

OPERATIONAL RESEARCH: A TOOL FOR ECONOMIC DEVELOPMENT

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EXTENDED ABSTRACT

1. Introduction

Economic development, we mean a situation where a country strive towards improving the standard of living by creating jobs, supporting innovation and new ideas, and by creating overall better quality of life. Some of the objectives of economic development include building or improving infrastructure such as roads, bridges, etc.; improving our education system through new schools; enhancing our public safety through fire and police service etc.

Operational Research provides a well-articulated platform in the form of techniques and models for making optimum decision tailored toward economic development.

The term “operational research” (O.R.) is British and European, while “operations research” is USA. Both terms mean the same thing. It is often shortened into “O.R”. Many researchers have given various definitions to the O.R. Operational research in three words means systems, improvement, science (SIS). The origin is as far during World War 1, in Thomas Edison’s antisubmarine warfare studies, which analyzed the effectiveness of zigzag- going movements in protecting merchant ships. During World II, O.R. was firmly established as an effective problem solving method. Among the first attempted definitions are:

1. “Operations Research is a scientific method of providing executive department with quantitative basis for decision regarding the operations under their control”.
2. “Operations Research is the application of the theories of probability, statistics, queues, games, linear programming, etc to problems of war, government and management”.
3. “Operations Research is the use of scientific method to provide criteria for decisions concerning man-machine systems involving repeatable Operations”.

4. The Operational Research Society of Britain defined Operational Research as: “The application of the methods of science to complex problems arising in the direction of the management of large systems of men, machines material and money in industry, business, government and defense. The distinctive approach is to develop a scientific model of the system, incorporating measurements of factors such as chance and risk, with which to predict and compare the outcomes of alternative decisions, strategies and controls. The purpose is to help management determine its policy and actions scientifically”
5. The European Journal of Operations Research defines OR as: Involving the application of scientific methods to the study of complex systems. It seeks to produce an understanding of their problems and to develop models which will enable the consequence of decisions to be investigated”.
6. Operational Research is scientific approach to operational decision-making. It is a modern discipline concerned with operational decision by applying scientific methodology. The major fact is operational decision making and the emphasis is scientific methodology.

Operational Research other Names

- Operations Research
- Operations Analysis
- Management Science
- Management Engineering
- Systems Engineering
- Decision Support
- Analytics, etc

2. Nature of Economic Development

Development generally is the change, or changes, that has/have taken place to bring a system to an advanced stage of functioning. A child is a development over a baby, mechanized farming is a development over traditional mode of farming; air transportation is clearly a development over road transportation etc. A country is generally classified developed when it is able to produce qualitative standard of life for her citizens, and able to produce means to sustain it even though it may decide not to produce some but obtain it in an exchange relationship with other countries.

Development is multi-dimensional: economic, social, cultural, institutional, etc. It is clearly inadequate, therefore, viewing development in narrow economic growth terms.

Development Issues in Nigeria

In the foregoing all-embracing context contemporary Nigeria is far from being developed. This is despite the enormous resources endowments in human, material, even environmental terms, available to her. Obstacles to national development in developing countries have variously been highlighted.

Kemball Cook and Wright (1981), for example identifies the features of underdevelopment as:

1. Lack of productive resources, e.g capital, skills, and infrastructure.
2. Inability to exploit resources, e.g to acquire (1) above, and which is partly due to wrong attitudes and low quality institutional arrangements, administrative and managerial inadequacies
3. Maladministration of resources, particularly at the political level.

Also Ackoff (1977) viewed the obstacles to national development as not "economic" but "cultural". This suggests a remedy of cultural re-orientation that emphasizes prudent resources management which is clearly negated in corruption

SOME OF THE QUESTIONS O. R. ADDRESSES THAT IMPACT DEVELOPMENT

- How well is the system performing?
- What will count as improvement?
- What changes might bring about improvement?
- How could we assess their likely success?
- What should work best?
- How can desired change be implemented?
- What resources will be needed?
- What are the risks?
- How will we know if there has been improvement?

O.R. CAN HELP IN HANDLING SUCH FACTORS

(a) Complexity, (b) Change, (c) Uncertainty, (d) Risk, (e) Pressure

3. Problem and Common Operational Research Solution Methods

Standard techniques have been developed for tackling categories of tasks or problems, which are recurrently encountered in carrying out operations or in managing operating systems generally. Below are the common problems areas and Operational Research solution methods that are available in solving them.

SN	PROBLEM AREA	COMMON OPERATIONAL RESEARCH SOLUTION METHODS
1	Data gathering and analysis to ascertain quantitative attributes and characteristics of populations of items	Statistics
2	Project and program management, with problems of coordination	Network analysis models such as Critical Path Method (CPM) and Project Evaluation and Review Technique (PERT)
3	Efficient allocation of limited resources. How to avoid budget padding	Linear programming and other mathematical programming techniques

4	Assignment: How to assign men to machine; police commissioners to various states, etc	Assignment techniques
5	Conflicts, competition and bids: Niger-Delta militancy and Boko – Haram insurgency in the north; Restructuring problem; Derivation formula	i. Game theory ii. Metagames iii. Hypergames iv. Analytic Hierarchy process (AHP) method v. Simulation
6	Search problems as in advertisement, security and resources in government and business strategic position	i. Search and inverted search techniques ii. Simulation iii. Forecasting techniques
7	Human Resources management problems	i. Simulation ii. Markov chains analysis iii. Dynamic programming
8	Route selection: Routing problem of congestion, pipeline routing problem	Routing techniques
9	General decision problem	Decision theory, including decision trees
10	Job analysis and quality control problems	i. System analysis ii. Statistical quality control
11	Corporate strategic planning	i. General systems study and analysis ii. Simulation iii. Forecasting
12	Assembly-Line	Line balancing techniques
13	Materials Management	Inventory management techniques e.g. the use of Economic Order Quantity formula and the Variants
14	Equipment maintenance and replacement	i. Simulation ii. Replacement techniques iii. CPM and PERT
15	Transportation problems	Transportation techniques
16	Job arrangement to facilities	Job shop techniques
17	Priority Ordering	Analytical Hierarchy Process (AHP) techniques
18	New product development and promotion	i. Simulation ii. CPM and PERT

4. Other Applications of Operational Research

1. Government operational Research Service (GORS): They operate in different departments of the U.K. Government. They work with ministers in shaping their policies and improve delivery of public services. We can introduce GORS into the operations of the Nigeria Government. Let us consider the following:

a)The Nigerian Immigration service: Passport is officially N15000, but they charge between N30,000 – N35,000. The extra money goes into individual pocket.

Solution: priority ordering, Data science, etc

b) The Nigeria Prison service: money meant for feeding is diverted, money meant for welfare are diverted, prisoners are put in different stratum in the prison, but money paid by prisoners in special classes end up in the pocket of few warders

2. Supply Chain Management (SCM)

SCM is the process of planning, implementing and controlling the operations of a supply chain in an efficient way. Supply chain planning is the process of allocating resources over a network of interrelated locations with the goal to satisfy customer requirement (service level, demand). It spans all movement and storage of raw materials, work –in – process, inventory, and finished goods from the point origin to the point of consumption. According to Stefan Nickel, Operations Researchers support supply chain planning by developing adequate mathematical optimization models and providing suitable solution procedures. Global supply chains are faced with variety of potential risks. The up- and – down movements in oil prices or volatile exchange rates challenge as currently being experience in Nigeria is a problem.

3. Decision models and predictive analytics according to Eva K. Lee are playing fantastic roles in advancing and transforming the healthcare delivery system. Many problems can be formulated into mathematical models and can be analyzed using sophisticated optimization decision analysis, and computational techniques. In Nigeria today, the sector is near collapse as result poor statistics, lack of planning, poor implementations of plans, weak system, poor medical facility, etc.

4. An emerging research area of OR which is known as Behavioral Operational Research (BOR). The goal of OR is to facilitate thinking and problem solving. Behavioral issues are always present when supporting human problem solving by modeling. The research in BOR ranges from studies on how behavior is captured in OR models to how to identify and avoid undesirable behavior effects (Raimo P. Hamalainen.

5. Search methods for multi – objective mixed integer programming

Many real world problems involve multiple objectives, finding a feasible solution that simultaneously optimizes all objectives is usually impossible. In practice, decision makers want to understand the trade- off between objectives before choosing a suitable solution. The objective of multi objective optimization is to generate many or all efficient solutions, ie. solutions in which it is impossible to improve the value of one objective without a deterioration in the value of at least one other objective. Martin Savelsbergh

6. Dynamic Programming: The hottest debate in Nigeria now is whether or not to sell national assets. Markov and semi –Markov Decision Processes may assist in solving the problem. Infact, the Markov and semi – Markov decision processes models can be applied to a variety of developmental problems such as: Maintenance, investment, production, medical care demands, replacement, etc.