

Application of Operations Research Techniques in Human Resource Decision Making in Various Organizations

Shveni Pujari, Siddhant Vasudeva, Sidharth Kudva, Sonika Meharia, Srishti Gupta, Sukriti Pathak

Students, Anil SurendraModi School of Commerce, NMIMS, Mumbai, Maharashtra

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ABSTRACT: Human resource decision making has a marked tendency to be unorganized and arbitrary, often lacking objectivity and real structure- marked techniques and interfaces that act as guides to decision making. Almost every industry faces a variety of industry-related Human Resource management and planning problems. For e.g., the healthcare industry has been burdened with recruitment issues due to discrepancies in supply and demand of manpower, and also with the extremely large amount of workload, struggling with task allocation. Tourism industry suffers from a lack of up-to-the mark training, leading to a large amount of unskilled and untrained human resources.

These issues can be resolved by introducing objectivity and structure into the process of human resource decision through the application of Operations Research management, which when done properly can provide interfaces and solutions for every situation and crisis imaginable in the realm of HRM. This paper studies a variety of popular Operations Research techniques and procedures, their pros, cons and characteristics and their applicability in HRM crisis' to establish a clear interdependency and by extension, interface between the two fields of study.

Keywords: Operations Research, Human Resource Management, Recruitment, Training, HR Decision-Making

I. INTRODUCTION:

Human resource management boomed from the early 20th century when researchers began documenting methods for generating company value through workforce strategic management. Human resources were once dominated by transactional work such as payroll and aids

administration, but as a result of globalization, company association, technological progression, and improved research, the function has shifted to strategic initiatives such as mergers and acquisitions, talent management, succession planning, industrial and labour relations, and diversity and inclusion (obedgiu, 2017). As the HRM industry is increasing and becoming complex it is estimated that over the next seven years, the change in workforce management from millennials to baby boomers may boost HR software demand (HR Software Market Size, Share, Trend | Industry Analysis Report, 2025, n.d.). 74% intend to increase their investment in HR technology. Most businesses seek to expand their use of a human resources management system (HRMS) as a result of the cost savings and opportunities it provides (PricewaterhouseCoopers, n.d.). Realizing the progress of HR development, it is foreseen that by 2022, the worldwide HR software industry is estimated to surpass USD 10 billion. (HR Software Market Size, Share, Trend | Industry Analysis Report, 2025, n.d.)

Given the huge size and complexity of HRM, the need for research and optimization is growing at a fast pace. Application of operational research is thus helpful and necessary OR in the field of HR is a fast track to knowledge and understanding that can be used to substitute the more time-consuming and riskier path of trial and error. It entails extensive research, re-examinations, re-assessments, and revaluation. It's methodical and purposeful research that's aimed to examine carefully studied hypotheses or well-posed questions. (Yoder, 1942)

Perceiving the growth, popularity as well as issues about HRM, this research paper is formulated for searching and analyzing data to

solve HR problems or create rules and laws regulating their solutions using OR techniques. In almost every corporate setting, operations and human resources are inextricably linked. Recognizing this fact opens up numerous possibilities for significant advancements in both research and practice. The paper entails OR in HRM to reveal what works, what doesn't, what needs to change, as well as the type and scope of change. The purpose of this article is to highlight the importance of linking OR and HRM, to propose an initial organizing framework for those links, and to provide examples of past and future studies that demonstrate the benefit of those linkages. Furthermore, we have addressed the issues in HRM by using OR normative techniques to make decisions regarding personnel more systematic and parsimonious.

Using a mathematical model to optimize HRM also aids in the development of a systematic framework. Despite this, such research findings are rarely mentioned in scholarly discussions on OR, and even fewer are known by operating managers. Similarly, organizational behavioral scientists, HR managers, and industrial psychologists rarely use the OR context to determine which specific goals and ways of assigning labour have the greatest impact. Fulfilling the potential of linkages between OR and HRM will require scholars and managers in HR and OR to work together. As a result, we hope to find an audience among those involved in both disciplines. Additionally, we are targeting practitioners training for the profession, institutions of higher education, professional associations, and companies dedicated explicitly to the duties of the function.

Literature Review: The need for applications of quantitative techniques in Human Resource Management is greater than ever. It is well recognized that humans are prone to making mistakes while working without the use of rational or scientific techniques. However, the application of quantitative models can significantly increase the efficiency and effectiveness of human resources in an organization. (John Boudreau, 2002) used a variety of OR tools to formulate an interface applicable to a variety of situations to determine formulae for more efficient decision making by HR management. Another study by (Ashu A, 2018) analyses the errors in pre-existing methods of HRM and tries to present a more systematic mathematical model to measure and evaluate the discrepancies in this entire function including hiring, retaining and compensation of employees. Focusing on a specific sector, the study by (Aleksandra Marcikic, 2016)

describes how the healthcare sector is facing numerous difficulties, and how implementation of OR techniques can help solve this problem. Managing scarce human resources in this sector is the main focus of the OR techniques that have been implemented by the healthcare sector.

Moreover, aging has been noted as one of the issues in prior investigations. Many businesses are, or will be, dealing with the effects of ageing and diminishing returns. These trends will reduce the available labor in the coming years; even with stable workforce requirements, keeping the available workforce at the prescribed level will become increasingly difficult. This means that, even if the company keeps the same size, more individuals must be hired each year to meet the labor demand, putting a strain on the recruitment department (The OR in HR; Manpower Planning, 2008).

Furthermore, there is a profound evidence that some specific OR techniques can drastically improve the HRM process in organizations. Linear Programming is one such technique. The LPP methods used by the researchers can be utilized to determine the effect of human resource management decisions within the organization. The linear programming technique used by (Mariel S. Lavieri, 2008) promise applications within the organization. Their paper focused mainly on equating the supply to the demand for registered nursing in British Columbia, thus providing a guideline to policy and decision making by the government. In essence a guide to the education, recruitment and training of registered nurses and the government policies and decisions behind them. In another research by (Raj Kishore Singh, 2013), the area of personnel management in an organization is brought up. Decision making is of utmost importance and has become a cumbersome task in today's business environment. Here, an institution wants to send its teaching and non-teaching staff for an all-around development training program at the minimum costs. For this, (Raj Kishore Singh, 2013) proposes a linear programming model to minimize the training costs. The model gives the optimum number of junior and senior staff members that should be sent from each of the divisions for the training in order to minimize costs thus giving an appropriate example of applicability of Linear Programming in HRM.

In another case, (Taiwo, 2007) determines the optimal size of competent manpower which should be engaged in production organizations at a particular point of time using the Linear Programming model. This model divides the manpower into two categories of high performance

and low performance. High performance manpower has to be paid higher. Therefore, an optimal mix of both high and low performance workforce is required which this model tends to provide considering the constraints. The applicability of the model was validated with a maintenance job shop operating in Lagos, Nigeria. The attempts made by (John Boudreau, 2002) can also be incorporated into this interface. Their research paper speaks on the interdependency between the two fields of study.

Now that the usefulness of Linear Programming in HRM is known, there is one more OR technique known as Assignment Problems which is equally helpful. The research paper (William L. Tullar, 2007) provides a case of the Ajax auto company where a plant manager of the plant in Mexico assigns workers cross-trained in all the main tasks to maximize the efficiency and effectiveness of workers. It is further noted that though they are trained in all tasks the training ratings are different for each worker in each task. Their model outcome was the assignment of tasks to the best possible worker and achieving optimality thereafter. In his study, (Teow, 2009) uses some practical yet simple solutions to increase HRM in hospitals. Firstly, he studies the overflow of patients in the ward. He uses LPP and assignment problem method to assign specialties an equitable bed and according to the future needs of specialists' future growth. In the second application, (Teow, 2009) studies outpatient appointment schedules over the last 50 years. He suggests that clinics can place follow-up patients above first-visit patients. These techniques can certain the time invested on each patient by specialists hence increasing their efficiency.

Besides these two techniques, Simulation Modeling Approach to Human Resources Management has also gained prominence. This Research paper by (Marjana Merkac Skok, 2013) proposes usage of the application of system simulation methodology to the investigation of the burnout effect and the learning of the consequences of the burnout effect. Several experiments have been conducted and presented which indicate increase and collapse behavior in case of burnout experience by the individual. Multiple experiments conducted with this model indicate a significant burnout effect in multiple situations. One more research by (Appelman, 2014) shows that job simulations are becoming more and more fashionable employers because they're going to help companies more accurately predict whether or not they're going to hire candidates. For example, for the position of secretary, the job simulation may

involve accurately entering paragraphs and filling out forms. Work simulations can also assess interpersonal skills, such as resolving complaints from enthusiastic customers.

As a result, there exists a solid evidence that OR techniques improve the Human Resources Practices in the organization. Recruitment and Selection, Training and Development, Performance Appraisal, Rewards and Recognition, Organizational Environment, Employee Engagement, and Organizational Loyalty are all HRM practices that help the organization meet its targets and goals and the use of OR techniques can certainly make an impact on these processes.

Research Objectives:

- [1]. Bringing structure to all human resource activities including recruitment, selection, training, task and resource allocation using OR techniques.
- [2]. Quantifying Human Resources directives and objectives to bring objectivity to Human Resource activities.
- [3]. Using linear programming, assignment problems and system simulation techniques to establish a reliable and consistent framework for decision making in the realm of Human Resources.

Methodology: This paper discusses the importance of the preparation of a defined mathematical model using OR techniques in human resource management. Using secondary research, we learned that there are times when prejudices abound throughout the training, selection, and other processes, all of which come at a significant cost. As a result, we laid out different OR techniques that can be applied to avoid biases and make it fairer and systematic. OR techniques can optimize the problem and minimize the cost. We broke down problems into essential components and after that resolved them in characterized steps by scientific analysis.

Analysis and Findings: Human Resource Management is a wide area and a very important function of an organization. A few point by point investigations in HRM uncover that enlistment, preparing, allotment, career improvement, progression arranging, workforce arranging and other forms in numerous companies are based on sole human judgments. As it is human nature to make mistakes, the scope of error in this entire function is a lot greater. Therefore, quantification has become the need of the hour in HR decision making.

Recruitment is an important element of HR process. This is the process of recruiting the best employee for your organization based on their set of skills. Since this process is for the humans and dealt by humans, mistakes, whether intentional or unintentional can be made. Some of the reasons HR recruiters make mistakes are personal bias, conflicting opinions and HALO effect. Faulty decisions and human errors can be skill-based, knowledge based or rule based and cost of such errors can cause organization unbearable losses. Thus, it becomes extremely necessary that decisions regarding various aspects of human resource should be made with a proper defined model.

LPP, a mathematical modeling technique, can be used to avoid traps of faulty decisions. LPP can help minimize errors. It can be used to develop a framework to help in decision making regarding human resources. With the help of model, the recruitment and allocation of employees can be done efficiently. This model can help in reviewing performance of employees regularly and deciding the promotion and incentives.

It is an obvious fact that the companies incur huge amount to conduct all the activities of human resource management mentioned above. As per Society for Human Resource Management, the average cost per hire for companies was \$4,129 (ALEXANDRIA, 2016). Organisations, whether operating on a large scale or a small scale need human resources and their efficient utilisation.

Linear Programming can bring structure to various activities under the helm of human resource management. For instance, if we take recruitment, as said it is one of the most important aspects of this function. Boston Consulting Group research revealed that recruitment has the major impact on a company's revenue growth compared to any other aspect (Dana Pessach, 2020) However, the costs involved are generally a major portion in proportion to the revenue of the firm. So, it becomes of utmost importance to have a model in place which can keep the costs of this activity in check while ensuring that the most appropriate resources are recruited.

With the help of Linear Programming, we can construct a model where the objective function is to minimize the recruiting costs for the selection of people for various roles. Some of the constraints can be the number of rounds to be there in the whole process, maximum costs to be incurred for each round, maximum number of days available for the completion of the process, minimum qualifications required and minimum experience

required in that field. Thus, a solution can be obtained where all the constraints are met and the cost comes out to be minimum.

Similarly, linear programming can be used to formulate models in the arena of personnel development and training, workforce scheduling and compensation and benefits. Here, the models can again have the objective of minimizing costs with subject to different constraints in different arenas. The optimum solution can be found out and thus, will lead to a positive impact on the organisation's other functions. Therefore, standardization and structure can be given to a lot of such processes in the organization where the human involvement is a major factor through Linear Programming.

Another major OR technique which is the Assignment Problem technique has been an integral part of Human Resource management and have a major application in the field of Human Resource decision making. The goal of AP is to assign/appoint workers to perform tasks (usually jobs) and maximize overall efficiency or minimize overall cost/time. Assignment problem techniques such as the Hungarian Assignment method can help optimize these decisions to achieve maximum efficiency. This can be done by considering any and all possible parameters of measuring efficiency: time taken, cost, profit, sales quantity, sales revenue etc.

Qualitative variables and parameters in the context of these decisions also receive representation. These can be ranked by relevant judges such as the employees or management personnel. As long as the number of employees equals the number of tasks at hand, (not fulfilling this requirement is not a problem either and can be solved by dummy employees/tasks) the Hungarian Assignment method can be used to make the best decisions of task assignment, resource allocation, optimizing assembly lines, etc.

However, the results and the advice generated by the Hungarian Assignment method should act as just that: advice. It should be used by HR managers and organizing management as a guide and a framework rather than rigid and religious must-follow material. For e.g., while the results of the method may provide a certain allocation, it must be considered whether or not such an allocation is feasible and for this purpose, the human resources themselves must be consulted to incorporate more human elements into the solution. Thus, tools like prohibited routes must be used effectively. If these measures were followed,

Assignment problem techniques- more specifically Hungarian Assignment method could become a valuable asset and procedure in the constantly developing interface between HRM and OR. Therefore, this technique can serve as an important standardization tool for HR decision making.

System simulation is a set of OR techniques used by computers to simulate the operation of various tasks or processes in the real world through simulation. Computers are used to generate numerical models to describe or display the complex interactions between multiple variables in the system. Job simulations are becoming really important today. For example, for the waitress position, the simulation may involve correctly accepting false customer orders or processing checks. (Appelman, 2014)

Job simulation has a lot of benefits. There is a higher predictive validity which means candidates are more likely to do a good job if they score high in the job simulation. Secondly, candidates have a better understanding of the job. In the simulation, candidates will be exposed to the tasks they will perform and be able to determine whether they like the job or not. Thirdly it ensures fairness. Since the simulation is work-related, job seekers can immediately understand the relationship between the test and work, and believe that the evaluation process is fairer than other employment tests.

From the above, it can be found out that these OR techniques can help the HR department to provide better explanation and answers to a lot of questions. Firstly, these techniques help understand more logically as to what is happening within an organization and why is it happening. Secondly, it puts further better information about people while creating a link to overall business performance. Thirdly, it helps in easily assessing issues while driving continuous improvement. Therefore, the use of quantitative techniques in such functions such as HRM should be propagated since they allow firms to track HR program's effectiveness while also delivering actionable information, insights and data about the function's effectiveness as well as efficiency.

Conclusion: Our attempt at studying and analyzing Operations Research techniques and their application in the field of Human Resources Management has helped us identify a strong interdependency between the two fields of study. Operations research brings objectivity and streamlines decision making within human resources making it more considerate of Quantitative organizational variables.

During the course of the study, we analyzed three very important techniques of Operations Research: Linear Programming, Assignment Problems with a focus on Hungarian Assignment Method and System Simulation. Each of these techniques have their pros and cons and varying levels of applicability in different situations of Human Resources decision making.

Linear Programming is obviously the close ideal decision for boosting or limiting any evaluated objective like deals, benefit, income, cost, time taken to finish a job. Assignment Problems are ideal for application on the factory floor and in large, complex organizations where there are a large number of employees to be assigned to a large number of tasks (or jobs) of the organization and finally system simulation which has become more popular than ever and increasingly accurate in predicting tasks and processes and the outcome of simulated situations. These methods used are diverse and almost universally applicable in nearly all fields of HRM, as long as the right parameters, rules and constraints are firmly set.

Taking everything into account, these strategies for streamlining human asset dynamic with Operations Research enjoy a ton of benefits as we became more acquainted with here. Be that as it may, anticipating that any one of these methods should work in each circumstance is just off-base and insignificant. Shaping the right interface between the two fields to build up their between materialness and association includes drawing from every single legitimate/pertinent discipline any place and at whatever point important. Indeed, a solitary choice might utilize various instruments, each apparatus taking care of one specific perspective or issue of the entire circumstance.

Limitations: The research lacks a humanistic approach and social reality due to the absence of research and analysis in qualitative data on human resources of various organizations. We have taken a general view of human resource management in our research. However, this function can vary drastically across organizations right from recruitment to compensation. Thus, there might be instances where the applicability of the findings is hampered. While collecting and analyzing information, maintaining the security and privacy of data is a major concern. Developing a system to prevent unauthorized access can lead to greater cost thus preventing universal applicability of OR research. Moreover, in the research, we talked about various indicators and constraints we can use to reduce the costs of HRM, but we couldn't

practically showcase it through OR techniques due to the unavailability of real data.

Recommendations: Researching the applications of operations in human resource management using primary data. Gaining primary data on numerous organizations from multiple industries in order to gain a sense of more practicality into the research. The application of operations research on human resource management could be studied better by using quantitative techniques using figures derived from primary research. Using other contemporary techniques than Linear Programming, Assignment Problems and System Simulation to study the application of operations research in human resource decision making.

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