

**RECENT DEVELOPMENT OF OPERATIONS  
RESEARCH IN THE WORLD**

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I'm very glad to be here. We have been trying to arrange a trip to Japan to meet our colleagues in operations research for two years, and we have now been successful, and we are very glad we have been successful because we feel this has been an extremely interesting and instructive trip for us.

I want to report this afternoon about the developments of operations research in all of the various countries around the world. As you know, operations research was active during the World War II, and after World War II it continued quite strong both in England and the United States. During the time from about 1948 until about 1955 it began to be applied in industrial work and commercial work in both England and the United States.

In the meantime, some work in operations research had begun in France and in other countries, so that about 1955 a number of us talked with our friends in England and with our new acquaintances in France and decided that it was about time to have an international meeting to discuss operations research. And so, in September, 1957, a meeting was

held at Oxford, England, where several hundred people from all over the world came to discuss developments in operations research. Mr. Koyanagi came from Japan and some came from India, as well as from the European and the American countries.

At that meeting it was decided that there should be an international federation created, and so the International Federation of Operational Research Societies-IFORS, for short, was formed, with Sir Charles Goodeve as the first international secretary. It was decided that the first official meeting of IFORS, would be in 1960, at Aix-en-Provence in France. Representatives were there from all of the countries that are active in operations research; there were a number from Japan, a number from India, and from many other parts of the world. This meeting also was quite successful, and towards the end of the meeting the official representatives of all of the societies met to decide where to go next. Considerable discussion about this and many other questions took place.

The United States wished to have the third international meeting there, but it was pointed out that it was easier for the people from the United States to go to Europe than it was for the people from Europe to come to the United States. So, after much discussion, it was decided to hold the next meeting in July of 1963, in Oslo, Norway. We hope that we will see many of you at the Oslo meeting in 1963.

At the Aix-en-Provence meeting I was elected to be the next international secretary, so that it is my task to organize this Oslo meeting. I will be in correspondence with the officers of the Japanese Society to see how we can be of help to the Japanese delegation. At Oslo we will have the task of deciding where the 1966 international conference will be. There will be many who will hope to see it in the United States; there will be some who will suggest having it again in Europe; perhaps it may be decided that it should go to Japan. This possibility is something that we hope you will consider. Of course, there are many considerations that will have to be taken into account in reaching the decision as to where the 1966 meeting will be. One of the important ones will be the expense of other delegates coming to the meeting. And this may make

it necessary to continue having the next meeting in Europe where the majority of people can come more easily. However, I myself would very much enjoy, seeing the next meeting here in Japan.

In the meantime other international activities concerning operations research have been taking place. In particular, NATO, which is the organization of the Atlantic Treaty states in Europe and America, has been taking an active interest in operations research, not only from the military point of view but also from the industrial and governmental point of view. The NATO organization has two parts. One is a military division, and the military parts of NATO have several operations research groups working for them. The other is a civilian part of NATO that has to do with the industrial and non-military aspect; an important part of this organization is the office of the Science Advisor to NATO.

The Science Advisor has been instrumental in setting up a number of scientific laboratories that are used by all of the European countries. For example, there is the peacetime nuclear laboratory in Geneva which was organized by the Science Advisor to NATO. There are also what are called NATO fellowships for young men who are citizens of NATO countries, for use in studying in one of the other NATO countries. These have been used for students in physics to go to France or to England or to the United States, and for students in many of the other sciences to go to study in other countries.

Three years ago the Science Advisor, at that time Dr. Seitz from the United States, asked me whether there should be some activity of his division which was interested in operations research. I agreed this should be so and, accordingly, he named me the chairman of an Advisory Panel on Operations Research-APOR-to advise him what NATO should do with respect to operations research. Six panel members were chosen, one each from England, France, Italy, Germany and Norway, (and myself). We had our first meeting more than three years ago and we have considered various needs for operations research in the NATO countries. We found, as, of course, we knew before, that some of the countries were using operations research very early, that some of the other countries

were just beginning to use it, and some of the NATO countries knew nothing whatever about operations research. So, at the beginning, the problem was in interesting the countries that did not know about O. R. in the subject; also in educating the students in the subject. We drew up a four-part program of activity which our panel could supervise, and which we advised the Science Advisor to approve.

The first suggestion was that these NATO fellowships which have been used for other sciences be made available for students who wish to study operations research. The second suggestion was that money be made available so that persons from those countries in NATO which have knowledge of O. R. could go to the other countries which had no knowledge of it, to give short courses of a week or two during the summer to people who wish to learn about operations research. These first two recommendations were approved and this was done without much need for budget; NATO fellowships had the money already; short courses required some contribution of money from the countries to which the groups were sent and some contribution from NATO, but the amount was small. We began a series of short courses three years ago. The first course was given in Brussels in 1959. There were four of us who gave the lectures and a hundred and twenty people came from various NATO countries. In the summer of 1960 there was a conference in Freiburg, Germany. This was given by a team of two people from the United States, one person from France and one person from England. This summer, 1960, a short course was given in Venice for people from all over Italy, and another course will be given next month in Munich for people from German industry. I spent the first two days at the Venice course before I had to leave to come to Tokyo. In each of these cases, the group that gives the lectures comes from a different country. In Venice there were two from France, one from England and one from the United States. In Munich there will be one from Norway, one from France, one from England and one from the U. S..

The third recommendation we made to the Science Advisor was that after a country had begun to be interested in operations research, the next step was to start something in that country so that students could learn about O. R. in their own country. And so we suggested that

funds be made available so that a visiting professor, one who knew something about O. R., could go to a university in an interested country, stay for the academic year, give lectures, and help organize the training course in operations research. This was also approved by the Science Advisor; the arrangements were that the country to whom the visiting professor would go would pay approximately one-third of the professor's salary and expenses, and NATO would pay the rest of the expense and salary. When this was approved and when the notice went out to the different countries, there were requests from three countries this last winter: one from Norway, one from Italy and one from Germany.

We have arranged to send visiting professors to all three of these places. The one in Norway goes to the University of Oslo; the one in Italy goes to the University of Rome; and the one in Germany goes to the University of Bonn. The one going to Norway is a professor from Case Institute; the one goes to Italy is a scientist who has been working at the Rand Corporation in Santa Monica and has been teaching O. R. at the University of California in Los Angeles; the one goes to Germany is a member of the Navy OEG; he has been lecturing on operations research at the Naval War College.

The fourth recommendation to the Science Advisor was that means be set up so that persons from one operations research group could exchange ideas and suggestions with people from another operations research group, so that after activity has been started in other countries there would be a chance for interchange of ideas. For two years I have felt that the activities which we have started in NATO should also take place in other countries around the world. And so, I have been busy for the last two years, for example, trying to set up similar arrangements like the ones between the NATO countries. I'm glad to say that we have at least begun to get results. We have come here to Japan for a series of short courses. I hope that arrangements can be made to activate some of the other points here also, between the U. S. and Japan perhaps not only with the U. S., but between England and France and Japan. I do not know what the arrangements for scientific fellowships are, but I hope that something like the NATO fellowships could be arranged so that students

from Japan could go to either England or France or the U. S. to study Operations research. And I hope that arrangements could be made for funds to be made available for a visiting professor to come to an appropriate Japanese university

Let me now review the status of operations research in some of the countries around the world. England is the country where industrial operations research first began, although I think the United States began almost as early. England, the United States and France are three countries that have developed the greatest interest and activity in operations research. In these countries there are many groups which are doing operations research. In England, probably, there are twenty or thirty large operations research groups doing work for the English railroads, for the Coal Board, for the steel industry and for many other industrial companies. England is well advanced in the teaching of O. R. There are at least two universities in England that are giving very good training in O. R. : the University of Manchester and the University of London. In the United States there are, of course, many industrial operations research groups, and in contrast with England, much of the industrial O. R. is done by consulting organizations which will contract to do a special study for some industrial company. In England most of the work is done by organizations that work for just one company, and there are not many consulting groups. However, in the United States I would guess that nearly fifty percent of the industrial operations research activity is carried on by consulting groups.

This does not mean industry does not appreciate operations research, It means that consulting groups of all sorts are more usual in the United States and companies utilize consulting groups to introduce a new subject to them. For example, in the United States a company will ask a consulting group to do an operations research study to see whether O. R. can do them some good. If it likes the result, it will then hire some people and have its own group. It is, therefore, a matter of habit that consulting groups are popular in the United States and not popular in England.

There are several universities in the U. S. that give training in operations research. We do at M. I. T. ; Case Institute does ; Johns Hopkins does ; the University of California does ; several other universities

give courses in operations research.

Interestingly enough, France has developed quite rapidly in operations research. It had very little operations research until about 1950, and at that time some of it began. Although there was no very strong tradition for consulting in France, they have developed a number of very strong operations research consulting teams. In each of these teams, the group was started by a small number of very brilliant scientific graduates from the better French universities, such as the Ecole Polytechnique and the Sorbonne. These young men found that there was no place for them in the universities and they did not want to go to a single commercial company. These men joined together to form a consulting group. And they were brilliant enough to be able to break the habit in France of not using consulting groups. As a result, at least three consulting groups have been very successful in France. One of these groups has the financial support of a large private bank in France. Another group has the support of an industrial financing corporation. The groups are well financed; they are well run; and they are doing excellent work. They work to some extent with the government in planning the productivity and development of the country; they work for industry; and they work to some extent with the military. So, here is a case where brilliant young men can change the habits of the country, and O. R. can become successful very rapidly. There are, of course, also groups in France that work for single companies. For example, there is a very successful O. R. group which works for the French National Railway.

Operations research has also made promising starts in Italy, Japan, Norway, Netherlands, Belgium and Canada. In each of these countries there is an active O. R. society. They are doing good work in industry and in governmental planning, and in most of these countries there is a beginning of a training course for young men in operations research. A course in O. R. has been started at the University of Rome, for example, and courses in the subject are taught at the University of Oslo and in Freiburg. The Norwegian government is supporting an O. R. group which will do consulting work in operations research for the government and for industry. A similar group has been formed in Holland. Countries like

India and Greece and Turkey have hardly started in this field on the other hand; although there is some interest in each of these countries and there is a request from Greece and Turkey for a short course to be given. I have not been able to find out how much O. R. has been carried out in Russia. There seems to be some secrecy connected with these questions. I have talked to several scientists from Russia to see if they knew something about it, and have received only rather vague answer, so I have nothing definite to report in the case of Russia. I believe, however, that they have translated *Methods of Operations Research* into Russian and I intend to go to Moscow sometime in the next couple of years and try to find out who has read it.

There are many things to be done in order to develop O. R. activities in every country. For example, countries such as India, Turkey, Brazil and the Congo all need operations research and have not enough of their own citizens who know its techniques. They will need help in setting up education in operations research, in showing how O. R. can be used, and in advice on how O. R. problems can be solved. I hope in the next five or ten years that I will be able to call on you in Japan for your share of assistance in helping develop operations research all over the world.