the best way of deciding on the cost/benefit of simple versus sophisticated methods.

ix) Whatever the accuracy or inaccuracy of a quantitative method, a comparison should be made to other alternatives, notably informal and subjective predictions before any judgements about its usefulness and effectiveness are made.

2.4.5.6 **Selecting an Appropriate Forecasting Method**

In choosing an appropriate forecasting method, one has to consider several factors. Researchers and experts in the field of forecasting have outlined or discussed these factors. Note that a chosen method need not have satisfied all the factors, but a good number of them, especially the most crucial ones like accuracy, cost and availability of data. These factors are:-

a) Availability and relevance of hard data. Quantitative methods of forecasting depend on hard data. If historical data is not available, and no experiment can provide the data, it will probably be necessary to use a qualitative method. Also, the type of data, if available, determines the type of method to be used as different methods require different types of data.

b) The desired level of accuracy. Generally, the greater the level of accuracy required, the greater the need for sophisticated methods since they have few forecast errors. Also, short-term forecasts require greater accuracy than long-term forecasts. Sophisticated methods are costly and therefore there should be a balance between cost and accuracy required.

c) The importance of the forecast. It is necessary to know the nature and importance of the forecast because it will give some indication

of the resources that could be used to prepare the forecasting method to be used and the required degree of accuracy.

d) Reliability of the method. The method should adhere to the conceptual assumptions underlying it. In addition, it should be able to produce good and consistent results (forecasts).

e) The cost involved. This refers to the total costs of the forecasting method itself from start to finish, and the cost to the firm of making inaccurate forecast. The method which minimizes total forecasting costs is better or appropriate.

f) The time horizon. This refers to the length of time into the future for which the forecast is desired. Different methods have different forecasting time horizons.

g) The level of the user's understanding. A good method should be easy to understand and be applied by the user.

h) Ease of implementation and interpretation of results.

i) The time taken to prepare forecasting method. Sophisticated methods usually take longer time to be prepared relative to the less sophisticated ones.

j) The availability of the resources required. It is necessary that the requirements of the forecasting method be matched with the resources available.

k) The user's experience. Experience enable users and forecasting experts to know the most reliable methods for different situations.

l) Capabilities and limitations of the method.

m) The user's attitude towards the method.

n) The level of detail required. Macro forecasting methods are more detailed than the micro ones. The method should be complete on the issues perceived to be important by the users.

o) Ease of communication. A good method is one that the user can be able

to change user specified input information easily and obtain (US) that model output in a simple form with equal facility.

p) Adaptability or flexibility. A good method should be able to accept fresh information and use it to update the value of parameters.

q) Robustness. An appropriate method should be specific so that it gives answers to plausible input information.

In general, the forecasting method selected should be one that mostly produces the information needed in a particular situation, with the desired level of accuracy, in the time available, at the minimum cost possible and with the data available. Thus, decisionmakers must also understand the comparative advantages, costs and applications of the alternative forecasting methods available. Also, if a simple method offers an acceptable level of accuracy using the available data, then users should not try to "gold plate" it by using a more advanced method that offers potentially great accuracy but that requires non-existent information or information that is costly to obtain. This is the contention of such researchers as Chambers et al. (1971), Hanke et al. (1992), Dennis et al. (1991), Bails et al. (1992) and others.

2.5 Efficiency (Performance) of Forecasting Methods

Some inconsistencies in reported empirical evidence regarding the performance of explanatory and time series forecasting methods exist. In his analysis of twelve published studies that reported sixteen different comparisons between explanatory and time series methods, Armstrong (1978)[**] found no single study where econometric method was significantly accurate or superior, six of the comparisons showed the econometric method to be superior, three suggested no difference and seven found that it was inferior.

[**]Information extracted from Wheelwright and Makridakis (1985).

Spivey and Wrobleski (1980)** concluded from their findings of past studies of econometric models developed in the United States of America (U.S) that non-econometrically based forecasts appeared generally to be at least or as accurate as those based on the econometric models. They also found that the accuracy of econometric forecasts for time horizons of three or more quarters deteriorated considerably. This result made the authors doubt the ability of econometric models to forecast far beyond one year.

The above findings suggest that time-series methods are more accurate than explanatory models, though the latter are more complex, accurate and expensive. Explanatory models are, nevertheless, supported by McNees (1982)** who argues that time-series methods might do better than econometric ones but only for a period of less than one year (short-term). McNees points out that econometric methods perform better in the longer term. This argument contradicts that of Spivey and Wrobleski (1980)**.

Wheelwright and Makridakis (1985) attribute the above inconsistencies on the comparison of explanatory and time series methods on the basis of predictive accuracy alone. They argue that explanatory models provide information on how important factors affect the variable to be forecast and thus how changes in those factors will influence the forecast, something that time series methods cannot do. For this reason, therefore, the authors believe that explanatory methods (regression and econometric) can play an extremely important role in the overall forecasting effort, while short-term extrapolations are left to time series methods.

** Ibid.

Published empirical evidence suggest that large explanatory models do not perform much better than small ones (Armstrong, 1978; McNees, 1982; Zarnowitz, 1984)**. This suggests that forecasting accuracy does not necessarily improve with increases in complexity and statistical sophistication (Wheelwright and Makridakis, 1985). This is so inspite of the fact that longer explanatory models provide additional understanding of the factors influencing the variable to be forecast. Wheelwright and Makridakis (1985), therefore, advice that in choosing an explanatory model to use, users should recognize the important differences between greater predictive accuracy and additional explanatory power.

One common conclusion that can be made from a review of several empirical tests on various time-series methods by Makridakis, et al. (1982 and 1984)**, is that increasing complexity and statistical sophistication do not automatically mean an improvement in forecasting accuracy as some simple methods performed extremely well in many situations. The results indicate that single exponential smoothing method was the best for short-term but poor for long-term forecasting horizon. Similar conclusions were reached by Makridakis, et al. (1983).

Of all the forecasting methods available, the subjective method of the jury of executives opinion is one of the simplest and most widely used, according to the results of the Conference Board (1978)**, despite its drawback of personality influence and inaccuracy compared to quantitative methods. The studies of the conference Board and others also indicate that the sales force composite method is frequently used. Another method that is shown to be popular is customer expectations.

** Ibid.

Inspite of their wide popularity, subjective forecasting methods have been empirically proved to be less accurate compared to quantitative ones. This is mainly because of biases and limitations of human judgement (Simon, 1971; Kahneman et al., 1982; Hogarth and Makridakis, 1981; Slovic et al., 1977; Lewin, 1947; Janis and Mann, 1977)**.

2.6 Studies on Forecasting Application and Practice

Although quite a number of studies have been done on forecasting in Kenya, none attempted to find out the extent of usage of forecasting methods. In other countries, especially in the U.S and the United Kingdom (U.K), however, several surveys of forecasting application and practice have been undertaken (e.g Mentzer and Cox, 1984; Sparkes and McHugh, 1984; Dalrymple, 1975; and Wheelwright and Clarke, 1976)**.

Given that there are several formal forecasting methods, it is natural that some of them will be more popular and hence used more regularly than others. In a survey of 175 major U.S firms conducted by Dalrymple (1975)**, it was found that the jury of executives opinion method was the most popular with 52% of the respondents using, followed by sales force composite with a score of 48%. The results also show that exponential smoothing and leading indicators were the least popular methods (13% and 12% respectively). Whereas the popularity of the subjective methods is consistent with empirical evidence, that of exponential smoothing is inconsistent. Empirical evidence show that exponential smoothing is more popular among the set of quantitative methods.

** Ibid.

In their survey of 127 major U.S firms, Wheelwright and Clarke (1976)** asked responding firms to indicate the extent to which they used various forecasting methods to determine their forecasting status in the industry. Their findings indicate that those firms which rate themselves as being behind industry most commonly use the methods of the jury of executives opinion (68%) and sales force composite (50%) and least use the Box-Jenkins Methodology (11%). Those firms which view themselves as being average in the industry most commonly use the jury of executives opinion (84%), time series smoothing (71%) and sales force composite (65%) in that order. The Box-Jenkins was also used least by these firms (18%). As for those firms which viewed themselves as being a head of industry, they most commonly use regression analysis (76%), jury of executives opinion (71%), sales force composite (71%), time-series smoothing (66%) and econometric models (63% in that order. The Box-Jenkins methodology is again used least. These results are consistent with other empirical evidence.

In a related study undertaken in the U.K by Sparkes and McHugh (1984), users were found to prefer simple forecasting methods to sophisticated ones which is consistent with other empirical evidence. 88% of the respondents indicated that they were not aware of the existence of the Box-Jenkins methodology, whereas 63% of the respondents indicated that they use trend analysis most frequently and mainly for medium-term forecasting. Regarding application areas, subjective methods and trend analysis were found to be used in all the situations surveyed. Regression analysis was the least applied method, only used in one situation (market share determination). The results also show that forecasting is mostly

applied in determining market share. It can also be seen that none of the methods is used extensively in all situations or functional areas. This is true since there is a great diversity of requirements in planning and decision-making situations.

The results of the Mentzer and Cox (1984)[**] study indicate that overall, all subjective and simple quantitative forecasting methods are quite popular among managers. From the set of quantitative methods surveyed, moving averages is the most popular (85% of the respondents). The Box-Jenkins Methodology is the least popular or familiar (26%), followed by classical decomposition method (42%). The popularity of classical decomposition method contradicts other empirical findings.

Regarding the overall level of satisfaction when the various forecasting methods are used, Mentzer and Cox (1984)[**] found that forecasting users are less satisfied with the subjective methods than with the quantitative ones. The results indicate that regression is the method with which users have the highest level of satisfaction (67%) followed by exponential smoothing (60%), moving averages (58%) and simulation (54%). The Box-Jenkins methodology was the one with whichusers are most dissatisfied. Slightly more than half of the respondents were satisfied with the jury of executives opinion method.

In the same study, Mentzer and Cox (1984) surveyed the use of different forecasting methods for different forecasting time horizons. The results of the survey indicate that the jury of executives opinion method was used almost uniformly across all the forecasting time horizons. This method was also the most widely used. The other subjective methods, sales force composite and customer expectations are used more for short-term and medium-term time horizons than for the long-term horizon.

[**]Ibid.

From the set of quantitative methods surveyed, exponential smoothing and moving averages are used more for short-term, less for medium-term and even lesser for long-term horizons. Trend-line analysis and trend-line projection are used almost uniformly for all forecasting time horizons.

Regression is used more for medium-term and long-term horizons and very less for short-term horizon. The Box-Jenkins, simulation and life cycle analysis are not used very much for any forecasting time horizon.

Another dimension of forecasting practice that was surveyed by Mentzer and Cox (1984)[**] was the application areas where various forecasting methods are being used. The results of the survey indicate that production planning is the heaviest user of forecasting followed by budgeting and strategic planning in that order. Materials resource requirements planning and product planning are the least users of forecasting.

The various issues discussed in the literature above relate to developed countries. These issues may or may not be experienced in developing countries like Kenya. It is with this in mind that the research was conducted so as to find out if the issues are similar in the two categories of countries.

**Ibid.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter deliberates on how the research study was designed. It covers the population of the study, the sample and sampling design, the data collection method, the respondents and the data analysis techniques used.

3.1 The Population

The population of the study consisted of all large manufacturing firms located in Nairobi. In determining the size of a firm, several different measures have been used and accepted as appropriate. One of these measures is the number of employees in the firm [(KirkPatrick, (1984)***; Steel and Page, (1984)***; Kenya Industrial Research and Development Institute (KIRDI)]. Other measures of size are capital employed, volume of sales turnover and level and type of technology used (Kukalis, 1991; Woodburn, 1984; Steel and Page, 1984)***. In their survey of forecasting practice in US firms, Mentzer and Cox (1984)** used sales turnover as a measure of size, while Aosa (1992) combined sales turnover and number of employees.

For all those cases where the number of employees is used as the basis for determining the size of firm, a large manufacturing firm is defined as one with at least 50 employees. The current study adopted this definition, although a combination of two or more measures could have given a better definition. This criteria of number of employees was used for two reasons. Firstly, the short time available for the study could

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** Ibid.

*** Information extracted from Aosa (1992).

not allow the researcher to establish the volume of sales turnover, capital employed or level and type of technology used by the firms. Even if there was reasonable time, this information could not have been obtained easily as firms usually treat such information as sensitive and confidential, especially in this era of stiff competition. Secondly and perhaps more importantly, the list (names) of the firms constituting the population of the study was obtained from KIRDI'S Directory of Manufacturing Industries of 1993. The directory was chosen mainly because it appeared more comprehensive and organized compared to various business directories. Also, the directory categorizes manufacturing firms according to the number of persons they employ and so it was easy to pick those with at least 50 employees which is their definition of a large manufacturing firm. This categorization is shown in Table 3.1 below.

In order to capture the very large manufacturing firms, the study restricted itself to sizes D, E and F with over 100 employees. Ownership and type of Product manufactured were not considered in choosing or constructing the sampling frame for the study.

Table 3.1: Size of Firms

Size Class Code	Number of Employees
A	5 - 19
B	20 - 49
C	50 - 99
D	100 - 199
E	200 - 499
F	Over 500

Source: Kenya Directory of Manufacturing Industries, Revised Edition, KIRDI, 1993.

The choice of Nairobi as the area to be covered by the study was mainly due to convenience in terms of accessibility, time schedule and financial resources available to the researcher. These factors were quite restrictive and as such, the study could not be extended to cover the whole country. Also, according to KIRDI's directory of manufacturing industries, most large manufacturing firms are located in Nairobi.

3.2 The Sample and Sampling Design

After considering the diverse distribution of large manufacturing firms in Nairobi's industrial area, the field of the study, and the limited budget and time available, a sample of 45 firms was settled for. This sample was considered large enough to provide a general view of the state of forecasting in the manufacturing sector of the country and hence provide a basis for valid and reliable conclusions.

A random sample of firms was picked from the sample frame. The firms in the sample frame were numbered and the starting point was determined through the use of random numbers. Thereafter, every third (3rd) firm was picked until the required 45 were picked. During the study fieldwork, it turned out that some few firms were not willing to respond to the questionnaires. This necessitated the researcher to use convenience sampling design. In such cases, the firms which refused to accept the questionnaires were replaced with those within the reach of the researcher and which are included in the population of the study. This was aimed at maintaining the sample number of 45 firms. However, despite this effort, only 35 firms took the questionnaires and eventually 29 of them responded.

3.3 Data Collection Method

The required data for the study was primary data. This was collected using a semi-structured questionnaire consisting of both open-ended and closed

questions. The open-ended questions were aimed at obtaining qualitative data on the general view of the forecasting situation in the manufacturing sector of the country and suggestions from the respondents, while closed questions were aimed at obtaining quantitative data for statistical analysis.

The questionnaire was not divided into sections. However, the first seven questions (Q1 to Q7) sought to obtain data pertaining to the general characteristics of the firms and the forecasting methods used for the purpose of qualitative analysis. Such questions included the ownership of the firms, type of products manufactured, the period of existence of firms, whether the firms carry out forecasting and how they do it, the date of establishment of the forecasting method(s) they use and whether they have independent forecasting units.

The last eight questions (Q8 to Q15) asked for data specifically relating to the forecasting function in the firms. The questions asked included the level of familiarity with various methods of forecasting, the extent of usage of the various methods, the reasons for using the methods, the situations in which forecasting is used and the problems encountered when applying the various forecasting methods. These questions provided quantitative data for statistical analysis.

In preparing the questionnaire, reference was made to the relevant literature. Due to limited time, however, a pilot study was not undertaken and therefore the questionnaire was not pretested with the target respondents. Nevertheless, copies of the questionnaire were distributed to some members of staff of the Department of management Science and MBA colleagues with the aim of improving it in wording and clarity of questions. The recommendations made were incorporated in the final questionnaire.

The questionnaires were largely administered on the basis of "drop

and pick later". In some cases, the researcher was present when the questionnaires were being filled and in others, he was available to clarify some issues to the respondents. In these latter cases, the researcher picked the questionnaires as soon as they were completed.

3.4 The Respondents

The targeted respondents of the questionnaires were planning, marketing or production managers as it was assumed that firms do not necessarily have forecasting managers. Thus, these various managers were assumed to be in charge of forecasting in their firms. However, as it turned out in quite a number of firms, general managers and/or managing directors were the ones responsible for forecasting and therefore became the respondents. In general, the respondents were all those officers who use forecasting methods in their firms.

An attempt was made to use respondents who had acquired some experience with the firms. A two year working experience was thought useful in providing reliable answers to the items in the questionnaire.

3.5 Data Analysis Techniques

The data collected was analyzed by use of descriptive statistics. In particular, frequency tables and proportions or percentages were used.

For data that could not be quantified, qualitative analysis was applied. These data analysis techniques were used in similar studies by Mentzer and Cox (1984), Wheelwright and Clarke (1976) and Sparks and McHugh (1984), among others.

Of course, descriptive statistics do not provide a clear cut basis of making conclusions as would have been the case if more robust statistical methods were employed. Nevertheless, being an exploratory type of study, the summaries obtained through descriptive statistics

should provide a general picture of the forecasting methods used by most of the firms and the reasons for using them. Through descriptive statistics, the problems associated with the use of various methods and other issues of forecasting should also be identified.

The analysis and responses were summarized and classified to fit the following sections:

- Overview of data collected and analyzed.
- Familiarity with various forecasting methods.
- The most commonly used forecasting methods.
- The reasons behind the use of forecasting methods.
- The time horizon for various forecasting methods .
- The situations in which forecasting is used.
- The problems encountered when using forecasting methods.

CHAPTER 4

DATA ANALYSIS AND FINDINGS

This chapter analyses the data collected. It also presents and discusses the findings of the study. It is divided into eight sections namely:- Overview of the data collected; familiarity with various forecasting methods; the most commonly used forecasting methods ; the situations in which forecasting is used; the forecasting methods' time horizon and the problems encountered in using the forecasting methods.

4.1 Overview of the Data Collected and Analyzed

Out of 35 questionnaires that were distributed, 29 were returned, two (2) of which were incomplete. This represents a response rate of 82.9%. Tables 4.1.1 and 4.1.2 below show a summary of the questionnaires returned as per company ownership and type of manufacturing firms. As it is seen from the tables, the majority of these firms are locally owned, and are in the category of food manufacturing and chemical processing .

It should be noted that the data was analyzed on the basis of the number of respondents to particular questions in the questionnaire. As two of the questionnaires returned were incomplete, the findings of

Table 4.1.1: Summary of Questionnaires Returned as per Firm Ownership

Type of Ownership	Number of Questionnaires Returned
Foreign Owned	3
Locally Owned	20
Joint Venture	6
Total (n)	29

Source : Research Data

Tables 4.4, 4.5, 4.6, and 4.7 were, therefore, calculated as a percentage of 27 respondents rather than 29.

Table 4.1.2: Summary of Questionnaires Returned as per Category of Manufacturing Firms

Category of Firm	Number of Questionnaires Returned
Food Processing / Manufacturing	8
Chemical Processing	7
Textile Manufacturing	2
Steel Manufacturing	1
Metal/Plastic Manufacturing	3
Paper/Wood Products Manufacturing	1
Autobatteries and Solar Lighting	1
Rubber Products Manufacturing	1
Building Materials Manufacturing	3
Tooth Brush Manufacturing	1
Cigarettes and Tobacco Manufacturing	1
Total	29

Source: Research Data

4.2 Familiarity with Various Forecasting Methods

Currently, most, if not all, management staff in any organization in the country are either university or college graduates. Since almost all of these institutions offer OR/MS and business related courses, most management staff are therefore expected to possess formal knowledge of forecasting and other OR/MS tools. It is against this background that the researcher found it necessary to test the level of familiarity of various forecasting methods among the respondents as starting point towards the establishment of the most commonly used forecasting methods which was the main objective of the study. Table 4.2 below presents the

results of this test.

Table 4.2 : Familiarity with Forecasting Methods

Method	Level of Familiarity					
	Very Familiar		Vaguely Familiar		Completely Unfamiliar	
Qualitative (Subjective)	No	%	No	%	No	%
Jury of Executives Opinion	13	44.6	6	20.7	10	34.5
Sales Force Composite	24	82.8	0	00.0	5	17.2
Customer Expectations	26	89.7	0	00.0	3	10.3
Morphological Research	2	6.9	0	00.0	27	93.1
Subjective Probability Assessments	6	20.7	13	48.6	10	34.5
Quantitative (Objective)						
Moving Averages	16	55.2	7	24.1	6	20.7
Exponential Smoothing	4	13.6	7	24.1	18	62.1
Trend-line Projection/Analysis	13	44.6	6	20.7	10	34.5
Classical Decomposition	1	3.4	8	27.6	20	69.0
Regression Analysis	10	20.7	5	17.2	18	62.1
Life Cycle Analysis	10	34.5	7	24.1	12	41.1
Econometric Models	4	13.6	5	17.2	20	69.0
Simulation	6	20.7	1	3.4	22	75.9
Box-Jenkins	1	3.4	2	6.9	26	89.7
n=29						

Source: Research Data

It can be observed from the table that the respondents are generally familiar with both subjective and quantitative forecasting methods. They are, however, more familiar with the former than the latter, a result that is consistent with empirical findings.

On individual methods, most of the respondents are very familiar with the subjective methods of customer expectations (89.7%) and sales force composite (82.8%). Jury of executives opinion is the third most familiar method (44.8%) among the subjective methods surveyed. Morphological research is the least familiar subjective method. Empirical findings show that the jury of executives opinion is always the most popular among users, yet the findings of the study show that is the third most familiar. This is, however, a slight and insignificant difference between the two findings.

Regarding the set of quantitative methods Surveyed, the results indicate that most respondents are very familiar with moving averages (55.7%) followed by trend-line projection/analysis (44.5%) and life cycle analysis (34.5%). Box-Jenkins method is the least familiar among the respondents followed by classical decomposition. These results conform to a great extent with empirical findings.

From the above results, it appears that the majority of the respondents are familiar with simple methods which do not involve alot of calculations and almost completely unaware of or avoid using hard methods that require numerous calculations as those shown in the Box-Jenkins method.

4.3 The Most Commonly Used Forecasting Methods

As the results of Table 4.2 above show that some methods of forecasting are very familiar among users than others, it follows that some of these methods are also used much more than others. Table 4.3 below shows the research findings on the extent of usage of various forecasting methods in Kenyan Manufacturing firms surveyed.

The findings indicate that firms use subjective methods of forecasting much more than quantitative ones. Among all the forecasting

Table 4.3 : Extent of Usage of Various Forecasting Methods

Method	Extent of Usage					
	Most Commonly Used		Rarely Used		Never Used	
Qualitative (Subjective)	No	%	No	%	No	%
Jury of Executives Opinion	17	58.6	4	13.8	8	27.6
Sales Force Composite	20	69.0	4	13.8	5	17.2
Customer Expectations	22	75.9	3	10.3	4	13.6
Morphological Research	0	00.0	2	6.9	27	93.1
Subjective Probability Assessments	8	27.6	8	27.6	13	44.8
Quantitative (Objective)						
Moving Averages	14	48.3	9	31.0	6	20.7
Exponential Smoothing	1	3.4	4	13.8	24	82.8
Trend-line Projection/Analysis	13	44.8	3	10.3	13	44.8
Classical Decomposition	1	3.4	3	10.3	25	86.3
Regression Analysis	2	6.9	3	10.3	24	82.7
Life Cycle Analysis	5	17.2	7	24.2	17	58.6
Econometric Models	1	3.4	6	20.7	22	75.9
Simulation	0	0.0	7	24.1	22	75.9
Box-Jenkins	0	0.0	1	3.4	28	96.6
n = 29						

Source: Research Data

methods included in the study, customer expectations is the mostly commonly used (75.9%) followed by sales force composite (69%) and jury of executives opinion (58.6%). Morphological research is the least used subjective method followed by subjective probability assessments.

From the set of quantitative methods, moving averages is the most commonly used (48.3%) followed by trend-line projection/analysis and life cycle analysis (44.8% and 17.2% respectively). The findings also show that the Box-Jenkins method is the least used - almost not used at all.

These findings are somewhat consistent with empirical evidence. Although in the overall, the popularity and wide use of subjective methods viz-a-viz quantitative ones is consistent with empirical findings, the order of popularity of the subjective methods is inconsistent. Whereas the findings of the study show that customer expectations is the most commonly used method, most empirical findings show that the jury of executives opinion is the most widely used. As for quantitative methods, apart from the finding of classical decomposition, the findings are generally consistent with most empirical studies reviewed while moving averages and trend-line projection/analysis are more popular, which is the case in the study.

The results presented in Table 4.3 further show that, despite some quantitative forecasting methods being more familiar than some subjective ones, they are less used than the latter. One possible reason for this result is given by the information provided by the respondents of the questionnaires returned. Most of them indicated that top management has influence on the forecasting methods used in these organizations. As top management usually require quick results, they tend to dismiss the use of quantitative methods as they are complicated and take alot of time in development and application.

Another possible reason for the low use of quantitative methods of forecasting is lack of awareness of the fact that quantitative methods of forecasting produce objective, reliable and more accurate forecasts than subjective ones, a situation that raises the question about the

role of departments of management science in the country's institutions of higher learning. They are expected to promote education about the use and importance of management science tools, such as forecasting, in planning and decision making in such organizations.

Still another reason which could explain why quantitative methods are not very much used, is the fact that most firms indicated that they established their forecasting systems long before the liberalization of the economy. During that time, forecasting was not much needed as it is now since the business environment was more stable and hence subjective methods did very well.

4.4 The Reasons Behind the use of Various Forecasting Methods

As discussed in one of the sections of chapter two, the selection of a forecasting method(s) by any firm depends on several reasons or factors. Table 4.4 below shows some of the reasons which were given.

From the table, it can be seen that simplicity is the main reason behind the choice of forecasting methods to be used. The results indicate that 77.8% of the respondents used their methods because they are easy to understand and apply, an equal proportion of 62.9% use their methods because they are both flexible and less costly to develop and apply, while 59.3% use their methods because they produce results (forecasts) that are easy to interpret and implement. Accuracy or reliability of the methods used was rated fifth while detailed analysis and enhancement of teamwork spirit are the least important reasons (18.5% and 3.7% respectively).

These results are quite consistent with the literature cited in chapter two which give cost, ease of use, ease of interpretation of results, flexibility and accuracy as some of the principal reasons for choosing forecasting methods to be used. Empirical evidence also show that simple forecasting methods are mostly preferred to sophisticated ones even though the latter are superior in terms of accuracy. This

Table 4.4 : Reasons for Using Various Forecasting Methods

Reasons	Frequency	Proportion
Accurate/Reliable	13	48.1%
Easy to understand and apply	21	77.8%
Less costly in development and application	17	62.9%
Results are easy to interpret and implement	16	59.3%
Detailed analysis	5	18.5%
Flexible	17	62.9%
Enhances teamwork spirit	1	3.7%

Source: Research Data

means that forecasting methods that have moderate (reasonable) degree of accuracy but are simple to use and less costly in development are preferred to those with high degree of accuracy but are expensive and time consuming in development and are difficult to understand. This implies that accuracy is not the sole determinant of the choice of forecasting method(s).

The findings of Table 4.4 also justify the findings of Table 4.3 which indicate that subjective methods are used most commonly in forecasting than quantitative ones. Subjective forecasting methods, compared to quantitative ones, are really less costly to develop and apply, easy to understand and apply, provide results that are easy to interpret and implement, are not very accurate or reliable and are flexible (allows adjustment in response to environmental input and output requirements).

In a fairly stable environment, accuracy and reliability of forecasting may be relegated to the fifth place as the results of this study indicate. However, in a more turbulent environment, accuracy and

reliability of forecasts will begin to assume more importance. It is expected that with a more liberalized environment, manufacturing firms in Kenya will begin to require quantitative forecasting tools more because they provide fairly accurate and reliable information for effective planning and decision making.

4.5 The Situations in which Forecasting is Used

Several forecasting application situations, each of which require forecasting, exist in any organization. In manufacturing firms, the principal ones are listed in Table 4.5 below. The information presented in the table indicates that some situations require forecasting much more than others. It can be observed that production planning is the situation that requires the heaviest use of forecasting with a score of 85.2% of the respondents. Other situations with heavy uses of forecasting are sales analysis (81.5%); budgeting (77.8%); marketing planning (74.1%) and purchasing (70.4%). The results indicate that forecasting is least used in human resource planning (22.2%); research and development (22.2%); and logistics planning (18.5%).

With exception of production planning, the findings of the study as shown in Table 4.5 are inconsistent with empirical findings which indicate that budgeting is second while strategic planning and material requirements planning are least users of forecasting.

It is the view of the researcher that the findings of Table 4.5 reflect reality. Given that manufacturing firms are primarily concerned with production of goods and the fact that production of the needed goods depends on the raw materials available, it is not surprising that forecasting is used mostly in these situations. As production expansion and contraction depend on sales forecasts, sales analysisalso becomes another situation that uses forecasting most. The high score received by budgeting is because every activity in a manufacturing firm requires a lot of funds. These reasons are therefore expected, in the opinion of the researcher.

Table 4.5: Forecasting Application Situations

Situation	Frequency	Proportion
Production planning	23	85.2%
Budgeting (Finance and Accounting)	21	77.8%
Human Resources Planning	6	22.2%
Research and Development	6	22.2%
Strategic Planning	14	51.9%
Sales Analysis	22	81.5%
Inventory Control	17	62.9%
Marketing Planning	20	74.1%
Logistics Planning	5	18.5%
Purchasing	19	70.4%
Materials Resources Requirements	22	81.5%
Product Planning	11	40.7%
n = 27		

Source: Research Data

4.6 The Time Horizon for Various Forecasting Methods

Different methods of forecasting are suitable to different situations and time horizons. Some of them perform better when used to forecast for the short-term, others perform better when used to forecast for medium-term, while others do well when used to forecast for the long-term.

Table 4.6 below summarizes the findings of the study regarding the time horizons in which various forecasting methods are applied in Kenyan manufacturing firms. The results presented in the table indicate that among the subjective methods included in the study, the jury of executives opinion is used almost uniformly across all the time horizons. The results also show that sales force composite and customer expectations

are used more for short-term and medium-term forecasting and very less for long-term. These results are quite consistent with empirical evidence and literature in general which indicate that qualitative and explanatory forecasting methods are suitable to a great extent for medium-term and long-term forecasting time horizons.

Table 4.6: Forecasting Method Vs Time Horizon

	Forecasting Time Horizon					
Method	Short-term (Upto 3 months)		Medium-term (3 months to 2 years)		long-term (over 2 years)	
Qualitative (subjective)	NO	%	NO	%	NO	%
Jury of Executives Opinion	5	18.5	7	25.9	5	18.5
Sales Force Composite	11	40.7	9	33.3	1	3.7
Customer Expectations	11	40.7	10	37.0	1	3.7
Subjective Probability Assessments	2	7.4	3	11.1	3	11.1
Quantitative (Objective)						
Moving Averages	4	14.8	7	25.9	5	18.5
Exponential smoothing	0	0.0	2	7.4	2	7.4
Trend-Line Projection/Analysis	3	11.1	9	33.3	6	22.2
Classical Decomposition	0	0.0	1	3.7	2	7.4
Regression Analysis	0	0.0	1	3.7	1	3.7
Life Cycle Analysis	2	7.4	2	7.4	5	18.5
Econometric Models	1	3.7	2	7.4	2	7.4
Simulation	1	3.7	2	7.4	2	7.4
Box - Jenkins	0	0.0	1	3.7	0	0.0
n = 27						

Source: Research Data

From the set of quantitative methods surveyed, moving averages is applied almost uniformly across all time horizons. It is, however, used mostly for medium-term followed by long-term forecasting situations. Though the findings shown earlier indicate that exponential smoothing and classical decomposition are not widely used in Kenya, the few firms which use them indicate their forecasting time horizon as medium-term and long-term. These results contradict empirical evidence which shows that these methods in general, are best suited for short-term forecasting time horizons and to some extent medium term .

The results in Table 4.6 further indicate that trend-line projection/ analysis is used more for medium-term and long-term and less for short-term, which is consistent with empirical evidence. Like in other empirical studies, the results of the study indicate that the Box-Jenkins is almost not used at all for any forecasting time horizon.

4.7 The problems Encountered in Applying Forecasting Methods

In applying their forecasting methods, firms encounter several problems which, if not checked, will result into serious forecast inaccuracies or errors and hence poor firm performance. The problems mentioned by the manufacturing firms surveyed are shown in Table 4.7 below. It can be observed from the table that some problems are very serious while others are not.

The findings in the table indicate that the most serious problem faced by firms in applying their forecasting methods is rapid and inconsistent environmental changes with 81.5% of the respondents citing it. This is followed by inaccuracy of the methods (55.6%), insufficient and irrelevant data (48.1%) and lack of resources and skills (44.4%). Other problems that are cited as serious are communication breakdown (40.7%) and lack of good forecasting methods (40.7%). Lack of organizational support, expensiveness in developing and difficulty in understanding the forecasting methods are cited as the least serious problems of forecasting application (14.8%, 11.1%, 11.1% respectively).

Table 4.7: Problems of Forecasting

Problem	Frequency	Proportion
Insufficient and/or irrelevant data	13	48.1%
Inaccuracy	15	55.6%
Expensive/Costly to develop	3	11.1%
Difficult to understand	3	11.1%
Inadequate or lack of resources/skills	12	44.4%
Lack of organizational support	4	14.8%
Communication failure between forecasting experts and users of forecast	11	40.7%
Lack of staff commitment	5	18.5%
Lack of good forecasting methods	11	40.7%
Lack of forecasting consultancy services	5	18.5%
Rapid and inconsistent environmental changes	22	81.5%
n = 27		

Source: Research Data

These results are absolutely consistent with literature as well as the findings presented in Table 4.3 and Table 4.4 of this study. Literature cites environmental dynamism as the principal cause of all problems of forecasting as does the findings of this study. As the earlier findings of the current study indicate that subjective forecasting methods are most commonly used by manufacturing firms in Kenya, it is not surprising that expensiveness in developing and difficulty in understanding the methods are cited as the least problems. Subjective methods are normally not expensive to develop, they are easy to understand and apply and are not as accurate as quantitative ones.

Rapid and inconsistent environmental changes affect the performance of quantitative and especially subjective methods of forecasting. This is because under such circumstances, acquisition of relevant data becomes difficult and even if obtained, are quickly rendered absolutely useless. As a result, forecasts produced become inaccurate. It is because of this problem that objective, effective forecasting is needed. This is provided by quantitative methods.

The fairly high response given to lack of skills and lack of good forecasting methods as some of the serious problems encountered in applying the forecasting methods in use, further justify the findings presented in Table 4.4. They explain why quantitative methods are not commonly used in forecasting and explain the wide use of subjective methods in the country's manufacturing sector. They also mean that most respondents are only aware of the existence of various quantitative forecasting methods but actually do not know how to apply them.

CHAPTER 5

SUMMARY, RECOMMENDATIONS AND LIMITATIONS

This chapter mainly summarizes the findings of the study in relation to the objectives put forward in chapter 1. It also discusses the recommendations of the study, its limitations and suggested areas for further research.

5.1 Summary and Conclusion

This study sought to achieve four objectives namely, to find out the most commonly used methods of forecasting by large Kenyan manufacturing firms, the reasons behind the use of these methods, the situations in which forecasting is used most and the problems encountered in applying forecasting methods. The study also addressed two other issues. These are the time horizon in which the various forecasting methods are applied and the level of familiarity with the various methods.

The results of the study show that most Kenyan large manufacturing firms are very familiar with many subjective forecasting methods and a few of the simple quantitative ones. The findings show that the five most familiar methods are customer expectations, sales force composite, moving averages, jury of executives opinion and trend-line projection/ analysis in that order. The least familiar methods are morphological research and Box-Jenkins.

Regarding the extent of usage, subjective and simple quantitative forecasting methods are most commonly used. Specifically, the findings show that the most commonly used methods are customer expectations, sales force composite, jury of executives opinion, moving averages, and trend-line projection/analysis. The Box-Jenkins and morphological research are the least used methods - almost not used at all.

As for the reasons behind the use of the various forecasting methods

Surveyed, most respondents indicated that they are easy to understand and apply, are flexible and less costly in development and application and results are easy to interpret and implement. The findings also indicate that users are not quite satisfied with the performance of the methods as less than half indicated that the methods are accurate.

For the situations in which forecasting is used, the findings indicate that the heaviest users of forecasting are in production planning, sales analysis, materials resource requirements planning, budgeting and marketing planning, while the least users of forecasting are in logistics planning, human resources planning and research and development.

In the case of the forecasting time horizon in which the various methods used are applied, the findings show that among the most commonly used methods, jury of executives opinion is used almost uniformly across all time horizons, sales force composite and customer expectations are used more for short term and medium term than long-term while moving averages and trend-line projection/analysis are used more for medium-term than short- and long-terms.

The principal problems encountered in using forecasting methods in order of seriousness as indicated by the findings are; rapid and inconsistent environmental changes, inaccuracy, insufficient and irrelevant data and inadequate or lack of resources and skills. Cost and complexity of the methods are not considered as serious problems.

From all the findings of the study, some conclusions can be made. Firstly, the findings are to a very large extent in conformity with theoretical and empirical evidence in forecasting literature. Secondly and contrary to expectation, quantitative forecasting methods are not widely used in large manufacturing firms in Kenya, a situation that confirms the argument presented by Gass (1991) that OR/MS tools in general

are not as widely used in developing countries as in the developed ones. This implies that even in small manufacturing firms, less use of quantitative forecasting methods is expected to be the case. The third conclusion is that, though users of forecasts in Kenyan manufacturing firms are aware of a reasonable number of quantitative methods, they have inadequate forecasting application skills and more so lack organizational support, especially from top management who seem to have great influence on the firms' forecasting function. This is why most firms extensively use subjective methods as they are easy to understand and apply. Another observation is that users seem not to be aware that quantitative methods are objective, more accurate, reliable and offer more benefits than subjective ones.

Next, all the firms surveyed do not have independent forecasting departments or units and hence the limited use of quantitative forecasting methods. They seem to be contented with subjective methods, though they acknowledge that these methods are not very accurate.

As the firms are expected to face stiff competition due to a liberalized environment, the need for them to put into practice more accurate and reliable methods of forecasting will be greater. Although such a need will arise, those involved in applying forecasting tools must first be exposed to the knowledge and skills required before wide scale application of such tools is to be expected. This is where the role of management science departments in the higher institutions of learning in this country is required to be extended to the organization of seminars, workshops and courses to cover the appropriate knowledge and skills in this area. These departments must also help organizations to develop and implement forecasting methods that are appropriate to them.

5.2 Recommendations

Arising from the findings of the study, some pertinent recommendations can be made. These recommendations are aimed at improving the state of forecasting and hence effective planning and decision -making. As OR/MS techniques, forecasting being one of them, have been empirically shown to improve planning and decision-making, manufacturing firms and other organizations are advised to establish independent OR/MS sections. In addition, they should let their OR/MS staff attend OR/MS seminars on a continuous basis and train them effectively. In this way, planning and decision-making will improve.

Another recommendation is that the Departments of Management Science in the country's educational institutions, especially that of Faculty of Commerce of the University of Nairobi which is well established, should take an active role (as they are supposed to) in educating organizations on the importance of quantitative methods of forecasting as opposed to subjective ones. They should also provide to these organizations the best ways of achieving effective forecasting and application of OR/MS tools in general. The findings of the study indicate that these institutions have not been fulfilling this role, yet they offer several courses in this area, at least to their own undergraduate and postgraduate students.

Still another recommendation of the study is that the departments of management science should have links into manufacturing firms where students from the departments would carry out research in forecasting and have these results published and shared into the firms. The importance and benefits of forecasting methods will be clearly demonstrated to these firms using this approach.

5.3 Limitations of the Study

When analyzing the significance of the findings of this study, several limitations have to be taken into account. The most significant

constraint to the study was time. The short time schedule given to the study could not allow a comprehensive survey to be carried out. As a result, few companies were visited.

Also, some respondents refused to fill or accept the questionnaires citing short time given to them to complete all the questions as their reason. This affects generalization of the results of the study.

Another limitation pertains to the answers provided to the questions in the questionnaire. Some respondents may have given biased or dishonest answers or they may not have clearly understood the questions as there was no other way of providing another source of interaction such as interviews or use of company documents to counter-check the information provided. This may have affected the quality of the research findings.

5.4 Suggested Areas for Further Research

One of the issues that the study addressed but did not materialize is the situations in which particular forecasting methods are applied. Clearly, certain methods are applied to certain situations. Further research should, therefore, attempt to tackle this issue.

As the findings of the study show that forecasting methods are not widely used, it could be of interest particularly to the Departments of Management Science, that a survey of the use of other OR/MS tools be carried out. This will give a clear picture of the state of OR/MS application and practice in the country.

Another area that future research could address itself, is to find out the methods used by foreign and local firms and test whether or not the use of certain forecasting methods is independent of firm ownership. Also, a survey should be carried out to see if the same category of firms use the same methods of forecasting or not.

Still another possible area for further research is a survey of the extent of usage of various forecasting methods in the retail and wholesale businesses, public sector organizations as well as in non-profit making organizations.

APPENDIX A
COMPLIMENTARY LETTER TO THE RESPONDENT

UNIVERSITY OF NAIROBI
FACULTY OF COMMERCE
DEPARTMENT OF MANAGEMENT SCIENCE

Telephone: 732160 Ext. 205
Telegrams: "Varsity" Nairobi

P.O.. Box 30197
Nairobi, Kenya

Date..../9/1995.

Dear Respondent,

I am a Postgraduate student in the Faculty of Commerce, University of Nairobi. Currently, I am conducting a Management Research Project on, " **The Extent of Usage of Forecasting Methods in Kenya: A Survey of Large Manufacturing Firms in Nairobi**". This is in partial fulfillment of the requirements for the Master of Business and Administration (MBA) Degree.

Your company is one of those selected for the study. I am, therefore, kindly requesting you to fill the attached questionnaire the soonest possible and to the best of your knowledge. The information you give is needed purely for academic research purposes and will therefore be treated with strict confidence. In no way will your name or that of your organization appear in the final Report.

A copy of the final Report will be made available to you upon request.

Your assistance and cooperation will be highly appreciated. Thanking you in advance.

Yours Faithfully,

David Kiprop Sirikwa Yego
MBA II Student.

Dr. I. M. Mbeche
Mr. J. K. A. Kenduiwo
Supervisors,
Seniour Lecturers,
Department of Management Science.

APPENDIX B
QUESTIONNAIRE

Please answer the following questions by placing a tick in the space ( ) provided.

Q1. (a) How would you classify your firm with regard to ownership?

Foreign Owned ( )

Locally Owned ( )

Joint venture (foreign & local) ( )

(b) In case your firm is a joint venture between foreign and local investors, what is the proportion of ownership?

Largely Local Owned ( )

Largely Foreign Owned ( )

Equally Owned ( )

Q2. In which of the following categories does your company fall under?

Food Processing or Manufacturing Industry ( )

Chemical Processing or Manufacturing Industry ( )

Textile Manufacturing Industry ( )

Steel Manufacturing Industry ( )

Metal/Plastics Manufacturing Industry ( )

Paper or Wood Products Manufacturing Industry ( )

Other (Specify) .....

Q3 For how long has your company been in existence?

Less than 10 years ( )

Between 10 Years and 20 years ( )

More than 20 Years ( )

Q4. (a) Do you carry out forecasting in your firm?

Yes ( )

No ( )

(b) How do you forecast or predict the demand for your products/ or services, your resource requirements and other variables (needs)?

Through experience (judgemental) [ ]

By use of statistical methods or tools [ ]

(c) Please give a brief description of the method you use.

.....

.....

Q5. When did your company establish the forecasting method or methods that you are currently using?

More than 10 years ago [ ]

Between 5 years and 10 years ago [ ]

During the past 5 years [ ]

I don't know [ ]

Q6. Who developed or designed the forecasting method or methods that you are using in your company?

Forecasting consultant(s) [ ]

Your company's staff [ ]

Others (specify)----------

Q7. (a) Does your company have an independent and active Forecasting Department or Section?

Yes [ ]

No [ ]

(b) If No, who is responsible for forecasting in your company?

.....

.....

.....

Q8. Which of the following forecasting or prediction methods are you familiar with or aware of?

	Very Familiar	Vaguely Familiar	Completely Unfamiliar
Jury of Executives Opinion	[ ]	[ ]	[ ]
Sales Force Composite	[ ]	[ ]	[ ]
Customer Expectations	[ ]	[ ]	[ ]
Subjective Probability Assessments	[ ]	[ ]	[ ]
Morphological Research	[ ]	[ ]	[ ]
Moving Averages	[ ]	[ ]	[ ]
Exponential Smoothing	[ ]	[ ]	[ ]
Trend Line Projection/ Analysis	[ ]	[ ]	[ ]
Decomposition Methods	[ ]	[ ]	[ ]
Box-Jenkins	[ ]	[ ]	[ ]
Regression Analysis	[ ]	[ ]	[ ]
Econometric Models	[ ]	[ ]	[ ]
Life Cycle Analysis	[ ]	[ ]	[ ]

Others (Specify) .....

.....

.....

.....

29. (a) To what extent do you use these forecasting/prediction methods in your company?

	Most Commonly Used	Rarely Used	Never Used
Jury of Executives Opinion	[ ]	[ ]	[ ]
Sales Force Composite	[ ]	[ ]	[ ]
Customer Expectations	[ ]	[ ]	[ ]
Subjective Probability Assessment	[ ]	[ ]	[ ]
Morphological Research	[ ]	[ ]	[ ]
Trend-line Projection/Analysis	[ ]	[ ]	[ ]
Exponential Smoothing	[ ]	[ ]	[ ]
Regression Analysis	[ ]	[ ]	[ ]
Simulation	[ ]	[ ]	[ ]
Life Cycle Analysis	[ ]	[ ]	[ ]
Classical Decomposition	[ ]	[ ]	[ ]
Box-Jenkins	[ ]	[ ]	[ ]
Econometric Models	[ ]	[ ]	[ ]

Others (specify) .....

.....

(b) Please indicate the appropriate reason(s) for using the method(s)

Accurate/Reliable [ ]

Easy to understand and apply [ ]

Easy and less costly to develop [ ]

Easy interpretation of results [ ]

Detailed in analysis [ ]

Flexible (accepts fresh information) [ ]

Others (please specify).....

.....

Q10. (a) Do you use the same forecasting method for different time horizons (periods) e.g for short-term and long-term?

Yes [ ]

No [ ]

(b) Please indicate the forecasting time horizon (period) in which you use your forecasting method(s).

Method	Forecasting Time Horizon		
	Short-Term (Upto 3 months)	Medium-Term (3 months to 2 years)	Long-Term (Over 2 years)
Jury of Executives Opinion	[ ]	[ ]	[ ]
Sales Force Composite	[ ]	[ ]	[ ]
Customer Expectations	[ ]	[ ]	[ ]
Subjective Probability Assessment	[ ]	[ ]	[ ]
Morphological Research	[ ]	[ ]	[ ]
Trend-line Projection/Analysis	[ ]	[ ]	[ ]
Exponential Smoothing	[ ]	[ ]	[ ]
Regression Analysis	[ ]	[ ]	[ ]
Simulation	[ ]	[ ]	[ ]
Life Cycle Analysis	[ ]	[ ]	[ ]
Classical Decomposition	[ ]	[ ]	[ ]
Box-Jenkins	[ ]	[ ]	[ ]
Econometric Models	[ ]	[ ]	[ ]
Others (specify)			

Q11. (a) Do you use similiar forecasting methods for all situations / functional areas of your company?

Yes [ ]

No [ ]

(b) Please give a brief explanation of your response in (a) above.

.....

.....

Q12. Which of the following situations do you apply forecasting or use forecasts most?

Production Planning.....[ ]

Budgeting (Finance and Accounting).....[ ]

Human Resource Planning.....[ ]

Research and Development.....[ ]

Strategic Planning.....[ ]

Sales Analysis.....[ ]

Inventory Control.....[ ]

Marketing Planning.....[ ]

Logistics Planning.....[ ]

Purchasing.....[ ]

Materials Requirements Planning.....[ ]

Product Planning.....[ ]

Others (specify).....

Q13. Which situation(s) / functional area(s) do you apply the forecasting method(s) that you use most commonly in your company? Please the abbreviations in the table below are defined as:-

DP	Distribution Planning
PP	Production Planning
BG	Budgeting
HRP	Human Resource Planning
GP	Strategic Planning
SA	Sales Analysis
IC	Inventory Control
MP	Marketing Planning
LP	Logistics planning
MRP	Materials Requirements Planning
FTP	Facilities and Transportation Planning
RD	Research and Development

Method	Applied Situations/Functional Areas											
	DP	PP	BG	HRP	GP	SA	IC	MP	LP	MRP	FTP	RD
Jury of Executives Opinion	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Sales Force Composite	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Customer Expectations	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Subjective Probability Assessment	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Morphological Research	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Trend-line Projection /Analysis	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Exponential Smoothing	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Regression Analysis	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Simulation	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Life Cycle Analysis	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Classical Decomposition	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Box-Jenkins	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Econometric Models	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Others (specify).....												

Q14. What are some of the problems that you encounter while using your forecasting method(s)?

Unavailability and irrelevance of data.....[ ]

Inaccuracy .....[ ]

Expensive to develop and apply.....[ ]

Difficult to understand .....[ ]

Inadequate or lack of resources / skills.....[ ]

Lack of organizational support.....[ ]

Communication failure between forecasting experts or staff and users of forecasts.....[ ]

Lack of Staff Commitment.....[ ]

Lack of good forecasting methods.....[ ]

Absence of strategy and insufficient database.....[ ]

Lack of forecasting consultancy services.....[ ]

Rapid and inconsistent environmental changes.....[ ]

Others (please specify).....[ ]

THANK YOU FOR YOUR COOPERATION.

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