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Research Article

OPERATIONS RESEARCH MODEL FOR ENHANCING PRODUCTIVITY OF A MATERIAL HANDLING SYSTEM

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A B S T R A C T

In this paper, we have discussed the Material Handling problem in Industries for enhancement of productivity. The purpose of study to find the role of Operations Research techniques for designing a Material Handling model which will help to increase the productivity and reduce cost. This paper presents the way to select the path and route of vehicles for safe and low cost in industries and improve the productivity.

INTRODUCTION

In last some years the material handling system have become a new complex and rapid growthing science. Guilherme Bergmann Borges Vieira, Giorena Savitri pasa, Albert Pandolfo, Gabriel Sperando & Maria Beatriz Nanes de oliveira [1] study focused on improvements in internal materials handling management, approaching the case of a large company in the automotive industry. Materials handling is intrinsically associated with product flow because of this, it has direct influence on transit time, resources usage, and service levels.

Gaurav Sharma, S.H Abbas, & Vijay kumar Gupta [2] used the transportation problem techniques to minimize the transportation cost of manufacturing industries using Dual Simplex Method. Automation concept of Material Handling in Liquor Industries is proposed by Gautam B.Ghegadwal, Ashok K.Patole, Prof. Vaishali S. Kumbhar, & Prof.Vinayak H.Khatawate [3]. Material handling systems are commonly used in almost all the industries all over the world. It is an art and a science involving moving, packaging and storing of substances in any form. In the field of engineering and technology, the term material handling is used with reference to industrial activity. Prasad Karande and Shankar chakraorty [4] proposed the right method to implement the material handling system.

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They applied weighted utility additive (WUTA) method to solve an MH equipment selection problem. As a wide variety of MH equipments are available today, selection of the proper equipment for a designed manufacturing system is a complicated task. B. Naveen and Dr. Ramesh Babu [5] suggested the Industrial Tools for improvement of productivity in manufacturing industries. Sanjoy Saha [6] studied the total factor productivity trend in India. The study attempted to estimate the aggregate Total Factor Productivity (TFP) for the Indian economy using the conventional growth accounting method. The study reveals that TFP estimates in India are not sensitive to factor shown. According to A.P. Bahale & Dr.S.S. Deshmukh [7] the Material Handling is more complex for manufacturing industries and logistics also Material Handling System (MHS) design has a direct influence on the logistics cost therefore, how to improve the efficiency of material handling system gets more and more people attention. The paper deals with a case study of ginning machine manufacturing company. Dr.Chukwueemeka Negru and Dr. John U.Ezeokonkwo [8] studied the Appraisal effects of the materials management on building productivity in south east Nigeria. According to this study the problem of material management is one of the key issues facing the building industry in Nigeria. The activities identified in the supply channel (the sourcing and transmission of purchase orders up to the control of material wastages) are considered key to materials management because they primarily affect the economy, effectiveness of material movement, productivity, optimization of profit and reduction of materials cost.

We introduce the new concept of cost and risk matrix. In any material transportation basic thing to be considered is the safer approach to convey material with lower cost.

The process prepares matrix that first give the rank of safety which further depends on the road condition and the way of transportation. In matrix we prefer the path which gives the lower marks in safety aspects. Lower marks are given to the path of transport which having minimum manual intervention. We consider that manual activities may be leads to some incidents so in material handling avoid the manual activities.

In safety matrix we give the marks from 1 to 5, there 1 leads to very safe process which may be zero probability of any incident. We provide the 2 mark means the process having low risk and 3 mark leads to medium risk. In this matrix 4 and 5 denote for the high and very high process.

Very low chance of any incident	------	1
Low and poor chance of incident	------	2
Medium chance of any incident	-------	3
High chance of any incident	--------	4
Very high chance of any incident	--------	5

If a process finds the mark 5 then we should avoid that path of transportation and try to find the substitute of this way. In case of 4 marks, we should prepare the safety analysis of the path and strictly follow the standard procedure.

In the same way we prepared the cost matrix and gave the mark from 1 to 5. In this marking, 1 means the process is cheap and having the very low cost. The marking 2 and 3 show the process having low cost. The management always tries to install the process which finds the mark 2 and 3. These types of processes have the low payback period. In this matrix 4 and 5 denote for the high and very high costly process. It is not beneficial for the industries to accept these types of material handling and transportation system. This is very difficult and challenging for the management to choose the transportation path and material handling system.

Very low cost of handling and transportation	----	1
Low cost of Transportation	----	2
Medium cost of any transportation	-----	3
High cost of any transportation	-----	4
Very high cost of any transportation	-----	5

Now we prepare the matrix which consider both the factors cost and safety.

Table 1 Cost- Safety Matrix

		Safety				
		1	2	3	4	5
Cost	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

In above matrix the table gets the marks with multiplication of the cost factor and the safety factor. The process obtaining low marks is more productive and low cost process and the same priority to the safety.

This matrix is showing with three zone i.e.

- Red Zone
- Yellow Zone
- Green Zone

The matrix having the red zone is the section achieving the marks above 15. This shows that the transportation of material is risky with aspect of cost and safety. This shows that the cost of material transportation is very high and the path of transportation is very dangerous??? (Repeat??).

The yellow zone is in between of marks 8 to 15. This may be considered as with medium level risk. In this zone the cost of transportation is not much high & the process is not much hazardous. But the process is in medium zone due to may be the cost of process low but not much safer for transportation and vice-versa. In this matrix Green zone is the best for any industry. This zone shown with the marks less than 8. In this section the cost of the transportation is in lower side. Same way the process of transportation or handling is safer than other process.

Example: For understanding the Cost – Safety matrix let us take an example of industry. The process for supply powder in each section from the 3 different units. The costs of the transportation paths are different. This cost depends on the distance and quantity of material. In this manner we prepare the cost matrix

Table 2 Cost Matrix

Plant/unit	P1	P2	P3
R1	48000	60000	55000
R2	30000	25000	35000
R3	45000	60000	40000

The cost of transportation from a unit to each plant are different which depends on the distance and path. Now we give the marks from 1 to 5 in the cost matrix. The marks in the matrix and path followed are given in consultation with management. Now we make the cost matrix as below

In cost matrix (Table-3), R1 unit transport the power in all plants with the different costs. We see that R1 to P2 transport cost is in higher side so give the marks 4 and R1 to P1 cost is lower in compare of all plant where supplied the power from R1 unit. So we can give 2 marks to P1 plant. There is a compulsory factor that each unit will supply to a plant only. So with this steps we make the cost matrix

Table 3 Power-Cost Matrix

Plant/unit	P1	P2	P3
R1	2	4	3
R2	2	1	3
R3	2	3	1

We see that the marks in cost matrix are different for each unit in every plant. These marks considered only the cost of transportation.

Now we are consider the safety matrix (Table-4), In this matrix we focus on the safety aspect in the transport the material. The safety of the material depend on the route, condition of path and the vehicle management system.. If any path having high manual intervention then the process is highly unsafe. Thus in any process more the automation less the probability of incidents. If any transportation system having hazard and not common route of transportation or not favorable condition of transportation which we have in highly unsafe system.????

In this safety matrix we review the transportation system & give the marks 1 to 5. If the process is highly unsafe we give the mark 5 to that process and any system having very low risk

then we give the mark 1. The marks should be given by the team of experts and management. In the above example we make the safety matrix (Table-4) as below:

Table 4 Safety-Cost Matrix

Plant/unit	P1	P2	P3
R1	2	3	2
R2	1	1	3
R3	1	3	3

With the team discussion and the past incidents history we make the safety matrix. Now we have both types of matrix which affect the cost of transportation and the safety aspects. Now we make the resultant matrix with help of both matrixes: First we take the R1 unit to three plants transportation system

Table 5 Cost-safety matrix for Unit R1

R1	P1	P2	P3
	2	3	2
2	4	9	4
3			
2			

The resultant of the cost – safety matrix with respect to unit R1, we find the value marks 4, 9, 4. In this we see that the highest value 9 is for the R1 unit to plant P2. Thus its transportation is not feasible and not in favor of industry. Now in same manner we make the value matrix for the unit R2 to all three plants.

Now we take the R2 unit to all plants transportation system

Table 6 Cost-safety matrix for Unit R2

R2	P1	P2	P3
	2	1	3
1	2	1	3
1			
3			

The resultant matrix of the cost – safety matix with respect to unit R2, we find the value marks 2, 1, 3. In this we see that the R2 to plant P2 tranportation value mark is 1 which is minimum value in R2 matrix. This show that the R2 to P2 is feasible and the favorable for industry.

In similar manner we make the value matrix for R3 unit.

Table 7 Cost-safety matrix for Unit R3

R3	P1	P2	P3
	2	3	1
1	2	9	3
3			
3			

In this R3 value matrix we see that the unit R3 to P2 transportation path having highest marks. So this path from R2 to P2 is not feasible for the industry.

CONCLUSION

With the combined R1, R2, & R3 units value matrixes and a resultant matrix is developed and conclusions made as below.

Table 8 *Resultant Matrix*

Plant/unit	P1	P2	P3
R1	4	9	4
R2	2	1	3
R3	2	9	3

1. In this resultant matrix we see that for R1unit the path P2 is having the largest number so the management will not be in support this transportation system. Always the management prefers the path of transportation having low Risk number.
2. Similarly in the matrix we found that the route of transportation system from unit R3 to path P2 have the same Risk number 9 which is the highest risk number in matrix hence rejected on similar grounds as for unit R1.
3. Now we focus on the remaining transportation systems and see that the R2 to P2 transportation system have minimum Risk value. So the industry should follow this system of transportation having minimum Risk value.
4. Now we see that the next lowest risk number is 2 for the R3 unit to plant P1, hence allocated.
5. Next lower risk value is 4 for the R3 unit for plant 3, which is lowest for it hence allocated the R1 unit to plant P3 transportation system.

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