UNITED ARAB REPUBLIC

THE INSTITUTE OF NATIONAL PLANNING

Memo No. 558

Decision Making Systems In Management

By

Eng. Amina El-Hefny

April 1965.

Operations Research Center.

Introduction

Modern Concept of Management:

Management is considered to be both an art and a science. It is the art of working with and through people to accomplish some objectives and to control the purposive actions. This fuses leadership and management, since leadership is defined as being the activity of influencing people to cooperate toward some goal which they come to find desirable. Leadership is a mixture of art, craft and humanity. It is of the sprit compounded of personality and vision, yet its practice is an art.

Management is also a science, for its practice involves accurate calculation, statistics, methods and other scientific techniques. It involves taking a series of decisions and at different decision points or levels to achieve the different goals of the enerprise. Management objectives are maintained in several areas among which are innovation and development, the return on investment, the market position, profitability productivity, workers performance and attitude, the public responsibilities and the balance between short-range and long-range future.

The manager's main responsibility is to establish the conduct of the enterprise so as to accomplish these objectives in a way which optimises the whole rather than a partial area. The organisation, is the means by which executives can establish the structure to carry out such objectives.

Management problems are being looked into at an increasing rate and the various scientific tools and methods are being applied to the art of management. Among the developed or adapted concepts are programming, statistical control, feed back in control systems, which are becoming a considerable help in solving practical management problems. They also provide the means which permit the executive to see the firm as a whole.

There is still an increasing need for some more scientific discoveries to help management meet its objectives in an optimum manner, for the increasing rate of technological change requires highly coordinated planning and involves making decisions including the long run future of the company.

Management and the Theory of Decision Making:

Thus management involves decision making and an executive is a decision maker. His decisions are made to achieve certain objectives. Generally the decision-maker chooses the action which he believes will help him obtain his objective. This involves the utilisation of particular resources that he controls, selected from among all resources that are available to him. His decision, then, will consist of the selection of one of his available "strategies". Yet certain factors that effect the achievement of objectives remain outside the control of the decision maker. Some of them are due to the frequent intransigence of society and nature and could be referred to as a "state of nature" Another class of uncotrollables factors is the competition of rational opponents and these are usually a great number of different possible competitive actions. These factors could be referred to as "competetive strategies". Therefore the decision problem could be expressed in the following terms: "The decision-maker wishing to achieve some objective, selects a strategy from among those available to him. This strategy together with the state of Nature that exists, and the competitive strategy that occurs, will determine the degree to which his objective is obtained".

Operations research and Management Decisions:

From the business point of view operations research is defined as "the use of the analytic methods of the physical sciences for solving problems of business management". This involves the collection and analysis of information about operations. The objective being to provide executives with a more quantitative

basis for making sound predictions and decisions. Through the new science of operations research, management is able to make better decisions. Operations research provides management with information for making sounder decisions, it tends to consider more facets of the problems, so that a more effective over-all solution could be reached at. In fact O.R. is applied decision theory. A means to attempt to cope with the problems that confront the excutive when he tries to achieve a thorouphgoing rationality in dealing with his decision problems.

O.R. Contributes to the resolution of management problems in

a. Formulating objectives: it provides methods for the observation and measurement of meaningful payoff of different possibilities.

b. Discovering strategies and states of nature, for without them O.R. methods could not be applied.

c. Determining the outcomes of the decisions, after knowing the factors that produce it, O.R:s powerfull mathematical tools calculate the outcome.

d. Selection of strategies; by the use of mathematical representation.

Computers and Management Decision Making:-

Some management decision problems have an excessive number of possible strategies and states of nature that make it difficult to solve.

A decision concerning inventory level might include different possible strategies from stock piling for several years down to operating with virtually no inventory on hand. Also the possible states of nature relevant to a particular decision problem might involve an enormous number of weather conditions,

situations of interest rate; availability of credit and possible levels of demand, where the number of states of nature is the multiple of all the numbers of each. Such decision problems could be represented in mathematical form, but hardly be solved. The computers enable such solutions. Computers can turn out what would formerly have been years of analysis in a few days.

The operations a computer can perform are basically quite simple. It can search for information that is stored in its memory, compare too numbers and accept or reject the larger or the smaller and also add numbers etc. Computers are fed the information they use. They get careful instructions called "programs". Computer programs are combination of the previously mentioned simple operations, to yield the required mathematical analysis. Computer programming is, therefore, a translation of the operations-research description of a problem.

Computers are also very useful for the simulation of problems that have a number of different states of nature, each of which can occur with some probability. In these models the states of nature are allowed to appear randomly in proportion to the assigned probabilities and the outcome found out.

Leadership and Decision Making

Leadership is the interpersonal influence exercised in situation and directed, through the communication process, toward the attainment of a specified goal. Thus the essence of leadership is interpersonal influence, involving the influencer in an attempt to affect the behaviour of the influencer through communication. (While power is potential for influence, which must not all be used in a leadership situation.)

The leadership phenomenon consists of three delineable facets:-

1. The leader and his psychological attributes
2. The follower with his problems, attitudes and needs.
3. The group situation in which followers and leaders relate with one another.

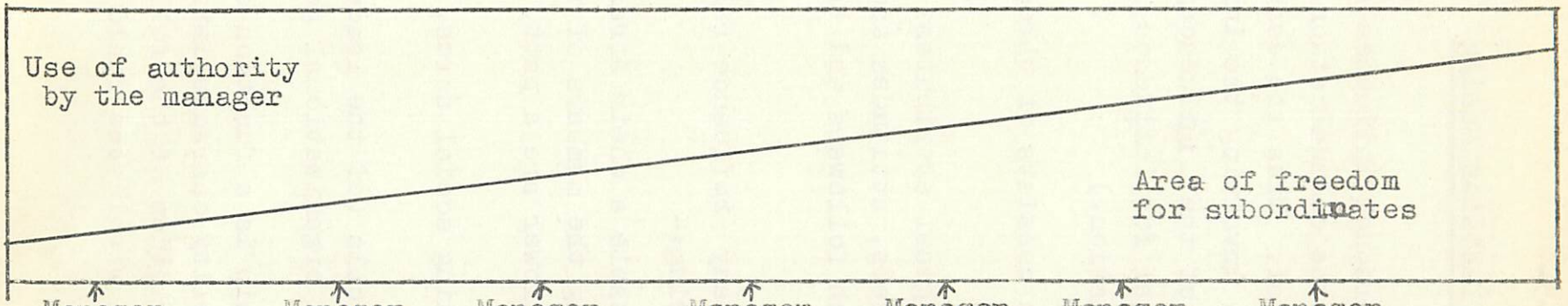
The objective context of any influence relationship might include any or all of the following:-

1. Physical phenomena(light, table a chair arrangement).
2. Other individuals, including the members of the specific group of which the leader of follower are a part.
3. The organization.
4. The broader culture, including social norms, role prescriptions.
5. Goals, including personal goals (of the leader or of the follower), group goals and organizational goals.

Effectiveness in leadership is a function of the dynamic interrelationship of the personality characteristics of the leader the personality characteristics of the follower and the characteristics of the situation within the field of each individual.

Patterns of leadership:-

Boss centered leadership → Types of leadership in a company ← Subordinate centered leadership.



In modern management the effective leader is he who can be "democratic" in his relations with subordinates and at the same time maintain the necessary authority and control in the organization for which he is responsible. New training techniques give leaders a first hand experience in full participation and decision making. This helps him choose the most suitable type of leadership for his case. In business leadership the following should be kept in mind:-

- The bosses responsibility is not relinguished by delegating it to his subordinate.
- Once he has delegated responsibility to his subordinates, the boss can contribute with his useful ideas but in a member role and not authority role.
- It is important that the boss's subordinates know what type of leadership he is using in a situation.
- The index of the freedom that subordinates enjoy is not the number of decisions which the boss entrusts to them but rather the significance of those decisions.

Factors influencing manager's action in a decisionmaking situation:-

These could be summarised under the three following headings:-

1. Forces in the manager.
2. Forces in the subordinate.
3. Forces in the situation.

The strength of each of them varies from instance to instance, and the manager must be sensitive to them in order to recognize the leadership behaviour which is most appropriate for him.

Forces in the manager:-

. His value system:

Concerning: . The share a subordinate should have in decision making.

. The relative importance he attaches to organizational efficieney, personal growth of subordinates / and company profits.

. His Confidence in his subordinates:-

Concerning : . Their knowledge and competence with respect to the problem.

. him having more confidence in his own capabilities than in those of others.

. His own leadership incline:-

Whether he functions more confortably in issuing orders than operating in a team role.

. His feeling of security:-

Since the predictability of the outcome is reduced by releasing control over decision making, some managers need a high predictability for the stability in their environment.

Forces in the subordinate:-

Each subordinate has his set of expectation about how his boss should act in relation to him. A sucessful leader needs to determine the most suitable type of behaviour on his part is needed for the effective work of each of his subordinates.

Subordinates differ in the following:-

- The need for independence, and the amount of direction that they desire.
- The readiness to assume responsibility for decision making.
- How they see additional responsibility, a tribute to their ability, or as passing the buck.
- Their interest in the problem and their feeling of its importance
- Their understanding and identification with the goals of the organization.
- Whether they have the necessary knowledge and experience to deal with the problem.
- The degree of share in decision making they are used to.

Forces in the situation:-

Several critical environmental pressures surround the manager and affect his behaviour. These stem from the following:-

- Type of organization:-

  Each organization has its values and traditions. These are communicated through job description, and different announcements by top executives. The behaviour of each superisor is greatly influenced by the concept of what the good executive should be. Also group participation is influenced by the type of organization, its geographical distribution, the degree of security required to attain company goals ... etc.

. Group effectiveness:-

The participation of a subordinate group in decision making depends upon their experience, the degree of confidence they have in their ability how effectively they work together as a unit.

. The problem itself:-

A problem can be best solved by a person or a group that has most of the background and factual data relevant to it, also if it has the kind of knowledge which is needed. Whether the boss delegates the responsibilty or makes the decision himself, it is most important to get the ideas of everyone who has the necessary knowledge to make a significant contribution to the solution of the problem.

. The pressure of time:-

The need for an immediate decision makes it more difficult for a manager to involve his subordinates. This depends on the type of organization as well as its organizational efficiency.

Conclusion:-

In making his choice of the leadership pattern to follow, a manager should rather think of largescale strategy rather than short term tactics. To achieve his longer-run objectives he should pay attention to the following:-

- Raising the level of employee motivation
- Increasing the readiness of subordinates to accept change.
- Improving the quality of all managerial decisions.
- Developing teamwork and morale .
- Furthering the individual development of employees.

Yet the sucessful leader is he who is aware of the different forces relevant to his behaviour, that of his group and the situation of the organisation. This understanding should go together with the ability to behave appropriately at any given time.

Management Through Systems

Introduction

Systems Engineering involves the overalls consideration of various methods of accomplishing a desired result. The systems Engineering method recognizes that each system is an integrated whole even though composed of diverse, specialized structure and sub-functions. It further recognizes that any system has a number of objectives and that the balance between them may differ widely from system to system. The methods seek to optimize the overall system functions according to the weighted objectives and to achieve maximum compatibility of its parts.

The system may be an economic, social, political or engineering. The primary objective is the success of the system, rather than the functioning of each part in an optimum fashion of itself. Therefore, the over-all system functions are optimized by combining in a weighted fashion the many subsidiary objectives in their proper value.

Other objectives of a system is that it accomplish a desired level of performance, e.g. accuracy, speed, efficiency ... etc, and that the desired performance be obtained within an acceptable cost goal. Costs include the purchase cost of the equipment, their installation, maintenance, operation etc.

and the over-all cost is also a function of downtime, of the equipment, service given, kind of maintenance .... etc. Cost involves also the loss incurred by the system or equipment not functioning properly. This brings out the importance of reliability as a factor affecting both performance and cost.

Reliability is the probability that the system of subsystems operate in the manner intended when operated in the enirvonment encountered.

Reliability is related to system performance because if certain parts of the system fail the designed performance is not obtained. It is also related to cost because reduced performance resulting from low reliability involves added cost factors e.g. repair charge, spoiling of product etc.

The Time required to accomplish the objectives also effects cost. The shorter the time, the sooner will the increased return on the money invested be realized, also being first or early with a new product is advantageous. Yet if time required to do the job is so short that extra effort and cost are needed to realize the system, the costs tend to increase, and these costs have to be balanced with the costs of performing the job too slowly, in order to obtain the optimum speed of performance or time required.

Procedure of designing systems for solving management problems:-

The solution to systems engineering problems involves successive approximations. The system requirements are first established, and one or more systems capable of meeting these requirements are postulated. Of these the most favorable are considered further, and are compared with the system objectives. They are then modified in the light of their inability to meet the initial requirements or to produce the most favorable results.

The modified system is again compared and again changed as required by performance data and systems requirements.

The design of a system would proceed in the following steps:-

1. Formulation and definition of the problem:-

Involves the determination of the requirements of the problem establishing the objectives, goals and restraints, and the determination of the weighting functions to place the proper emphasis on the various system requirements.

The study of the requirements of the problem is done in cooperation with the user, in order to arrive at some tentative set of specifications. Thus the system requirements are determined from a consideration of the users'stated needs as e.g. from specifications or previous experience or from a general knowledge of the same or similar processes. These include the answers to such questions as:

a. What is the system to do in terms of:-

- Performance (size, weight, efficiency, appearance,etc.
- cost (absolute, relative or competitive situations
- time (when is the product wanted, and the time required to produce it).
- reliability (life, failure rate-etc.)

b. What environment does it have to operate it:-

- home, commercial, military
- power supply, variations, etc.
- maintenance and service.

c.What environment is the product to be made in:

- engineering skills and facilities.
- manufacturing skills and facilities.
- what other products are being engineered and built.
- what materials are available.

The relative weighting factors to be used with the information gained from the answers to the foregoing questions should be determined as well as possible.

2. Synthesing systems to meet the previously defined requirements:-

The system requirements tend to emphasize different aspects of the problem that have to be satisfied. In most cases a number of separate subsystems tend to be generated e.g., electrical energy, thermal, structural, controls etc. More information of such subsystems are needed on the quantitative relationships which exist between the desired end results and the parameters producing them.

a. Defining the subsystems

breaking down the system into its parts in such a manner that the designs of the subsystems can proceed in parallel.

b. Analysis of the subsystems:-

Making a preliminary analysis to determine the nature of each problem area. This analysis would result in decisions as to which subsystems need changing or automating and which might be put aside for later review.

c. Study of the inter relationships:

Involves the re-examination of the division of the system into its subsystems and the optimization in regard to best separation into parts.

d. Decision of the implementation sequence:-

This is the scheduling of subsystems in the framework of the over-all system schedule. Time phasing of the design and implementation process can be laid out, based on the criticality of certain subsystem requirements and on the definiteness of subsystem specifications.

e. Designing the subsystems:-

The detailed design of the various subsystems is proceded more or less in parallel and based on the schedule defined, the usual methods of analysis, simulation testing and training would be employed as appropiate.

3. Verification of the validity of the system

This involves the testing and examination of the system i.e. measuring performance parameters and comparing them with the objectives. Performance errors are further used to refine the formulation, design and construction of the system. The steps followed could be:

a. Re-examination of the system requirements:-

In parallel with the activities of step "2" and in view of the results of the specifications, the over-all system requirements are continuously studied in order to insure an integrated design. Therefore the objectives of the system are continually re-examined and the bigger framework in which the system fits is studied. Changes in requirements, procedures .... etc, are system and subsystem designs.

b. Feed back of the design results:

The design process of systems is an iterative one of repeatedly trying to obtain improved solutions. First-order effects should first be understood, later the second-order effects should be included to be sure no obvious obstacles will appear later and that the most satisfactory over-all results will be obtained. Therefore the effect of different individual items on each other and on the over-all system is studied and emphasized.

By referring back to the systems requirement it is possible to weigh the relative effects of various part locations on the factors of performance, cost, reliability and time. Therefore it is necessary to relate back the significant decisions to see what effect they have on their portions of the system. It is essential to include the information and communication problems among individuals working on different parts of the system. Finally the measured and feedback data representing the production system is compared with the original objectives. Further any performance errors or deviation are used to refine the formulation, design and construction of the modified system. The modified system is again compared and again changed as required by performance data and system requirements.

The Use of Information for the Effective Development of Management Systems

Management could be defined as the process of converting information into action, and the conversion process called decision making. Therefore management success depends primarily on what information is chosen and how the conversion is executed. The difference between a good manager and a poor manager lies in the choice of the information sources, then the selection of the fraction of the available information to be used, and the speed with which it is converted to action.

Decision making is in turn controlled by various explicit and implicit policies of behaviour. For an industrial organisation is a complex, inter locking network of information channels. These channels emerge at various points to control physical processes such as hiring employees building workshops, producing goods ... etc. Every action point in the system is backed up by a local decision point whose information sources reach out into other parts of the organisation and the surrounding environment

For the effective use of information, its flow should have a reciprocating effect on behaviour. This associates the terms loop and "feedback" with the notion of information for decision making. The loop is a circular pattern involving the flow of information to the point of action, to feed it back to the point of decision with information on the action, and then a return to the point of action with new information and perhaps instructions.

The industrial system is not a simple single information-feedback loop, instead it is a very complex multiple-loop and interconnected system. Decisions are made at multiple points throughout the system. Each resulting action generates information that may be used at several but not at all decision points. The industrial system could therefore be described as a structure of

cascaded and interconnected information feedback loops. Within a company, these decision points extend from the shipping room and the stock-clerk to the board of directors.

Communication Systems

The effectiveness of an organisation depends in part on its having "the right information at the right place at the right time".

Systems and procedures analysts stimulated by the numerous installations of automatic data-processing systems, have been perfecting techniques of qualitative analysis of information and its flow.

Decision premises arise largely out of information and the ability of the individuals to handle that information. Thus the key to this decision approach is the identification of

1. The decision centres.
2. The channels by which communications are carried where:
   a. Communication traverses definite channels, either by formal plan or by the developed informal programs.
   b. Information and stimuli move from sources to points of decision; instructions move from points of decision to points of action; information of results moves from points of decision and control.
   c. Rational organization design would call for the arrangement of these channels so as to minimize the communication burden.

Control Systems:-

Control of a proces , means coordinated action based on the feedback of information about measured variables, to achieve a given objective most economically.

Any system of control embraces the following:-

1. Objectives establishing what is desired to accomplish
2. Procedures specifying how, when (plan) and by whom (organisation) the plan is to be executed.
3. Criteria (standards) as to what constitutes good performance.
4. Appraisal of how well it was done.

In designing a control system the essential interest is in the flow of information and in making sure that the control system is responding to a signal.

The effective control of industrial projects depends mainly upon the estimating, measuring and reporting of performance for quality, costs and time.

The control of quality is concerned with the conformity of the resultant product to the prescribed specifications in the planning phase.

The control of costs requires that means should be provided to prevent over-running the prescribed budgets.

The control of time deals with the provision of means to ensure the accomplishment of the objectives within the time prescribed.

Besides, the system should be simple streamlined, easy to apply and operate, and requiring minimum administrative effort. This requires the identification of those elements of cost and performance about which the manager would need information to adequately control his project. It also requires the provision of management with the mechanism and set of tools by the use of which the required information is laid before him regularly on a scheduled basis and in a from most usable by him with a minimum of a effort.

Practical Example of an Organization Model-building:-

The controllership study by Carnegie group sponsored by the controllership Foundation in 1954.

The study was concerned with how should a company's accounting department be organized in order that the data it assembles will be of greatest usefulness to the operating executives of the business in making decisions and solving problems? Seven large companies were chosen, first studies were made of the most important types of decisions taken in each organization; how accounting data might be useful in making these decisions; and at what point in the decision process, accounting information could be most usefully injected.

"By observation of the actual decisionmaking process, specific types of data needs were identified at particular organizational levels-the vice presidential level, the level of the factory manager and the level of the factory head, for example-each involving quite distirct problems of communication for the accounting department."

Then recommendation were made in terms of the accounting departments responsiblity for providing information and exerting influence on these operating decision.

"Recommendations for organizational change were to be implemented by bringing about changes in the communication patterns-in the pattersn of who-talks-to-whom-how-often-about-what rather than by formal changes in the organization charts".

The study proved that the decision, within its companion study of information flows, is a practicable means of organization analysis.

Decision Models For Management

Management science looks into management problems. It provides management with simple, communicable and manipulatable models of the enterprise. These permit management to meet sucessfully its objectives in an optimum manner.

In order that the manager sees his enterprse as a whole, he need to work on models including the physical level, the economic level and the human being level. The dimensional aspects of these models should meet the following design objectives:

1. A model should present the total organization in a comprehensive form.
2. It should present the details of the organisation and the detailed interrelations between levels.
3. It should have a method for manipulation.
4. It should show the effect of any organizational changes.

Such models could be constructed and made available to managers in the long run, while parts of it could be evolved in the short run. The short run benefits are derived from examining conceptually the overall model building as evolving in three stages:

1. Descriptive Models:

Portrays the situation as it exists. The model is changed everytime observations indicate actual circumstances. Descriptive models are used in business for accounting systems, production control, inventory control, sales analysis, plant layout .... etc.

These are the reason why a great number of business problems are still at the qualitative level.

Quantitative Models:

In quantitative models, the factors and variables included in the same take some measurable dimension. Spatial, temporal physical and symbolic dimensions are used in the construction of models. A model could also be multi-dimensional e.g. two-dimensional models such as maps, blue prints and plant layonts. Three dimensional models include scale prototypes such as ships, planes and buildings. and so on.

A suitable model must use all of the dimensions understudy and combine them so that the outcomes and the payoff measures are dimensionally sound. This goes also for qualitative models where the dimensions cannot be numerically measured for some reason, or another.

Quantitative models are of different types depending on the objective e.g. problem solving models,optimum value models, experimental models .... etc.

The mathematics of some models are complex, or their solution involves long time, such that a computer has to be used.

Computer Simulation of Models:-

The use of models which simulate a system provides a suitable means for examining a situation such as production production problems. The use of such models is not really new, but has recently increased as a result of high speed computers and new mathematical methods.

Simulation is the use of a symbolic model to imitate the behaviours of a real system so as to verify or demonstrate

the reaction of the system to new methods, techniques or design. It is also used for testing new ideas for the production system.

Procedure

The development of a model for the production system follows three steps:-

1. Understanding the significant physical characteristics of the system as it currently operates.
2. Building a functional or logical model incorporating the important features for evaluating the response of the system to varying conditions.
3. Conforming the logical or decision rule model to the computer operation.

An example of the application of computer simlation to a complex systems problem is the Job shop scheduling, to find better methods of scheduling. Computer simulation is used to test alternate decision rules in order to find an optimal method.

Scheduling is a problem of the right timing of machining. Plans are carried out through dispatching which is concerned with assigning jobs to machines. In order to cope with the statistical nature of the problem of variations in the scledule due to absenteeism, spoilage, rework ... etc, the decisions are made sequentially taking current information into account. Computer simulation rules are used to test the sequential decisions that are required to relate scheduling and dispatching.

Scheduling rules are designed to include queuing effects, inventory requirements, and delivery commitments. Dispatching rules assign relative priorities to the jobs, to carry out the planned schedule for meeting deliveries.

2. Predictive Models:-

Are derived from descriptive models, but incorporate a forecast of one or more of the variables. The model shows the executive the inter-relation of a number of variables, but does not indicate any course of action to be taken. For this choice he has to use his judgments. Budgets are the most common of predictive models in business.

3. Decision Models:

Their primary function is to tell the executive what to do in view of some stated purpose. Linear programming application is an example of decision models.

Qualitative Models:

Qualitative models do not yield numerical outcomes. Although more information could be obtained from quantitative models, and reality is better understood, yet most thinking about reality starts with qualitative models and subsequently develops to a point where quantitative models can be used. The earlier qualitative model must reach a certain degree of correspondence to reality before the quantitative step can be taken. Many sciences that deal with particularly complex kinds of reality are still at the stage of developing suitable qualitative models. These qualitative models can efford a great deal of insight into the complexities of their subject matter.

Operations research assists in systematizing qualitative models and developing them to the point where they can be quantified. Some of the difficults that have to be overcome in order to quantify a qualitative situation are:

- Inadequate measurement techniques.
- Too many variables required.
- The variables being unknown.
- The relationships being unknown or two complex to be formally stated etc.

Policy and Decision Rules

Policy is a formal statement giving the relationship between information sources and resulting decision flows. It includes decision rules and is sometimes expressed as the set of values guiding the decision.

In industrial organisations, some policy is very formal, and often written down for the guidance of the decision makers in the system. A big part of the guiding policy remains informal and as influential as the formal. This depends on habit, conformity, social pressures, ingrained concepts of goals, awareness of power centers within the organization and personal interest.

Decisions could be divided into three levels.

1. The lowest where action is random, unreasoned, and does not depend on inputs, therefore has no basis.
2. In the middle level, are unrationalized intuitive reactions, resulting from available flow of information, but without any comprehension by the actor concerning the structure and the basis of his actions.
3. The highest level of decision is that where a self-awareness exists of why certain decisions are made and the response reactions could be anticipated with some reliability.

As for management decisions, Professor J.W. Forrester* classifies them into four regions, according to the form of the controlling policy, and to the extend to which the policies that guide decisions are known and agreed upon.

---

* I.W. Forrester : "Indistrial Dynamics". Jub. Johan Wiley & M. I. T.

A. Those decisions that are now made on a fully automatic basis by machines where the guiding policy is rigidly prescribed with the introduction of computing machine this region is rapidly expanding. Besides the vast body of rules about the processing of accounting information, the flow and control of purchase orders ... etc, it includes now the formal policies for production-rate and employment decisions.

B. This group represents those decisions which are not mechanized, but which are made by a vast bureaucracy of middle management according to well-understood guiding policy.

C. Representing those decisions, usually near-guiding policy does not appear in writing and where decisions are thought of as being based on experience, intuition and judgment.

D. This region is of great challenge, but in which there is no basis for action in either experience or intuition. Information is acquired on a random and haphasard basis. On that information future intuitive judgement could be based.

The dividing lines between these regions are not sharp and are moving upward and outward.

Industrial Dynamic Models:-

A procedure of the dynamic process of decision making for industrial management was proposed by professor J.W. Forrester and could be summarised in the following steps:-

1. Make detailed studies of the decision making within a company or organization and formulate a model of the decision policy for each important decision center.

2. Use an electronic computer to simulate the resulting model of the over-all decision system in order to determine its characteristics.

3. Validate the model by checking it against the actual performance of the organisation.

4. Test proposed improvements in the system by performing experiments on the computer model.

5. Introduce the improved policies into the organisation and ultimately move toward administration of decision policies by the computer itself.