

**OPERATIONS RESEARCH MODEL FOR MANPOWER PRODUCTIVITY
ENHANCEMENT IN INDUSTRIES**

Sapna Shrimali and Govind Shay Sharrma

Department of Mathematices, Pacific University (Udaipur)

ARTICLE INFO

Article History:

Received 17th May, 2017

Received in revised form 12th

June, 2017 Accepted 9th July, 2017

Published online 28th August, 2017

Key words:

Productivity, Assignment,
Enhancement, Man power

ABSTRACT

In this paper, we have discussed the job assignment problem in Industries for enhancement the productivity. The purpose of study is to find the role of Operations Research techniques for made a job assignment model which help to increase the labor productivity and cost reduction with respect to time. The paper present that the groups for execute the work in industries can done the job with different efficiency which affects the machine running time. In paper we show the practical issues and rectify these types of problem with the enhancement of skills of man power. We analysis the practically production rate with the running time of machine.

Copyright©2017 Sapna Shrimali and Govind Shay Sharrma. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

The available resources such as Men, Machines, Material etc. have varying degree of efficiency So the utilization of resources is critical task for current scenario. The problem is that how the resource allocates so it can perform maximum. There is wrong assignment may be create big trouble for Management.

Nathan Betts & Francies J.Vasko [1] presented simplest way to solve more general Linear programming problem & Job assignment problem. Linear Programming is one of the strongest techniques which can be used by Managers to solve problems considering / subject to the settings of the problem. According to Maryam Solhi Lord & Samira Mohebbi Bazardeh [2], the managers are trying to maximize their profit on one hand, and minimize their costs on the other. Hoong Chuin Lau [3] presented polynomial algorithms to solve special case of the problem and show how they can be deployed to solve more complex versions of the shift assignment problem. Akinyele Samuel Taiwo [4] applies Linear programming [LP] model for effective size of man power to be engaged. The study deal with the production capacity / demand rate of operation in to the model to reflect the reality activities in production organization.

Asa Holm [5] studied the man power planning for airlines crew scheduling. A Linear programming model was formulated based on the aforementioned knowledge levels

with the inclusion of variables such as productivity of workers, product demand, cost of hiring manpower, training cost of manpower and the number of available workers at different stages of knowledge development in intensive operation.

VentepakaYadaiah, V.V Haragopal [6] propose an algorithms for solving multi-objective assignment problem through Hungarian algorithms and objective function by minimizing the resources. S.K Amponsah, D.otoo, S. Salhi [7] find the minimum penalty method as Hungarian method for optimize cost. The problem of multi-choice Linear programming cannot be solved directly by standard linear or non linear programming techniques, so transform such problems to a standard mathematical linear programming problem, Study by Tarek A. Khali & Yashpalsingh [8]. Jaseung hoi, David [9] study productivity growth in the transportation industries in United States. Manpower planning approaches and techniques studied by Dharamveersinghparamar and Dr. PrashantMakwana [10]. A model for skill of manpower presented by B.Kareem [11]. This study movement of manpower from one knowledge grade to another by training & skill enhancing. According B.Kareem and A.A Aderoba [12] Linear programming model was formulated based on the outcomes of the analysed data. The data analysed includes maintenance budget, maintenance cycle, production capacity, and waiting time of production facilities.

Case Study of Small Industry

The study of the small manufacturing industry which produce the Zn dust powder on the demand basis. The demand of the industry base on the chain industry product

*Corresponding author: **Sapna Shrimali**
Department of Mathematices, Pacific University (Udaipur)

production. The product of manufacturing industry use as reagent for next chain industry. The capacity of the industry 36 MT/ day & demand for chain industry as reagent is 27 MT/day. The industry is running 24 hours & having the three furnaces which capacity are 12 MT/day each. The plant is running in shift basis & manpower available for the all shifts. There are 19 manpower in plant whose are responsible for operation & maintenance. In plant 2 executive in general shift whose one is responsible for operation planning & one is for resource planning. There are 4 skill manpower can be call plant shift in charges & remaining are unskilled manpower can be call workers. Each shift having the different production rate according to demand. There are required 5 manpower in 'A' shift, 4 manpower in 'B' shift & 3 unskilled workers in 'Night' shift. Each shift having the individual production shift in charge who having the responsibility for each activity of plant relates to production. The general in charge is accountable for production & another executive for resources like raw material, machine planning, & manpower. The cost of unskilled manpower working in shift 475 Rs / shift, they accept the extra duty charge rule. In case After completion their duty hours if they stay in plant extra, management have to pay double remunerate.

The production on monthly basis data shown in the following table:-

Table 1

Month	Zn Dust Production	Running Hrs.	KWH/MT
Jan-16	810.959	1485	522
Feb-16	731.859	1388	532
Mar-16	817.433	1501	491
Apr-16	530.483	904	511
May-16	439.076	784	549
Jun-16	596.995	1107	515
Jul-16	600.429	1118	513
Aug-16	753.968	1410	512
Sep-16	986.703	1870	493
Oct-16	965.738	1792	490
Nov-16	1025.121	1910	484
Dec-16	1079.941	2027	485

With focus on the production report first half year, unit not performed as per the management expectation. The table shows the production on monthly basis with running hours of three furnaces units. The first six month shows the running hours were low & the power consumption was higher side with respect to production. This was the major concern for the industry that the breakdown was higher side and due to the breakdown power consumption was also higher than expected. Power loss was also affect on COP of plant. This means that the resources were not giving the desire results. With analysis the breakdown factor, there were three types of breakdown mainly likely Furnaces, Bag filter & compressors. So for improve the plant efficiency, management applied the Job assignment techniques. The unit drive the project for find out the skill of manpower and enhance their skills. So can be applied the Job assignment technique of Operations Research.

The Difference of skill and unskilled Manpower base on technical work. Skill manpower engage in maintenance work and do the PMI of machine like compressor, bag filter cleaning and furnace PMI etc. The 'A' shift manpower divides in two team, which include one skill manpower and two unskilled manpower in each team. Each team is expert for particular work. The planning is done by general in charge of operation who distribute the manpower according to work.

Furnace & Compressor PMI work almost take in 'A' shift and bag filter PMI take in 'B' shift. The criticality of machinery that these machines are in series so if one machine in breakdown the plant production be zero. So according to management any breakdown & delay in time very critical. There are three types of machine compressor, furnace, & bag filters and three teams are there A, B & C. According to the assignment problem model can be represent the time cost matrix

Team/jobs	Compressor PMI	Furnace PMI	Bag Filter PMI
A	4	6	5
B	3	7	5
C	5	7	4

By using the Assignment problem solving Method:

Step 1: Subtracting the smallest element in each row from every element of that row, We get the reduce matrix

Team/Jobs	Compressor PMI	Furnace PMI	Bag Filter PMI
A	0	2	1
B	0	4	2
C	1	3	0

Step 2: Subtract the smallest element in each column from every element of that column to get second reduced matrix

Team/Jobs	Compressor PMI	Furnace PMI	Bag Filter PMI
A	0	0	1
B	0	2	2
C	1	1	0

Step 3: Now assign the zero in row & cancelled the column zero:

Case 1:-

Team/Jobs	Compressor PMI	Furnace PMI	Bag filter PMI
A	0	0	1
B	×	2	2
C	1	1	0

If assign team 'A' first column zero then there is no zero to assign for team 'B'. So can not accept this case

Case 2:-

Now consider the second case of assign the zero

Team/jobs	Compressor PMI	Furnace PMI	Bag filter PMI
A	0	0	1
B	0	2	2
C	1	1	0

In this case all three team assign for a job. So

Job assignment A----- Furnace PMI 6 hours

B ----- Compressor PMI 3 hours

C----- bag filter PMI 4 hours

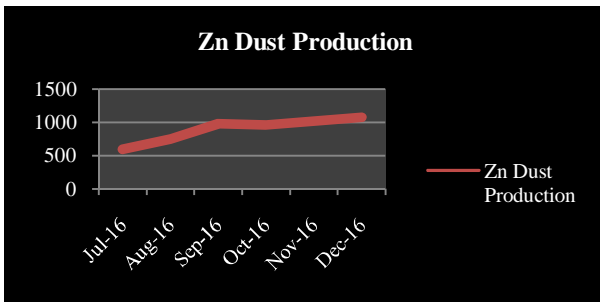
Total hours - 13 hours which minimize time to do the jobs in sequence but for plant productivity enhancement general shift operation manager plan to do all jobs parallel & call all team in general shift and assign the according to above result. So according to this the plant stoppage only for 6 hours, in this time duration they complete other jobs also. In this way to maintain the availability of plant unit decided to synchronized the all breakdown on decided day in each month & call the

experts agencies on this time. After applied these method the result were

Table 2

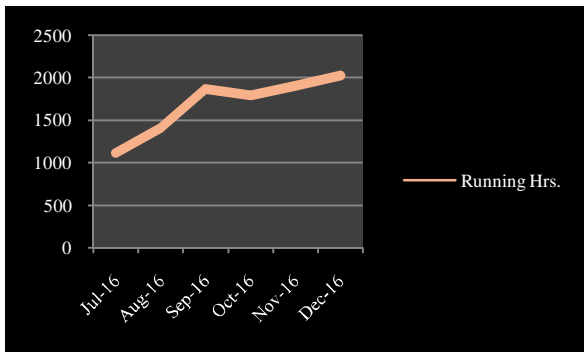
Month	Zn Dust Production	Running Hrs.	KWH/MT
Aug-16	753.968	1410	512
Sep-16	986.703	1870	493
Oct-16	965.738	1792	490
Nov-16	1025.121	1910	484
Dec-16	1079.941	2027	485

This shows the Improvement in production rate on monthly basis. Which can we shown. In this table we seen that the running hours also increased that means the breakdown reduces in plant. There we consider the breakdown that all units of the plant are in breakdown and production that time be zero. If any unit of furnace is in running condition that not be consider breakdown.



Graph-1

This graph shows the results after implementation of Job assignment techniques. & can be plot the graph of running hours improvement also



Graph 2

This graph shows the after half year there are significant increment in running hours of plant. The breakdown rate was decrease which impact on the production rate. Now we discuss on the productivity. The productivity may be measure as per the outcome from the input resources.

Productivity depends upon how labours are utilized. Labour productivity can be higher or lower depending on factors like availability of work load, material, working tools, availability of power, work efficiency, level of motivation, level of training, level of working condition (comfortable or poor) etc. Labour productivity can be measured in terms of hours or money and production metal :-

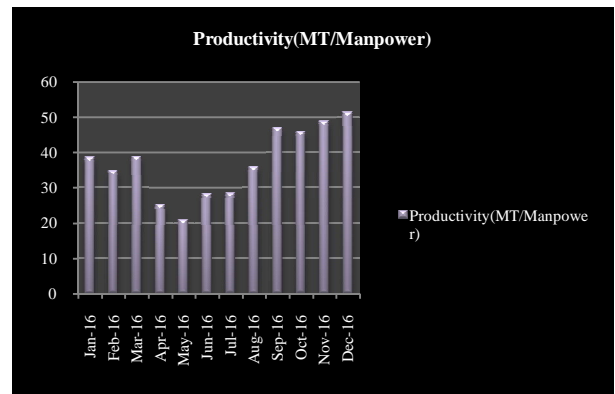
Productivity: - Total production / Total Manpower
Here we introduce the another table of productivity which shows the productivity rate against the manpower, we can

calculate the productivity with the production per man power. In this table can be easily see that after job assignment & training programmed for enhance the skills of manpower productivity increase.

Table 3

Month	Zn Dust Production(MT)	Man Power	Productivity(MT/Manpower)
Jan-16	810.959	21	38.61709524
Feb-16	731.859	21	34.85042857
Mar-16	817.433	21	38.92538095
Apr-16	530.483	21	25.26109524
May-16	439.076	21	20.90838095
Jun-16	596.995	21	28.42833333
Jul-16	600.429	21	28.59185714
Aug-16	753.968	21	35.9032381
Sep-16	986.703	21	46.98585714
Oct-16	965.738	21	45.98752381
Nov-16	1025.121	21	48.81528571
Dec-16	1079.941	21	51.4257619

Now with the help of data may be shown the result in graph



Graph 3

This plot show there is no change in the number of manpower, the manpower remains 21 in the unit but the production rate increased from the month August. This show that with the help of job assignment & proper training productivity of plant may be increased.

$$\begin{aligned} \text{Productivity increase} &= (\text{productivity last half year} - \text{productivity first half year}) \\ &= (257.70 - 186.99) \\ &= 70.71 \text{ MT /Man power} \end{aligned}$$

But we never take all the productivity enhancement due to man power because there are many factor which affects the productivity. There we may be consider the factors like Material handling & material quality, Manpower optimize & skill of Man power, Machine performance & breakdown and system reliability are the major factors which affects the productivity So we can consider 25% role of man power skills & job assignment in productivity. So there can take the

$$\begin{aligned} \text{Productivity enhancement due to man power} &= 0.25 * 70.71 \\ &= 17.67 \text{ MT/ Man power} \end{aligned}$$

$$\begin{aligned} \text{Productivity increase due to Man power assignment \& skill enhance (\%)} \\ &= 17.67/186.99 * 100 = 9\% \end{aligned}$$

This result shown the affects of Manpower job assigning & proper training given to the person according their job increase the productivity.

DISCUSSION

In summary, this paper present the Job Assignment modelling with the help of Operation Research techniques. The paper shows the utilization of Assignment model for Man power optimization & Assignment problem model for job assignment in manufacturing industries. Assignment problem discussed for proper job assignment for the crew whose having the different type of specialty in different field. This technique having the bigger role to enhance the productivity of industries.

References

1. Betts, N., & Vasko, F. J. (2016). Solving the unbalance Assignment problem: Simpler is better. *American journal of operations Research*, Vol. 6 ,296-299.
2. Lord, S. M., Bazarish, S. M., & Khoshnood, S. (2013). Linear programming Model" Linear Programming & optimizing the Resources. *Journal of contemporary Research in bussiness*, Vol.4, 11.
3. Lau, H. C. (1996). Combinatorial approaches for hard problems in Manpower scheduling. *Journal of the operations Research society of Japan*, Vol.39.
4. Jaiwo, A. S. (2007). Determination of the optimal Manpower size using Linear Programming Model. *Research Journal of business Managment*, 30-36.
5. Holm, A. (2008). Manpower planning in Airlines, Modeling and Optimize. Sweden: AVdelhing Institution .
6. yadaiah, V., & Haragopal, V. . (2008). A New approach of solving single objective unbalanced assignment problems. *American Journal of operations Research*, 2016, Vol.6, pg.No.81-89.
7. Amponsah, S. K., otoo, D., & Salhi, S. (2016). Proposed Heuristic Method for solving Assignment Problem. *American Journal of Operations Research*, Vol.6, 436-441.
8. Khali, T. K., Raghav, Y. S., & Badra, N. (2016). Optimal solution of multi choice Mathematical Programming Problem using a New technique. *American Journal of Operations Research*, Vol. 6, 167-172.
9. Choi, J., C.Robert, D., & Lee, E. (2015). Productivity Growth in the transportation Industries in United States. *American Journal of Operations Research*, Vol.5, 1-120.
10. Paramar, D. S., & Makwan, D. M. (2012). *International Conferrence on Managment, Humanity and Economices*. Phuket,Thailand.
11. Kareem, B., & Akande, S. (2012). Knowledge Graded Manpower Planning Model for the Manufacturing Industry. *Intenational journal of Engineering Innovation and Managment*.
12. Aderoba, A., & Kareem, B. (n.d.). *Linear Programming based effective maintenance and Manpower planning Strategy: A case study*. Akure, Nigeria: Department of Mechanical engineering, Federal university of Technology.

How to cite this article:

Sapna Shrimali and Govind Shay Sharrma (2017) 'Operations Research Model For Manpower Productivity Enhancement In Industries', *International Journal of Current Advanced Research*, 06(08), pp. 5442-5445.
DOI: <http://dx.doi.org/10.24327/ijcar.2017.5445.0725>
