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Application of Operation Research in Government and Planning

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Abstract: *It is the primary responsibility of the government to cater to the needs of the citizens and OR as a science helps in making accurate decisions without any judgement and biasness. A methodology of operations research ensures the accuracy of the policies and activities executed by the government. In this paper, we have shown how operations research tools help the government to cover all the aspects necessary for decision making, budgeting, and economic development and project scheduling. This paper also shows how governments of different countries like China and South Africa use operations research in their decision making and development of their economy. OR is not free of any difficulties and restricts the government from applying the OR tools to its maximum.*

Keywords: *Operation Research, Government, Decision making, Planning, Public services.*

I. INTRODUCTION

Recently, ISRO (Indian Space Research Organisation) developed its 2nd lunar exploration mission Chandrayaan-2 which would improve our understanding of moon, help us in doing discoveries and would encourage more such voyages. But we know such missions need good research which in turn requires huge funds which are ultimately allocated by the Government. For e.g., our government allocated around 9918 crores rupees to ISRO for the year 18-19 and it's a huge amount. All this process seems quite simple but in reality, requires lot of efforts. Govt. don't allocate funds as demanded by Department of Space but use effective OR techniques before doing so. This is one of the examples which shows how important Operations Research is in today's life and specifically in working of Government.

Sometimes, it also happens that government has to make important decisions like if it wants to continue with the loss-making PSUs or not. Air India, BSNL are loss incurring units and govt. have to decide if it is in the greatest interest to shut these companies or to continue with these for social welfare of the people.

Time and again such problems occur in front of the Govt. and decisions are to be taken so that maximum benefit is achieved. Decision Making is important not only in govt. but everywhere like in business, engineering, economics etc. But unfortunately, we are not always naturally inclined to make the best decisions and fortunately, we have Management Science which serves the role of helping people to make more informed and logical decision.

Roles of Management Science

- 1) *Subduing Emotion:* One of the roles of management science in decision making is to subdue human emotion. Human emotion can get in the way of decision making. For example, a person might be emotionally attached to a project that logically will not be profitable; management science tools can be used to identify the rational decision of which project to abandon.
- 2) *Evaluating Complex Situations:* Often, a decision will involve a complex web of causes and effects. The human brain simply cannot handle so much data. Management science offers methods for arranging this data in a way that it can be interpreted easily.
- 3) *Overcoming Biases:* Humans are naturally inclined to have biases. Often, people aren't even aware of these biases. Biases can be very simple, such as a subjective preference for the colour yellow rather than the colour blue. Management science removes human biases from the decision-making process.

So, Management Science/ Operations Research is a discipline that deals with the application of advanced analytical methods to help make better decisions.

Through this research paper, we want to show how Operations Research has become a part of almost every govt. activity and planning. Since a country depends a lot on govt. and its activities, therefore study of OR in govt. is crucial.

II. INDUSTRY OVERVIEW

Government that individuals make for themselves impacts and completely changes them. The legislature chooses what property ought to be claimed, and what amount assessments ought to be paid. The administration additionally sets instructive necessities, put constraints on movement, and draft individuals into the military. Numerous open places likewise rely upon government. Individuals vote in favour of who they need to oversee them. The constitution characterizes what an administration can and cannot do. There are two sorts of administrative pioneers. Illicit government pioneers are pioneers that take control by power. A case of an illicit government pioneer is a despot. A legitimate government pioneer is a pioneer that has been offered capacity to oversee uninhibitedly by races. The government is enormous and confused. It improves and secures the lives of its kin. It works on a few levels like national, state, and neighbourhood. The American arrangement of government is a majority rule government. It has an administrative arrangement of government, which implies that the national government imparts obligations to the state and metropolitan government. Every legislature has certain forces. Designated forces are the obligations of the national government. Private forces are the states expert in specific circumstances. Simultaneous forces are obligations shared by the national and state governments.

This sector is very important as lives of the people, especially the marginalised section of the society, depends a lot on it. Every govt. aims to provide its citizens the best development, welfare and growth and Operations Research is the requisite for it.

Operations Research is a generally new discipline. If you talked about OR maybe 70 years back, you wouldn't know much about it. Operations Research devices are not from any one control. Operations Research takes apparatuses from various orders, for example, science, insights, financial aspects, brain research, building and so forth. What's more, joins these devices to make another arrangement of learning for decision making.

Today, O.R. turned into a professional discipline which deals with the application of scientific methods for making decision and particularly to the assignment of rare assets. The primary motivation behind O.R. is to give a balanced premise to choices making without complete data, in light of the fact that the frameworks made out of human, machine, and techniques may don't have total data. OR, in a sense, is a science as decisions are not taken by intuition or judgement of the manager but which is mathematically or rationally correct.

In this manner O.R. masters are engaged with three traditional part of science; they are as per the following:

- A. Determining the systems behaviour
- B. Analysing the frameworks conduct by creating proper models
- C. Predict the future conduct utilizing these models

The management science (MS) is a between disciplinary part of applied arithmetic committed to ideal choice arranging with solid connections with financial aspects, business, building and different sciences. It utilizes different logical inquire about based standards, methodologies and diagnostic techniques including numerical displaying, measurements and numerical calculations to improve an association's capacity to authorize judicious also, important administration choices by landing at ideal or close to ideal answers for complex choice issues.

China is one of the developing countries that embraces the use of OR tools not only in business, but also in government and non-governmental organizations.

In the 1980s, China developed a massive information system called the State Economic Information System (SEIS), which consists of many independent information sub-systems (Zhang, 1999). Because the SEIS are distributed to many regions and cities in China, it became necessary to evaluate its effectiveness in achieving its goals. The responsibility for evaluating and managing the SEIS fell on the shoulders of the State Information Centre (SIC).

In order to coordinate the activities of the different information sub-systems and evaluate their contribution to economic development, SIC constructed an extensive OR model. The model consists of parametric programming, analytic hierarchy process, and data envelopment analysis.

According to the authors, the new model can also be used as a decision management tool in other areas such as economics and finance. The OR model won IFORS's first prize in OR in Development in 1996. According to the authors, the OR model helped the SEIS to determine the roles that the independent information systems played "in the local social and economic development" of China.

III. RESEARCH OBJECTIVES

The following research paper has been formulated with the objectives as stated below: -

- 1) To understand how Operation Research can be used as an effective tool to solve real life problems and how effective and accurate it is in decision making and thus see if Operational Research can be proved to be the preferable method for the same.
- 2) To find how Operations Research is used in Government planning and decision making and to look at the scope of Operation Research in various public services provided by the government and hence find out the effectiveness of the policies implemented.
- 3) To describe how Operation Research is linked to various government all around the globe and hence understand the relationship between the two and thus understand the level of dependency of both.
- 4) To elaborate on how efficient has the use of Operation Research has been in implementation of the various public policy and hence evaluate its performance over the years.
- 5) To outline different challenges faced by government while using Operation Research.

IV. RESEARCH METHODOLOGY

The research methodology used is secondary research wherein we went through various research papers, articles and journals which helped in collecting various data which is incorporated in the research paper.

As a part of primary research, we spoke to a government official who is working in this field which helped in getting information on the real-life implication of Operation Research which turned out to be much different than the theoretical explanation of Operation Research.

V. LITERATURE REVIEW

The various research papers focused on how Operation Research can be used for effective planning in the government in various sectors like public service distribution like electricity, water, vaccines and medications, etc. These papers aim at understanding the effectiveness of Operation Research in various government sectors. Most of these papers show a contrast between the theoretical aspect of operational research and the real-life implications of the same. Also, they focus on various challenges faced by government in implication of these OR models and the reasons that lead to poor implications of these. Hence, they focus on the importance of Operational Research in government. They also speak of various models which can help implement and find optimal solution to economic and social problems.

A. *Economic Planning and Decision Making.*

Economic development refers to a multi-dimensional process involving major changes in social structure, popular attitudes and national institutions (E.g. Niti Aayog) as well as acceleration of economic growth, reduction in income inequality and eradication of absolute poverty, reduction in unemployment and improvement in material welfare.

- 1) *Business Decision Tool:* Business leaders and policy makers are using OR techniques to assist them in decision making in ways that directly or indirectly lead to poverty alleviation and economic development. For example, OR tools are used in optimal facility location, product design and manufacturing, inventory control, capital investment, and manpower planning. When a CEO of a company makes a right decision, the effect could be increased productivity, increased profit, pay increases for workers, provision of bonuses to workers or gaining new market share that might require new hiring.
- 2) *Planning and Scheduling:* Two specific OR project planning and scheduling techniques are the Critical Path Method (CPM) and the Program Review and Evaluation Technique (PERT). The CPM was developed by Morgan Walker at DuPont, while James Kelley, Jr., invented the PERT at Remington Rand. Successful completion of these projects contributes to job creation, community empowerment, most importantly, meeting the economic goals that led to the implementation of the projects in the first place. CPM, and PERT contributed immensely to the timely completion of the World War II Manhattan Project.
- 3) *Project Analysis and Evaluation:* In an era of scarce resources, policy makers demand accountability. They want to make sure that scarce resources are not wasted, projects are efficiently completed on time, and projects' goals are achieved. They are also interested in how lessons learned from one project can be used to improve the implementation of other projects in the future. OR is one of the tools that can be used to achieve these goals. For example, a linear or nonlinear programming could be used to construct and analyse different implementation scenarios or policy alternatives. Depending on the nature of the model, sensitivity analysis could be performed to see how changes in problem inputs affect the solution. This analysis could assist in a comparison of expected outcomes to actual outcomes, and hence determine the effectiveness of the project in meeting expected development goals.

B. Rational Budgeting

- 1) *Rationalism*: From the late 1950s the government began to play an activist role in economic and social development, formulating new policies and with increased level of expenditure. (Fozzard, 2001) Rationalist approach is where the policies are related to clearly specified goal. These goals are defined through a problem analysis and once the goals are defined, the technicians look for ways of implementing them through policies. This implementation is monitored and evaluated
- 2) *Planning, Programming and Budgeting System (PPBS)*: This was an approach of resource allocation introduced in USA in mid 1960s where resources would be allocated based on their contribution to the policy objectives. This was because the rationalist approach required a link between the policy objectives and the resource allocations. This technique relied on quantitative techniques of spending decisions. However, many analysts also emphasized on using methods derived from operations research like linear programming, systems analysis and decision theory.

Hence, various operation research techniques were used along with PPBS in order to allocate the budget funds to various sectors. However, PPBS had its own set of limitations and hence was eradicated by the 1980s.

C. Allocation of Public Health Services.

Operation research can help deal with a lot of issues in public health system, disease prevention and control along with community issues. The typical model of health program consists of inputs (necessary basic resources for services-technical and financial), processes (programme activities such as training, logistics, etc.), outputs (results at the programme level-services, service use), outcome (results at the level of target population- behaviour , practices) and impact (ultimate effect of project in long-term); OR typically tries to modulate inputs and processes in programmes and aims to measure the desired changes in outputs, outcomes and impact.

There are two approaches for OR in public health

- 1) *Secondary Data Analysis*: This refers to analysis the past data that already exists and using this data to full potential and hence finding out gaps by reviewing these data sets. Here, the program managers play a very important role as they can help guide the Operation Research (OR) process. A lot of useful and effective solutions and allocation solution have been derived through this technique over the years. The major advantage of this method is that it is easy to derive data in the least possible time as the reports are generated and maintained regularly.
- 2) *Primary Level Research*: There are 4 types of OR research studies involved in this approach. These methods are often linked to each other. They are as follows: -
 - a) *Exploratory Study*: They are carried out to know the extent of a problem and hence, help in problem identification which is the first step in this method. Typically, these studies employ qualitative methods as well as interviews, group discussions and also quantitative studies.
 - b) *Intervention Study*: This study usually works on randomised variables. Randomised experiments yield highest level of evidence on effectiveness and efficiency of new service delivery options, giving best choice for implementation to program managers and policy makers.
 - c) *Economic Analysis*: The last step in the evaluation is usually the economic analysis by costing and calculating cost effectiveness ratios and looking for cheaper optimal outcomes as health distribution programs are often supposed to be operating in scare resources.
 - d) *Monitoring And Evaluation*: Monitoring and evaluation have been two significant aspect of OR (M'OR'E) today. Monitoring basically refers to as a process of looking after inputs, processes and output in programmes and evaluation is outcome/output evaluation. This method requires data collection on a continuous basis and the effectiveness of various programs implemented have to be measured. It uses a set of pre-defined indicators which track the progress of the program. Hence this allows space for feedbacks and midcourse corrections.

Hence OR is a distinctive instrument leading to maximum benefit to health systems and programs end user at lowest cost. Translating the outcomes of OR will eventually better healthcare system for public that is accessible, affordable, available and acceptable.

D. Use of OR in Analysis and Evaluation of Govt. policies and schemes

It is a known fact that resources are scarce and hence it is essential that Government evaluate and analyse its policies and schemes so that resources are not wasted and project's goal is achieved.

OR helps the government in doing so. For example, a linear or nonlinear programming could be used to construct and analyse different implementation scenarios or policy alternatives. Depending on the nature of the model, sensitivity analysis could be done to see how changes in problem inputs affect the solution. This analysis could assist in a comparison of expected outcomes to actual outcomes, and hence determine the success of the project in meeting expected development goals.

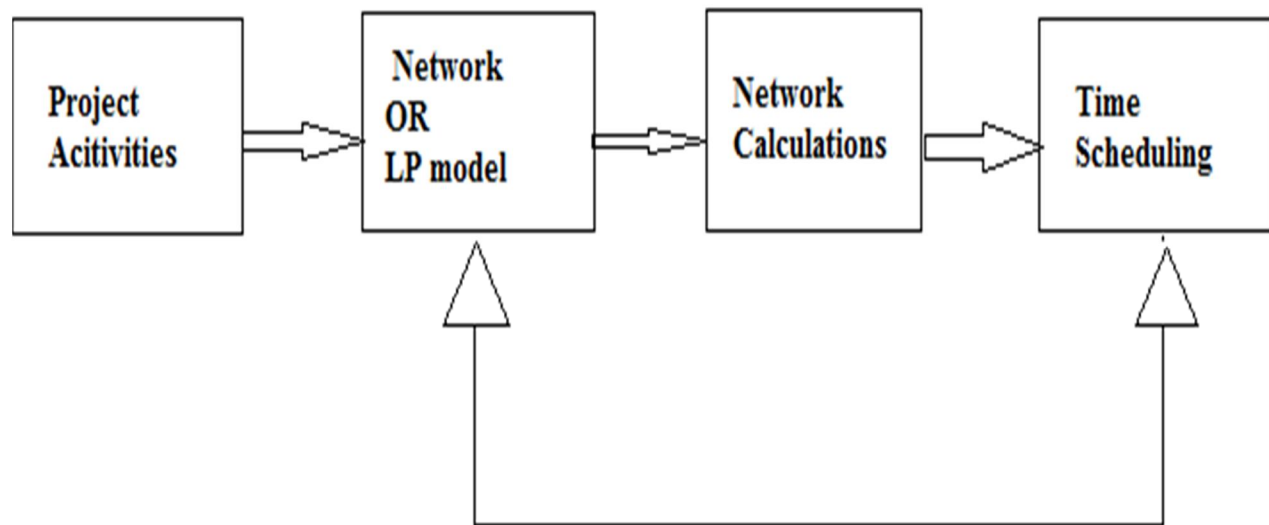
1) Other Fields

- a) **Prediction of Food Needs:** It's imperative for any country to feed its citizens for economic and health reasons. China takes accurate prediction of food need of its 1.35 billion people through an input-occupancy-output-analysis and a non-linear forecasting model. This model provides more accurate prediction of grain output than remote sensing techniques employed by US government.
 - b) **Efficient Distribution of Water:** A cost-efficient equitable OR tool was used in Kabylia, Algeria. It used a bi-criteria optimization technique. This model helped in efficient supply of water to all of South Africa. Water is an elixir of life and hence better OR models providing optimal solution to water distribution is a must for any economy.
 - c) **Efficient Distribution of Electricity:** An optimization model is used in Nigeria for optimum distribution of electricity. The model uses dynamic programming to optimize power outages cost, feeder cost, and substation cost and energy losses. The optimal allocation of electricity in a steel plant in India is modeled as a Linear Programming Model and is said to have increase net profit per ton of saleable steel by 58%.
- 2) **Findings:** Economic development refers to a multi-dimensional process involving major changes in social structure, popular attitudes and national institutions (E.g. Niti Aayog) as well as acceleration of economic growth, reduction in income inequality and eradication of absolute poverty, reduction in unemployment and improvement in material welfare.

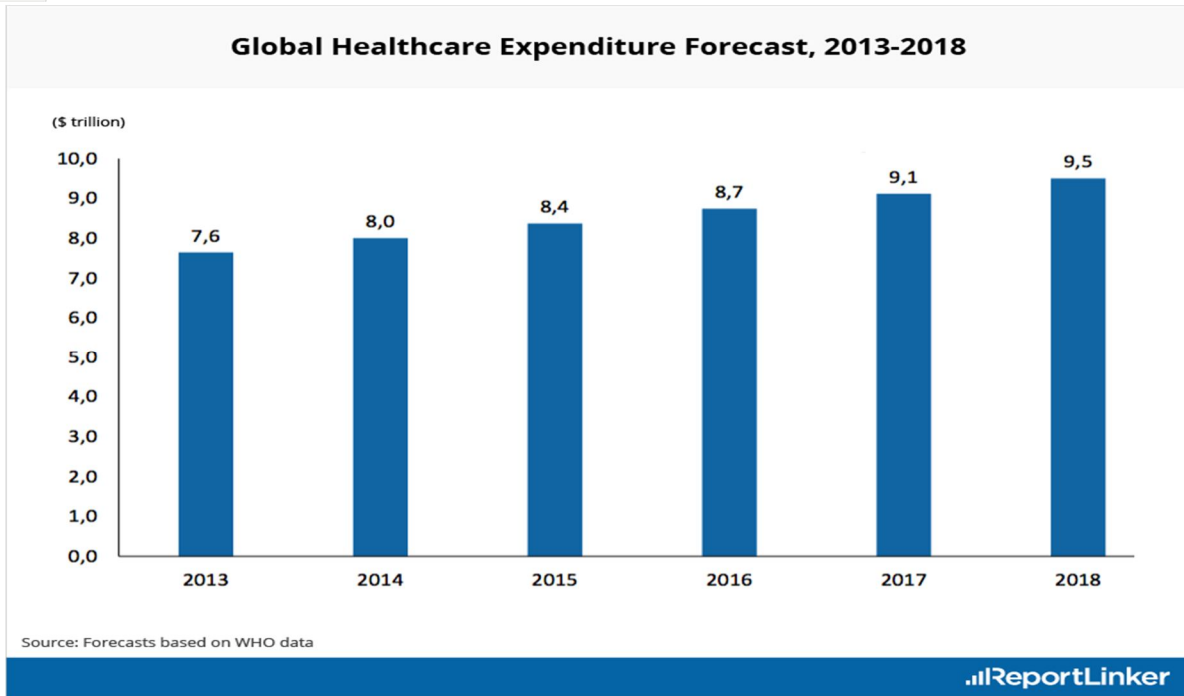
OR techniques are the best business decision making tools which help in solving real life problems with accuracy. OR techniques are used by the government to reduce poverty and improve our economic development. In doing so, they pick up the data from the surveys conducted and use OR techniques on it to find out the poverty levels of that particular area and they allocate the various subsidies, basic services and funds.

These can be done through techniques like CPM (Critical Path Method) and PERT (Program Review and Evaluation Technique).

Figure shows the CPM and PERT process.

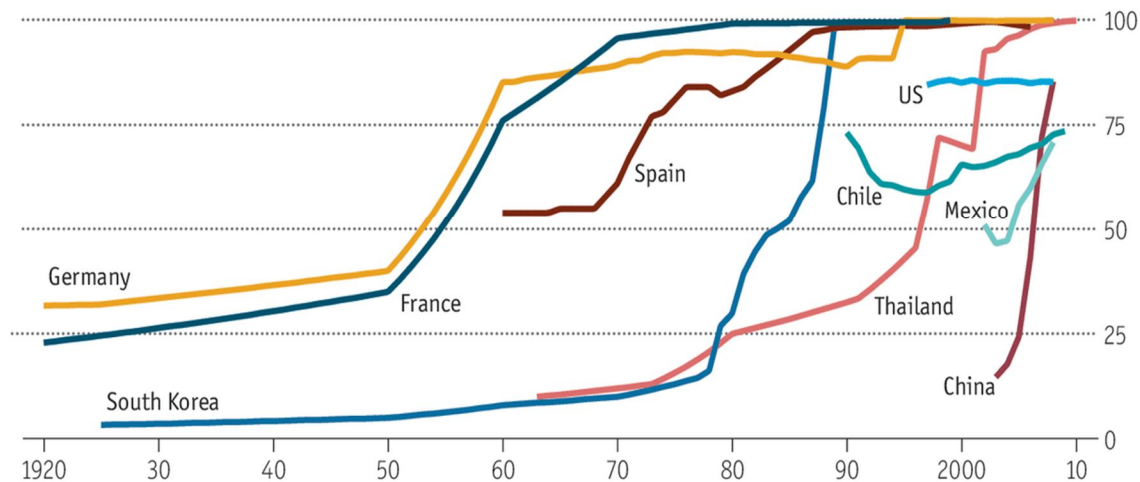


The techniques can be effectively used in allocation of health services, distribution of food and electricity and also in analysis & evaluation of existing policies and schemes. Speaking of distribution of public health services worldwide, it has been increasing over the years indicating effective use of Operational Research. Following graphs gives evidence to the same: -



Keep going

Share of population with public and private health-care coverage, % of total



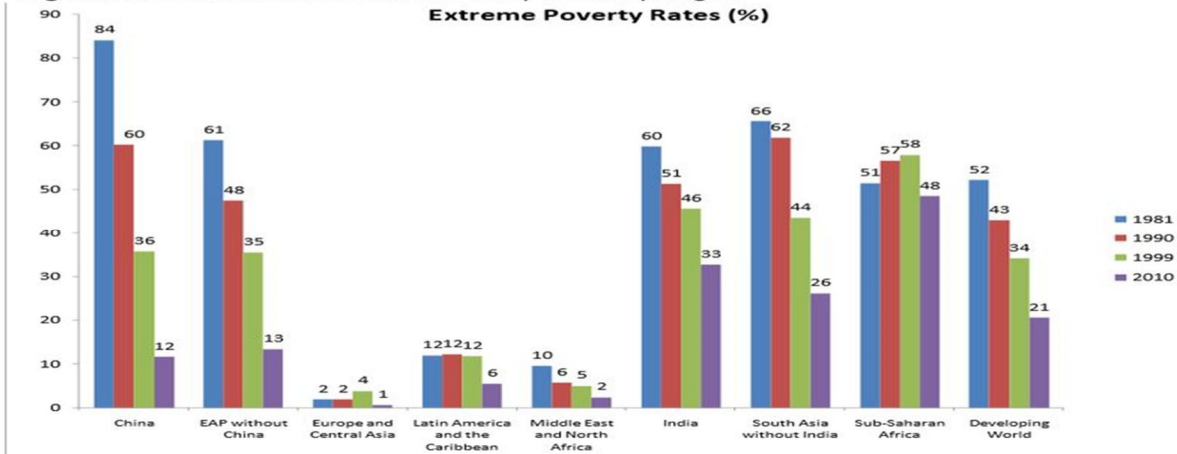
Source: United Nations Development Programme

Economist.com

However, there still exists a lot of potential opportunities that are not capitalised on by the various governments across the globe. If these opportunities are worked upon, it can lead to much improvement in economic development & eradication of various social challenges like poverty and a better standard of living. Better planning & allocation of resources will also give boost to the business sector as well as increase their efficiency in executing the plans.

However, in India Operational Research is under-utilised causing lack of effective planning and thus leading to a slow growth. Reduction in poverty and unemployment is happening at a very slow pace as compared to the growing nations.

Fig 1: The Evolution of Extreme Poverty Rates by Region
Extreme Poverty Rates (%)



Source: World Bank staff estimates.

E. Challenges faced by govt. In or

Operations research evaluates the business or industry in terms of the numbers. Intangible variables such as kindness and quality of life are also important in industry decisions but operations data typically doesn't consider their value. Hence, O.R. techniques used in government policies provide a solution only when all the elements related to a problem can be quantified. All applicable variables do not lend themselves to quantification. Factors that cannot be quantified do not find place in O.R. models. The application of operations research in government activities can make government decisions impersonal thereby making the decision loses the human element. O.R. techniques try to find out an optimal solution taking into account all the factors. In today's time these factors are important and expressing them in quantity and establishing relationships among these require large calculations that can only be done by computers. Carrying out the decisions is a delicate task. It must take into account the complex link of human relations and behaviour.

When the basic data are subjected to regular changes such as in the case of government activities and policies, applying them into the O.R. models is a costly task. A fairly good solution at present is preferably more desirable than a perfect O.R. solution available after sometime.

O.R. being specialist's job requires a mathematician or a statistician who usually is not aware of the government activity problems. It is tough for a manager to understand the complex working of O.R. Thus, there is a gap between the two. This is an advantage because a skilled and knowledgeable researcher can draw proper conclusions and formulate accurate and impactful policies.

OR requires model building which in turn requires good model builders and there is generally bureaucracy in govt. and thus good model builders may not be present. Moreover, Govt. Ministers are generally leaders, reformers who may not be well equipped with OR techniques and thus cannot apply OR.

The limitation of O.R. is mostly related to the model building, money and time factor problems and hence affects the application and efficiency.

VI. CONCLUSION

Operation Research has played a major role for governments across the globe. In this paper, we consider some of the ways in which government have used OR tools for project planning and scheduling, project analysis and evaluation, prediction of food and energy needs and efficient distribution of water and electricity. However, OR is used in various other public sector units such as transport, aviation industry, defense sector, etc. In each case, we discussed how each activity contributed to economic development and planning. However, OR as a tool for finding the optimal solution has proven to be efficient and accurate. Despite this, OR has not been used to full potential in India. This is because various challenges are faced by government in proper use of OR. Some of which include lack of knowledge on part of government officials, no proper development and system management as compared to other countries, ignores qualitative variables which are sometimes crucial, etc. hence, effective implementation can be ensured only when we combine human capital with technology. We hope that knowledge of how OR can be used for economic development and poverty alleviation will encourage people across the globe, especially those from poor and developing countries, to think creatively of how they could use OR tools to assist their governments in development projects in their communities. In short, OR plays a major role in uplifting economies and ultimately the lives of their citizens.



A. Limitations

There was lack of accurate primary data hence making the secondary sources of information less accurate. The information received maybe influenced by the data referred to of previous research papers. The authenticity of information on the internet is uncertain. Consideration of resources chosen is thus very vital. The information regarding government policies taken from secondary sources may not be precise. It is really (Bansal, Kumar, Chopra , Jain , & Saxena, 2017)tough to cover all the aspects of Government hence the paper may lack some information. The factual figures of Government policies and activities may be reliable but different sources present different information on the same topic.

Also, there was a lack of technical knowledge about the subject which posed as a problem for understanding the model in depth.

Also, lack of powerful computers led to difficulty in calculation of problems in OR models. However, the research paper includes all the best possible data and methods which could be done despite all above-mentioned limitations.

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