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Improvement in Plant Layout Using Material Handling Technique

Amrita Kirtane[1], Nagendra Sohani[2]

Abstract: ***The work in the present paper is based on study conducted in a medium job type small scale industry located at Pune, Maharashtra, which manufactures couplings. While manufacturing the parts, there is one modes of material handling that is with the help of trolley. The Existing Plant Layout of the Company has been designed in such a way that there is no optimum utilization of the resources. Travel Chart Technique is applied to minimize wastes of time, manpower and money and to generate higher profits for the same work from the same resources .Two improved layout have been developed by considering the material handling costs , First Improved layout is developed by making only one change [Assembly Section (f) and Fabrication (g) are interchanged their positions] to existing layout , This reduces the materials handling costs by Rs.136 per day , Second Improvement layout is developed by making one more change [Fabrication section (g) and\ Machine shop- 2 (c) are interchanged their positions]. It reduces the material handling costs by Rs.364.625 per day.***

Keywords: Material Handling, Travel Chart, Total Quality Management, Quality control, Plant Layout.

1. Introduction

With rapid increasing of demand in production, industrial factories need to increase their potentials in production and effectiveness to compete against their market rivals. At the same time, the production process needs to be equipped with the ability to have lower cost with higher effectiveness. Therefore, the way to solve the problem about the production is very important. There are many ways i.e. quality control (QC), total quality management (TQM), standard time, plant layout to solve the problems concerning productivity. For example, a case studies from the lamp industry [1]. The found problem was that the staff did not work in orderly manner, resulting in confusion and no standard time nor facilitating tool. The staff spent too much time on work. The way to solve these problems was to improve the steps in working and the area where they worked through observation and fieldwork as well as proposing tools to facilitate the work to set balance and find the standardized time. In additional Yookkasemwong *et al*. [2] studied the production process for Cable box to form metal. The problem was that the work could not be finished within 8 hours. The problem was then studied from data collection, the actual time, load, improper plant layout, and the duration of the process. The impact of improper plant layout on the manufacturing process for valve and metal parts production has been studied. The plant layout was changed to comply with the international standards through Systematic Layout Planning method [3]. Sucharitkul *et al*. studied the possibility of plant layout and installing aluminum foundry [4]. As for the layout of plant, it was done in accordance with the steps in systematic plant layout design. Yujie *et al*. studied the general plane of long yards using systematic layout planning method which the best layout showed the good workflow and practical significance [5].

The Company under consideration is manufacturing coupling parts and assembled together inside the industry in all 7 (A,B,C,D,E,F& G) Departments, located at various places inside industry .It and works for 3 shifts in a 24 hour day with an average of 100 worker per shift . Improvement of plant layout results in decrease in material handling cost and increase in productivity. Thus an attempt has been made in this work to improve the existing layout of the plant by making minor changes with respect to the position of the department/sections. The travel chart technique is used for analysis of material handling cost between the department/section

2. Summary of Different Shops

(a)Raw material and finish goods storage (b) Machine shop 1.comprises of 3 automobile lathe machines, boring machine, 2 drilling machine (C) Machine shop 2 comprises of small sizes of lathe machine, drilling machine, boring machine, milling machine. This shop if used for machining of small parts as per requirement by different shops. (d)Machine shop 3 comprises of milling machine, drilling machine. (e)Machine shop 4: Machine shop 4 comprises of milling machine (f)Assembly section: assembly section is a important section for an industry. In assembly section all the material arrive after machine in each section, finally coupling assembled in this section. (g)Fabrication/box section

2.1 Factors Influencing Plant Layout

1)Type of Production – Engineering Industry, Process Industry
2)Production System – Job Shop, batch production, mass production.
3)Scale of production.
4)Availability of the total area.
5)Arrangement of material handling system.
6)Type of building – Single storey or Multi storey.
7)Future Expansion Plan.
8)Type of Production facilities – dedicated or general purpose.

2.2 Plant Layout Procedure

1)Collect the detailed information about the product, process, etc., and record the data systematically.

2) Analyze the data using various techniques of analysis.
3) Select the general flow pattern for the materials.
4) Design the individual work stations.
5) Assemble the individual layout into total layout in accordance with the general flow pattern and the building facilities.
6) Coordinate the plan with plan for handling materials.
7) Complete the plant layout.
8) Convent the plant layout into floor plans that is to be used by the plant engineer for installation of equipment.

2.3 Tools and Techniques of Plant Layout

The quantity and quality of the data on various factors is required to develop a good layout. The data is to be collected regarding the various processes, sequence of operations, material flow frequency of travel, space requirements, activities and there relationships. The following tools and techniques are used to analyses the data.

2.1 Process Chart - (Operation process charts, flow process charts).
2.2 Travel Chart
2.3 Diagrams – (Flow Diagrams and String Diagrams).
2.4 REL – (Relationship chart).
2.5 Templates
2.6 Scaled Models

2.4 Plant Layout Analysis

The most important criterion for the analysis and selection of a plant layout is the material handling cost. The basic tool that is primarily used to analyze the material handling costs in process layout is the travel chart. Depending on the existing plant layout, an analyst may follow a procedure given follow:

Step 1. Summarize the interdepartmental moves of existing layout in a square grid (from interdepartmental flow diagram).
Step2. Simplify the grid (or from to chart) by combining moves and countermoves between any two departments.
Step3. Prepare the Material handling cost matrix of the existing layout by multiplying the unit material handling cost by the number of moves between various departments.
Step4: Calculate the total material handling cost of the existing layout.
Step5: Search the possible departmental changes that will reduce the number of moves and consequently calculate the total material handling cost.

2.5 Problem Identification:

The plant is to produce complete coupling by using the same manufacturing facilities arranged in 7 departments, viz., Raw Material storage Section (A), Machine Shop-1 (B), Machine Shop-2 (C) Machine Shop- 4 (D) Machine Shop-3 (E), Assembly Section (F) and Fabrication department (G). Trolley used for handling of raw material and other processed material between different departments. The salaries/month of hand trolley operator and diesel trolley operator are: trolley operator - Rs.8000/month Number of trolley operator –5

2.6 Department (From – To) Distance (meter)

Department (From – To)	*Distance (meter)*
A-B	40
A-C	40
A-G	80
A-D	60
B-C	80
B-D	20
C-F	30
C-D	80
D-F	70
D-E	40
E-F	30
G-F	90

2.7 Assumption and constraints

The assumptions and constraints used in the analysis are:

1. The position of generator complex, administration block and General Manager room are not changed for
2. Improvement because they are not involved in any material transfer.
3. The position of casting which is situated around 30kM from the industry is not changed.
4. Depreciation costs of hand trolleys and diesel trolleys are not considered while calculating the unit material handling costs.
5. Fixed costs of loading and unloading are not considered, as they cannot be reduced.

3. Results and Tables

3.1 Calculation of Material Handling costs

1. Existing Plant Layout

(A) For Hand Trolley
Total distance travel by hand trolley in between the various departments per day
= Σ MiDi
= 9330 m/day
= 9330/3per shift per day (3 Shift in one day)
=3110 m per shift per day

Average Material handling Cost /meter
= (Wages of worker/shift)*/average distance travel per shift per day
= (Number of worker* salary of one worker per day)/Average distance travel per day
=(5*Rs.8000/30)/3110
=Rs..0.4287/meter

Total Material handling cost/day for Trolley (Including all three shift) = Total distance in meter *average material handling cost per meter
= 9330*Rs.0.4287
=Rs. 4000 per day

Total Material handling cost/day for hand Trolley =Rs. 4000 per day

S. No.	*Movement*	*Material handling cost/day =Avg. cost/m* distance/day*	*Material handling cost in descending order*
1	A-B	0.4287*400=171.48	4
2	A-C	0.4287*1200=514.44	10
3	A-G	0.4287*2400=1028.8	12
4	A-D	0.4287*600=257.22	6
5	B-C	0.4287*800=342.96	8
6	B-D	0.4287*300=128.61	2
7	C-F	0.4287*600=257.22	7
8	C-D	0.4287*800=342.96	9
9	D-F	0.4287*420=180.05	5
10	D-E	0.4287*160=68.59	1
11	E-F	0.4287*300=128.61	3
12	G-F	0.4287*1350=578.74	11

Improved Layout

Changes:-In first improvement of layout the position of assembly shop –1(f) and fabrication (g) are interchanged and other department at the same position as in existing layout. Number of movement between different department is not changed i.e. Move grid is same as existing plant layout.

Department	Distance	No.of moves	Total distance travelled by trolley per day in meter
A-B	40	10	400
A-C	40	30	1200
A-G	10	30	300
A-D	60	10	600
B-C	80	10	800
B-D	20	15	300
C-F	120	20	2400
C-D	80	10	800
D-F	20	6	120
D-E	40	4	160
E-F	60	1	600
G-F	90	15	1350

Total distance travel by hand trolley in between the various departments per day = Σ MiDi

= 9030 m/day

Average Material handling Cost /meter = Rs.0.4287/meter

Total Material handling costs/day = Rs.0.428/meter*9030 m/day

= Rs. 3864 /day

S. No.	*Movement*	*Material handling cost/day =Avg. cost/m* distance/day*	*Material handling cost in descending order*
1	A-B	0.4287*400=171.48	5
2	A-C	0.4287*1200=514.4	10
3	A-G	0.4287*300=128.6	4
4	A-D	0.4287*600=257.22	7
5	B-C	0.4287*800=342.96	8
6	B-D	0.4287*300=128.61	3
7	C-F	0.4287*2400=1028.	12
8	C-D	0.4287*800=342.96	9
9	D-F	0.4287*120=51.44	1
10	D-E	0.4287*160=68.59	2
11	E-F	0.4287*600=257.22	6
12	G-F	0.4287*1350=578.74	11

Total Material handling costs/day =3864PER DAY

3.2 Improved Layout

Changes: In first improvement of layout the position of machine shop(c), fabrication (g)are interchanged and other department at the same position as in I-layout.. Number of movement between different department is not changed i.e. Move grid is same as existing plant layout.

Department	*Distance*	*No. of moves*	*Total distance travelled by trolley per day in meter*
A-B	40	10	400
A-C	80	30	2400
A-G	40	30	1200
A-D	60	10	600
B-C	40	10	400
B-D	20	15	300
C-F	90	20	1800
C-D	20	10	200
D-F	70	6	420
D-E	40	4	160
E-F	30	10	300
G-F	20	15	300

Total distance travel by hand trolley in between the various departments per day = Σ MiDi

= 8480 m/day

Average Material handling Cost /meter = Rs.0.4287/meter

Total Material handling costs/day = Rs.0.4287/meter*8480m/day

= Rs. 3635.37/day

S. No.	Move-ment	Material handling cost/day	Material handling cost in descending order
		#NAME?	
1	A-B	0.4287*400=171.48	6
2	A-C	0.4287*2400=1028.8.44	12
3	A-G	0.4287*1200=514.44	10
4	A-D	0.4287*600=257.22	9
5	B-C	0.4287*400=171.48	7
6	B-D	0.4287*300=128.61	3
7	C-F	0.4287*1800=771.66	11
8	C-D	0.4287*200=85.75	2
9	D-F	0.4287*420=180.05	8
10	D-E	0.4287*160=68.59	1
11	E-F	0.4287*300=128.61	4
12	G-F	0.4287*300=128.61	5

Total Material handling costs/day=3635.3/day

4. Conclusion

One existing layouts have been modified by using travel chart technique analysis and considering material handling cost as the criterion. By implementing the first improved lay out, the material handling cost is reduced by Rs.136 per day. The material handling cost gets reduced by Rs 364.625 per day .On the basis of minimum number of changes, the improved layout -1, will be considered as the optimum layout; and on the basis of cost reduction, the improved layout-2 can be considered as optimum layout .It is to be observed that by following any of the improved layouts the material handling cost of trolley reduced by the same amount. Therefore the company can adopt any of the improved layouts suitable to its practical operating conditions. This results in savings of amount of resources used, which can be utilized in increasing the numbers of movements per day or for other activities of the process. As a result the productivity will be increased.

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Author Profile

Dr Nagendra Sohani received the B.E in Mechanical Engineering from S.G.S.I.T.S, Indore, M.E. in Industrial Engineering. & Management from S.G.S.I.T.S., Indore and PhD in Strategic Modeling for Supply Chain Information Management: An Integrated Approach (Mechanical Engineering) from Devi Ahilya University, Indore .Experience: 17 years in Teaching and 07 years in Industry. He is Life Member of Indian Society of Technical Education (LM-15222),Life Member of Indian Science Congress L 13193.He has got wide exposure in the field of Automobile (Tempo Traveler assembly line) Production, Project planning, Erecting, Commissioning Utility and Maintenance.: 60 TPH Steam Generation, 350 cum D.M Water regeneration and 350 TPD Effluent Treatment plant, 2500 KVA Captive power generation, in industries like Bajaj Tempo Ltd., Pithampur, as Production Engineer, Alpine Industries, as Assistant Manager Project and Utility, Gujarat Ambuja, Ahemadabad as Manager Utility and Maintenance.