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THE ROLE OF QUANTITATIVE TECHNIQUES IN DECISION MAKING PROCESS

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***Abstract**: The second half of the 20th century has been marked by rapid advances of research methods in real problem solving, with rapid progress of the information technology and important structural and institutional changes that shaped a new landscape of the corporate and economic environment towards globalization of markets and trade. In that process the contribution that quantitative techniques can make to management decision making is significant.*

***Key words**: quantitative techniques, models, analysis, decision.*

Introduction

In the business world, and in fact, in practically every aspect of daily living, quantitative techniques are used to assist in decision making. In order to work effectively in a modern business organisation, whether the organisation is a private commercial company, a government agency, a state industry or whatever, managers must be able to use quantitative techniques in a confident and reliable manner. Accountants make decisions based on the information relating to the financial state of organization. Economists make decision based on the information relating to the economic framework in which the organization operates. Marketing staff make decisions based on customer response to product and design. Personnel managers make decisions based on the information relating to the levels of employment in

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the organization, and so on. Such information is increasingly quantitative and it is apparent that managers need a working knowledge of the procedures and techniques appropriate for analyzing and evaluating such information. Such analysis and certainly the business evaluation cannot be delegated to the specialist statistician or mathematician, who, adept though they might be at sophisticated numerical analysis will frequently have little overall understanding of the business relevance of such analysis.

The importance of quantitative methods for managers

The quantitative methods contain two component parts, the "quantitative" and "method", with asymmetrical attention to the "quantitative" term. Speaking about method, interest is focused upon the so-called "Scientific Method". Science is the mastering of things of the real world, by knowledge about the truth. The term method drives to dialogue on methodology in science which is clouded, as the phrase scientific method is used in two different ways. The one is very general, as a process of improving understanding. Although vague, it is considered as a powerful definition, since it leaves room for criticizing dogmatic clinging to beliefs and prejudices, or appreciating careful and systematic reasoning about empirical evidence. The other is the traditional sense, and supports that there is a unique standard method, which is central to identity of the science.

In effect, scientific progress requires many methods, so there is not a unique standard method, though taught as a straightforward "testing hypotheses derived from theories in order to test those theories". The more acceptable definition of scientific method is a process by which scientists, collectively and over time, endeavour to construct an accurate (that is reliable, consistent and non-arbitrary) representation of the real world. The popular "hypothetic-deductive" standard method is excluding consideration of the process of discovery in science. Rather, research is defined as a penetrating process of learning and understanding the substance of actual things and facts, by use of different methods. The research process incorporates formulation of a research issue and construction of a conceptual framework, by using all available information sources.

The quantitative methods have a number of attributes, such as: they employ measurable data to reach comparable and useful results, assume alternative plans for achieving objectives, plan data, concerning observations' collection, configuration and elaboration by statistical and econometric stochastic methods, check data reliability, choose appropriate sampling method, use carefully the estimates of the parameters for

forecasting and planning purposes, etc. since they derive from ex-post data concerning past.

In an increasingly complex business environment managers have to grapple with a problems and issues which range from the relatively trivial to the strategic. In such an environment the quantitative techniques have an important role. It is obvious that life for any manager in any organization is becoming increasingly difficult and complex. Although there are many factors contributing to this, figure 1 illustrates some of the major pressures making decision making increasingly problematic. Organizations find them selves operating in an increasingly complex environment. Changes in government policy, privatization, increasing involvement of the European Union contribute to this complexity. At the same time, organizations face increasing competition from both home and abroad.

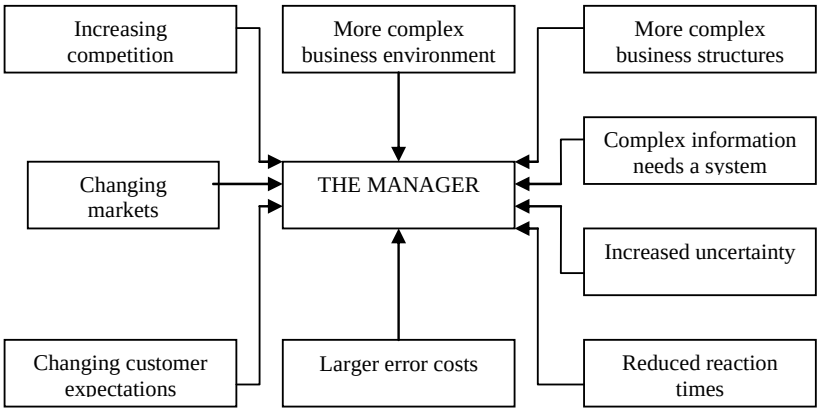

Figure 1. The manager and the decision-making environment

Because of the increasing complexity of the business environment in which organizations have to function, the information needs of a manager become more complex and demanding also. The time available to a manager to asses, analyse and react to a problem or opportunity is much reduced.

Managers and their supporting information systems need to take fast, and hope-fully appropriate, decisions. Finally, to add to the problems, the consequences of taking wrong decisions become more serious and costly. Entering the wrong markets, producing the wrong products or providing inappropriate services will have major and big consequences for organizations.

All of this implies that anything which can help the manager of an organization in facing up to this pressures and difficulties in the decision-

making process must be seriously considered. Quantitative techniques provide information about a situation or problem and a different way to examining that situation that may well help. Naturally such quantitative analysis will produce information that must be assessed and used in conjunction with other sources. Business problem are tackled from the quantitative perspective. The decisions that must be made lie at the centre od the process. These will be strongly influenced by the chosen organisaton's strategy with regard to its future direction, priorities and activities.[4, pg.2] Before reaching a decision many factors and information must be considered. Also, techniques have potentially important role to play in helping a decision but they are not sufficient by themselves. This is illustrated in figure 2. A business situation must be examined from both a quantitative and a qualitative perspective. Information and analysis from both these perspectives need to be brought together, assessed and acted upon.

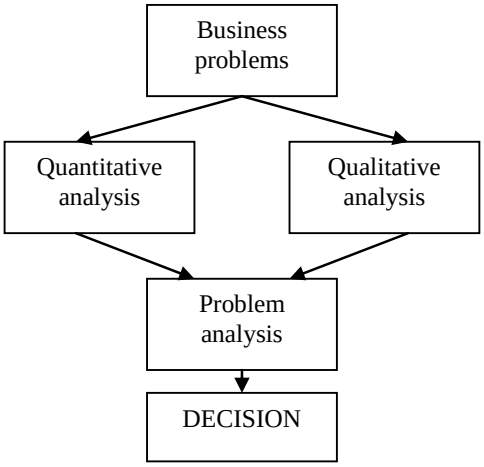

Figure 2. The decision making process

We can define quantitative techniques like mathematical and statistical models which are describing a diverse array of variables' relationship, and they are designed to assist managers with management problem-solving and decision making. There are many of mathematical and statistical techniques which can be used to help decision making by managers of all types of business organization: large or small, private sector, public sector, profit-oriented, manufacturing, or service sector. Statistics is defined as the process of collecting a sample, organizing, analyzing and interpreting data. The numeric values which represent the characteristics

analyzed in this process are also referred to as statistics. However, in statistics we are applying numerical way of exploration, and method of analysis and synthesis population of numerical data depend on their nature and extrapolation purpose. [2, pg.1] When information related to a particular group is desired, and it is impossible or impractical to obtain this information, a sample or subset of the group is obtained and the information of interest is determined. Collected data are the row material which by treatment should transform into useful quantitative measures. [2, pg. 19]

The quantitative models

The transformation of data into information, also called information analysis, was supported by management information system processes. Adequate models help develop quantitative techniques in a business context. Models are simplified depictions of reality and often take the form of an equation or set of equations that describe some economic setting. In economic theory models are deterministic.[3, pg.36] Models come in a variety of forms in business: they are not just quantitative. A scale model might be constructed of a new office development, a financial model may be developed to asses the impact of budget changes on product/service delivery; the marketing department may develop a model in terms of assessing customer response to product changes. However, any model, no matter what its form or purpose, has one distinctive feature: it is an attempt to represent a situation in a simplified form. Which model will be adequate depends on purpose of investigation and analysis. [5, pg. 104] Many operational problems and decision making have been based on research that deals with application of model or quantitative techniques. There are fundamentally four reasons why quantitative techniques are used by managers:

1. Models force managers to be explicit about objectives.
2. Models force managers to identify and record the types of decisions (decision variables) that influence objectives.
3. Models force managers to identify and record pertinent interactions and trade-off between decision variables.
4. Models force managers to record constraints (limitations) on the values that variables may assume.

In quantitative decision-making problems, different kinds of formal mathematical and other types of models have been implemented.

All organizations in business use many quantitative methodologies, including network analysis, forecasting (regression, path analysis, and time series), cost-benefit analysis, optimization (linear programming, assignment,

and transportation), sensitivity analysis, significance testing, simulation, benchmarking, and total quality management.

Moreover, decision support systems and computers based on this programmed techniques are increasingly being used for enhancing organizations' capabilities. Recently, there have been relatively rapid advances in the use of large amounts of data and in the development of new techniques for their analysis.

In some cases decision makers faced with complex problems cannot find, and perhaps should not seek, the best possible solutions. Qualitative analysis is based primarily on the manager's judgment and experience; it includes manager's conceptual and interpersonal ability to understand that behavioral techniques help to solve problems. Qualitative analysis is considered more as an art than a science. If the manager has had little experience with no routine problems, or if a problem is sufficiently complex, then a quantitative analysis might be a very important consideration for the manager's final decision-making.

Quantitative analysis concentrates on the facts, data, or quantitative aspects associated with problems. A manager's educational and technical knowledge of quantitative procedures help to enhance the decision-making process. The manager who is knowledgeable in quantitative decision-making procedures is in a much better position to compare and evaluate the qualitative and quantitative sources of information, or ultimately, to combine alternatives to make the best possible decisions.

At present, seat-of-the-pants, reactive managerial styles are already on the wane, and increased emphasis is being placed on "scientific" analysis and planning. Up-to-date experience is still invaluable, but it must be used with greater discipline. Analysis is now more rigorous, and computers permit more alternatives to be analyzed in greater depth. But, most important, formal planning is being used as a basis for action, not merely for pro forma exercises. On a higher and more conceptual level, quantitative analysis is facilitating communication where it never existed before. When a problem has been stated quantitatively, one can often see that it is structurally similar to other problems (perhaps from completely different areas) which, on the surface, appear to be quite different. And once a common structure has been identified, insights and predictions can be transferred from one situation to another; the quantitative approach can actually foster communication.

Thus it is not necessary-or even desirable-for modern managers to be skilled practitioners of quantitative analysis. But they frequently lack

even the ability to recognize the right tool or data when they see them, let alone the ability to focus on the basic structure of a problem rather than its situational uniqueness. Yet they must be able to do so if they are to do more than generate elegant nonsense. Managers must learn what the various tools are designed to do and what the limits of their capabilities are. They must be able to understand what staff specialists are attempting to achieve by a particular analysis and to discuss the appropriateness of alternative procedures sensibly (which also requires the development of additional vocabulary). They must fully understand the variables a model will and will not consider and be able to evaluate whether the relationships among the variables are sensible. Managers cannot use an analytical tool wisely unless they fully comprehend the underlying assumptions, what the analysis achieves, what compromises the model makes with reality, and how its conclusions are to be adapted to changing circumstances and intangible considerations. All of this requires a more thorough knowledge of operations than of mathematics.

The decision making process

Main turning points in the pace of the use of quantitative methods are mentioned: the “scientific management revolution” of the early 90s in last century, initiated by Frederic Taylor, the so-called “Keynesian revolution”, the Operational Research originated during the Second World War, followed by post-war developments of quantitative methods for decision-making, notably the simplex method for solving linear programming problems and many more methodological developments. As complexity rose, attention moved to the dynamic interface among processes in a chain to offer a definite output. In effect, it is (re)located in the thinking of logistics and the Supply chain management, extended more recently to the business process re-engineering. [7, pg. 11] Processes contain activities and are related among each other for specific ends. The processing of real problem’s solving involves the following steps:

1) Identification of corporate environment and uncertain conditions
2) Existence of Independent Management Units
3) Integrated approach of actual situations
4) Implementation of Scientific Approach

Processing is primarily a matter of understanding that the new reality is exogenously given, irreversible and one-way pace. Open-minded “cost/benefit analysis” overcomes hesitation and postponement and produces synergy effects in due course, whereas the cost of inaction may be

insuperably higher than the action now. Critical role has the timing for the problem of "competitiveness" in an uncertain environment, incorporating the probability distributions of the variables considered into the analysis. Decision-making under uncertainty conditions is an analytic framework of searching for:

a) Optimal strategies, as acts from all possible courses of action, choices under control of the decision maker.
b) Various possible outcomes, states of nature or events to be identified, beyond the control of the decision maker.
c) Determination of the pay-off function by describing different combinations of acts and events and the resulting consequences, the pay-off resulting from the *i*-th strategy and the *j*-th event. A pay-off is a conditional value - a conditional profit, loss or, may be, a conditional cost. In building up a pay-off matrix, the alternative courses of action and the possible outcomes (events) must be clearly determined.

The trade-offs among decisions under uncertainty, within "cost/benefit analysis", uses a number of basic principles, as parts of the decision matrix:

- the Laplace Principle (highest mean value or lowest average cost),
- the Maximin or Minimax Principle (choice of the maximum from a set of strategies with minimum pay-offs, adopted by pessimistic decision makers. While such a principle has the logic of ensuring that decision makers are in the best possible position if the worst happens, the principle does obviously ignore the potentially larger profit contributions that can be made by other decisions);
- the Maximax or Minimin Principle (choice of the maximum from strategies with the highest pay-offs, adopted by optimistic decision makers. In general, for this principle, decision makers determine the maximum pay-off for each decision and then choose the largest of these. This principle has the advantage of focusing on the best possible outcome.);
- the Hurwicz Principle (choice somewhere between the extreme pessimism of the maximin and the extreme optimism of the maximax principle);
- the Savage Principle (choice of action that minimizes the maximum opportunity losses from the so called "regret table");
- the Maximum Likelihood Principle (considering first the event that is most likely to occur and choice of the course of action which has the maximum conditional pay-off.);

- the Bayesian Decision Rule (an extension of the optimal strategy choice by calculation of the expected pay-offs by using posterior probabilities, as additional information about events is acquired);
- the Expectation Principle (the optimal choice represents the strategy with the highest expected pay-offs, calculated by multiplying the pay-off values with their respective probabilities and adding up these products).

The choice in decision making under risk conditions depends on a series of objective and subjective factors, to mention a few: information, enough knowledge of technology possibilities, attitudes against risk, etc. Just faster and cheaper data communication is not enough for gaining competitive advantage. Decision support systems, analytical information technology and decision trees are helpful in decision-making. The methods for creating and analysing models, incorporating multiple scenarios and more explicit treatment of uncertainty, involve two overlapping disciplines: stochastic programming and a relatively new field of strategy analysis called scenario planning.

The risks of errors in estimates and predictive power of the scientific methods are higher in phases of structural changes to adjust in an irreversible new world around us. Scientific methods aim at assisting the adjustment process that is a matter of philosophy and conceptual framework e.g. the management that serves the fundamental economic axiom, by eliminating the misconceptions and co-ordinating effective mobilization of total available resources.

Testing hypotheses leads to either confirmation or rejection of a hypothesis. Theories, which cannot be tested, because, they have no observable ramifications, do not qualify as scientific theories. If the predictions are found to be in disagreement with new experimental results, the theory may be discarded as a description to reality, but it may continue to be applicable within a limited range of measurable parameters.

Conclusions

To an ever-increasing extent, modern management is adopting and applying quantitative techniques to aid in the process of decision making. The intelligent use of the appropriate tools can reduce an otherwise highly complex problem to one of manageable dimensions. The collection of these techniques has become loosely known as "decision theory," although there certainly is no such thing as an integrated theory of how to make decisions. Nevertheless, one would seriously underestimate the ultimate impact these

methods are going to have if they are viewed as nothing more than a handful of tools that are sometimes used to solve particular types of problems. Indeed, there is a growing body of opinion that believes that the greatest impact of the quantitative approach will not be in the area of problem solving, but will rather be on problem formulation. It will radically alter the way managers think about their problems-how they size them up, gain new insights, relate them to other problems, communicate with other people about them, and gather information for solving them. Thus quantitative analysis could have a profound effect on the "art" of management.

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ULOGA KVANTITATIVNIH TEHNIKA U PROCESU DONOŠENJA ODLUKA

Rezime: Drugu polovinu dvadetog veka obeležila je široka primena metoda istraživanja u rešavanju realnih problema, uz nagli progres informacione tehnologije i važne strukturne i institucionalne promene, koje su koje su proširile ekonomsko okruženje i usmerile ga ka globalizaciji tržišta. U okviru tog procesa, doprinos koji kvantitativne tehnike mogu da pruže donošenju odluka je značajan.

Ključne reči: kvantitativne tehnike, modeli, analiza, odluka.