Study of Make Shift Automobile Manufacturing Process in India Using Simulation

Upendra Kumar  
Amity University, Haryana

Rajat Butola  
Amity University, Haryana

Lokesh Singh  
Amity University, Haryana

Sparsh Pratik*  
Amity University, Haryana

Abstract: Most of the makeshift auto manufacturers lack in the technology; as a consequence the manufacturer cannot satisfy the market demand at right time and right cost. Currently they are following the traditional manufacturing (Jugaad) technology. Improper layout, uncontrolled process, inefficient due date management, non-standardized transportation of semi-finished goods all together, less automation, uncertain demand, lack of training of workers, leads to ineffective and delayed production or prolonged production time. The above scenario was studied using a three wheeler manufacturing company of Kanpur called “ABC Auto”. Time and motion study was conducted in their manufacturing plant to quantify their process. The resulting model of ABC Auto was simulated with the help of ARENA. Using the results from simulation, the capacity of manufacturing plant was calculated and developed the benchmark for the company. Process analysis was conducted and bottlenecks were removed. Through the elimination of the bottlenecks, plant capacity was increased.

Keywords: Makeshift, Simulation, Arena, Manufacturing Process.

Introduction: Indian automotive industry was born in the early 1942 when Hindustan Motors was set up. Since then it has evolved technologically and economically. Hindustan Motors, which produced the first car, The Land master upgraded the version and later branded it as ‘Ambassador’ [Export Import Bank of India, 2008]. Indian auto component industry is emerging as a global manufacturing hub for auto component manufacture. The Auto components industry is predominantly divided into the following segments: Engine parts: 31%, Drive Transmission & Steering Parts: 19%, Suspension & Brake Parts: 12%, Electrical Parts: 9%, Body and chassis: 12%, Equipments: 10%, others: 7%. Indian auto component industry is one of the front runners for grabbing the global auto component outsourcing market, estimated to be worth US$700 billion by 2015. This study is based on small and medium-sized automobile manufacturing firms in India. The major problem of such manufacturing processes is the ever increasing expenses of manufacturing. In India there is a significant demand for three wheelers; popularly known as auto rickshaw or autos. In India there are few manufacturers who make variants of auto rickshaws by using makeshift technology. They procure some components from other manufactures and produce some component
they assemble all those components and make the end product, which is the auto rickshaw or just auto. These small automobile industries do not have proper assembly line for manufacturing. These small automobile industries work on makeshift technology, which depend on the man- machine combination, where human still dominates. Every company that works using the makeshift technology has the following type of situation: Planning of manufacturing process is not scheduled, Less skilled labour, Inefficient equipment, Less automation, Inappropriate plant layout, Substandard equipment, Transportation of semi-finished goods is not standardized, Data management is inefficient, Lack of training for labour. Due to all this above mentioned factors such manufacturing processes are very inefficient, which result in very low manufacturing rate of the automobile. So in order to fulfill their demand, they need to work overtime which increases their expenses. For study the manufacturing process, we took five major component of auto and found their process flow. Every component has their own process flow, for collecting the data we did the time and motion study for every component, in this we recorded the time taken by the component at different process.

**Literature Review:** Indian industries are presently on fast track development. Especially Indian automobile industry has improved indigenous technology and as well as importing modern technology to improve the manufacturing process, so that cheap and reliable vehicles can be manufactured for Indian population. The strength of Indian industries has to be identified in terms of development of indigenous technology as well as in the acquisition adaptation of its own technology [1]. Some authors have studied the application of simulation model to identify optimal production, specifically in heavy rolling mill system and in steel making industry [2]. Methodology of modelling and the study of final process of automobile manufacturing and to develop efficient model which provide maximum throughput or ensure the targeted throughput [3]. Initial efforts of implementing the simulation model with help of visual management and analysis tool at automotive foundry plant that is manufacturing engine block is studied in [4]. Virtual simulation of a design of a production line for a mechanically assembled product is given in [5]. Real world manufacturing problem can be modelled with the help of simulation and that can be used as an optimization tool for most of the manufacturing process, [6], used simulation for complex production lines in order to minimize product lead times and maximize throughput. They explained meta model simulation based optimization and applied it to a multi objection real world manufacturing system. Depending upon the field of assembly planning and different objectives, the simulation analysis can be classified into four hierarchy classes of assembly shop, cells, station, and component [7]. Simulation is a very helpful tool for manufacturing. It can be used in different industrial field, for the analysis of the system’s behaviour and to test the system output. Simulation provides low cost, and fast analysis tool [8]. Survival of any industry in today’s competitive market place depends on the response time, production cost and flexibility in the manufacturing process. From analyzing the literature, it is quite evident that research in the field of Indian Jugaad auto manufacturers are lacking. Especially no studies are available in the base of simulation as a tool to study the processes of much industry and
improve them. Capacity benchmarking, utilization, and desired layout are the major issues playing such industries in India, which can very well be studied using simulation.

Factory Layout: ABC Auto is an old experienced auto manufacturer, providing autos to major cities in India and as well as overseas. Its major function is to assemble the equipments and vehicle part to provide the finished product. Most of the parts of the auto are in-house items. For implementing all those process ABC Auto has following department/shops: Machine shop, Welding shop, Press shop, Cutting Shop, Phosphating Shop, Painting shop, Assembly shop, Inventory & Store Room, Front show department. Factory layout is shown in the Fig 1.

![Figure 1: Factory layout of ABC Auto](image-url)
Overview of the Problem: The focus of ABC Auto is to restrict the level of production with increase in production time. The current layout plan of the plant is not properly planned and random as per the olden days. It has not been modified to fit to the modern production plan. Due to this the in-house transport of semi-finished goods take little bit greater time and thus results in reduced efficiency. Also as these parts are being moved from one part of plant to the other, the wear and tear of the material during the transportation occurs, which results in depreciation in the quality factor. The current layout plan of the plant is shown in the Fig 1.

Simulation Modelling in Arena Simulator: The model of the process was developed using ARENA software shown in the Fig 2. To begin the experiments, all the values are taken as constant. The processing time in the departments is constant with the average value of processing time from time study was used. Every resource is fixed with a quantity of one each. The simulation is first carried out with constant system, for which the bottleneck was noted and removed or eliminated by increasing the number of resources. An optimal number of resources were worked out for achieving the rate of auto manufacturing of 3.36 autos per hour. After achieving the set of fixed optimal resources the variability was introduced in the system to simulate the real life scenario. The distributions are applied to the various section or machines in a sequential manner and again bottlenecks are noted and removed or eliminated by increasing the number of resources. An optimal number of resources worked out for achieving the rate of auto manufacturing of 3.36 autos per hours. In this work basically the 5 components, chassis, front show, plane furse, and mudguard and rear wheel tube is taken.

Process Flow of Component: Input components and their process flow are shown in Table 1. Here every component has different process flow for manufacturing the component.

<table>
<thead>
<tr>
<th>S/No.</th>
<th>Component</th>
<th>Process flow (order wise)</th>
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<tbody>
<tr>
<td>1</td>
<td>Chassis</td>
<td>Cutting → machine1 → welding m/c → phosphating shop → painting m/c</td>
</tr>
<tr>
<td>2</td>
<td>Front show</td>
<td>Shearing → press m/c → milling m/c → spot welding m/c → phosphating shop → painting m/c</td>
</tr>
<tr>
<td>3</td>
<td>Plane furse</td>
<td>Shearing → press m/c → milling → spot welding m/c → phosphating shop → painting m/c</td>
</tr>
<tr>
<td>4</td>
<td>Rear wheel tube</td>
<td>Machine 2 → welding m/c → phosphating shop → painting m/c</td>
</tr>
<tr>
<td>5</td>
<td>Mudguard</td>
<td>Shearing → milling m/c → spot welding m/c → phosphating shop → painting m/c</td>
</tr>
</tbody>
</table>
Final Arena Simulation Model Shown Below of ABC Auto:

![Simulation Model](image)

**Figure 2: Simulation model for manufacturing process of ABC Auto**

**Result and Analysis:** Here the model is considered from starting and problem is analyzed, means finding the bottleneck, which is removed by analyzing the system, and repeated this process until we achieved our required manufacturing rate of auto. In this model we took the rate of incoming of material/entity is 3.36 auto per hour, and by proposed model we got rate of auto manufacturing is
3.365 auto per hour. Fig 3 and Fig 4 shown the utilization of the proposed machine is less which can be further deduced the proposed model’s waiting time is less.

Utilization of Machine

Figure 3 and Figure 4 show the machine utilization graph for current model and for proposed simulated model respectively.

Current Simulation Model

![Current Simulation Model Utilization Graph](image)

**Figure 3: Utilization Graph of Current Simulation Model**

Proposed Simulation Model

![Proposed Simulation Model Utilization Graph](image)

**Figure 4: Utilization Graph of Proposed Simulation Model**
Conclusion: In this work study of makeshift automobile manufacturing in India is done, for study of Indian scenario of manufacturing, one auto manufacturing firm ABC Auto is considered and their problem is studied. ABC Auto has very less auto manufacturing rate, so due to which they are unable to fulfil their target in 8 hours shift so for achieving the target they do the 4-5 hours overtime everyday which increases their expense. So for solving this problem, time motion study has been conducted in their plant and real time data is collected, and for the analysis of their system simulated model of the manufacturing process is made. So with the help of this model, bench mark of the system is found means it is found that where is the problem in the system. In the ABC Auto, three bottleneck were found, machine which is 100% utilized, due to this they created the large number of queue so this queuing processes their overall manufacturing process getting delay. By the use of simulation model the entire bottleneck has been removed one by one by increase the resources, and the process is known as shifting of bottleneck. So, finally required manufacturing rate of auto has been achieved, better utilization of machine, queue length of entity decreased. So this study shows with the help of simulation, problem in manufacturing process can be found and can be analyze for any manufacturing system. This simulation method can help lot in makeshift technology based automobile firm for improving their process and for analyzing the system. This method can be used in other industry also.

References: