Decision-making is an essential and dominating part of the management process and, as such, it pervades the activities of every manager. Since in carrying out the key managerial functions of planning, organising, directing and controlling, the manager is engaged in a continuous process of decision-making pertaining to each of them, the management may be regarded as equivalent to decision-making.

Managerial decision-making is a process by which management, when faced with a problem, chooses a specific course of action from a set of possible options. In making a decision, a business manager attempts to choose a course of action that is most effective in the given circumstances in attaining the goals of the organisation. The various types of decision-making situations that a manager might encounter can be listed as follows:

1. Decision-making under certainty where all facts are known fully and for sure or under uncertainty where the event that would actually occur is not known but probabilities can be assigned to various possible occurrences.
2. Decisions for one time-period only, called static decisions, or a sequence of inert-related decisions made either simultaneously or over several time periods, called dynamic decisions.
3. Decisions where the opponent is nature (digging an oil well, for example) or a rational opponent (for instance, setting the advertising strategy when the actions of the competitors have to be considered).

These classes of decision-making situations are not mutually exclusive and a given situation would exhibit characteristics from each class. Stocking of an item for sale in a trade fair, for example, illustrates a static decision-making situation where uncertainty exists and nature is the opponent.

The elements of any decision are:

(a) a decision-maker, who could be an individual, group, organisation or society;
(b) a set of possible actions that may be taken to solve the decision problem;
(c) a set of possible states that might occur;
(d) a set of consequences (pay-off) associated with various combinations of courses of action and the states that may occur; and
(e) a relationship between pay-off and the values of the decision-maker.
In an actual decision-making situation, definition and identification of the alternatives, the states and the consequences are most difficult, albeit not the most crucial, aspects of the decision problem.

In real life, some decision-making situations are simple while others are not. Complexities in decision situations arise due to several factors. These include the complicated manner of interaction of the economic, political, technological, environmental and competitive forces in society; the limited resources of an organisation; the values, risk attitudes and knowledge of the decision-makers, and the like. For example, a company’s decision to introduce a new product will be influenced by such considerations as market conditions, labour rates and availability, and investment requirements and availability of funds. The decision will be of multidimensional response, including the production methodology, cost and quality of the product, price, package design, and marketing and advertising strategy. The results of the decision would conceivably affect every segment of the organisation. The essential idea of quantitative approach to decision-making is that if the factors that influence the decisions can be identified and quantified, then it becomes easier to resolve the complexity of the tools of quantitative analysis. In fact, a large number of business problems have been given a quantitative representation with varying degrees of success and it has led to a varied approach labelled as operations research (or operational research), management science, decision analysis, decision science and so on. Quantitative analysis is now extended to several areas of business operations and represents probably the most effective approach to handling of some types of decision problems.

A significant benefit of attaining some degree of proficiency with regard to quantitative methods is exhibited in the way the problems are perceived and formulated. A problem has to be well-defined before it can be formulated into a well-structured framework for solution. This requires an orderly and organised way of thinking. However, it should be clearly understood that although quantitative analysis represents a scientific approach to decision-making, a decision by itself does not become a good and right decision for adoption merely because it is made within an orderly and mathematically precise framework. A certain degree of constructive scepticism is as desirable in considering a quantitative analysis of business decisions as it is in any other process of decision-making. Further, some allowance must be made for qualitative factors involving morale, motivation and so on, which cannot be ignored. But they should not be allowed to dominate to such an extent that the quantitative analysis may look to be an interesting, but worthless academic exercise. In fact, the manager should seek some balance between quantitative and qualitative factors.

Quantitative Analysis Approach to Decision-making

The quantitative analysis approach to decision-making involves the following steps:

1. Formulate the problem.
2. Determine the assumptions (model building) and formulate the problem in a mathematical framework.
3. Acquire the input data.
4. Solve the model formulated and interpret the results.
5. Validate the model.
6. Implement the solution obtained.

The first step in quantitative analysis is to develop a clear and concise statement of the problem. In many cases, defining the problem proves to be the most important and difficult step. Logically speaking, we cannot expect to get the right answer if the problem is identified incorrectly. Thus, it is very important that the problem should be correctly formulated.

Once the problem has been identified, it is categorised as being standard or special. The *standard problems* are also known as programmed problems. Theses are the well-structured problems characterised by routine, repetitive decisions that utilise specific decision-making techniques in their solution strategy. Standard solution procedures have been developed to handle such prototype problems. On the other hand, there are *special* or *non-programmed* problems. They are unique and non-recurrent in nature and, therefore, ill-structured. Undertaking of a research and development project and the merger and consolidation decisions illustrate such type of decision situations.

Having defined the problem, the next step is to build a suitable model. The concepts of models and model-building lie at the very heart of the quantitative analysis approach to problem solving. A model is a theoretical abstraction of a real-life problem. In fact, many real life situations tend to be very complex because there are literally innumerable inherent factors in any given situation. Thus, the decision-maker has to abstract from the empirical situation those factors which are most relevant to the problem. Having selected the critical factors, they are combined in some logical manner so that they form a counterpart or a model of the actual problem.

After an appropriate model has been formulated, the next step is to obtain the data to be used in the model as input. Since the quality of data determines the quality of output, the importance of obtaining correct data cannot be overemphasized. Obviously, the finished product can be no better than the raw materials used. This situation may be described as GIGO: gold in gold out, or garbage in garbage out. Obtaining correct and relevant data may indeed be a difficult exercise when relatively large problems are involved. A number of sources, including company reports and documents, interviews with the company personnel and so forth may be used for collecting data.

Having formulated an appropriate model and collected the relevant input data, the next stage in the analysis calls for the solution of the model and interpretation of the solution in the context of the given problem. A solution to a model implies determination of a specific set of decision variables that would yield a desired level of output. The desired level of output, in turn, is determined by the principle of choice adopted and represents the level which ‘optimises’. Optimisation might mean maximising the level of goal attainment from a given set of resources or minimisation of cost as will satisfy the required level of goal attainment, or maximisation of ratio of goal attainment to cost. Further, there is a need for validation of the model used. The validation of a model involves determining if the model can adequately and reliably predict the behaviour of real system it seeks to represent. Also, it involves testing the structural assumptions of the model to ascertain their validity. Usually, the validity of a model is tested by comparing its performance with the past data available in respect of the actual system. There is, of course, no assurance that the future performance of the system will continue to be in the
same manner as in its past. Therefore, one must take cognisance of the changes in the system over time and adjust the model as required.

The final step is the implementation of the results. It is the process of incorporating the solution in the organisation. Implementation of solution is often more difficult than it may apparently seem to be. No standard prescription can be given that would ensure that the solution obtained would automatically be adopted and implemented. This is because the techniques and models used in quantitative analysis may sound high and may be detailed in mathematical terms, but they generally do not consider the human aspects that are significant in implementation of solution. The impact of a decision may cut across various segments of the organisation and the factors like resistance to change, desire to be consulted and informed, motivation and so forth may come in the way of implementation. Equally important as the skill and expertise needed in developing a model is the requirement of tackling issues related to factors that may have a bearing on the implementation of a solution in a given situation. Thus, a model that secures a moderate theoretical benefit and is implemented is better than a model that ranks very high on obtaining theoretical advantage but can not be implemented.

Quantitative Analysis and Computer-based Information Systems

Quantitative analysis has become an integral part of the modern computer based information systems. A computer-based information system comprises of:

- **Hardware** – input, CPU, storage and output
- **Software** – general operating software, general and specialized application software
- **Files** – tapes, disks, documents
- **Procedures** – user, input and operating procedures
- **People** – managers, analysts, technical support personnel, and operating personnel
- **Database** – information about various factors of the organisation

Such systems may include management information system (MIS), decision support system (DSS) and the use of artificial intelligence. Quantitative analysis tools are used in each of these sub-systems.