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A CASE STUDY ON ASSEMBLY LINE BALANCING IN A ENCLOSURE MAUFACTURING SHEET METAL INDUSTRY

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ABSTRACT

A case study has been conducted in a Sheet – Metal based Enclosure manufacturing industry, to create a streamlined Manual Assembly Process for a Single products. Existing Assembly Line has been studied and the true precedence of activities has been extracted. The Single Product manual assembly process has then been systematically rearranged by adopting 'Largest Candidate Rule' as the line balancing technique. This rearrangement is carried out independent of user intervention after feeding the data to a computer algorithm implemented in C++ language. The results of the study are encouraging.

Key Words: *Algorithm, Line Balancing, Largest Candidate Rule*

1. INTRODUCTION

The project work was carried out at Rittal India Pvt. Ltd, Bengaluru. Rittal India Pvt Ltd is 100 % Subsidiary of Rittal GmbH & Co. KG, Germany. Rittal is the world's largest manufacturer of enclosure systems. It belongs to the FriedhelmLoh group of companies in Germany. Founded in 1961.. Rittal started its operation in India in the month of June 1995. In the initial Phase, Rittal products were imported from Germany and introduced to the Indian customers. The plant in India started its operations in November 97. Rittal Plant is 15,000 Sq. meters in size, situated on a 12 acre plot equipped with the latest state of art machinery and paint plant from Germany. The Plant also has a stocking facility of over 2,200 sq. mts area to ensure immediate / ex -stock delivery / service to our customers.. This plant currently operate in three shifts and produce approximately 50,000 free standing large enclosure and 1,00,000 small boxes per year.

The problem of balancing the activities, under different workstations, has been a challenge ever since the Industrial Revolution when the Assembly lines were first introduced. Many of the useful techniques have been developed by researchers to obtain meaningful solutions. Few of the widely used techniques are Kilbridge – Wester method, Ranked Positional Weightage method, Largest Candidate rule and hybrid techniques. Further investigations continue to obtain solutions for suitable applications. Many of these calculations are still performed manually for complex Mixed Model scenarios. Introduction of automation into these techniques is required for faster results.

PROBLEM STATEMENT

The difference in workload distribution between the workstations increases the waiting time of other workstations and thereby increasing the cycle time. In manual assembly line, the starting of any work or task of a work station should be in synchronization with the completion of task of the previous workstation. In the assembly line, there is a waiting time between the workstations and the flow of frame is not smooth. Hence, workload should be distributed uniformly between the workstations so that there is least waiting time.

PROCESS

Number of activities in assembly line= 21

1. First the frame is loaded into assembly line.
2. From here, the frame moves from one stage to another.
3. At each stage, components or parts gets assembled into the frame.
4. This process continues till the final stage.

METHODOLOGY

Workload distribution by grouping workstations

- Find out the work activity precedence and record the task time for each activity.
- Group the workstations till the task times of grouped workstations reaches near the cycle time of the assembly line. Note that the task time of grouped workstations should never cross the cycle time of the assembly line.
- Redistribute the activities according to the largest candidate rule under different workstations.

Assembly line Balancing by LARGEST CANDIDATE RULE Using Software:

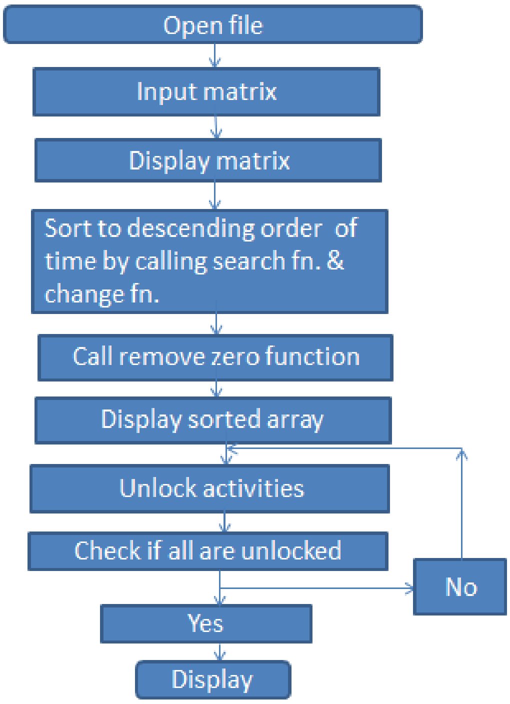

Figure 1 Flow chart

1. Open file
2. Input data matrix into the file, first the task time then the immediate preceding activities of that particular task. Continue till last task.
3. Clear the screen and display the entire matrix that has been entered and stored in the file.
4. With the largest activity time at the top, arrange in descending order all the activities according to their activity times.
5. Due to sorting operation the resulting zeroes are to be eliminated and hence, a function called remove zero is called by the program to trim the matrix.
6. Then display the trimmed and sorted array on the screen
7. Unlock the activities with the least precedence requirement and the largest activity times and simultaneously print them.
8. Check for each loop whether all activities have been unlocked.
9. If no, then continue unlocking activities as in step 7 and checking in step 8.
10. If yes, then end the loop and inform the user that the rearrangement is complete.

DATA COLLECTION

PS-4808500 SINGLE DOOR MODEL (STANDARD)

ACTIVITIES	AVG. CYCLE TIME
1. FRAME LOADING	.16
2. MOVING WHEEL DISMANTLING	.09
3. HINGE FIXING & LOCK HOLDER FIXING	.32
4. FIXING BACK PANEL HOLDERS	.38
5. SINGLE DOOR RETAINER	.38
6. LOCATOR PIN FIXING	.18
7. MOUNTING PLATE BRACKET FIXING	.52
8. TOP COVER EYE BOLT FIXING	.79
9. BOTTOM COVER FIXING (DIN RAIL)	.44
10. PLACE THE PALLET & UNLOAD FRAME ON PALLET	.18
11. GLAND PLATE FIXING	1.27
12. CHASIS/DEPTH MEMBER FIXING	.21
13. DOOR CENTRE LOCK FIXING	.10
14. MOUNTING PLATE BUSH ASSEMBLY	.11
15. MOUNTING PLATE ASSEMBLY	.62
16. MOUNTING BRACKET ASSEMBLY TO CHASIS	.67
17. REAR PANEL ASSEMBLY	.68
18. FIXING PRE ASSEMBLED DOOR TO HINGE 6 SIDE TAPPING	.69
19. PAINT TOUCH UP,DUST CLEAN &IF REQD LOOSE SUPPLY PARTS	1.1
20. STRETCH FILM TIEING, CORNER BLOCK FIXING & WRAPPING	1.8
21. MOVING TO STRAPING MACHINE & STRAPING	.61

*(The above time is in minutes)

PS-4808500 SINGLE DOOR MODEL (STANDARD)
PRECEDENCE DIAGRAM

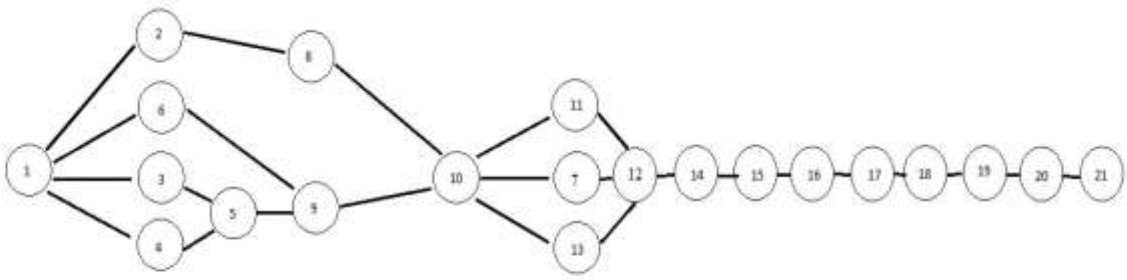

Figure 2 Precedence diagram

The bottleneck cycle time occurs due to activity number 20 (B)= 1.8 min.

Total task time(T) = 11.97 min.

Theoretical minimum number of workstations = T/B =11.97/1.8= 7.99

The minimum number of workstation has been rounded off to 8.

RESULTS

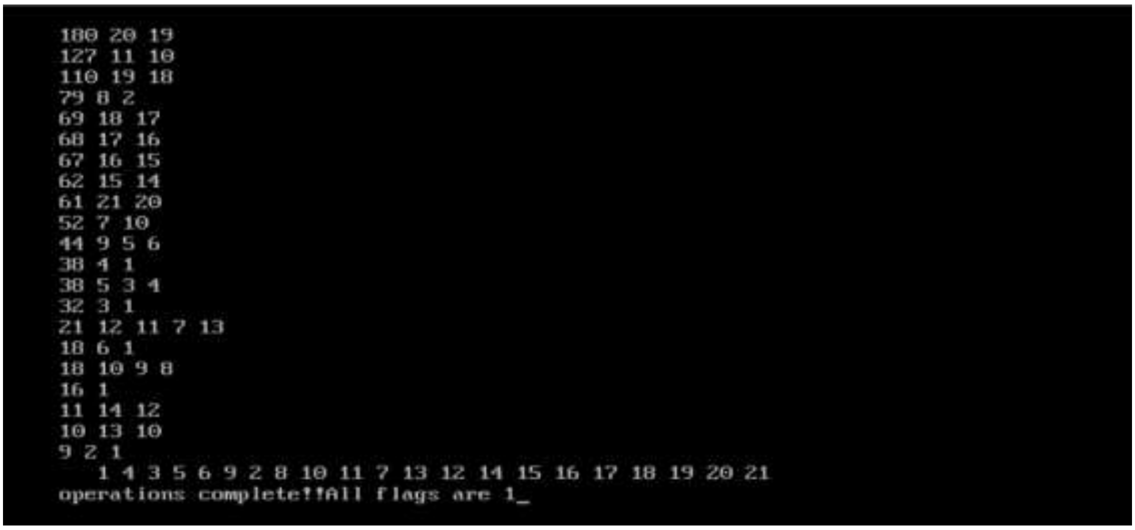

Figure 3 Output screen

*(Column 1 contains task time without decimal, Column 2 is the task number and others are precedence of each task)

*(The last line gives arrangement of activities /work elements based on HIGHEST CANDIDATE RULE)

Table For Rearrangement Of Activities

STATION NO.	1	2	3	4	5	6	7	8
ACTIVITIES	1,4,3,5,6,9,2	8,10	11,7	13,12,14,15,16	17,18	19	20	21
STATION TIME (min.)	1.63	0.97	1.79	1.71	1.37	1.1	1.8	0.61
IDLE TIME (min.)	0.17	0.83	0.01	0.09	0.43	0.7	0	0.72
IDLE TIME (sec.)	10	49	0.6	5.4	25.8	42	0	43.2
TOTAL IDLE TIME:- 181.2 sec(3.02 min)								

CONCLUSION

A target of 2 min or less cycle time was assigned , and thereafter reducing the idle time.Finally a cycle time of 1.8 min was achieved and total idle time has been reduced to 181.2 sec(3.02 min) after the study.

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