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Significance of Operations Research in Human Resource Management

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ABSTRACT

A deeper look into the usage of operations research techniques and their effects on human resource management in a method proving to be beneficial through various trials and streamlining the allotment of limited resources in human resource management.

Keywords— *Operations Research, Human Resources Management, Optimized, Queuing, Linear Programming*

1. INTRODUCTION

An astounding number 98% of organizations fail to apply the best available practices while making decisions. This was the inference made from a study of over 500 managers and executives, shedding light on the fact that we are in dire need for better and optimized decision making in our day and age. There are several complications that we face in the workplace because of inept decision making, like incomplete information, conflicting interests, limited resources, high cost of technology, competitive pressure and energy consumption.

If we focus specifically on Human Resources, the significance of the Department is undisputed, its role critical for the symbiotic relationship between the employers and the employees. However, intricate research reports reveal that the majority of the HR decisions made are solely based on human judgement, making them prone to bias and error resulting in loss of morale, underutilization of resources, attrition, etc.

This is where **Operations Research** comes into play, OR helps one to determine the most optimal course of action among several options available. In order to do this, we would have to create a mathematical model which can help us bring a relation to the mathematical expressions and our objectives.

Linear Programming (LP) is a mathematical technique that helps us allocate limited resources (time, energy, labour, materials) in the most optimal fashion. Here, the word optimal is in terms of performance, efficiency and profit. An example, as stated, would be: - If you Consider a situation in a company XYZ where the HR must choose the optimal number of employees in two departments to maximize the productivity of each department. But they have constraints like salary budget, work hours, training budget and system availability. Linear programming will be suitable in this scenario, or even for problems such as labour scheduling.

Another significant and useful Operations and research technique is called **Queuing theory**, it is quite literally the mathematical study of 'Queuing' or standing in queues which incorporate the service process, waiting time period, customer influx and more.

Real-life applications of Queuing cover a wide array of businesses and may be utilised for vital aspects like swift customer service, traffic flows , shipment speeds and so forth.

The purpose of this study is to show how effective Linear Programming and Queuing theory can be useful in Human Resource Management, considering it has all the conditions needed to be optimized i.e., Limited resources,budget constraints, time constraints. Therefore, the aforementioned inefficiencies in the decision making and underutilization of available resources can be reduced and options with the more optimized and fruitful results can be chosen.

2. CAUSE AND EFFECT/LITERATURE REVIEW

There are several issues in the Human Resource industry! Whether it is characterizing the industry, determining optimal staffing levels or even the analysis and forecasting of demand. While forming a solution to these, it is very important to keep in mind that workforce and capital are not unlimited! The problems that we are looking into are - The Assignment Problem and Queuing Theory We believe that by tackling these problems through linear programming, we can enhance the decision-making process and help organisations opt for the most viable result. Our objectives would be to -

- Locate the problem
- Find an optimal solution using an Operations research technique,
- Apply the solution and observe the effects, both positive and negative.

The first problem that we would like to discuss is the Human Resource allocation problem!

3. THE HUMAN RESOURCE ALLOCATION PROBLEM

Is a special problem where assignees are assigned to perform tasks. For example, assignees may be employees who need to be allocated to a specific task. Allocating employees to specific tasks is a common application of the Human Resource Allocation problem. However, the assignees sometimes may or may not be people. These can also be tools, machines, vehicles or even time slots. Such problems can be easily solved using the Linear Programming method.

However, there are some certain rules that need to be followed while trying to solve such problems. They are:

- The number of assignees and the number of works should be the same.
- Each assignee should be assigned exactly 1 work at a time.
- Similarly, each work should be done by exactly 1 assignee.
- There ought to be a boundary related with the appointee – work relationship that must be amplified or limited whilst performing the work. This is popularly known as the objective function
- The aim is to determine how all the assignments should be assigned to the assignees in order to fulfil the objective function in the best possible way.

The human resource allocation problem are further of two types:

- Balanced: If there are an equal number of columns and rows
- Unbalanced: If the given objective function of the problem is not a square matrix, the problem is said to be an unbalanced problem. In such cases, dummy rows or columns are added as and when required so that the matrix becomes a square one.

4. RESEARCH PROBLEM

Now, we face a real-world problem of assigning professors to teach classes. We are given 5 professors and they all teach the same 5 subjects. The problem lies in which faculty to assign to which respective subject. Using LP, we first create a matrix with all of the professors' efficiency ratings out of 100 (these ratings are evaluated by results, student feedback etc). In order to create the Linear Programming problem, we need to assign variables for each condition. Let i be the name of the Faculty and j be the name of the course.

The problem can be modeled as:

$$\text{Minimize } \sum_{i=1}^{n}\sum_{j=1}^{n} C_{ij}X_{ij}$$

$$\text{Subject to } \sum_{j=1}^{n} X_{ij} = 1$$

$$\sum_{i=1}^{n} X_{ij} = 1$$

X_{ij} = the assignment of teacher i to subject j

C_{ij} = the regret cost or time of assigning teacher i to

Through a series of Linear Programming calculations using a linear programming software, we arrive at the solution that maximizes efficiency and is proven to bring the best results. The solution gives us the optimal and most efficient allocation of professors to subjects. The second problem we would like to consider is the queuing theory.

5. QUEUING THEORY

is the mathematical study of queues or waiting lines? In queueing theory, a model is constructed so that the length of the queue and waiting time can be predicted. Now, in this fast-paced world, a long waiting line and unemployed personnel are a measure of inferior management. Managing a queue is a hassle for the organisation, because if the waiting time and the service time are high, then the customers might leave dissatisfied, impacting the demand and eventually the profits. The most valuable asset of any organisation is human resources and the primary source of competitive advantage for generating fundamental capabilities in any organization.

This is where Queuing theory enters the picture, one of the important aspects of queuing theory is to consider mathematical logic and analysis, of the possibility of the precise and logical deduction. The successful implementation of this technique can solve the economic and management problems, and can make a desirable vision towards implementing quantitative techniques in various fields.

6. RESEARCH PROBLEM

The staff strength plays a vital role in human resource management and inadequacy leads to decreased service rates and makes the queue sizes larger. For example, after an initial check of the Financial Department of XYZ Branch, it is found that the personnel unemployment is too long. The study is required to understand the expected waiting time of customers, and the actual waiting time in the studied department of the university, in which the gap between the actual and expected time can be analysed to know if any improvement is necessary.

For this study, two blueprints are considered. The first model, known as the descriptive model, concentrates on situation explaining and the actual problem. The second model, known as the prescriptive model, introduces the optimal behaviour for introducing the goal. In other words, it is explained how customers use queueing theory to obtain services from a system. Consumers then travel to the relevant department after waiting in the system for the desired service, and after passing the required time for the service to end, they eventually leave it.

From the fundamental features of the queueing theory, we can designate the consumer's arrival pattern, the server's service pattern, the queue discipline, the system capacity, and the number of parallel servicing channels and awareness of these features in developing a model is an unavoidable matter. The service time in a queueing procedure may be one of the probability distributions, which is a negative exponential distribution.

Multi-Server Queueing Systems - M/M/C : The M/M/C model is one of the most commonly used to analyse queuing problems. This system calculates the average waiting times and the length of the queue, given the rate of arrivals, number of servers and rate of service. This specific system works in scenarios where there are multiple channels served in a singular queue.

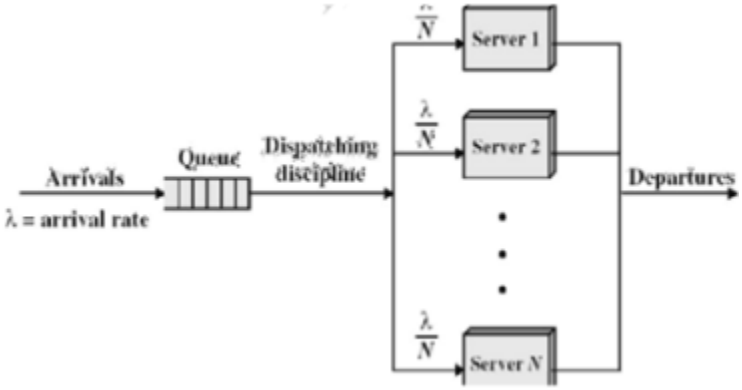

Figure.2

Figure.2 above shows a generalization of the simple model of a multi-server queueing system. If a customer/user arrives and a server is available, then the customer is allotted to that server. A waiting line is created when all the servers are unavailable. As soon as a server becomes available, a customer is dispatched respectively.

The cost of people and operators in the line is related to their waiting time in the queue. From the figure below, we can see that with the increase of staff numbers or servers, the number of queues is increased so the waiting cost in a queue decrease. The other curve shows the cost in generating a new server. The waiting cost of a queue has an inverse relationship with the number of employees. In addition, increasing the number of employees has a direct relationship with increasing employment costs as well as the cost of generating the servers and employing the new personnel. At this point, the waiting cost in a queue for applicants is equal to the cost of generating the servers and employment of personnel for the organization. With the usage of the multi-server queueing model, we give an answer to the question of what the optimal number of employees is in the considered unit. In this study the influence of changing parameters on assessments criteria and finally on total system cost are re-examined. Due to these changes the best response of cost reduction is achieved.

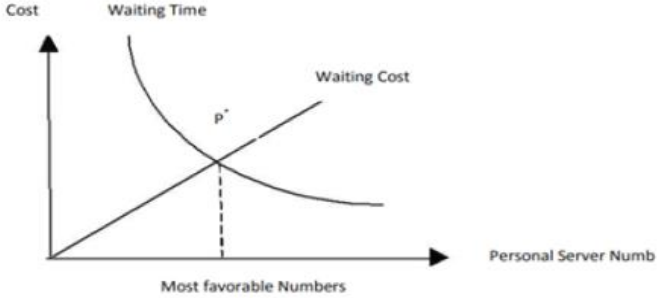

Fig: 2
Most favorable solution for Queueing Model

7. CONCLUSIONS AND INFERENCES

From both of the aforementioned research problems, it is evident that these can be solved efficiently by applying the respective Operations Research technique. Both cases showed an improvement after operating the optimised solutions. In the assignment problem, we were given a solution which assigned the best professors to the subjects of their highest expertise, this proves the competence and ability of applying Linear programming in Human resource management.

In the Queuing theory problem, the main objective was to reduce waiting time and estimate the length of the line. We were able to determine a system to reduce the wait time significantly, and also make the process move seamlessly. The queuing theory was used to recognize the optimal number of required human resources in an institution. The queue analysis is performed for different numbers of staff members.

In both problems, we were able to ascertain the problems and their cause i.e. problem of choice in the assignment problem and mismanagement in the queuing theory problem. We were then able to use the Operations research techniques to devise an optimal solution for both the issues. The main objective was to bring about a wider usage of Operations Research techniques in various sectors to boost productivity and improve the workplace as a whole.

From a business perspective, our applications show a significant boost in the human resource department, an integral unit of every organisation. By boosting this unit, the business as a whole will save more money on recruitment, experience better team chemistry and will see an overall improvement.

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