Research Paper

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Capacity Management and Job Scheduling at Bogie Frame Shop in Integral Coach Factory-Chennai

Management

KEYWORDS : Indian Railways, ICF, Capacity, Shell shop, Job Scheduling

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ABSTRACT

Economic, technological and political factors are a few of the diverse external conditions that can influence company's decisions to open, close or modify their manufacturing locations and facilities. These factors change over time but especially so in environments of growing global competition, where the development of a capacity and facilities strategy is essential to any manufacturing enterprise. Attention to capacity utilization can help increase a company's profitability. The study is aimed at analyzing the installed capacity, its effective utilization and the factors influencing capacity utilization of Integral coach factory, Chennai. The study is also extended to analyze the production scheduling which is closely related to capacity management. The findings show the various factors that cause the underutilization of installed capacity, both men and machines. The study also provides suggestions to improve the productivity of the integral coach factory.

1.0 Introduction

Indian Railways (IR) is the principal mode of transport of the country for more than 150 years. It has played a vital role in the over all development of the country and national integration. The growth of IR is closely linked with the economic, agriculture and industrial development of our nation. IR has also absorbed advancements in modern technologies emerging around the world to meet the requirement of moving large volumes of freight and passenger traffic with safety and comfort. The Integral Coach Factory, Chennai business span covers design development and manufacture of various types of passenger coaches to Indian Railways. It manufacture all-steel, all-welded, light weight, Integral Coaches with Anti-telescopic end-construction in collaboration with M/s.Swiss Car & Elevator Manufacturing Corporation Limited, Switzerland.

The Integral Coach combines the three major factors of modern day passenger transport Speed, Comfort and Safety. The design incorporates an all welded integral construction of under frame, trough floor, side-walls and the roof which form a tube like "Shell" which is light weight and strong enough to withstand the service stress including those in case of accidents. A system of built-in shock-absorber on the bogies provides enhanced riding comfort and high-speed potential. Initially, the factory was designed to produce only Broad Gauge shells which were to be furnished by the Zonal Railways. Later, towards the middle of the Second Five Year Plan period, a separate Furnishing Division was set up to take advantage of mass production techniques. This facility was established and commissioned on 2nd October 1962. ICF has obtained the transfer of coach building technology from Swiss car Elevators manufacturing Co.Ltd for BG third class Coach only. Then without any foreign collaboration, Double Decker Coaches, Metro Coaches and Stainless steel Coaches and Custom built Coaches such as palace on Wheels, Defence Coaches etc. Diesel Multiple units and the Main-Line Electric Multiple Units. To meet the increasing demand for different types of coaches, ICF has developed over 300 different designs to suit the varied requirements of Indian Railways and for Export consisting of sleeper Coaches, AC Coaches.

1.1. Objectives of the study

- To determine whether ICF is utilizing the installed capacity.
- To analyze the job scheduling technique carried out in the plant.
- To identify the factors that affect capacity utilization.
- To determine the utilization rate of the installed capacity.
- To determine the optimal production schedule.
- To provide suggestions to improve productivity.

1.2 Limitations of the study

- The study is confined to Bogie frame shop of the Coach Factory.
- The study is based on secondary data which has its own disadvantages.

1.3 Research design

Research design is descriptive and explorative in nature.

1.3.1 Sources of data

The study majorly depends on secondary data which has been obtained from books, journals, company reports, data sheets and web sites. The primary data also collected through questionnaire from the supervisors of the shop.

1.3.2 Sampling size and sampling area

A sample size of 50 samples was taken from supervisors of different shops in the factory. Judgmental sampling technique was used to select the respondents.

1.3.3 Tools used for analysis

Percentage analysis, Trend analysis, Johnson's Scheduling Technique and PERT were used for data analysis and interpretation. Analysis and interpretation was based on the data collected and obtained from various reports, observations and records maintained in the different sections of the Planning Department of the Integral Coach Factory. The analysis and interpretation is based on the past years performance of the Factory.

1.4. Analysis & Discussion

The number of direct workers involved in the production process has declined by 16.4%. Despite the decrease in the number of direct workers there has been increase in productivity in the shop. Thus productivity not depends only on the number of workers but also on other factors like automation, efficiency, supervision and effective utilization of resources. About 12.5 % absenteeism was the target set by the management while the actual absenteeism always exceeded the target limit. Absenteeism forms a major concern in the loss of productivity. Incentives are provided to the direct workers in the factory, but they don't show interest in earning incentives provided. Average incentive earned by the direct workers was just 53.91%, while the target set was 70. Average load lifted by the direct workers has never achieved the target set by the management over the last 5 years. Since the target load is not achieved by the man, the utilization of man or the load lifted by man needs to be improved. Decreased average load leads to loss in productivity.

Man idle hours due to lack of material from floor has shown an exponential increase over the last 5 years. Considerable hours are lost in productivity due to idle time caused by lack of material from floor. Significant number of hours has been wasted on waiting for the cranes to move the materials in the shops due to increased operations in the shops. A single crane has to lift the loads for various processes from one end to another. Overall

the essential services are of importance and there has been a minimum significant loss in productivity in concern to the same.

From the opinion of supervisors, it is vivid that daily performance of their employee just stay in the average. Only 6% of the supervisors believe that their employee performance is excellent. Inefficient utilization of machine is of high concern since it reduces not only productivity but also incurs a financial loss in long term. The supervisors also opinioned that man hour utilization is in average level. Effective planning and scheduling is required to improve the man hour utilization. The factory mostly achieves its daily production target with certain exceptions such as unexpected machine repairs. The lack of material from floor forms a major cause for man/ machine to remain idle. Hence it is clear that the factory has not utilized the installed capacity efficiently.

The shell output has grown by 58.60% over the past 9 years. Turnover of shells has shown a gradual rise over the years. There has been increase in the demand for coaches with rising infrastructural development across the globe. The trend analysis shows a rising trend for shell demand in the future. ICF has to ensure that it has the sufficient capacity to supplement the rising demand. Bogie set turnover has shown a rise of 22.16% over the last 5 years gradually. Shop no 23 (Bogie frame shop) has to ensure that it has the sufficient capacity to supplement the rising demand of bogie.

1.4.1 Production time calculation for bogie frames

Man/ Machine hours taken to manufacture components for 1 Bogie Frame = 202.764 hours Assembly Time per frame
= 24 man hours
Total Time taken to complete a bogie frame
= 226.76 man/ machine hours
Actual time taken to manufacture a frame
= 333 man/machine hours
Average hours lost per frame
= 106.24 man hours
Average hourly rate for an employee of shop no 23
= Rs 141.62
Productivity loss in financial terms
= 106.24* 141.62
= Rs. 15045.71

It is found that ICF incurs a loss of Rs.15045.71 in manufacturing a bogie frame. This loss is considerable high in large scale production.

1.4.2 PERT for Bogie side frame manufacturing

Table 1.4.1: Bogie side frame manufacturing operations

Load Center	Operation	Optimistic Time	Most Likely Time	Pessimistic Time
11330011	Hand-grind	163.11	181.23	199.36
11330094	Assemble	388.67	431.85	475.04
11330023	Co2-weld	61.32	68.13	74.95
11330569	Auto-weld	269.81	299.78	329.76
11330023	Co2-weld	124.59	138.43	152.28
52000000	Test-x-ray	1.88	2.08	2.29
11330011	Hand-debur	594.30	660.33	726.37
11330183	Hyd-bend	226.56	251.73	276.91
11330223	Radial-drill	46.04	51.15	56.27
11330011	Hand-grind	56.48	62.75	69.03

Source: Production schedule sheet, internal reports

S.No	Activity	Earliest Start	Earliest Finish	Latest Start	Latest Finish	Slack
1	Hand-grind	0	181.23	0	181.23	0
2	Assemble	181.23	613.08	181.23	613.08	0
3	Co2-weld	613.08	681.21	613.08	681.21	0
4	Auto-weld	681.21	980.99	681.21	980.99	0
5	Co2-weld	980.99	1119.42	980.99	1119.42	0
6	Test-x-ray	1119.42	1121.50	1119.42	1121.50	0
7	Hand-debur	1121.50	1782.49	1121.50	1782.49	0
8	Hyd-bend	1782.49	2034.22	1782.49	2034.22	0
9	Radial-drill	2085.37	2085.37	2085.37	2085.37	0
10	Hand-grind	2148.12	2148.12	2148.12	2148.12	0

Table 1.4.2 Activity Slack
Expected project duration: 2148.12 minutes
Source: Production schedule sheet, internal reports

Expected project duration: 2148.12 minutes Critical path

Act1àAct2à Act3à Act4à Act5 àAct6 àAct7à Act8à Act9à Act10

Variance of critical path = 1.111
Standard deviation = 1.054

The PERT scheduling technique that is applied to Bogie side frame manufacturing has provided the optimal schedule with reduced variance in the process.

1.5 Findings

- Man capacity utilization has always been in fluctuations between .84 to .923 over the last 5 years. The factory has never achieved 100% utilization of man hours.
- Factors influencing Man Idle Time

✓ Machine repair
✓ Lack of Material from Shop
✓ Lack of Material from Floor
✓ Waiting for crane
✓ Essential Service

- 42% supervisors believe that the utilization of machine remains average.
- 36% supervisors believe that lack of material from floor form a major cause for idle time.
- 32% supervisors say that lack of material from shop form a major cause for idle time.
- 65% of the supervisors believe that the installed capacity is not utilized efficiently.
- The total optimal processing flow time for shear operation in load center 18311118 by SRT/OP rule is 1772.5 minutes.
- Idle time for the machines in load center 16600208 is reduced to .61 hours and 3.86 hours respectively when Generic Algorithm is applied for the job scheduling process.

1.6 Suggestions

The following are the suggestions for improvement in the performance of Integral Coach Factory

- The number of shifts could be increased from 2 shifts of 8 hours to 3 shifts of 6 hours to increase productivity.
- Privatization of the factory might yield increased productivity and turnover.
- Automated machinery must be installed to improve quality and productivity.
- Automated production reporting could be implemented.
- Automate production scheduling; job tracking system must be implemented.
- Preventive maintenance must be scheduled based on actual machine/tool/ component usage (run hours and count cycle).
- Read and Print Bar Code labels at each machine as parts are made.
- Japanese 5S principle must be strictly introduced in the factory.

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1.7. Conclusion

The study undertaken by the researcher concludes that the capacity has been under utilized yet it follows an increasing trend with respect to the future. The study also provides suggestions for improving productivity and utilizing maximum capacity so as to supplement the increasing demands in the future. At the present the Integral Coach Factory holds a good position in the market. With developments in the Indian Economy towards Rail sector and demand for coaches in developing countries, ICF will flourish financially over long term.

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