REMARKS ABOUT METHODOLOGY IN OPERATIONS RESEARCH*

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ABSTRACT

This paper is of a discussion nature and is concerned with the problem-solving aspects of operations research. The emphasis is on pitfalls that are encountered by the operations researcher. The characteristics of practical problems are considered first. Next, the capabilities and background that are important for problem solving are outlined. The desirability of a "middle of the road" viewpoint is stressed. The steps in the solution of a problem are outlined and discussed. Finally, some comments are made about presenting the results of a study.

INTRODUCTION

The remarks made here are directed toward persons who are concerned with solving technical problems that are of an operations research nature. Many of these remarks consist of calling attention to areas in which the operations researcher should proceed with caution. The other comments are mainly concerned with a discussion of fundamental considerations from a general viewpoint. None of the material presented furnishes detailed metods for solving operations research problems. The ideas underlying the cautions have a common sense basis and undoubtedly are knowh to many persons in the operations research field. However, the author has encountered many situations in which one or more of the stated pitfalls have occurred, even for senior level operations researchers. Also, with respect to the general contents of the paper, only part of this material seems to have appeared in published form. Moreover, the portions that have been published occur separately and do not furnish a coordinated examination of the over-all problem.

*) Based on a Luncheon Address given at the 1961 Annual Meeting of the Northwest Section of the Operations Research Society of America.

The subjects touched upon are organized into several short sections. The title of a section furnishes a description of the subject discusse in that section.

NATURE OF PRACTICAL PROBLEMS

The practical problems encountered in the operations research field are usually specialized, complicated, and with scope and goals that are poorly defined. Also, their solution nearly always represents a compromise between two or more conflicting effects. Often, one of the major contributions of the operations researcher is to determine, by an iteration procedure involving the persons who posed the problem and specialists in the associated technical areas, a suitable scope and set of goals. This determination, combined with the ability to formulate and solve the resulting technical problem, has implications concerning desirable characteristics for an operations researcher.

DESIRABLE CAPABILITIES AND BACKGROUND

The desirable characteristics for a person concerned with the problem solving aspects of operations research include accurate conceptual thinking, objectivity, ingenuity, adequate technical knowledge, sufficient experience, and ambition. When in occurs in combination with accurate conceptual thinking and objectivity, strong ambition is very desirable. However, strong ambition can be definitely undesirable in some cases. Many of these desirable characteristics are interrelated. For example, it is difficult to do accurate conceptual thinking without adequate technical knowledge and sufficient experience. A very important characteristic is the possession of a high level of ingenuity. In fact, it is difficult to become an outstanding problem solver without having at least a moderate amount of ingenuity.

STATEMENT OF SOME PITFALLS

A person who is objective and thinks accurately should not have much in the way of biases with regard to problem formulation and solution. However, possession of technical knowledge, experience, ingenuity, and ambition are not necessarily enought to avoid the pitfalls that face the operations researcher.

One somewhat common pitfall is the overuse of technical metho-

dology. Due to the fact that a person possesses some special technical skills, he attempts to make use of these skills wherever possible. The result is that he formulates problems so that their solution requires the use of his special skills. In many cases, the problems could be more easily formulated and solved in some other way and, in some cases, the formulation may be outright unsatisfactory.

Another pitfall is undue reliance on specialized experience. This can involve strong bias and often leads to overlooking worthwhile solutions.

In general, with regard to both specialized skills and specialized experience, the operations researcher should be careful to avoid the pitfall of too much self-importance. Namely, he should not be guilty of adopting the viewpoint that what he has is wonderful and that what he doesn't have is not worth having.

Finally, in formulating a problem and selecting the method for its solution, the pitfall of bypassing realism, by oversimplification or basically changing the problem, should be avoided. Sometimes the desire to obtain a solution to a problem, especially a solution that is easily applied, leads to a problem formulation that has little in common with the actual problem.

STEPS IN HANDLING OF PROBLEMS

The steps in the over-all treatment of problem can be broadly classified under the headings of conceptual and computational. The conceptual steps include specfication of the scope and the goals of the problem, abstraction of the problem into the form of a model, and selection of a measure of effectiveness. Here ingenuity and accurate conceptual thinking, supported by adequate technical knowledge and sufficient experience, are especially important (objectivity is basic to all parts of problem solving). The computational steps include the application of the model and the reaching of decisions through use of the measure of effectiveness. Experience, technical knowledge and ingenuity are important in the application of the model while accurate conceputal thinking and objectivity are important in reaching realistic decisions. In some senses, the reaching of decisions also falls in the conceptual area.

Every model is based on something in the way of assumptions. If

small changes in these assumptions can cause large in the conclusions, these conclusions, do not have a very firm basis. Thus an investigation of the sensitivity of the results to the assumptions (a sensitivity analysis) is usually desirable.

Some problems are of a pioneering type. That is, they deal with areas in which very little prior information has been obtained. Here preliminary probing studies are usually desirable. Often what happens at detail levels can be established but obtaining an understanding of the over-all properties is needed. For situations of this nature, simulation frequently furnishes a useful tool for "seeing the forest instead of just the trees."

PRESENTATION OF RESULTS

An important aspect of problem solving that is sometimes overlooked is an effective presentation of the results of the study. In some respects, the "payoff" for a problem solving effort depends critically on the impact created by the results that are obtained. Here, as always, accuracy and objectivity are necessities. However, results that are presented in an accurate and objective manner can have various levels of impact. The preferable manner for presenting results depends, of course, on the particular situation that exists. In any case, however, the presentation should be understandable and oriented toward the audience to which it is being made.

MESSAGE GIVEN BY MR. S. OHNISHI

The former president of ORSJ,
at welcome meeting for MIT OR group
on the 18 th of August,1961 at Daiichi Hotel, Tokyo

Prof. Morse, Dr. Dobie, Dr. and Mrs. Howard and Ladies and Gentlemen,

First of all allow me to convey the sincere regrets of Mr. Michizo Kishi, president of the Operations Research Society of Japan that his previous appointment has prevented him from thanking you in person for the great assistance you have rendered us. In his absence, I, Ohnishi, former president of the society, have been accorded the honour of expressing our heartfelt gratitude.

In Japan, at present time, operations research and linear programming are yet in the academic research stage, and under study mostly by professors of universities and experts, however your generous efforts through a number of seminars and speeches have brought their intrinsic value and potentialities to the attention of the top management of various enterprises. Your short but full programs have been instrumental in inviting the serious contemplation of their incorporation into the present business routine.

Words cannot fully express how much we have appreciated your having spared us so much of your valuable time to come all the way to Japan to assist us in a field we are yet a novice, for we are not blind to the good fortune in receiving first hand instructions from three of the most world renowned experts in this advanced field. I only hope that we can express even a fraction of our gratitude by putting your teachings into practical use.

Before saying good-bye to you, we wish to present you with the famous Japanese dolls as a souvenir of your visit to Japan which we hope you will like. These dolls which are braught to U. S. may fade with the passage of years but the seeds of your efforts in promoting

operations research in Japan will on the contrary grow with each passing year.

Wishing you the best of health and every happiness upon your return to your homeland, I would like to close my short speech.

Thank you very much.

Sadahiko Ohnishi
Vice-president, Hitachi, Ltd.

1961 AUTUMN MEETING

The Autumn Meeting of the society for 1961 was held in Nagoya during 4th-5th November 1961.

The lectures and papers presented are listed as below.

INVITED LECTURES

Computer Centers in Europe and America, Sigeiti Moriguti (Tokyo Univ.)

On Applications of Formal Logic to OR, Katsuji Ono (Nagoya Univ.)

Recent Tendency of Airplanes and OR, Tomio Kubo (Shin Mitsubishi Co.)

PAPERS CONTRIBUTEDS

1. System Engineering for Digital Communication Systems, Tadahiro Sekimoto (Nippon Elec. Co.)
2. Job-Sequencing with Time Lags, Ichiro Nabeshima (Hiroo High School)
3. On the Tabulation of the Capacity of Binary Communication Channels, Minoru Sakaguchi (Electro-Communication Univ.)
4. A Study for the Case of that, Several Loads which are Constant Distances Apart from Each Other, pass through Many Resistance Zones by One Dementional Removal, Minoru Morishita (JNR)
5. Numerical Computation of a Large Scale Bottleneck Dynamic Programming Problem, Tsuyoshi Arimizu (Ministry of Agriculture and Forestry)
6. An Extension of Combinatorial Processes, Tsuyoshi Arimizu (Ministry of Agriculture and Forestry)
7. On Estimation in Multistage Hydro-Graphs, Tsuyoshi Arimizu (Ministry of Agriculture and Forestry)
8. How to decide the Number of Circulating Spare Parts at Sheds and the Railway Workshop, Masaaki Fujimoto (JNR)
9. On the Multi-Channel Queuing Problem with Hyper-Poisson Arrival and Exponential Holding Time, Toshio Nishida (Konan Univ.)
10. On a Simulator for Dueuing Systems, Sachio Mizuno (Nippon Elec. Co.), Kiyonori Kunisawa and Hidenori Morimura (Tokyo Inst. Tech.)
11. An Example of the Simulation on the Inventory Model, Shigeyuki Matsumura (Fuji Seitetsu Co.)
12. On the Influence of a Traffic Light to the Poisson Traffic Stream, TakashiKishi and Kenji Hiyoshi (Defence Acad.)
13. A Financial Control Chart, Akio Miyauchi (Fuji Film Ind.)
14. On Computational Methods for Component Analysis, Marumoto Inoue (Tonen Sekiyu Kagaku Co.)
15. A Technique in Simulation Analyis, Hidenaga Harano (Toshiba Co.)

16. On a Method for Solving Non Linear Programming Problem under Certain Conditions, Heihachiro Hukuda (Waseda Univ.)
17. Dynamic Programming and Quality Control, Toshio Odanaka (Metropolitan Technical College)
18. On Control Process with Some Probability Criterion (I), Toshio Odanaka (Metropolitan Technical College)