ASSEMBLY LINE BALANCING IN EICHER GROUP TRUCKTOR USING FUTURE FACTORY CONCEPT

[1]MINAKSHI RANGARE, [2]ARUN BHUNERIA

[1]Minakshi Rangare R.G.P.M Bhopal

[2]HOD.ME Arun Bhuneria

ABSTRACT

This master thesis has been carried out at Eicher Tractor in order to answer the question "how will line balance efficiency change when following a modularization concept with fishbone layout instead of doing lots of different tasks in the main assembly line?" Currently a lot of different tasks are made in the main assembly line which due to the high product variety causes line balance efficiency losses. In order to do this study, a concept of modularization in production with a fishbone layout has been studied. This concept has been modeled with discrete event simulation in order to find the balance efficiency in the final assembly. The current final assembly has also been modeled in order to find out the line balance efficiency in production today.

1.INTRODUCTION

In this chapter a short description to the reason for this study is presented. First, a brief background regarding the Eicher and one of its challenges in its production system is presented. Following, the objective and goals of this master thesis are described. At the end, the delimitations, thesis outline and the list of abbreviations are presented. Industries that utilize the assembly line to obtain their products currently go through great challenges. The first is the need to assemble a large number of product models and their variants in their lines, due to the variety required by the market. Another challenge is the need to maintain an adequate level of manpower occupation and other utilized resources. In this scenario the activity of balancing operations appears. In order to increase the efficiency and reduce the operating costs of the line, balancing activities among workstations are performed. They can be done by different methods, such as: Heuristic Methods of Line Balancing

1. Largest Candidate Rule Algorithm (LCR)
2. Kilbridge and Wester Column Method(KWM)
3. Ranked Positional Weight Method (RPW)
4. Meta-heuristics methods,
5. Moodie -Young Method
6. Killbridge and Wester Heuristic
7. Hoffmans or Precedence Matrix
8. Immediate Update First Fit Method

Simulation in assembly lines that produce more than one model, total and individual assembly times are often different among models, so the operation times of each station vary from model to model. The balancing in lines that produce more than one model can be performed by using the weighted averages of the times of the different models. Another possibility is to use an objective function that considers the unbalance among the models and try to minimize it. Using real data from an assembly line meets the need of a greater amount of practice research in assembly lines balancing, because according to Boysen, Fliedner and Scholl [1], researches using real data represented only 5% of the work on assembly lines balancing. The application of different methods of balancing and the comparison among them will be a further indication of which alternative best serves the large-scaledenterprises in the automotive industry, which rely on assembly lines with the same characteristics as the ones of the enterprise being studied in this present work. A well-balanced assembly line reduces wastes, such as operator idleness, the need of fluctuating operators, stock, and faulty products, it also decreases the production costs of the unit for the company and allows the company to reduce the price of their products. The objective of this study is to evaluate eight methods of mixed model assembly lines balancing, by applying them to an assembly line of a large-scaledenterprise in the automotive industry. The limitation of this study was the inability to access the real balancing method used by the enterprise, which uses the Maximum Task Time method, however it was not possible to make a comparison between it and the theoretical result.

2. PROBLEM DEFINITION

As been described earlier Eicher has a strategy of providing their customer with a highly customized tractor. This has introduced a high level of complexity in the entire manufacturing organization. Focusing on the assembly process, it has led to producing a large number of unique Tractor (variants) in the same assembly line. As these truck variants differ a lot, as an example the length of chassis vary between 5 to 8 meters, the amount and type of tasks related to each truck varies which leads to assembly time variations. Since a large amount of the customization is carried out in the main assembly line (MAL), balancing of the line is hard and eventually losses will occur. By increasing the amount of tasks in the MAL and simultaneously decreasing the flexibility in the assembly line, inefficiency and losses have been increased. As newer variants require more tasks, the MAL is running out of space. Several types of losses occur in the system because of the large number of variants and tasks related to each variant. It's hard to identify the best way and place to deal with these losses. Eicher Group Tractor has an approach to improve their assembly process. This approach is defined as Future Factory Concept (FFC) or Eicher Assembly Concept. Focusing on assembly

3. OBJECTIVE

The purpose of this master thesis is to explore the effects on line balance efficiency by implementing the fishbone strategy. This study will be based on the production system at the Eicher plant. This master thesis tries to study positive and negative effects related to line balance efficiency when implementing the fishbone strategy. This will give the opportunity to examine the validity of the hypothesis described in the problem definition.
Considering the above description the following research question is formulated;

• How will line balance efficiency change when following a modularization concept with a fishbone layout instead of doing lots of different tasks in the main assembly line? This research question will be answered by creating simulation models of both current situation and the fishbone concept. These models will help to calculate and analyze the line balance efficiency in both scenarios. The model will be created using data from the production system at the Plant.

Fishbone layout

The idea with a fishbone strategy is an amount of sub-assemblies connected to a main line. The sub-assemblies are producing different modules (sub-systems) that are merged on the main line. Figure 4 shows an example of a fishbone layout. The round circles and the line between them symbolize the assembly line where the modules are mounted in the marriage points. Connected to the marriage points are sub-flows with different amount of stations. In these sub-flows the modules are built.

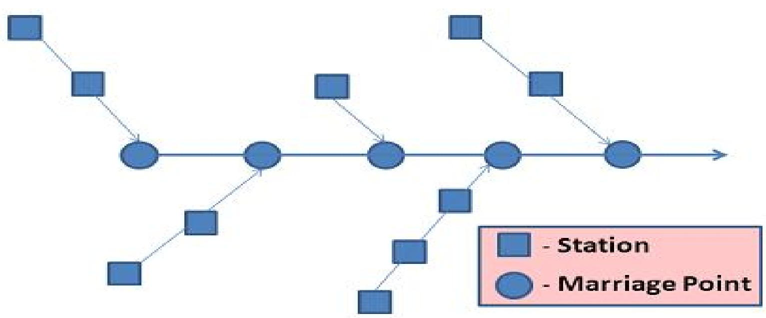

Figure 4: Fishbone layout

4.LINE DESIGN

There are some common and general factors for designing any production system. These factors focus on required tools and machines, needed space, production logistic (material handling) and necessary manpower. Beside these factors some other factors consider when the production system has a line layout. Number of stations, takt-time, balancing the line and minimizing any kind of stoppages in the line are some of these factors. This study will focus more on line balancing. A line will be fully balanced if all the operator and stations through the entire line have the same amount of workload. Any failure to have exact same amount of work load for all operator leads to balance losses. When the line is a mixed-model assembly line the variation between different variants might also lead to balance losses which can also be called variant losses. It’s essential that losses are kept as low as possible in order to maximize profits. Balance losses occur when there are deviations in work load at different stations or between operators. To minimize balance losses it’s important to allocate tasks in a sufficient way.

5. DATA COLLECTION

This data collection contains some tables which show common assembly line and cylinder head assembly line for existing and proposed set up. Collection also contains the experimental set up of proposed engine assembly line. Note – Time is calculated by stop Watch and length is calculated by inch tape.

Table.1. EXISTING COMMON (BLOCK) LINE

S.no.	Description	Process time in second	Manpower	Length of conveyor in meter
1	Cooling jet	151	7	14.2
2	Thrust plate	186	,,	
3	Main bearing	135	,,	
4	Piston sub assembly	67	,,	
5	Piston oiling	186	,,	
6	Piston installati on	170	,,	
7	Piston projection	146	,,	
8	Idler shaft	233	,,	
Total time in second		1274		

Table.2. PROPOSED COMMON (BLOCK) LINE

S.no.	Description	Process time in second	Manpower	Length of conveyor in meter
1	Cooling jet	147	6	12.03
2	Thrust plate	185	,,	
3	Main bearing	135	,,	
4	Piston subassembly	67	,,	

5	Piston oiling	182	,,	
6	Piston installation	165	,,	
7	Piston projection	140	,,	
8	Idler shaft	221	,,	
Total time in second		1242		

Table.3. EXISTING CYLINDER HEAD LINE

S.no.	Description	Process time in second	Manpower	Length of conveyor in meter
1	Cylinder head assembly valve station	265	6	13.18
2	Cylinder head assembly station	372	,,	
Total time in second		637		

Table.4. PROPOSED CYLINDER HEAD LINE

S.no.	Description	Process time in second	Manpower	Length of conveyor in meter
1	Cylinder head assembly valve station	261	5	12.76
2	Cylinder head assembly station	368	,,	
Total time in second		368		

5.CONCLUSION

By comparing both the assembly line layouts it was found that the proposed design has better and delivers good efficiency of the assembly lines. The results for both the layouts are taken to find the real time efficiency and manpower which also has a bearing on optimal working area for assembly lines. We can improve the efficiency of any manufacturing unit by applying improved technique and design methods. good conveyor can improve the efficiency of plant

REFERENCES

[1] Rahani AR, Muhammad al-Ashraf, Production Flow Analysis through Value Stream Mapping: A Lean Manufacturing Process Case Study, Procedia Engineering 41 (2012) 1727 – 1734.

[2] Alireza Anvari, Yusof Ismail and Seyed Mohammad Hossein Hojjati, A Study on Total Quality Management and Lean Manufacturing: Through Lean Thinking Approach, World Applied Sciences Journal 12 (9): 1585-1596, (2011), ISSN 1818-4952.

[3] Dilip Roya and Debdip Khanb, Optimum Assembly Line Balancing by Minimizing Balancing Loss and a Range Based Measure for System Loss, Management Science Letters 1(2011) 13–22.

[4] G. Michalos, S. Makris, N. Papakostas, D. Mourtzis, G. Chryssolouris, Automotive Assembly Technologies Review: Challenges and Outlook for a Flexible and Adaptive Approach, CIRP Journal of Manufacturing Science and Technology 2 (2010) 81–91.

[5] Tarcisio Abreu Saurin, Cle´ ber Fabricio Ferreira, The Impacts of Lean Production on Working Conditions: A Case Study of a Harvester Assembly Line in Brazil, International Journal of Industrial Ergonomics 39 (2009) 403–412.
[6] Editorial, Introduction to Design and Analysis of Production Systems, Int. J. Production Economics 120 (2009) 271–275.
[7] Nigel Slack, Stuart Chambers, Robert Johnston, Operations Management. 5th Edition, Pearson Education Limited, Essex, (2007), ISBN 978-0-273-70847-6.
[8] Marcus Sandberg, Design for Manufacturing Methods and Applications Using Knowledge Engineering, Luleå University of Technology, (2007) ISSN 1402-1544.
[9] Ortiz, C. A., Kaizen Assembly: Designing, Constructing and Managing a Lean Assembly Line, Taylor and Francis Group, Boca Raton, (2006), ISBN 0-8493-7187-2.
[10] Mahmoud Houshmanda, Bizhan Jamshidnezhad, An Extended Model of Design Process of Lean Production Systems by Means of Process Variables, Robotics and Computer-Integrated Manufacturing 22 (2006) 1–16.
[11] Selcuk Karabat, Serpil Sayın, Assembly Line Balancing in a Mixed-Model Sequencing Environment with Synchronous Transfers, European Journal of Operational Research 149 (2003) 417–429.
[12] Baudin, M., Lean Assembly: The Nuts and Bolts of Making Assembly Operations Flow, Productivity Press, New York, (2002), ISBN 1-56327-263-6.
[13] Joseph Bukchin, Ezey M. Dar-El, Jacob Rubinovitz, Mixed Model Assembly Line Design in a Make-to-Order Environment, Computers & Industrial Engineering 41 (2002) 405-421.
[14] Llu!ıs Cuatrecasas Arb!os, Design of a Rapid Response and High Efficiency Service by Lean Production Principles: Methodology and Evaluation of Variability of Performance, Int. J. Production Economics 80 (2002) 169–183.
[15] Stephan Eskilander, Design for Automatic Assembly- A Method for Product Design: DFA2. Kungl Tekniska Hogskolan, TRITA-IIP-01-02, (2001), ISSN 1650-1888.
[16] RC. Barker, Production Systems without MRP: A lean Time Based Design, Omega, Int. J. Mgmt Sci. Vol.22, No. 4, pp. 349-360, (1994), 0305-0483(94)00029-8.