CHAPTER-6
DECISION MODELING APPROACH

Decision analysis can be defined as a methodical approach to decision making that allows managers to handle problems where different alternatives and/or a certain degree of uncertainty are involved. Decision analysis overlaps operations research and statistics that has the purpose to model and analyzing decisions made by decision makers. The objective purpose of decision analysis is to assist decision makers in making better decisions. Options are essential for decision analysis, because if only one option is available, there is no choice to make, thus no decision Cooke and Slack,(1984). Clemen (1996) argues that the steps in decision analysis are the following:-

Identification of the decision and objectives, identification of alternatives, modeling the problem structure, choosing the better alternative, sensitivity analysis, if further analysis is not needed, then implement the chosen idea. He states that the decision analysis process is iterative and what-if scenarios should be considered. Decision making is the process of making a selective judgment when presented with different alternatives consisting of several decision variables, and often defining a course of action. Decision making studies the identification and selection of alternatives based on the values and preferences of the decision maker. When a decision is made, it is
implied that there are different alternative choices that are considered, and
the decision maker wants to choose the one that best fits with his goals and
objectives (Harris, 2008). Oglesby et al. (1989) and Heller (1998) state that
decision making involves three different steps: identification of the decision
to be made, seeking out feasible alternatives, and choosing the most suitable
alternative.

Models are representations, with assumptions, of our interpretation of reality
and not reality itself. This representation should include the relevant aspects
of the process being modeled. Models therefore illustrate simplifications of
more complex real situations and/or processes. Decision modeling attempts
to develop a model of the decision process used to make important
decisions. A decision model is a framework that assists a decision maker in
estimating the outcomes of different alternatives and quantifying the
tradeoffs inherent in choosing one alternative over another. This modeling
approach presumes that a number of different factors are considered when
comparing various alternatives. In addition, in such type of analysis, some
of the factors could have more impact than others. The decision maker
weighs the effects of each parameter on the different alternatives. Based on
the judging of the importance of the effect of the parameters, the decision
maker chooses the "best" alternative (The Futures Group, 1994).

Decision models are ever-present in the materials management processes of
industries other than small scale segment and have proven their worth in
improving productivity and profitability. Fundamentally, a decision model
describes quantitatively the cause-effect relationship between two sets of
causative factors and the set of evaluative measures that the decision maker
uses in order to judge the desirability of each alternative. The causative
factors are divided into two sets. The controllable factors are those that
constitute the alternatives or decision variables. The un-controllable factors are called parameters and must be measured, estimated or forecasted. The evaluative measures are called performance measures because they quantify the "performance" of each decision alternative.

6.1 MODELING APPROACH USED

Chapter 1 introduced the problem statement and the objective of this research work, which is mainly to use decision-modeling techniques to develop an integrated system of decision support for material procurement for the electrical contractor. A computer program or algorithm that performs the calculation of performance measures for each alternative is called a descriptive model because it only describes a cause-effect relationship without making any judgment about the desirability of each alternative. This judgment is left to the decision maker. The decision model at any decision node will be as depicted in Figure 6.1. The factors (or parameters) and alternatives define the inputs. Performance measures define the output.

Alternatives represent the different courses of action that a decision maker could exercise for a particular decision node or possibilities from where the decision maker chooses. Parameters represent "values" that affect the decision making process. A parameter could remain constant throughout the analysis or could be an uncontrollable variable. Uncontrollable variables refer to those parts of the decision that although having an effect in the decision taken, is not controlled by the decision maker; its values are given by factors external to the model.
An example of an uncontrollable factor could be the level of demand when deciding how much production to allocate to a new product. In reality, many parameters that affect the decision making process are variable, however they are treated as constant. This assumption is part of the simplification that characterizes decision modeling processes (Cooke and Slack, 1984). Parameters must be satisfied while selecting an alternative and are critical data to be considered in the analysis since they could have a great impact in the decision making process.

The identification of model parameters could be time consuming and tedious since they are related to many areas such as project schedule, suppliers, and storage, among others, and they have to be filtered from unstructured records. As part of the research, a classification system for the model parameters was developed. This system allows classifying the model parameters into different categories. The system will be discussed in detail in Chapter 8. Figure 6.1 is a schematic representation of the decision model for choosing the order quantity of an item that illustrates how such an program would be designed.
Some decision models go further than describing the outcomes of each alternative by determining the better choice from among all of the alternatives. These kinds of models are called prescriptive models and embody a search routine that a computer uses to carry out an intelligent, restricted trial-and-error search for the better solution. Prescriptive models leverage the decision maker by evaluating tradeoffs that are too complex or numerous for human judgment to comprehend. Figure 6.2 depicts the structure of a prescriptive model. This prescriptive model is used in the framework for the decision models in Chapter 7 to assist the user in decision making.

![Figure 6.2: Structure of Prescriptive Model](image)

For example, a descriptive model could be used when a company needs to decide on how much material to order. Decision alternatives might include ordering material as estimated, order less material than estimated, order
more material than estimated, order material based on actual quantity or order the quantity calculated with the EOQ model. Examples of parameters might include the storage capacity, availability of space, location of the job, discounts, progress of the work. Examples of performance measures might include shortages, surplus of material.

6.2 DECISION MAKING PROCESSES STUDIED

Chapter 4 presented the current material management practices in the electrical industry. This representation is based on field interviews with personnel from different electrical companies. Five phases, in which the current management material management practices could be divided, were identified: Bidding Phase, Sourcing Phase, Materials Procurement, Construction Phase, and Post-Construction Phase. Decision nodes related to material management in each of the phases were also identified. This research focuses in the material management process during the construction phase. Problematic areas or challenges in the current material management practices were identified. These challenges were described in Chapter 5. Based on the challenges described in Chapter 5, the decision making process was studied to minimize the problems that could be encountered. Six questions that describe the decision making process during the construction phase were identified, this decision making process was analyzed to provide a framework to assist the decision maker. This framework is explained in Chapter 7.

The six questions that were studied by this research are: what type of material to buy and from whom, how much material to buy, when to buy the material, when to deliver the material, where to deliver the material, where to store on site. The decision of what material to buy and from who is
important to assure that the correct material is bought. If a different material than the specified is bought, the contractor will incur extra costs to get the correct material. Additional costs due to delays could be incurred. The decision of how much to buy is very important to assure that material quantities needed are available and that there are no material shortages. The decision of when to buy is important to ensure that the material order is placed in time, considering supplier lead time, to minimize delays with deliveries and giving suppliers the required advance notice to deliver the material before it is needed. The decision on when to deliver requires keeping records of the construction schedule and progress of the work in order to have the material available when needed. The decision of where to deliver the material requires space planning and consideration of site limitations, pre-fabrication strategies, and subcontractors to be used. The decision on where to store on site requires space planning and contingencies to avoid damage and to be able to track the material on site.

These six questions were identified from the interviews with companies. Field personnel’s were inquired about the main considerations when ordering material and what were the main decisions to tackle for this task. Based on their responses and on studying the flowcharts developed, it was concluded that the six questions considered in the study are essential for material management.

This chapter presented an overview of decision modeling and the approach taken to model the decisions considered on the study. The following chapter presents the detailed framework for the decision making system, SPARCS, which is a new system developed for small scale electrical contracting & manufacturing industry.