International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Productivity Improvement By Using Time Study: A Case Study on Mid Body Frame Manufacturing

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Abstract:
This abstract elucidates the pivotal role of industrial engineering principles in the meticulous optimization of intricate processes inherent to the manufacturing industry. The comprehensive integration of Lean Manufacturing, Six Sigma, Information Systems, Process Capability, and DMAIC principles serves as the bedrock for orchestrating the synergistic alignment of labor, materials, and machinery while concurrently fostering advancements in quality and productivity. The focal point of the research centers on a case study investigating the temporal intricacies entailed in the manufacturing of Piaggio Ape 3-Wheeler mid-body frames within the confines of Budhale Stampings, a cornerstone entity within the multifaceted Budhale & Budhale Group of Companies.

The methodical implementation of a proposed methodology at Budhale Stampings has yielded not only a substantial annual financial gain of 21,84,000 but also a discernible 14% augmentation in overall productivity. These commendable outcomes substantiate the efficacy of the adopted approach, underscoring its latent potential for enduring influence on the company's fiscal performance and productivity metrics. Consequently, this research serves as a scientific elucidation of the pivotal role played by innovative methodologies in the optimization of manufacturing operations, thereby furnishing nuanced insights for organizations poised to derive tangible and quantifiable benefits within their production processes.

Introduction:
The goal of industrial engineering is to design, improve, and implement integrated systems of people, money, knowledge, information, and equipment in order to optimise complicated processes, systems, or organisations. An essential component of manufacturing processes is industrial engineering. Industrial engineers specify, anticipate, and assess the outcomes of systems and processes using specialised knowledge and abilities in the mathematical, physical, and social sciences as well as the engineering analysis and design principles and techniques.

The manufacturing sector adheres to a number of industrial engineering principles to guarantee the efficient operation of its systems, processes, and operations. Lean Manufacturing, Six Sigma, Information Systems, Process Capability, and DMAIC are a few examples of this. These ideas not only enhance the quality and productivity of physical or social systems, but they also enable the development of new systems, procedures, or circumstances for the productive coordination of labour, materials, and machinery. Industrial engineering may overlap with other sub-specialties such as operations research, manufacturing, production, supply chain, management science, financial, safety, logistics, and engineering, depending on the user's perspective and motivations.

Literature review:

V.N. Kulkarni et al. (2014) underscore the paramount importance of work study in organizations, emphasizing the quest for optimal resource utilization to achieve high-quality work in the shortest time and with minimal worker fatigue. Their specific focus on Vaibhav Vidyut Company Private Limited in Hubli involves a meticulous study of cycle times and existing methods at various workstations. The inefficiencies identified, particularly in the assembly area, prompted a targeted work study. This initiative directly addresses the reduction of inefficient time, offering a pathway to increased productivity. Notably, the innovative use of Video work study techniques adds a unique dimension to the research, making it a pioneering effort in Hubli.

M.S. Salman et al. (2008) delve into the vast array of methodologies and techniques available for enhancing the effectiveness and efficiency of operational activities within enterprises. Their exploration encompasses diverse philosophies such as Scientific Management, Lean Thinking, Six Sigma, Business Process Re-engineering, and Business Process Management. The paper distinguishes these methodologies based on their technical origins, highlighting Lean Thinking's emphasis on waste elimination and Six Sigma's focus on statistical experiment design. Despite their differences, the paper emphasizes the common thread of continuous improvement, prompting a discussion on integrating these diverse approaches for more effective enterprise management.

Elsevier B.V et al. (2015) contribute to the discourse on productivity enhancement by spotlighting the success of lean manufacturing principles. The paper presents a real-world case study focused on the sheet metal stamping process, demonstrating how lean manufacturing effectively eliminates waste and non-value-added activities. By employing visual control, Poka-Yoke, and 5S, the study identifies opportunities for waste reduction and efficiency improvement. The tangible results showcase a substantial reduction in processing time, non-value-added activities, and overtime costs, underscoring the positive impact of lean manufacturing on overall productivity. This study provides valuable insights into practical applications of lean principles for long-term success in competitive markets.

Problem Statement:

To optimize the operations involved in manufacturing of the mid body frame of Piaggio Ape 3-wheeler vehicle for improving the productivity using time study.

Machines used in manufacturing process:

Press machines of load capacities ranging from 60 ton to 100 ton are used.

About Industry:

Budhale & Budhale Group of Companies in which Budhale Stampings consist of, established in 1967 is now the MOST DIVERSIFIED sheet metal component manufacturing company having 4 fully equipped manufacturing plants in Kolhapur. Company is acknowledged as total solution Provider in precision manufacturing of Sheet Metal Press Parts, Welded Press Parts Assemblies and Sub-Assemblies in Western Maharashtra. Budhale Stampings has evolved into a system supplier capable of designing, developing & manufacturing components, assemblies and modules for the automotive industry.

About component:

The component used is the mid body frame of Piaggio Ape 3-wheeler vehicle.

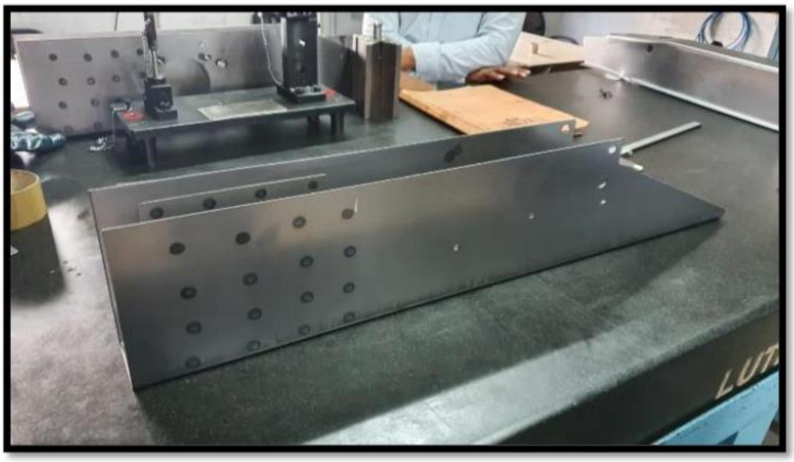

Fig No. 1. Mid body frame of Piaggio Ape

Fig No. 2. Mid body frame of Piaggio Ape

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Process flow in manufacturing process:

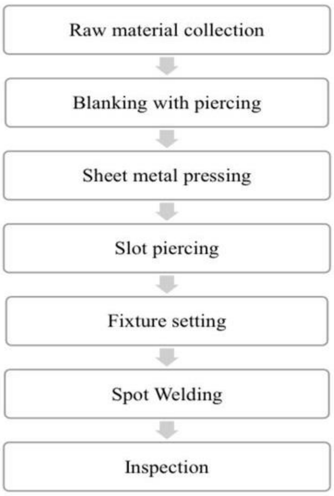

Fig. No. 3 Process Flow Chart

Time Recordings:

Actual Method:

Sr. no.	Procedure	Idle time (sec)	Working time(sec)	Missing time(sec)	From	To
1	**Blanking with Piercing**					
	Loading the job		15		1.00.00	1.00.15
	Machining the job	10			1.00.15	1.00.25
	Unloading the job		15		1.0025	1.00.40
2	**Shifting of job from position a to b**					
	Move the job		30		1.00.40	1.01.10
3	**Bending Operation**					
	Loading the job		15		1.01.10	1.01.25
	Machining the job	10			1.01.25	1.01.35
	Unloading the job		10		1.01.35	1.01.45
4	**Shifting of job from position b to c**					
	Move the job		20		1.01.45	1.02.05
5	**Slot piercing**					
	Loading the job		5		1.02.05	1.02.20
	Machining the job	10			1.02.20	1.02.30
	Unloading the job		10		1.02.30	1.02.40
6	**Shifting of job from position b to c**					
	Move the job		90		1.02.40	1.04.10
7	**Fixture setting**					
	Job and Fixture collection		15		1.04.10	1.05.25
	Fixture setting		50		1.04.25	1.05.15
8	**Spot wilding**					
	Fixing the job		12		1.05.15	1.05.27
	Spot welding		60		1.05.27	1.06.27
	Unloading the job		15		1.06.27	1.06.42
9	**Shifting of job from position d to e**					
	Move the job		30		1.06.42	1.07.12
10	**Inspection of job**					
	Inspect job manually		25		1.07.12	1.07.37

Table No. 2. Time recordings (Actual method)

Proposed Method:

Sr. no.	Procedure	Idle time (sec)	Working time(sec)	Missing time(sec)	From	To
1	**Blanking with Piercing**					
	Loading the job		5		1.00.00	1.00.05
	Machining the job		10		1.00.05	1.00.15
	Unloading the job		15		1.00.15	1.00.30
2	**Shifting of job from position a to b**					
	Move the job		30		1.00.30	1.01.00
3	**Bending Operation**					
	Loading the job		5		1.01.00	1.01.05
	Machining the job		10		1.01.05	1.01.15
	Unloading the job		10		1.01.15	1.01.25
4	**Shifting of job from position b to c**					
	Move the job		20		1.01.25	1.01.45
5	**Slot piercing**					
	Loading the job		5		1.01.45	1.01.50
	Machining the job		10		1.01.50	1.02.00
	Unloading the job		10		1.02.00	1.02.10
6	**Shifting of job from position b to c**					
	Move the job		90		1.02.10	1.03.40
7	**Fixture setting**					
	Job and Fixture collection		10		1.03.40	1.03.50
	Fixture setting		50		1.03.50	1.04.40
8	**Spot wilding**					
	Fixing the job		12		1.04.40	1.04.52
	Spot welding		60		1.04.52	1.05.52
	Unloading the job		15		1.05.52	1.06.07
9	**Shifting of job from position d to e**					
	Move the job		30		1.06.07	1.06.37
10	**Inspection of job**					
	Inspect job manually		25		1.06.37	1.07.02

Table No. 3. Time recordings (Proposed method)

Two handed process charts for fixture setting operation:

Actual method:

TWO HANDED PROCESS CHART

(Present method)

Task: Fixture setting for spot welding

Chart begins: Both hands free before assembly

Chart ends: Both hands free after assembly

Charted by:

Date of charting:

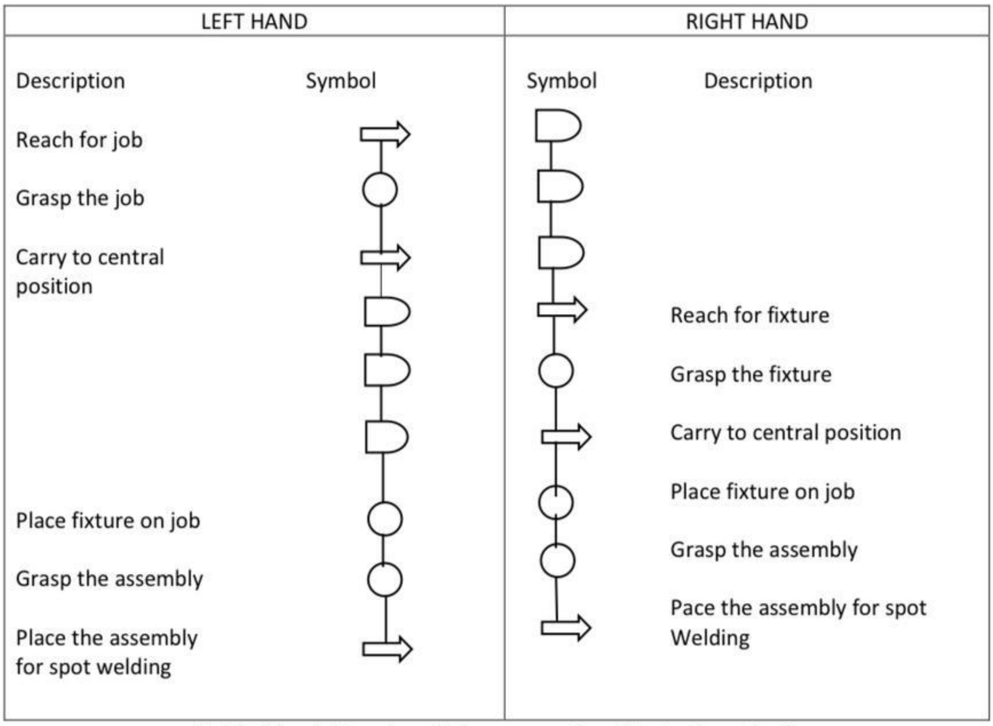

Table No. 4. Two handed process chart(Actual method)

Proposed method:

TWO HANDED PROCESS CHART

(Proposed method)

Task: Fixture setting for spot welding

Chart begins: Both hands free before assembly

Chart ends: Both hands free after assembly

Charted by: Date of charting:

LEFT HAND		RIGHT HAND	
Description	Symbol	Symbol	Description
Reach for job	⇨	⇨	Reach for fixture
Grasp the job	○	○	Grasp the fixture
Carry to central position	⇨	⇨	Carry to central position
Place fixture on job	○	○	Place fixture on job
Grasp the assembly	○	○	Grasp the assembly
Place the assembly for spot welding	⇨	⇨	Pace the assembly for spot Welding

Table No. 5. Two handed process chart(Proposed method)

Here we have utilized the delay/idle period and save five seconds in whole process.

Calculation:

Time required for 100 jobs = 28700+170 (shifting of jobs)
= 28870 seconds = 481 mins
= 8 hours in one shift

Proposed:

Time required for 100 jobs = 25200 + 170 (shifting of jobs)
= 25370 seconds = 422 mins

= 7 hours in one shift

We have saved 1 hour through the proposed method,
In this one-hour productivity can be increased
Quantity of products that can be manufactured in this one-hour,
As one job can be manufactured in 252 seconds, total jobs in one hour = 3600/252 = 14.13
I.e.
14 jobs per shift can be increased.

Price of each job manufactured = 3000Rs

Therefore cost of 14 jobs = 3000*14

= 42000Rs per day

Therefore, production of 42000Rs per day can be increased by using the proposed method.

Profit calculation:
Profit margin per job is 500 rs,
So we have produced more 14 jobs per shift,

14*500=7000/day

1,82,000/month extra gain in profit

21,84,000/year increased in profit.

Conclusion:
The implementation of the proposed method has proven to be highly advantageous for the company, resulting in a substantial annual financial gain of 21,84,000. Furthermore, the observed increase in overall productivity by 14% per year underscores the efficacy of the proposed method in enhancing the company's operational efficiency. These positive outcomes not only validate the viability of the implemented approach but also highlight its potential for long-term impact on the company's financial performance and productivity levels. As organizations continue to seek ways to optimize their operations, the findings of this research underscore the importance of adopting innovative methods to achieve tangible and quantifiable benefits.

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