STUDIES OF PRODUCTIVITY IMPROVEMENT IN INDIAN AUTOMOBILE INDUSTRIES PLANT LAYOUT

Prof. Jayant Hemachandra Bhangale[1] , Dr. Ashish. Manoharrao Mahalle[2]

[1] Ph.D. Scholar, Laxminarayan Institute of Technology, Nagpur, Maharashtra, (India)

[2] Head of Dept. General Engg. Laxminarayan Institute of Technology, Nagpur, Maharashtra, (India)

ABSTRACT

Cellular layout is having a good recognition and acceptability in Automobile industries of Europe and other developed countries due to space and operator problems. Most of automobile industries are working under for cellular concept. The work related with rearrangement of existing plant layout for specific production assembly line. Like TVS, very few companies in India have implemented this layout. Some of the automobile industries have not implemented this type of layout for any line, so preparatory work is going on for implementation and restructuring of Plant. Sharda Motors Industries Ltd., Nasik is planning to rearrange existing layout to new suitable layout. This study indicates Cost Saving in two major factors like manpower reduction and productivity of cell. Results show that a) No. of operator required is reduced by 03 and b) Job target / Shift is increases by 31.

Keyword- Automobile Firm, Cell Development, Plant Layout, Parametric Studies.

I. INTRODUCTION

Cellular Manufacturing System design is a complex creative decision activity which applies scientific knowledge, engineering theories and technologies to process a large quantity of information about products, machines, human resources and markets. Optimising the system is much more complicated, not only for human designers, but also for computers. This research concentrated on the layout design and its related problems.

1.1 Research Work Areas

1. Research type: addressing design issues, operational issues, or study based on empirical research
2. Resources consideration: machines, handling equipment, and people resources and related issues
3. Virtual Implementation level
4. Layout consideration
5. Use of Group Technology
6. Automation or non-automation issues of the manufacturing system.

1.2 The Need For Re-Layout Decision

Why do layout problems arise? Ordinarily when one thinks of plant layout, one links it with planning an entirely new plant starting from scratch. Although such occasions undoubtedly do arise, this usually is not the reason all the time. More frequently, layout work consists of making minor changes in the existing layouts, locating new machines, revising a small section of the plant, or making occasional changes in material handling systems or so. The most common reasons for redesigning of plant are the result of one or more than one of the following:

1. Inefficient operations i.e. high cost of production, bottlenecks etc.
2. Changes in the design of production/services.
3. Introduction of new product services.
4. Changes in mix of outputs.
5. Changes in volume of output.
6. Obsolescence or failure of existing equipment.
7. High percentage of rejection.
8. Congestion in plant, lack of storage space etc.
9. Workers complaint regarding working conditions, (noise, light, temperature etc)
10. High rate of accident or safety hazard.
11. Changes in the location of market for existing products.
12. Environmental changes.
13. Changes in factory legislation.
14. Redesign of material handling system.

1.3 Space Requirement

Once the flow pattern is designed and some thought is given to the service and auxiliary activities, it is necessary to make preliminary estimates of the total space required for production centres, space for storage of material and for each activity in the faculty. A first estimate of the total space required may be arrived at by estimating an appropriate number of square feet(with the aid of a production space requirement sheet), for each piece of machine or equipment, including the area for workers, maintenance services, material get down, access to aisle and general or supporting areas. After estimating space needed for each activity or function the Total Space Requirement is worked out for all activity areas.

It should be emphasized that space determination made at this stage are estimates. They should very likely be optimistic enough to be sure that there is sufficient area.

In making the space calculations, space must be included for:

a) Raw material storage
b) In- process inventory storage
c) Finished good storage
d) Aisles, cross aisles and main aisles
e) Receiving and shipping
f) Material-handling equipment storage
g) Tool rooms and tool cribs
h) Maintenance
i) Packaging
j) Supervision
k) Quality control and inspection
l) Health and medical facilities
m) Food service
n) Offices

o) Employee and visitors parking

p) Receiving and shipping parking.

II. LITERATURE REVIEW

In CM part families are formed based on their similar processing requirements and the grouping of machines into manufacturing cells to produce the formed part families investigated by Barve [1]. In order to handle new product designs and product demand general- purpose machines and equipment are use in CM which reduces efforts in term of time and cost. Thus it gives great great flexibility in producing a variety of products as explained in recent reviews by [2]. Pasupuleti investigated the performance measures like the make span, mean flow time, mean lateness and mean tardiness are used to evaluate the considered dispatching rules. The method gives the sequence of parts to process on each machine and the total schedules for all the operations of the parts [3]. Elmaraghy et al. developed model for assessing the layout structural complexity of manufacturing systems. Guidelines such as reducing number of cycles, density and decision points are recommended to reduce manufacturing systems layout complexity. Author focused on two important planning objects the planning of capacities and orders [4]. To bridge the gap between conceptual works on the one hand and quantitative contributions on the other, they provided a framework for the structuring of planning tasks. In showing similarities and differences between existing works and planning tasks, the review aims at contributing towards a common understanding of production management in the automotive industry [5]. Thottungall and Sijo suggested that the optimal layout strategy for the company which is a combination of product line layout and process layout [6].

Dombrowskia and Ernsta studied a scenario based simulation approach to find out factory layout variants that are adequate for future requirements which is verified by a case study. Results showed that a scenario-based simulation approach is feasible for developing, analyzing and evaluation various variants of the production [7]. Yinhua examined perceptual error in the monitoring mode and cognitive error in fault diagnosis during malfunctions. The simulation results coincide well qualitatively with observations of actual plant operations and simulator training. This operator model can be used to analyze the generation mechanism of various types of human errors from the viewpoint of cognitive information processing [8].

Andrew developed A discrete event simulation model was developed and used to estimate the storage area required for a proposed overseas textile manufacturing facility. Discrete event simulation is concerned with the modeling of systems that can be represented by a series of events. The process of undertaking the simulation project initiated useful discussions regarding the operation of the facility covering areas such as the management of the departments and their interrelationships, the accuracy of data held on machine capacity, working practices such as shift patterns and examination of production rules that had evolved over time without any formal assessment of their appropriateness [9].

III. METHODOLOGY

3.1 Plan Possible New Layouts

When the team has an idea of what to change, it plans a new layout. The team follows several guidelines:

1. Layout in the process sequence is the basic principle.
2. Machines are placed close together, with room for only a minimum quantity of WIP.
3. The layout curves in a U or C shape, with the last machine near the first to reduce walking between cycles.

4. The process flow is often counter clockwise. As people walk around to operate the cell, the right hand, which has more control in most people, is then next to the machine; this allows efficient handling of tools and parts, with less turning and reaching over.

3.2 Methodology Adopted To Achieve the Objectives Is As Follows

1. Experiments to eliminate waste, to improve the division of processes and balancing of labour.
2. Approach starts by coordinating the timing of production with customer needs.
3. Studying the existing layout
4. Identifying operation sequence & elemental Operation time details for each machine.
5. Calculation of machine capacity for each machine.
6. Developing proposed layout for each production line in cellular layout.
7. Calculation of manpower utilization for each production line in new layout.
8. Determination of material handling route for each production line in new cellular layout..
9. Determination of WIP inventory and trolleys requirement for each production line in new cellular layout.
10. Cost analysis.

IV. EXISTING LAYOUT

Case considered for study is from Sharda Motors Industries Ltd., Nasik, one of the major automobile manufacturers for various MNC like Mahindra & Mahindra Ltd., Maruti Udyog Ltd., TELCO and many more.
Name of Component: Scorpio W105 Front Pipe for Mahindra & Mahindra Ltd. Nasik.
Fig. 1 shows present layout of Scorpio W105 Front Pipe Assembly Layout in Sharda Motors Industries Ltd.
Problems identified in existing layout are-

- ✓ Manpower utilization is less than required capacity.
- ✓ Material handling route are not properly defined, so handling time required for components is more in existing
- ✓ layout.
- ✓ High Work in Process (WIP) inventory.
- ✓ Space Utilization
- ✓ Capacity utilization of machines are low.
- ✓ Machine changeover time is more.
- ✓ The wide entry and exit points between lines have the operator empty-handed too much of the time.
- ✓ Extra operator makes line crowed.

Fig.1 shows layout is used for production of two different front pipe assembly i.e. one for New Launch MHAWK Scorpio Model and second for old LCCR Scorpio model.

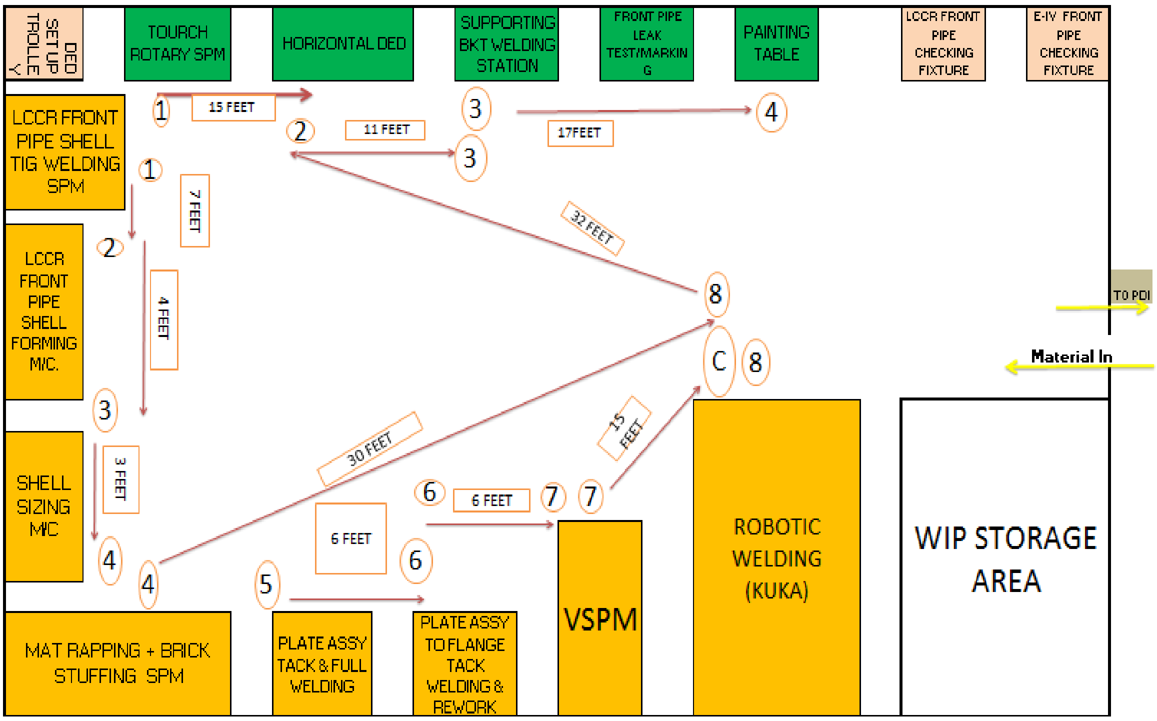

Fig.1 Scorpio W105 Front Pipe Assembly Layout

1. Layout No. 01

Scorpio W105 MHAWK Front Pipe Assembly Layout

Operation sequence in current layout is as shown in Fig.1 by arrows.

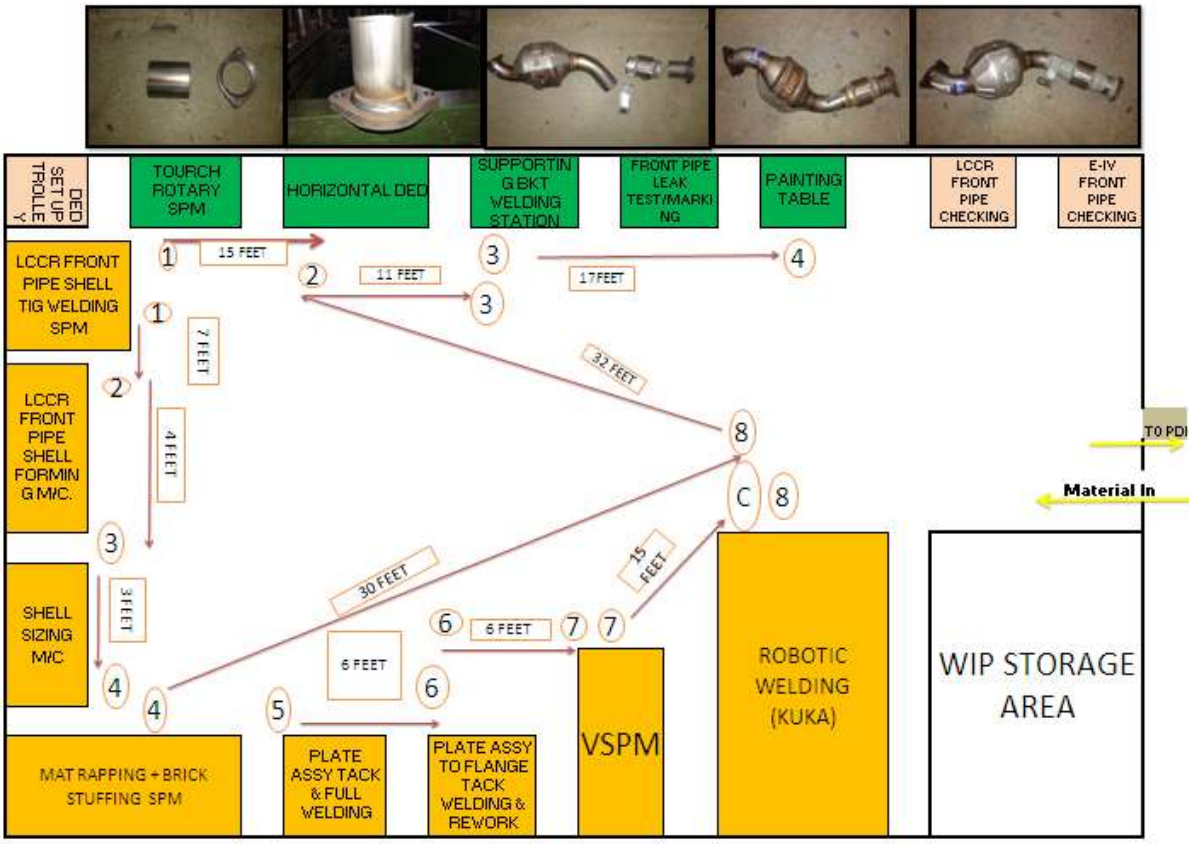

Fig.2 Scorpio W105 MHAWK Front Pipe Assembly Layout

Table 1 Operations Time Details of MHAWK Front Pipe Assembly Line

CYCLE TIME for FRONT PIPE ASSY MHAWK										
TOTAL OPERATORS 5	ST. NO.	DESCRIPTION	TIME IN SECOND						AVAILABLE TIME IN MIN	JOB PER SHIFT
			1ST	2ND	3RD	4TH	5TH	FINAL		
OPERATOR NO. 1	1	STRAIGHT PIPE+FLANGE SPM	88	84	85	96	88	88.2	27000	306.12
OPERATOR NO. 2	2	BELLOW+CATCON+BELLOW OUT PIPE SPM	112	129	129	132	125	125.4	27000	215.31
OPERATOR NO. 3	3	FRONT PIPE BKT WELD	133	130	131	128	140	132.4	27000	203.92
OPERATOR NO. 4	4	LEAK TEST/TAPPING/MARKING	155	152	142	143	155	149.4	27000	180.72
OPERATOR NO. 5	5	CHEAPING & PAINTING	182	190	185	187	188	186.4	27000	144.84
OPERATOR NO. 5	6	HEAT SHIELD AASY								
OUTPUT PER OPERATOR PER SHIFT	33	TOTAL TRAVELING LENGTH IN FEET		63				681.8	THROUGHPUT TIME	

In present MHAWK layout –

1. Total travelling distance = 63 feet
2. Throughput time = 681.8 seconds

Layout No. 2 -

Scorpio W105 LCCR Front Pipe Assembly Layout

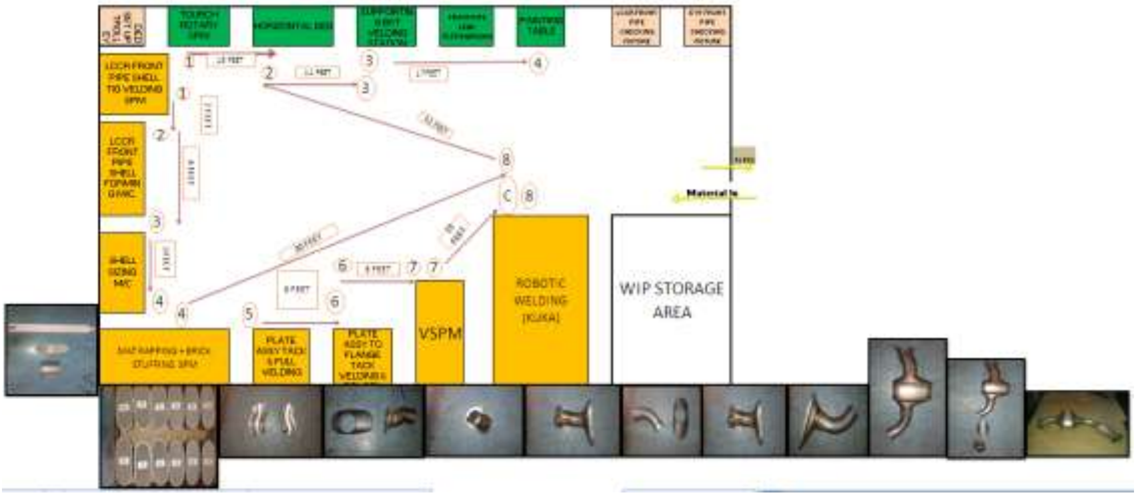

Fig.3 Scorpio W105 LCCR Front Pipe Assembly Layout

Table 2 Operations Time Details of LCCR Front Pipe Assembly Line

CYCLE TIME for FRONT PIPE ASSY LCCR										
TOTAL OPERATORS	ST NO	DESCRIPTION	TIME IN SECOND						AVAILABLE TIME IN MIN	JOB PER SHIFT
			1ST	2ND	3RD	4TH	5TH	Average		
OPERATOR NO. 1	A	LCCR FP Shell TIG Welding	53.6	51	49.8	52	51	51.5	27000	524
	B	Shell Forming	41.3	41	41.8	42	41.2	41.5	27000	650
	C	Shell Sizing	18.7	18.2	18.9	19	18.5	18.7	27000	1443
	D	Mat Rapping+Brick Stuffing+Stamping	78.6 +60	78.2+ 59	78+61	77.2+ 62	77.8+ 60	78+61	27000	194
OPERATOR NO. 2	E	Plate Ass. TACK & Full welding	110	115	108	119	116	114	27000	236
	F	Plate Ass. To Flange TACK welding & Rework	45	47	45.2	48.1	45.6	46	27000	586
OPERATOR NO. 3	G	SPM Welding	61	60	60	69	70	64	27000	421
OPERATOR NO. 4	H	Mat welding robot	145	145	144	146	145	145	27000	186
OPERATOR NO. 5	1	STRAIGHT PIPE+FLANGE SPM	49	50	48.8	49.5	50.2	49.5	27000	545
	2	BELLOW+CAT CON+BELLOW OUT PIPE SPM DED	122	120	124	126	122	123	27000	219

OPERATOR NO. 6	4	LEAK TEST/TAPPING/MARKING	105	76	90	101	84	91	27000	296
OPERATOR NO. 7	5	CHEAPING & PAINTING	71	70	72	71	71	71	27000	380
	6	HEAT SHIELD AASY								
162.2 Ft	TOTAL TRAVELING LENGTH IN FEET							955	THROUGHPUT TIME	

In present LCCR layout –

1. Total travelling distance = 162.2 feet

2. Throughput time = 955 seconds

V. PROPOSED LAYOUT FOR SCORPIO W105 MHAWK/LCCR FRONT PIPE ASSEMBLY LAYOUT

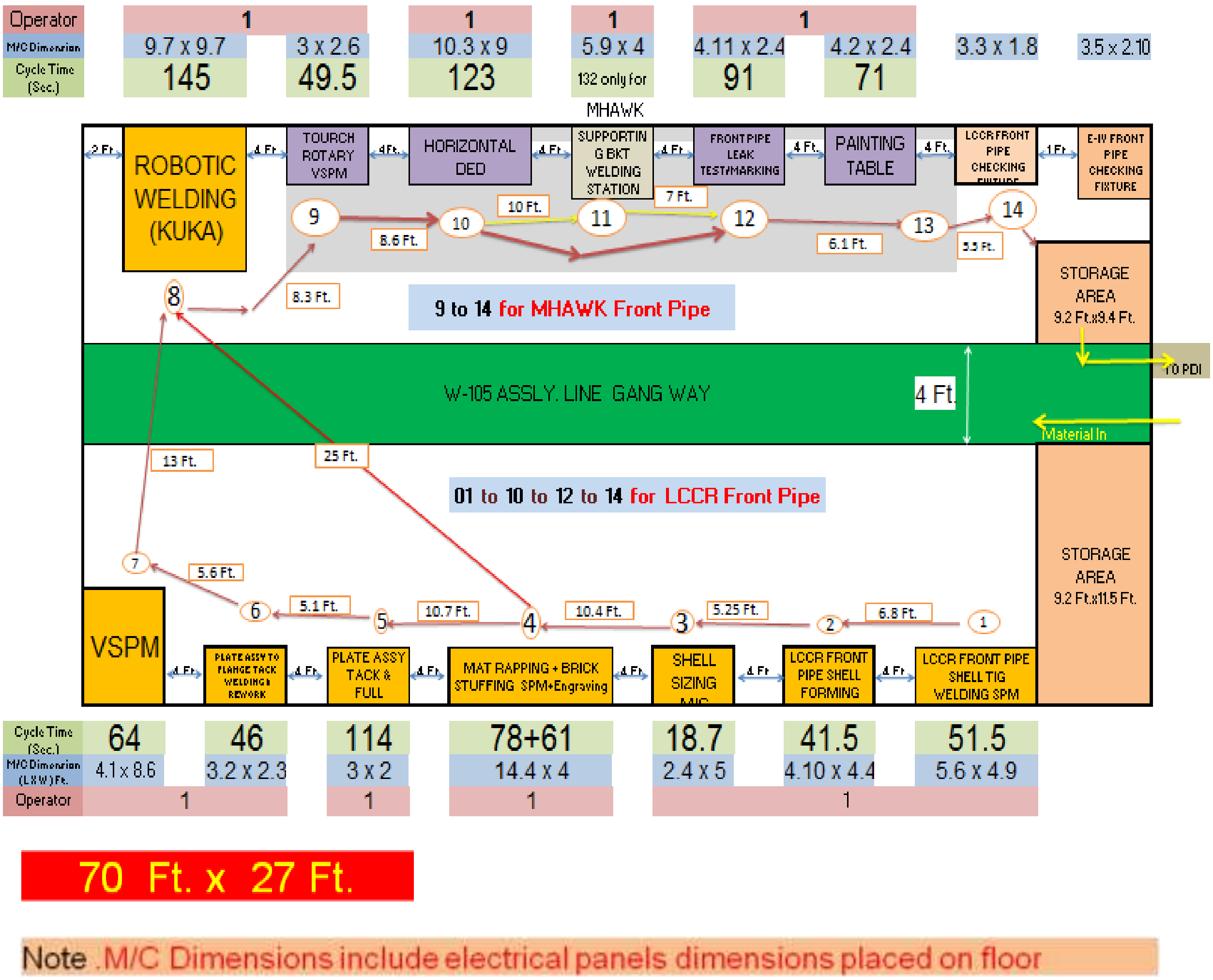

Fig. 4 Proposed Layout for W105 MHAWL/LCCR Front Pipe Assembly Line

In proposed layout, machines are rearranged as per operation sequence which avoids backtracking of component within cell while processing.

VI. COMPARISON OF EXISTING & PROPOSED LAYOUT FOR FRONT PIPE ASSEMBLY LINE

Table 3 Capacity Utilization of Cell

Shift Time	7.5 Hours	27000 Seconds		Proposed Job / Shift
Total Cycle Time for LCCR FP		955 Sec / Job	28 Job / Shift/Operator	28 x 7 = 196 Job / Shift
Total Cycle Time for MHAWK FP		466.5 Sec /Job	57 Job / Shift/Operator	57 x 3 = 171 Job / Shift
Job	**Operator**			Existing Job / Shift
	Existing	Proposed		
LCCR FP	8	7		140 Job / Shift
MHAWK FP	5	3		140 Job / Shift
Job	**Material Travel**			
	Existing	Proposed		
LCCR FP	162.2 Ft.	126 Ft.		
MHAWK FP	43 Ft.	37.2 Ft.		

Tabe 4 Manpower Requirement

Operator Required (LCCR)
Time /Operator=27000 Sec./ (28 Job x 7 M/c Combined) = 137.75 Sec.
Operator Required = Available Time/ (Total Job/Shift* No. of M/C) = 955 / 137.75 = 6.93
Operator Required (MHAWK)
Time /Operator=27000 Sec./ (57 Job x 3 M/c Combined) = 157.89 Sec.
Operator Required = Available Time/ (Total Job/Shift* No. of M/C) =466.5 / 157.89 = 2.95

VII. CONCLUSION

7.1 Evaluation for Effective Layout

1. Plant layout is a plan of, or the act of planning, an optimum arrangement of industrial facilities, including personnel, operating equipment, storage space, materials handling equipment, and all other supporting services, along with the design of the best structure to contain these facilities.

2. Because plant layout covers a wide range of activities, the criteria used to evaluate plant layout must necessarily vary from one problem to another. Thus, the term "optimum" in the definition refers to planning the best layout by whatever criteria may be chosen to evaluate it. In one problem the criterion may be the amount of materials handling; thus, the optimum arrangement should have a minimum number of handlings. In another problem the criterion may be the overall costs of processing through a particular department; thus, the optimum arrangement should minimize this overall cost.

3. It is quite possible that an optimum solution to a layout problem might maximize the output of a given set of facilities with little regard to overall costs. Of course, it was the urgent demand for war materials that brought about this rather unusual situation.

4. The most difficult part of the plant layout procedure is evaluation of the various alternative proposals. To date, no procedure for evaluating layout alternatives has achieved general acceptance. It may well be that each layout problem is so unique that a general evaluation procedure cannot be found.

5. Recently mathematicians have become interested in the problem of plant layout and location. This interest has led to the development of a number of techniques which can be most helpful to the layout analyst in evaluating alternatives. More research is needed to prove whether or not general procedure for evaluating layouts can be evolved.

7.2 Advantages of Proposed cell Layout

1. Manpower utilization greater than 90%
2. Through put product
3. Flexible layout
4. Low cycle time
5. Low inventory and synchronous material handling.

7.3 Cost Saving

1. No. of operator required is reduced by 03.
2. Job target / Shift are increases by 31.

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