

**APPLICATION OF DECISION TREE IN DECISION MAKING OF FIRMS IN THE
MANUFACTURING SECTOR: A STUDY OF AKER NIGERIA LIMITED, PORT HARCOURT,
RIVERS STATE**

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ABSTRACT

This study focused on the application of Decision Tree in decision making of firms in the manufacturing industry, with reference to Aker Nigeria Limited Port Harcourt. The objective of the study was to examine the effect of decision tree on effective decision making in Aker Nigeria Limited. The study makes use of secondary data obtained from the management of Aker Nigeria Limited. The study examined the two decision alternatives open to Aker Nigeria Limited; building a large plant and building a small plant which necessitated the use of the decision tree model to identifying the decision alternative with the highest payoff. The study proved that it was better to build a small plant with a payoff of 4.0 m than to build a large plant with a payoff of 3.4m. The implication of the work is that, it is of practical significance to Aker Nigeria limited, scholars, managers, businessmen and students alike. The paper recommended the use of the decision tree in other firms.

INTRODUCTION

Background of the Study

The success or failure of an individual or organization depends to a large extent on the ability of making appropriate decisions. Decision making is an essential process in organizational effectiveness. It has been well-defined as choice amongst alternatives. It is almost related to all managerial functions. Within the manufacturing domain, effective designs are meant to achieve zero defects. Currently, this term has also been applied to the service sector in order to create zero defects. Decision making is an organizational process that has a powerful effect on organizational goals (Prasad, 2004). Decision making is the hallmark of effective management. Over the past ten years many firms in the manufacturing industry such as Aker Nigeria Limited have experienced inefficiencies due to choosing a wrong decision option.

Managers have to make decisions on available resources aimed at achieving organizational efficiency. Decision making is a process of reaching a conclusion which starts at the point in time of awareness of the need to make decision, determining a feasible and viable alternative, the projection of consequences associated with different alternatives, and a measure of effectiveness to identify the best alternatives to be used.

Decision tree, is a means of representing the sequential multistage logic of a decision probe (Khama, 2012). Sharma (2010), a decision tree involves the construction of a diagram that shows at a glance, when decisions are expected to be made in what sequence, their possible consequences and what are the resultant payoffs.

The results of the computation can be shown directly on the trees. A decision tree consists of nodes, branches, profitability estimates and payoffs. Hence, two types of nodes; decision nodes and chance nodes, A decision node is usually represented by a square and indicates places where a decision maker must select one alternative course of action among the available actions. The alternative courses of action are shown as branches. If there is a cost or profit associated with a course of action, it is necessary to keep track of it along the path. Each course of action may result in a chance node. The chance node is represented by a circle and indicated a point at which the decision maker will discover the response to his decision.

Statement of the Problem

A common problem these days in various organizations is the choosing of a wrong decision problem usually results from a lack of long-term planning, and typically, the lack of strategic planning. Individual employees and the organization as a whole live from day to day, never knowing what to expect. This may result in the loss of organizational productivity and effectiveness.

Besides, decision making problems may arise due to inadequate analysis of the payoffs, state of nature, causes of actions and probabilities associated with the occurrences of states of nature are not subject to chance. Besides, situations may arise when a decision-maker needs to revise his previous decision related to getting new information and make a sequence of several interrelated decisions over several future periods. Such a situation is called a sequential or multi-period decision process such as deciding on the size of production. The resultant issues are; determining the alternative decisions which have higher payoffs, the loss associated with choosing the alternative option and the cost associated with each of the decisions. In this paper the problem posed is determining the size of plant to produce a new product.

Objectives of the Study

The major objectives of this study were to critically look into decision tree and its application in decision making in the manufacturing sector and to aid organizations such as Aker Nigeria limited to make decisions that will help it to operate profitably in a competitive environment. Specially, the study seeks to:

- i. Determine which of the alternative decisions which, have higher payoffs for Aker Nigeria limited.
- ii. Ascertain the loss associated with Aker Nigeria limited, choosing the alternative option.
- iii. Identify cost Aker Nigeria limited will incur in choosing each of the decisions option.

Implications of the Study

The relevance of the decision tree process model cannot be over-emphasized because it is one of the techniques that is useful in tackling risky capital investment. Besides, the study will be of great help to Aker Nigerian Limited in identifying the projects that yield higher profits and those that result in higher cost.

More so, decision tree enhances decision making as it highlights the best alternative course of action to follow. However, if the findings are not applied it can make the organization to be less profitable and may even incur losses.

Generally, this study will further enrich management literature on decision making. This work is of practical significance to scholars, managers, businessman and students alike.

REVIEW OF RELATED LITERATURE

Definition/Meaning of Decision Tree

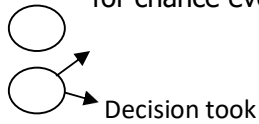
Qmowumi (2015) opines that Decision Tree is a data meaning technique which can be used for classification which is widely used because knowledge discovered from it is illustrated in a hierarchical structure which makes it to be easily understood. Besides, decision tree can be defined as a graphic display of various decision alternatives and the sequence of events as if they were branches of a tree (Jhingan & Stephen, 2013).

Decision tree can also be defined as a diagram used to structure and a systematic, sequential layout of decision points, alternatives, and chance events (Everett & Ronald., 2012). In the same vein, Sharma (2010) defines Decision Tree as the graphical display of the progression of decision and various events.

Components of Decision Tree

Akingbade (2000) states that a Decision Tree consists of the following;

- a) Nodes: for decision
 ○ for chance events



- (b) Branches
(c) Probability estimates
(d) Payoffs (Positive or negative)
Positive payoffs includes profit sales, etc while cost and expenditure are examples of negative payoffs.

Construction of Decision Tree

Jhingan and Stephen (2013) states that the construction of a decision tree requires definition of proposal, identification of alternatives, graphic, the decision tree forecasting cash flows, and evaluating results can be undertaken in the following ways:

- (a) The first step in the construction of decision tree is the definition of the proposal.
(b) The second step in the decision tree is the identification of alternatives. Each proposal will have at least two alternatives-accept or reject. In some cases there may be more than two alternatives.
(c) The third step is graphing the decision tree. Decision tree is a graphical method. It usually helps the decision maker view his alternatives and outcomes.

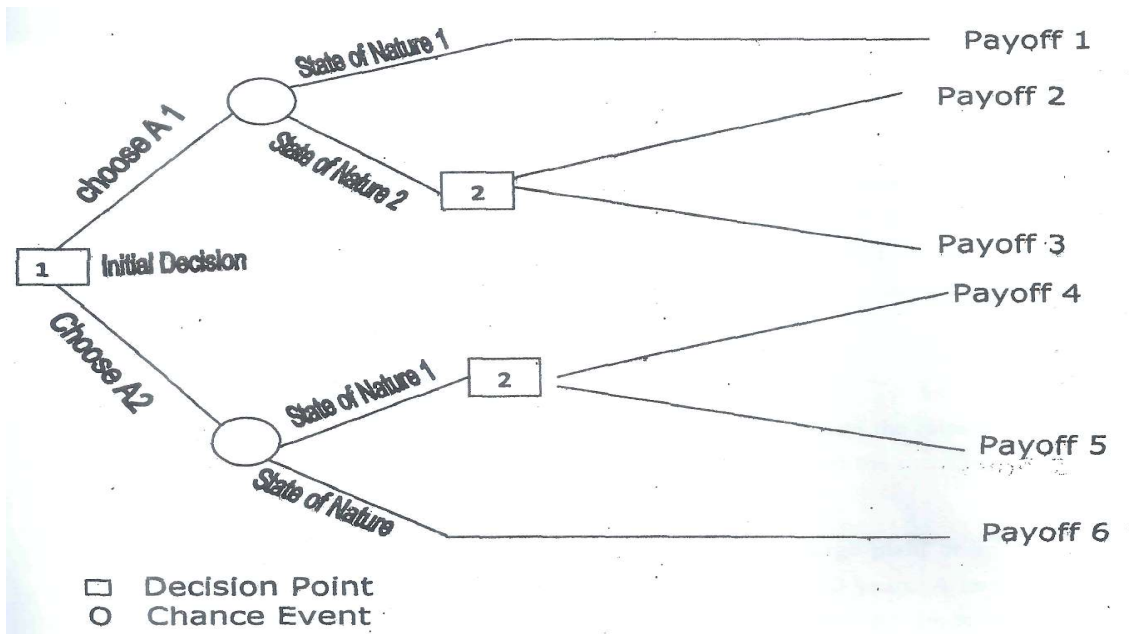


Fig 2.1: Decision tree model showing the process of computing payoffs.

Source: Managerial Economics by Thingen M.L. & Stephen J.K. (2013).

- (d) The fourth step is forecasting cash flows: The forecasting cash flow regarding each decision branch were also shown along with the branch. Probabilities are also assigned to each flow. The probabilities of each event will be different,
- (e) The fifth step in construction of a decision tree is indicating results. The evaluation will be based on managers' experience, consultation with others and Information available in this result. On the basis of the expected value for each decision. The results are analyzed. The firm may proceed with profitable alternatives.

The payoff for ultimate alternatives has been calculated by taking into account the probabilities of alternative as well as for the previous alternative and multiplied by the expected pay-off of the first alternative without its probability. By incorporating probabilities of varies events in the decision tree, it is possible to comprehend and trace probability of a decision leading to results desired.

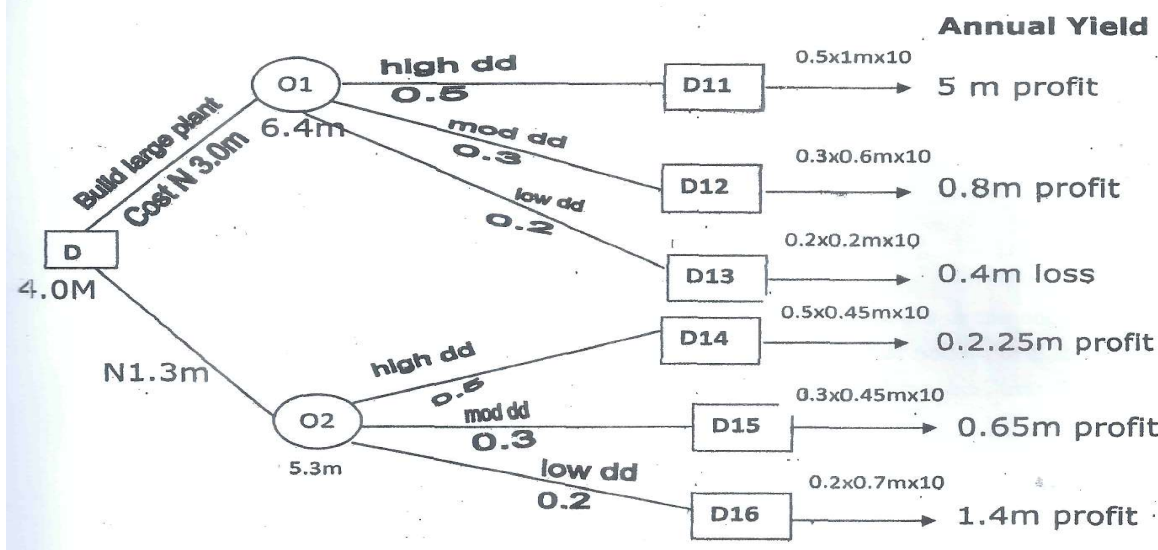
Contextual Framework

To accomplish the stated objectives the researcher must evaluate the relevant data to aid decision making. This study made use of secondary data obtained from the management of Aker Nigerian Limited.

Aker Nigeria Ltd wants to decide on whether to build a large plant or small plant to produce a new product which is expected to have a market life of 10 years. A large plant will cost N3,0m to build and put into operation while a small plant will cost N1 .3m to build and put into operation. The company's best estimate of a discrete distribution of sales over the 10 years period is high demand 0.5, moderate demand 0.3 and long demand is 0.2. Cost, volume and profit analysis done by the management indicates the following:

Plant	Demand	Annual estimate
Large	high	1m profit
Large	moderate	0.6m profit
Large	low	0.2m loss
Small	high	0.45m profit
Small	moderate	0.55m profit
Small	low	0.7m profit

Construction of decision tree and computation



Explanation of Decision Tree Analysis

The analysis of a decision tree involves calculating the position value of each node through the process of roll back. Roll back means that you start from the end of the tree where the payoff associated with the terminal branches are indicated and go or roll back toward the first decision mode. The process of roll back starts from the figures indicated at the end of the terminal branches and move backward towards D. As you roll back, you can face either a chance node or a decision node. The position value of a chance node is the expected value of branches payoffs represented by various branches that emanate from the node. For instance, the position value of chance node, o (ie is arrived at by getting the sum of expected value of the payoff as follows).

$$O_1 = 0.5 (5m) + 0.3 (1.8m) + 0.2 (0.4m) \\ 6.4m$$

The position of decision node is the highest of the position values of nodes or the node which it is connected less the cost involved in the specific branch leading to that node. For instance, D1 (ie 3.0m) is obtained by picking the higher position value of the two branches; branch 1 being build a large plant and branch 2 is build small plant.

Branch 1 is $6.4m - 3.0m = 3.4m$

Branch 2 is $5.3m - 1.3m = 4.0m$

4.0m is higher than 3.4m hence, it is recommended to build small plant,

Empirical Review

Alao and Adeyemo (2013). conducted a study on analyzing employee attrition using decision tree algorithms; this study identifies employee related attributes that contributes to the prediction of employees attrition in organizations. Three hundred and nine (309) complete records of employees of one of the higher institutions in Nigeria who worked in the institution between 1978 and 2006 were used for the study. The demographic and job related records of the employee were the main data which were used to classify the employee into some predefined attrition classes. Windows were used to generate decision tree models and rule sets. The results of the decision tree models and rule-sets generated were then used for developing a predictive model that was used to predict new cases of employee attrition. A framework for a software tool that can implement the rules generated in this study was also proposed.

Kabari and Nwachukwu (2013) , conducted a study on decision support using decision tree and neural networks state that decision making in a complex and dynamically changing environment of the present day demands a new techniques of computational intelligence for building equally an adaptive hybrid intelligent decision support system. In this paper, a decision tree-neuro based model was developed to handle decision support system and clinical decision support system (Eye Disease Diagnosis) which are two important decision problems that require delicate care. The system uses an integration of decision tree and artificial neural networks with a hybrid of decision tree algorithm and multilayer feed-forward neural network with learning algorithm to build up the proposed model. The system developed, give 88% success rate.

Abolfazl (2011), researched on the use of "CHIAD", "CRT", "QUEST", and "C5.0" Decision Tree algorithm to the organizations determine the criteria needed for the identification of potential customers in the competitive environment of their business. Mechanism for the identification of potential customers liable to becoming real customers was also provided by combinations of (CRM) Customer Relation Management field result and data mining results. The main criteria are identified and their importance are determined in this paper and then assuming that each main criterion consists of several sub-criteria, their importance in turning potential customers into real ones was in turn determined. According to their investigation, organization decision tree seemed to be a proper tool for identification and classification of the factors for turning potentials into real customers.

Theoretical Framework

This study is supported by decision tree theory developed by Rose Quinlan in 1986. It is a sequential classifier in the form of recursive tree structure. There are three types of nodes in the decision tree.

The node from which the tree is directed and has no incoming edge is called the root node. A node with outgoing edge is called internal or test nodes. All the nodes are called leaves (also known as terminal or decision node). The data set in decision tree is analyzed by developing a branch like structure with appropriate decision tree splits into branches based on the splitting criteria. Each test node denotes a class. Each terminal node represents the decision. They can work on both continuous and categorical attributes (Manprat,2013).

ISSUES/GAPS AND OUTCOMES

The reviewed literature extensively emphasized on the quantitative analysis of Decision Tree and its applicability in effective decision making without giving cognizance to human and environmental factors. Besides, the models found in literature are based on certain assumptions such as: the decision maker is objective, there are clear and identifiable decision alternates, the cost can easily be estimated etc. Hence, the models are over simplified and are not intended for complex problems. However, the literature has shown feasible outcome in the applicability of the decision tree model using Aker Nigeria Ltd as a case study.

CONCLUSIONS/RECOMMENDATIONS

Conclusions

Decision tree is a powerful technique for aiding managerial decision making for certain kinds of problems. It is a means of representing the sequential, multistage logic of a decision problem.

The decision tree is an off-shoot of probability trees which uses two symbols, a box to represent a decision node and a circle to represent a chance node. The outcomes emanating from chance nodes are the various events that may occur: these are referred to as states of nature and the decision maker has no control over them. Probabilities are associated with their occurrences.

This study examined the applicability of decision tree model on decision making in Aker Nigeria Ltd. From the result of the study, it can be seen that decision trees model can be applied in decision making where there is more than one decision alternatively.

The decision tree model can be used to enhance decision making where there are two or more decision alternatives. This model provides consideration insight into ways of enhancing decision making.

Recommendations

Decision tree model is a method of optimal decision making. it has been used successfully as a decision making aid in many areas such as: predicting annual and seasonal pasture production, mass classification in mammography, automated machine learning classification method, decision tree classification to identify the gender of a person etc. Besides decision tree be employed for data analysis as a comprehensible knowledge representation in a broad range of fields such as customer relations management; engineering, medicine, agriculture, computational biology, business management, productivity statement detection etc; These are enhanced by the application-of the predictive decision tree modeling technique developed by Rose Quinlan in 19.86. Decision can be also being applied using a computer-based programme called decision tree algorithms such as: D3, C4.5, C5.Q, CHAID and CART. The study strongly recommends the use of decision tree to other firms to determine its applicability in effective decision making.

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