

OPERATION RESEARCH AND ITS APPLICATION.



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INTRODUCTION.

- ❑ **Operational Research is the scientific study of operations for the purpose of making better decisions.**
- ❑ **Operations Research is an Art and Science.**
- ❑ **It is a science which deals with problem, formulation, solutions and finally appropriate decision making.**
- ❑ **It is most often used to analyze complex real life problems typically with the goal of improving or optimizing performance.**

WHAT IS OPERATIONS RESEARCH?

□ Operations

The activities carried out in an organization.

□ Research

The process of observation and testing characterized by the scientific method. Situation, problem statement, model construction, validation, experimentation, candidate solutions.

□ Operations Research is a quantitative approach to decision making based on the scientific method of problem solving.

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- ❑ **Operations Research is the scientific approach to execute decision making, which consists of:**
 - ❑ **The art of mathematical modeling of complex situations.**
 - ❑ **The science of the development of solution techniques used to solve these models.**
 - ❑ **The ability to effectively communicate the results to the decision maker**

TERMINOLOGY.

- ❑ **The British/Europeans refer to “Operational Research”, the Americans to “Operations Research” - but both are often shortened to just “OR”.**
- ❑ **Another term used for this field is “Management Science” (“MS”). In U.S. OR and MS are combined together to form “OR/MS” or “ORMS”.**
- ❑ **Yet other terms sometimes used are “Industrial Engineering” (“IE”) and “Decision Science” (“DS”).**

HISTORY OF OR.

- ❑ **Operational Research has been existed as a science since 1930's when it began in a systematic way.**
- ❑ **But as a formal discipline Operational Research originated by the efforts of military planner during World War II .**
- ❑ **70 years ago it would have been possible to study mathematics, physics or engineering at university it would not have been possible to study OR.**

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- ❑ In the decade after World War-II the techniques began to be applied more widely in problems of business, industries and societies.**
- ❑ Since the time Operational Research has expanded into a field widely used in industries ranging from petro-chemical to airlines, finances, logistics and government.**
- ❑ Now it has become an area of active academic and industrial research.**

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- ❑ **The techniques of Operational Research have been applied and proven in many industries under different names.**

For instance :-

- **'Lean' in manufacturing.**
- **'Supply Chain' in logistics and**
- **'Yield Management' in airlines**

PROBLEM SOLVING AND DECISION MAKING.

□ 7 Steps of Problem Solving

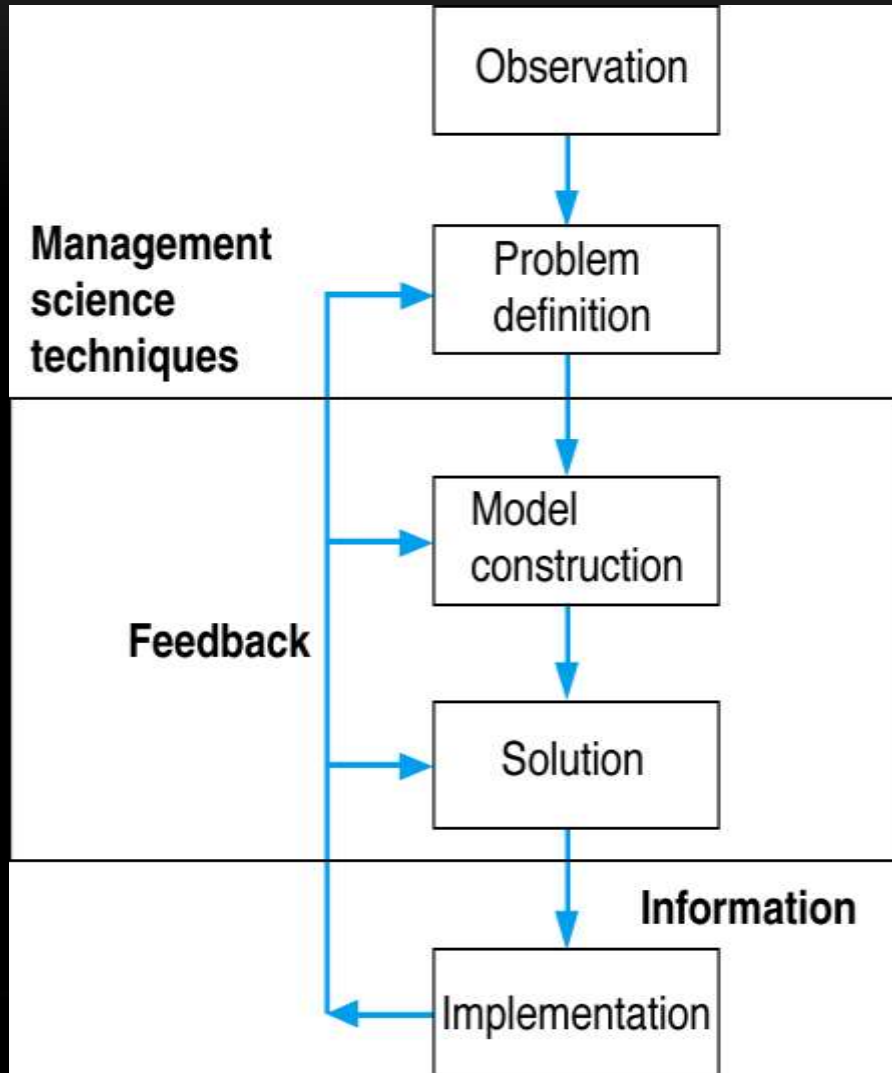
(First 5 steps are the process of decision making)

1. **Identify and define the problem.**
2. **Determine the set of alternative solutions.**
3. **Determine the criteria for evaluating the alternatives.**
4. **Evaluate the alternatives.**
5. **Choose an alternative.**

6. **Implement the chosen alternative.**

7. **Evaluate the results.**

MANAGEMENT SCIENCE APPROACH.



Observation

- Identification of a problem that exists in the system or organization.

1. Identify and define the problem.

- ❑ **“Right solution” can not be obtained from the “wrong problem.”**
- ❑ **The first and most important stage of the work is defining the problem well.**
- ❑ **This phase helps examine the problem at hand quantitatively.**



2. Determine the set of alternative solutions.

□ Development of the functional mathematical relationships that describe-

✓ **Decision variables**

✓ **Objective function**

✓ **Constraints of the problem and**

✓ **Non negativity condition**



3. Determine the criteria for evaluating the alternatives.

❖ A good solution must be measurable, easy to implement and sustainable.

❖ To determine effectiveness of proposed solution two designs are used-

(a) quasi-experimental design.

comparison of situations before and after the solution.

(b) true experiment.

comparison of outcome between experimental and control groups.

4. Evaluate the alternatives.

- This phase obtains an optimal solution for the model by using various techniques.

✓ Various Techniques/Methods;

1. **Linear Programming Problem (LPP)**
2. **Transportation Problem (TP)**
3. **Assignment Problem (AP)**
4. **Simulation**

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- ❖ **Model Development (Models are representations of real objects or situations).**
- ❖ **Forms of models are;**
 - 1. Iconic models are physical replicas (scalar representations) of real objects.**
 - 2. Analog models are physical in form, but do not physically resemble the object being modeled.**
 - 3. Mathematical models represent real world problems through a system of mathematical formulas and expressions based on key assumptions, estimates, or statistical analyses.**

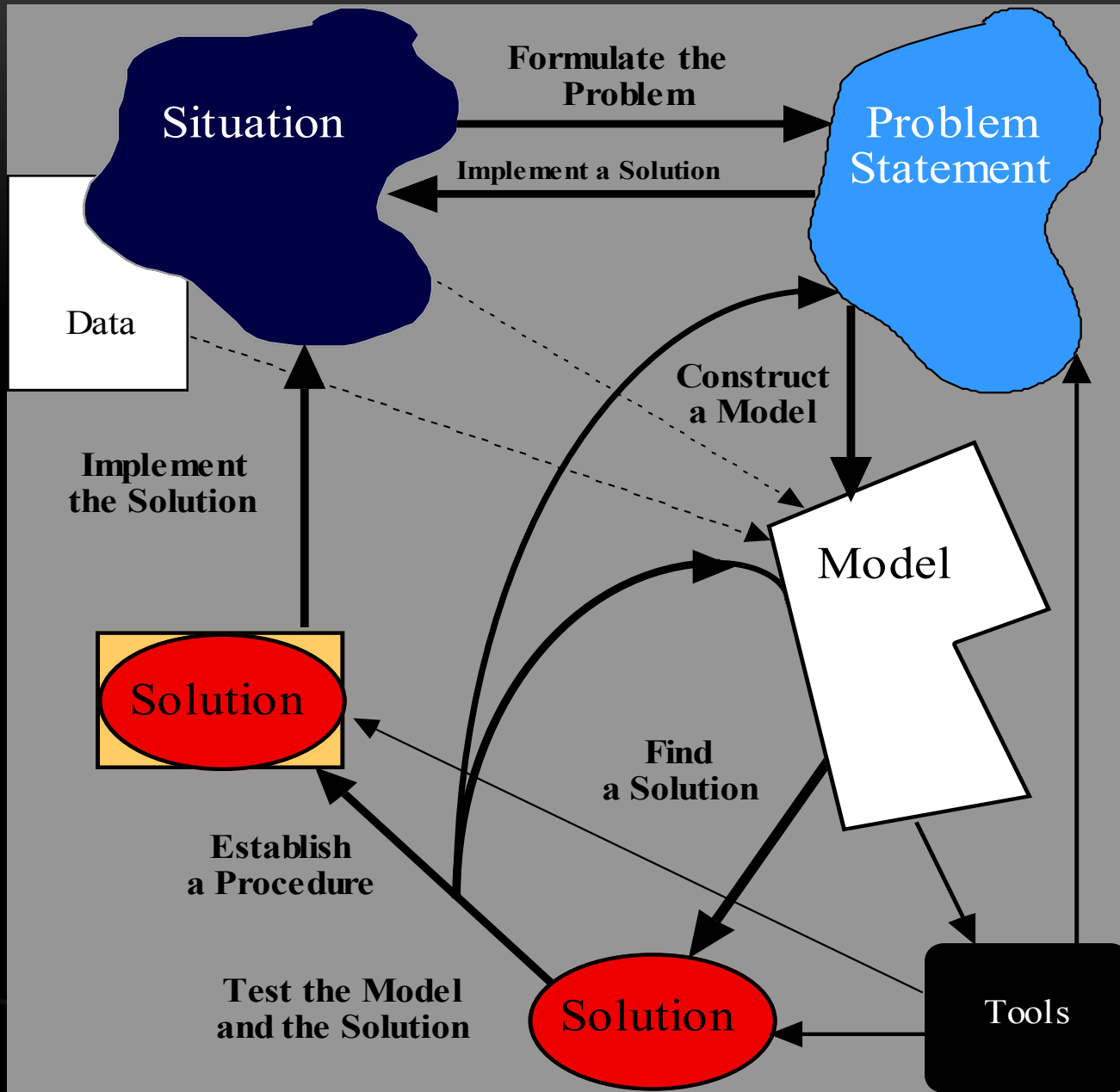
5. Choose an alternative.

➤ *Testing Of The Model Solution.*

- **Before the application of the model solution, the validity of model and reliability of the solution should be tested.**
- **Validity of the model can be decided by comparing its outputs with the results of past**

6. implementation.

- ❑ **A solution to a problem usually implies changes for some individuals in the organization.**
- ❑ **Implementation of the solution obtained from a validated model is a reliable solution to the real-life problems**



FEATURES OF OR

- 1. Decision-making** - Every industrial organization faces multifaceted problems to identify best possible solution to their problems. OR aims to help the executives to obtain optimal solution with the use of OR techniques. It also helps the decision maker to improve his creative and judicious capabilities, analyze and understand the problem situation leading to better control, better co-ordination, better systems and finally better decisions.
- 2. Scientific Approach** - OR applies scientific methods, techniques and tools for the purpose of analysis and solution of the complex problems. In this approach there is no place for guess work and the person bias of the decision maker.

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- 3. System Approach** - The main aim of the system approach is to trace for each proposal all significant and indirect effects on all sub-system on a system and to evaluate each action in terms of effects for the system as a whole.
- 4. Use of Computers** - The models of OR need lot of computation and therefore, the use of computers becomes necessary. With the use of computers it is possible to handle complex problems requiring large amount of calculations.

OBJECTIVES.

- Decision making and improve its quality.
- Identify optimum solution.
- Integrating the systems.
- Improve the objectivity of analysis.
- Minimize the cost and maximize the profit.
- Improve the productivity.
- Success in competition and market leadership.

SCOPE OF OPERATIONAL RESEARCH.

1. National plans and budget.
2. Health care services and National Health Programs.
3. Government development and public sector unit.
4. Industrial establishment and private sector unit.
5. National defense services.
6. Research and development in engineering.
7. Public works department.
8. Business management.
9. Agriculture and irrigation projects.
10. Education and training.
11. Transport and communication

METHODS.

➤ Despite the number of technical labels most projects of Operational Research apply one of three broad groups of methods :-

1. Simulation methods.
2. Optimization methods.
3. Data-analysis methods.

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1. Simulation method.

It gives ability to conduct sensitive study to -

(a). search for improvements and

(b). test the improvement ideas that are being made.

2. Optimization methods.

Here goal is to enable the decision makers to identify and locate the very best choice, where innumerable feasible choices are available and comparing them is difficult.

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3. Data-analysis methods.

- **The goal is to aid the decision-maker in detecting actual patterns and inter-connections in the data set and**
- **Use of this analysis for making solutions.**
- **This method is very useful in Public Health.**

COMPONENTS OF OR-BASED DECISION SUPPORT SYSTEM

- Data base (nurse profiles, external resources, rules)
- Graphical User Interface (GUI); web enabled using java or VBA
- Algorithms, pre- and post-processor
- What-if analysis
- Report generators

EXAMPLES OF OR APPLICATIONS.

❖ Examples of where OR has been successful in recent years are the following:

1. Airline Industry (routing and flight plans, crew scheduling, revenue management);
2. Telecommunications (network routing, queue control);
3. Manufacturing Industry (system throughput and bottleneck analysis, inventory control, production scheduling, capacity planning);
4. Healthcare (hospital management, facility design);
and
5. Transportation (traffic control, logistics, network flow,

APPLICATION AREAS OF OR.

- Strategic planning
- Supply chain management
- Pricing and revenue management
- Logistics and site location
- Optimization
- Marketing research
- Scheduling
- Portfolio management
- Inventory analysis
- Forecasting
- Sales analysis
- Auctioning
- Risk analysis



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British Airlines transportation.

One of the most challenging as well as rewarding application areas of O.R. has been the airline industry. Never before have so many people or products needed to be moved around the world. As passengers and consumers we expect everything to run smoothly whether we are flying on holiday or travelling to school, university or work.

Operational Research gets involved in a whole range of decisions here starting with the whole booking process where O.R. is involved in helping to set the ticket prices and calculate the seat availability through to the flights logistics on the day. O.R. has a massive part to play in

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Ticket pricing.

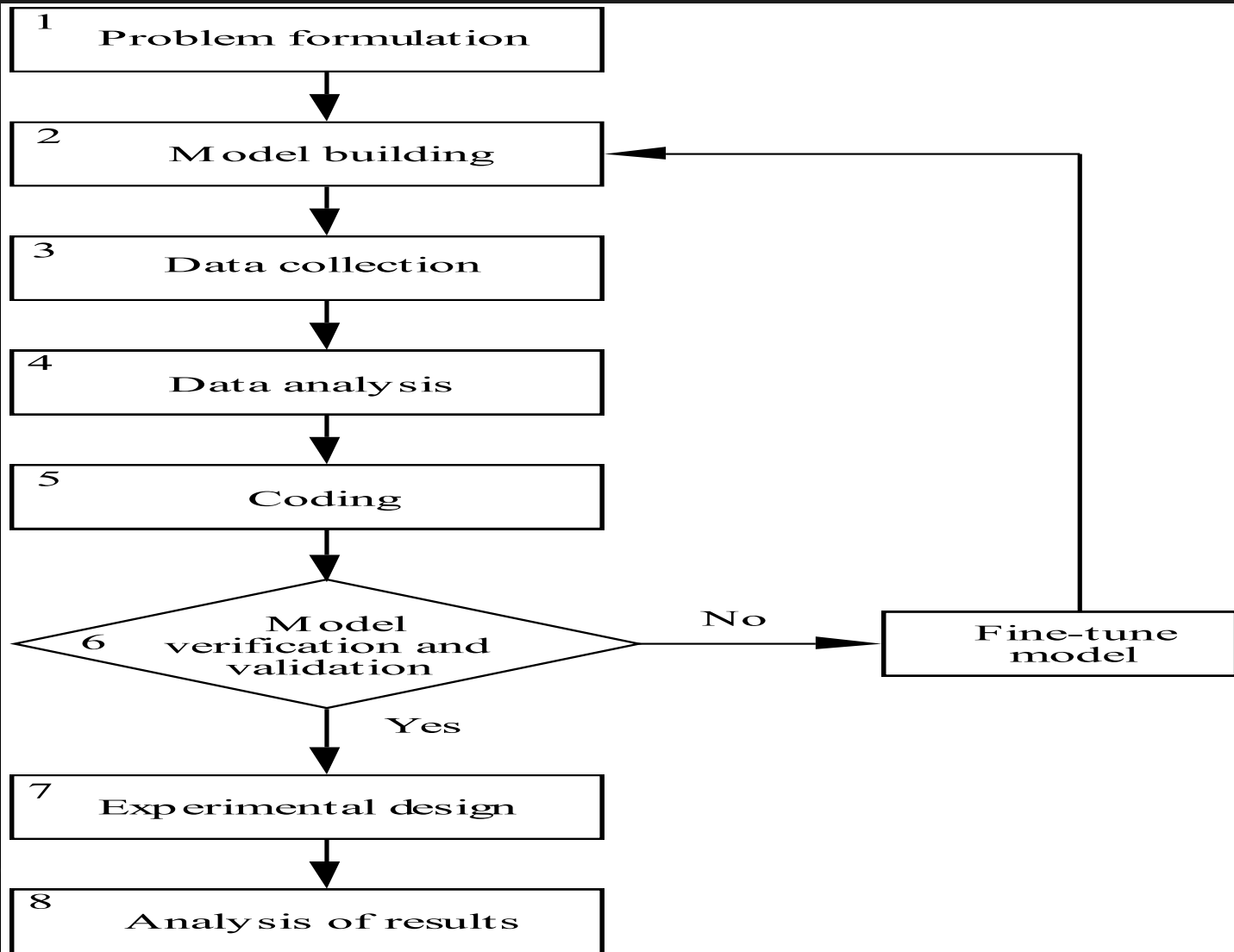
There's one challenge that every airline faces: Seats on any flight are perishable – once the plane has taken off, there is no possibility of selling any empty seats. This being so, it pays an airline to fill a seat, even at a very low fare, rather than have it take off empty. But obviously it isn't viable to sell every seat at a low price, so a 'model' has to be found for selling seats at different prices.

The real skill comes in working out how many tickets to sell at each fare. Ideally, on any flight, the airline would first like to see how many people are willing to pay the highest price, sell as many tickets as possible to them, then sell as many as possible at the next highest price,

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This is where the airline uses O.R. By observing the day to day variations in the number of high priced tickets sold, the number of seats that need to be reserved to give high fare passengers the best chance of being able to get on the flight can be estimated. In addition the profile of bookings – how bookings come in over time - is monitored on a continuous basis, compared with the typical profile for the flight, and the number of seats held back is adjusted according to whether bookings are heavier or lighter than the typical profile

Steps in OR study.



PROCTER & GAMBLE SUPPLY CHAIN.

- ❑ Problem: To ensure smart growth, P&G needed to improve its supply chain, streamline work processes, drive out non-value-added costs, and eliminate duplication.
- ❑ Strategic Objectives and Requirements: P&G recognized that there were potentially millions of feasible options for its 30 product-strategy teams to consider. Executives needed sound analytical support to realize P&G's goal within the tight, one-year objective.

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- **Model Structure**: The P&G operations research department and the University of Cincinnati created decision-making models and software. They followed a modeling strategy of solving two easier-to-handle sub problems:
 - **Distribution/location**
 - **Product sourcing**

- **Project Value**: The overall Strengthening Global Effectiveness (SGE) effort saved \$200 million a year before tax and allowed P&G to write off \$1 billion of assets and transition costs.

CONCLUSIONS.

- It tell how decision-making problems are characterized.
- What a model is and how to assess its value.
- How to go from a conceptual problem to a quantitative solution.
- Operational Research needs to be integrated as an essential part of monitoring and evaluation efforts.

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Thank
You