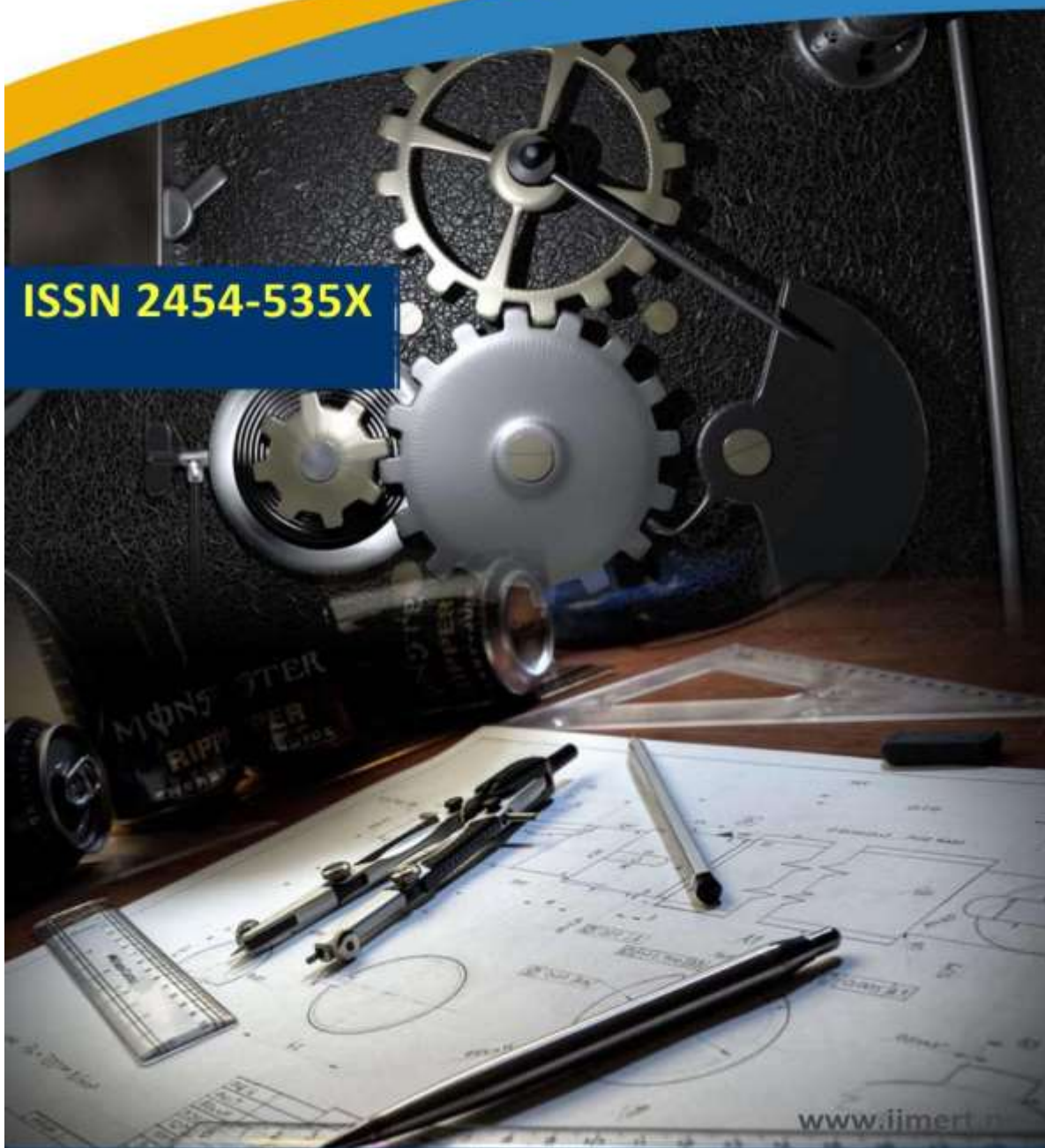




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Inflicting Agility through Just-in-time Practices in a Truck Tyre Manufacturing Plant

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ABSTRACT: In the recent period the spectacular developments have been witnessed in the manufacturing management front in case of the modern firms. Just-In- Time (JIT) is one of the fundamental instruments of the industrial management. It not only enables a manufacturing unit to run at the least feasible inventory level, but also it delivers great convenience in the operations of the material handling devices with appropriate batch load. In truth JIT is a novel idea and the problem is its simplicity for successful management of working capital. It offers no advance technology or difficult ideas but instead it attempts to minimize unneeded costs of complexity in manufacturing process resulting to minimum inventory keeping. This study deals about the introduction of JIT- techniques for a Y- box rubber tread extruder at a prime Indian truck tyre production plant. Y-box extruder is a key equipment in truck tyre manufacturing process as it is capable of extruding two distinct materials to generate finally a tread rubber equipped with two side wall along the two sides of it. This tread rubber and side wall rubber are of distinct materials because of their various uses. In this study of a diagnostic evaluation has been made for die changing time of this Y-box extruder and goal performance monitoring table is developed for different decreased values of die changing time. The findings of this review are rigorously studied to acquire a comprehensive justification of including reduced cycle time of this important die changing operation and the various approaches are offered for execution

Keywords: JIT, Truck Tyre Manufacturing, Manufacturing Management, Inventory

LITERATURE SURVEY

He et al. 14 [2002] highlighted the need of delayed product specifications for achieving production system agility in scheduling. In order to achieve short cycled production at the lowest feasible cost, he emphasized the significance of the delayed product differentiation. It's possible, but it's not the only factor. The entire team has been concentrating on the schedule instead of taking an agile engineering strategy. In order to achieve agility in the manufacturing system, Sawik et al. 23 [1993] concentrated on adaptable flow lines, whereas Silver et al. 26 [1985], Gupta11, and Krishnan[1998] emphasized a decision system for inventory and production planning. However, these are one of the important factors that contribute to agility, and yet a holistic perspective overlooks them. The advantages of delayed product diversification were described by Gupta et al. 11-12 [1991], [1998] as lower safety stock

and faster customer reaction time. To replace a one-of-a-kind integrated element, He et al. 15 [1996] claimed that modular designers would assemble standard parts that could be produced during the machining stage or obtained directly from suppliers. Additional assembly stations may be needed in the system if the modular architecture increases the number of assembly operations and the assembly time. Because of this, the system into long-cycled manufacturing, as opposed to the short-cycled manufacturing typical in agile production. For the purpose of representing the order of assembly, Kausiak18 [1989] advocated using a digraph G, where each node represents a component or subassembly and each arc denotes a dependency between two nodes.

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When the number of edges incident to a node is greater than one, we know that it represents an assembly or subassembly. An assembly is always represented as the diagram's root node. According to Hull C. et al.¹⁶ [1995], rapid prototyping technology has the potential to help businesses achieve short cycled production. He stated that fast prototyping had the potential to explode in popularity and replace many established technologies. The need of intelligent fast prototyping approaches for accompanying quick response manufacturing has been stressed by Dong⁷ [1998]. In order to achieve proactive manufacturing, Hansen,¹³ [1993] discussed the best production techniques for factories with various production lines. Layered manufacturing was mentioned by Comb,⁶ J.W.⁶, et al., [1994] as a means of quickly achieving complicated customer-requested profiles. Cho, K.Y.⁵ et al. [1996] examined the role of simulation in improving production at a Korean Motor industry. Accelerated simulation modeling for real-time operation plan optimization was emphasized by LU,²¹ C.J.²¹, et al. [1995]. The potential layout of a was first proposed in [2000] by Chattopadhyaya S.³ and Varma, A. mechatronic factory of an Indian manufacturing unit where, with the right mechatronics in place, quick response production may be deployed. Facility management strategies in relation to an agile engineering environment for prompt response to customer demand were explored by Chattopadhyaya,^{S2.} and Basu, A.K., [1999]. The application of cutting-edge manufacturing techniques in various nations has been examined by Kotha¹⁹ et al. [1998], [2000]. According to Swamidass²⁶⁻²⁹ et al. [2000], [2002], [2002a], [2002b], manufacturers in the United States are incorporating a variety of Japanese technologies into the system in order to increase its responsiveness. In order to make their products profitable and competitive, the Japanese prioritized quality, variety, and cost leadership at the same time in order to achieve agility in their manufacturing system, as evidenced by studies by Wheelwright [1981],

Schonberger [1982], Grewin [1992], and Womack et al [1990]. Gordan and Soha¹⁸ [2001] contrasted the manufacturing sectors of Canada and Australia, specifically looking at how each country uses manufacturing technology and what kinds of practices they employ. According to Jaikumar¹⁷ [1986], the adoption of manufacturing process improvements in the form of Advanced Manufacturing Technology is far higher in Japan than in the United States. Significant attention has been paid to contrasting the production methods used by American and European companies by Vastag and Whybark³⁰ [1994]. The challenges of justifying and evaluating various forms of advanced manufacturing technology were highlighted by Mansfield²² [1993]. Manufacturing technology adoption techniques were compared and contrasted by Grewin and Kolondy⁹ [1992]. Based on the results of the preceding poll, it is clear that most papers discussing the adoption of agile manufacturing practices remain mostly theoretical. Closer inspection indicates that a number of the pieces talk about the complexities of putting the agile manufacturing tenet into practice. Despite its obvious significance to the success of agile manufacturing, academics can't seem to agree on its weight in the equation. As a result, it's important to pinpoint the unique factors that may affect the success of each of the agile engineering philosophy's fundamental principles in various sectors. We utilized citation frequency as a proxy for the significance of these factors in our analysis. studies had to use their best judgment to classify and organize the variables covered in the papers due to the uncertainty surrounding the terminology employed by various studies. This suggests that the factors are not always independent of one another and may interact. Therefore, at least in analogous circumstances, a mathematical model is needed to estimate the relative agility of various production techniques.

Despite being one of the world's major rubber product manufacturers, little study has been conducted in truck tyre factories.



manufacturing the aero tyres also. when the entire manufacturing varieties with their all-possible process sequences in the manufacturing plant are considered. Here an effort has been made to develop a model of this sort to get the preliminary ideal of the agility status of the concerned manufacturing units.

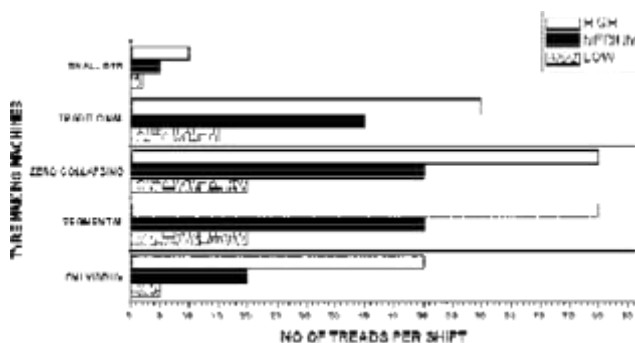
GOAL PERFORMANCE MONITORING

In the agile manufacturing system JIT practices are followed. Through this method all form of stocks and storages are reduced to minimum level through implementation of short cycled manufacturing operations. By implication of JIT practices for a y box extruder the number of treads manufactured per shift can be substantially increased.

The following tables shows a comparative study of number of treads per shift in truck tyre manufacturing unit using various tyre making machines using one Y box extruder and two Y box extruder conditions respectively.

One Y Box Extruder Condition

Serial no	Tyre making machine	Low no of treads/shift	Medium no of treads/shift	High no of treads/shift
1	Automatic	5	20	50
2	Segmental	20	50	80
3	Zero Collapsing	20	50	80
4	Traditional	15	40	60
5	Small OTR	2	5	10



The graphical representation for one Y box

Work Measurement

1. Opening the nuts and bolts;
2. Unloading the existing die;
3. Loading the new die;
4. Tightening the bolts with nuts.

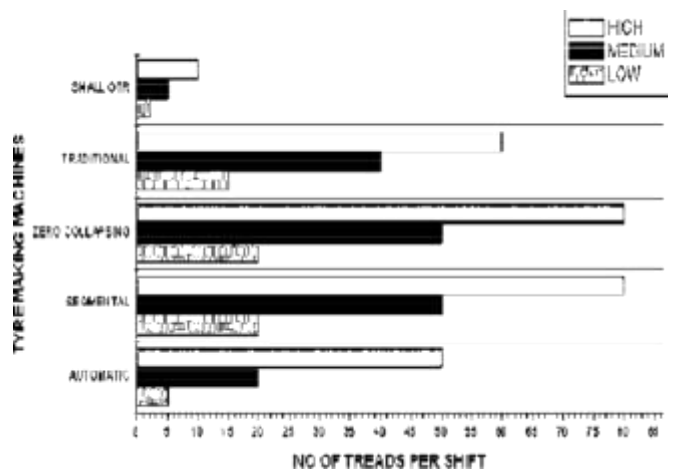
The following g tabular form shows the die changing times for the different operations involved in work

extruder condition for the above table

Figure 1: The Tabular Representation for No. of Treadsper Shift for Two Y Box Extruder Condition

Serial No	Tyre making machine	Low no of treads/shift	Medium no of treads/shift	High no of treads/shift
1	Automatic	2	10	25
2	Segmental	10	25	40
3	Zero Collapsing	10	25	40
4	Traditional	7	20	30
5	Small OTR	1	2	5

**Table 1
The Graphical Representation for Two YBox Extruder Condition**



The analysis of the above table and graphs shows that the no of treads per shift in each type of the tyre making machine is increased by about 4 -5 times from low no of treads /shift to high no of treads /shift and 1.5-2 times from medium no of treads /shift to high no of treads/ shift.

In the study of truck tyre manufacturing unit it has been found that for minimum operating inventory the implementation of JIT process is necessary. The areas where one should concentrate is to reduce the die changing time for attaining agility the following die changing operations add up for the work measurements.

measurement for low, medium and high number of treads /shift.

Table 2
Die Changing Time (in min)

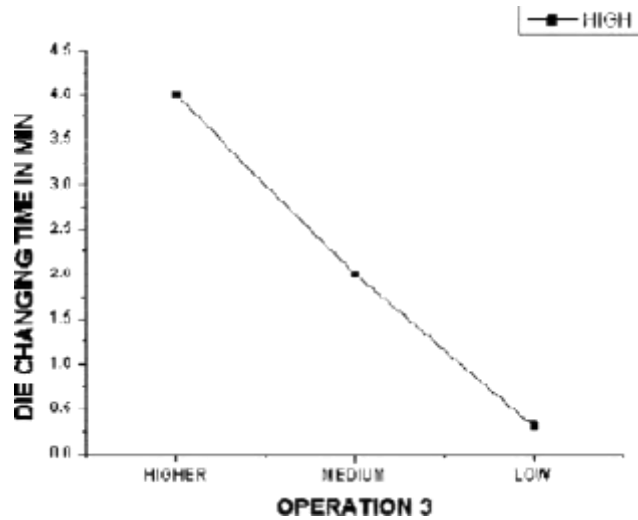
The graphical representation of the above data is asfollows:

Figure 3: Operation 1:Opening the Nuts and Bolts

Figure 4: Operation 2:Unloading the Existing DIE

Operation	Low no of treads/shift	Medium no of treads/shift	High no of treads/shift
1	1.5	0.5	0.1
2	4	2	0.3
3	4	2	0.3
4	1.5	0.5	0.1
Total time taken	11 min	5 min	'1 min

Figure 5: Operation 3 : Loading the New Die



The analysis of the above tables and graphs show a comparative study of die changing time for various work

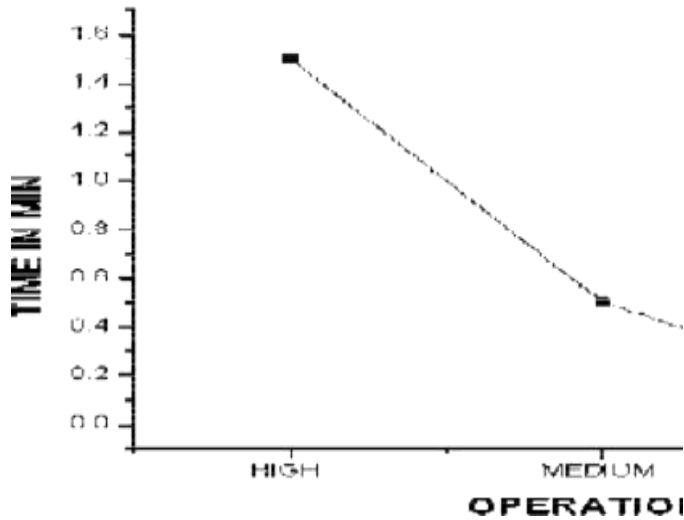


Figure 6: Operation 4 : Tightening the Bolts and Nuts

Figure 7: Total Die Changing Time Required for OneY Box Extruder

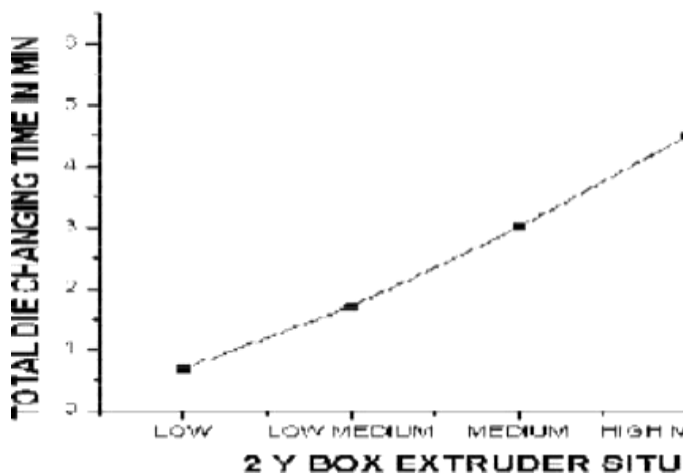
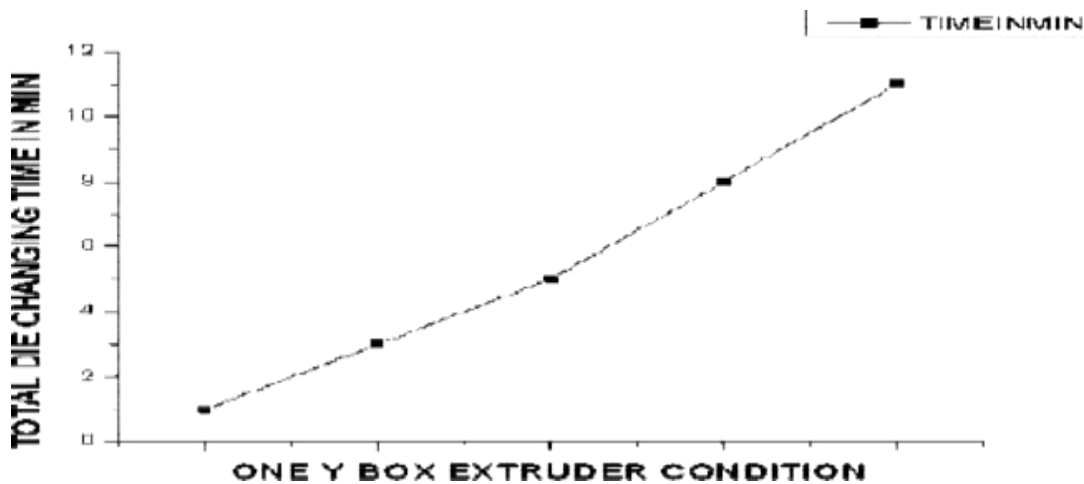


Figure 8: Total Die Changing Time for Two YBox Extruder Condition

measurement operations using one and two Y box extruder.

CONCLUSION

- One Y box extruder may greatly improve productivity in a truck tyre factory with a wide range of products without adding unnecessary complexity. Improving production requires doing a sensitivity analysis on the time spent changing dies. A manufacturing unit's potential to apply JIT and run a plant efficiently, safely, and cheaply depends on how quickly its dies can be changed.
- The peak of zero stockpile has not been reached. It has not fully matured yet. However, SMED (Single Minute Exchange of Die) is possible in the industrial sector. Technology has a low cycle time, and this method helps to maintain that. Methodologies that might be used are
-
- Using power spanners;
- Incorporating slider die magazines;
- Fitment with taper attachment of dies;
- Gang tree based dedicated loading and unloading of die magazines.

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