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Editor in Chief : Prof. Rakesh D. Raut, Professor In Charge (Research)

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Contact Address:

Dean (SRIC)
National Institute of Industrial Engineering (NITIE),
Vihar Lake, NITIE P.O., Mumbai - 400 087, India.
Tel.: +91-22-28573371 / 28035207
Fax: +91-22-28573251
E-Mail: udyog.paragati@nitie.ac.in
Website: www.nitie.ac.in

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IN THIS ISSUE...

Editorial

In the developing economic world, the manufacturing industry plays a vital role. It is challenging to develop high-quality products with minimal cost in today's competitive market.

The first research paper discusses using principles of elimination, combination, rearrangement, and simplification (ECRS) with the help of time study to increase the productivity of vibratory compactors by eliminating non-value-added activities and the number of workstations.

While enhancing productivity, the enigma of quality becomes the utmost in the manufacturing process. The second paper talks about process control tools and quality conformance to specifications measures how well the product or service meets the targets and tolerances determined by its designers. This study has been carried out in the tools manufacturing Industry for reducing rejections in a systematic way

The third research paper discusses the operational excellence that demands a variety of strategies like 'going lean', automating systems, and performing non-conventional ways to add value to its supply chain in the domain of the construction industry. This study significantly contributes to two areas: 'identifying non-value-added activities like scheduling and its optimization, and transforming traditional mass production into lean aspect following TIM WOOD quality principals.'

The overall development of industry psychological well-being and gender equality is essential. The fourth research paper attempts to understand the impact of psychological well-being domains on the salary package of management graduates.

I hope this issue will help readers, researchers open impetus of the manufacturing industry's essential attributes and practitioners.

Prof. Rakesh Raut
Editor in Chief

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Productivity Study in Vibratory Compactor Assembly Line: Work-study

Ms. Nisha Sahu[1], Mr. Atma Ram Sahu[2], Mr. Raviraj Garg[3] and Dr. R. C. Gupta[4]

In this highly competitive market, the manufacturing industry is developing rapidly in terms of productivity and profiting from high-quality products at the lowest cost. In order to minimize product costs, it is necessary to minimize non-value-added (NVA) activities that have no value to the product. Operators perform these activities on the assembly line during operation and waste their energy. In many manufacturing industries, multiple products are assembled on the final production line and contain NVA. This research paper using principles of elimination, combination, rearrangement and simplification (ECRS) with the help of time study to increase the productivity of vibratory compactors by eliminating non-value-added activities and the number of workstations. To verify productivity improvement operations, case studies in the automotive and heavy machinery industries were examined, in which the assembly process was analyzed in detail and imbalances were observed. To solve these problems, the study of a stopwatch on the assembly line was completed, the workload of the operators was calculated, and the activities were assigned to the operators on the assembly line according to the takt time so that workers are not overloaded with their work on the assembly line and perform their tasks without fatigue. The new balanced production line is designed to reduce the number of jobs from 13 to 8, thus simplifying the process and eliminating unnecessary activities, reducing the number of workers from 27 to 17 and shortening the production time from 504.3 minutes to 405 minutes, and productivity increased from 6 to 8 vehicles per day.

Keywords: *Non value-added activity; ECRS; Unbalancing; Time study; Throughput time.*

1. Introduction

Work estimation and method study are the techniques for estimating cycle time for a particular process and operator utilization of vibratory compactor and assigning workload to the operator so that idle time of man and machine can be minimized. A vibratory compactor is a heavy-duty machine that uses either a plate or roller mechanism to compact concrete, soil, or asphalt. The primary objective of this research is to restructure and balance the assembly line of existing vibratory compactors, as line change jobs have been proposed for future implementation. To carry out this objective, video analysis and the study of time at a particular workplace occurs. After analyzing, it was found that the cycle time at different workstations was not similar, and one operator was taking a long time, and another operator was taking less time at one station. In the case of this line, the total time invested by the operator was not balanced and caused the inefficiency of the assembly line. To reduce non-value-added activities, cycle time and the appropriate use of workforce balancing is an effective tool for improving the throughput of the assembly line.

The main objective of balancing the lines is to minimize the workstation and maximize the production rate. The stopwatch time study analyses processes and determine which process involves non-value added activities and consumes time. The

[1] Academic Associate at IIM Indore), Email- nsahu91@gmail.com

[2] Research Scholar, Dept. of Mining Engineering, IIT (BHU), Varanasi

[3] Chairperson of DL Medicals Pvt. Ltd., Email: dlmedical21@gmail.com

[3] Professor at SGSITS Indore, Email- rcgupta.indore@gmail.com

main focus of industrial engineering is improving productivity, reducing production cost, ensuring production quality by using strategies. To enhance productivity, time study analysis, motion study analysis, job evaluation analysis, and merit rating can be used to provide specialized services to production departments.

An operation is called the work done along the line at each station, and each operation is a combination of one or more elements. Productive and Efficient balancing on the line means combining the elements to equal the workload of the workforce and equal the processing time of each workstation to the takt time. Based on the literature available and the requirement of case new Holland following objectives are selected for the present research work:

The specific objectives of the project work -

1. To conduct method study and work measurement of vibratory compactor assembly line for minimization of lead time and elimination of wastes.
2. To analyze the line balance and reallocate the activities in the line efficiently.
3. To minimize the number of workstations and maximize output at the desired time.
4. To develop and suggest an improved assembly line with better efficiency.
5. To study how many operators should be present in the assembly line and balance the workload among operators.

There were 13 no. of workstations –

1. Assembling of the front axle, chassis, and hydraulic tank.
2. Assembling of the fuel tank and steering cylinder
3. Assembling of engine and hoses
4. Assembling of ROC and foot pump hose connection
5. Mounting of ROC bracket support
6. Cabin and Tire Mounting
7. Mount the Relay mounting plate
8. Frame and Headlight mounting
9. Roller Mounting
10. Oil filling and powering the machine
11. Mounting Roof
12. Mounting Fix hood and Deflector plate
13. Pasting Decals and finishing

2. Literature Review

The previous research work deals with the utilization of lean tools for lead time reduction in a gear manufacturing industry has influenced the results in the process duration by decreasing 300 minutes to 180 minutes and lead time also reduced from 7 days to 5.5 days proposed by Sivaraman Parthasarathi et al. (2021). Asareilla Findya et al. (2020) using Westinghouse assessment method to calculate standard time performance ratings and determine frequency and abnormalities in skill, effort, conditioning, and consistency. They lead to an efficiency improvement of 76.76% to 89.38% with this approach.

The research work proposed by G. V. Punna Rao and Nallusamy et al. (2020) raises awareness of the importance of implementing phosphorus technology in the medium-sized belt manufacturing industry. This study will help show the selection of the right technology to increase the potential and productivity that exists in the selected industry. They also aim to increase overall productivity by eradicating waste and non-value-added activities at all stages. As a result, after applying the appropriate phosphorus method, we noticed that lead time was reduced by approximately 1256 minutes and total production increased by approximately 9%.

Ismail W.R. Taifa and Tosifbhai N. Vhora (2019) proposed a systematic study to reduce cycle time to improve manufacturing productivity and reducing cycle time in various organizations and industries. Many researchers have applied multiple approaches to reduce the time they are no longer added to final products and services. When assessing the results of manufacturing processes in the manufacturing industry, it is important to keep in mind that the duration of the production cycle is considered one of the most important "economic and technical indicators".

Piyachat Burawat (2019) improve productivity using Lean Six Sigma, ECRS work studies and 5S in the cardboard manufacturing industry. Analyze questions collected from data managers and supervisors through brainstorming Pareto diagrams and cause-effect analysis. The results showed that manufacturing problems were caused by process delays, cluttered warehouse areas, shipping delays, and deceptive reasons in the cutting and die-cutting industries.

The standard assembly line is an important part of a production system that affects overall cost and efficiency. The manpower productivity on an assembly line has a direct impact on actual line efficiency. As a result of heavy physical workloads and monotonous attitudes, workers experience performance and work-related musculoskeletal disorders (WMSD). The WMSD imposes high compensation costs on businesses and completely degrades the quality of life of workers. To improve the efficiency of the assembly line, enterprises must consider not only the constraints of cycle time and priority but also the physical workload of the station. This article discusses the PFBA (Assembly Line) Type 2 balance problem, where the number of workstation lines is known. The main purpose is to balance the physical workload with the cycle time of the station at the same time. A rapid systemic assessment (REBA) methodology in the literature is proposed to determine workload. Goal programming models have been developed to solve problems and are used to explain the methodology of well-known examples of instances of small benchmark problems. (Olcay Polat et. al, 2018).

Jagdeep Singh (2017) investigating the importance of phosphorus manufacturing technology in the manufacturing environment. This study seeks to assess the performance of various phosphorus manufacturing tools in the manufacturing industry in northern India. The importance of the various phosphorus tools, the significant benefits gained after successfully implementing the phosphorus manufacturing approach, and the benefits gained after implementing the various phosphorus tools was identified. We surveyed one company and implemented the most important aspects of Lynn Productions. Research results clearly show that Just-in-time manufacturing is the most crucial element of value-added production. The results show a net reduction of 2,42,208 rupees per year after implementing the case company's lean manufacturing technology. This white paper shows the actual application of phosphorus technology and shows how manufacturing can lead to a real breakthrough in cost savings.

To increased productivity and profits of the leather goods industry by minimizing excess labour and developed the new methodology for specific tasks. Human resources research is the most important tool that helps increase productivity in the leather goods industry. Therefore, this investigation will help identify bottlenecks and suggest appropriate systems for improving productivity. Finally, applying the concept of a questioning technique, in which all relevant information is registered, and critical analysis was carried out on a specific production line. As a result, new and improved methods can significantly reduce the amount of work. We then did a time study

on the stopwatch to determine the default time for all task sequences and calculated the daily capacity of each workstation. Applying industry method research and work measurements on the Surma production line for women's bags increased productivity by 12.71%. Md. Abdul Moktadir et al., (2017).

Ramadina, Chyntia., and Sosodoro, Widaningsih, Ineu (2016), planning the manpower with the help of the yamazumi chart and precedence diagram based on the takt time to arrange of workstations. The Chompoonoot Kasemset et al. (2016), have improve the efficiency with the ECRS and simulation techniques used to reducing the processing time from 4.99 hours to 3.49 hours (28.06 %) in the paper package factory in Thailand. Arivoli, Ashwinkumar., and Ravichandran, Vignesh (2015), deals with the cycle time reduction in the manufacturing line by mapping the current state and find out problem areas in the line and focus on only the bottleneck station. Morshed, Md. Niaz., and Palash, Saifujjaman, Kazi (2014), focuses on efficiency improvement of the single model assembly line with the help of reducing the non-value-added activities, cycle time and distribution of workload by using line balancing.

Amardeep, Rangaswamy, and Gautham (2013) using traditional assembly line balancing with the cycle time calculation and workload distribution among operators in an optimal sense of the vibratory compactor shop. The proposed research was carried out in the heavy machinery manufacturing industry, specializing in loader backhoe and vibratory compactors to improve the production process and checked the machine's quality until final inspection.

3. Methodology

This assembly line was proposed to be shifted to another workplace; therefore, this research work objective was to perform a time study and find out the area of improvement between workstations so that these problems can be overcome in the proposed line. Initially, one shift was working, but the operator's workload was very hectic. They did overtime to complete their task on a daily basis to fulfil the demand of a particular day. This overtime duration was 4-5 hours after shift over. Sometimes, this assembly line needed workers from another assembly line also indicates that there was a need to plan this assembly line in an efficient manner from the industrial engineering perspective. For achieving the target of an efficient and productive Vibratory compactor assembly line following research framework follows:

1) Video analysis of operations at a different workstation.
2) Stopwatch time study takes place
3) Determine value-added, and non-value added activities
4) Determine workforce utilization
5) Proposed the modified assembly line by using ECRS
6) Comparison of calculation results before and after improvements.

The first stage of this research is video monitoring of the process based on this stopwatch time study performed to identify the exact value of timings. Classify the activities as value-added and non-value added, direct observation of workforce at workstation monitored to identify operator's utilization. Based on the data collection and classification of activities ECRS approach is used for eliminating non-value-added activities.

Line Balancing Efficiency Calculation

Processing time was measured with a stopwatch. The processing time for each work item is randomly measured five times. Takt time is the estimated time to produce one unit of product.

$$Talk\ time = \frac{Total\ avibaletime}{Customer\ demand}$$

This study focused on the vibratory compactor assembly line where before line balancing calculation as follows when the shift time is 430 minutes, customer demand = 6unit/day, takt time = 430/6 = 71.67 minutes.

Total Work Content = Sum of cycle time on all the workstations.

= M1 + M2 + M3 + M4 + M5 + M6 + M7 + M8 + M9 + M10 + M11 + M12 + M13

= 46.5 + 40.96 + 43.8 + 47.4 + 21.4 + 53.6 + 36.2 + 40.3 + 38.5 + 36 + 49.6 + 25.36 + 32.8 = 504.3 minutes

After calculation of total work content, theoretically, the minimum number of workstations (N_{min}) can be calculated as:

$$N_{min} = \frac{Output\ required * Total\ Work\ Content}{Production\ time\ available}$$
$$= \frac{6 \times 504.3}{430}$$
$$= 7.036 = 8\ Workstation$$

From the above calculation, it is clear that N_{min} should be 8 but in the existing assembly line, 13 workstations are present. Therefore, it is estimated that there is a possibility to decrease the number of a workstation with some improvements.

$$\text{Line balancing efficiency} = \frac{\text{Sum of task time}}{\text{No. of workstations} \times \text{Largest cycle time}}$$
$$= \frac{504.3}{13 \times 53.7}$$
$$= 72\%$$

It is clear that 72% of achievable efficiency would improve this efficiency by eliminating unproductive activities. The table below represents the manpower at the assembly line, and their idle time, utilization ratio are also calculated. As observed from the table, operation timings cause unbalancing between workers; this causes fatigue to some workers, and overloading occurs. As a result, the balancing of the lines with the ECRS methodology was applied on this line, and the number of workstations and operators was reduced.

The translation of the ECRS concept is eliminated (excluded from unnecessary movements), combined (more efficient because it is a combined movement that can be executed at the same time), and redeployed (the work elements of different workstations are exchanged more efficiently) and simplified (Simplify repetitive exercise) [Asarailla].

1. **Eliminate –** The elimination method is a method of deleting work elements that have been determined to be inefficient so that processing time can be reduced. Remove the OP3 load on the workstation and repair the work element. Deletion of unwanted work elements occurs on workstation 1, and human resources on 1, 5, 8 workstations. You can save time by reducing unnecessary motion elements in the assembly process through the removal process. Factors related to removal included packaging/ unpacking, walking, searching, body movements, waiting due to mechanical cycle time, handling, hoisting, and extra quality inspection. Find research time limits in stopwatch time study and eliminate unnecessary processing time for specific productive work tasks.

2. **Combine –** In this process, activities performed by more workers at a single workstation shifted to other workers of the different workstation so that operator's idle time is minimized and the number of operators also minimized. The combined method is a method that reduces processing time by combining several work elements into single. To the improvement of the work element by combining work station 3 with work elements 1 and 2. The combination of work elements combined at 2,3,4,5,6,7,8 work stations.

3. **Re-arrange –** Arrange activities in sequential order as Rear axle and front axle, chassis mounting takes place at workstation 1. The mounting of steering cylinder and hose mounting at workstation 2. The ROC mounting activity is completed at workstation 3. The cabin mounting takes place at workstation 4. The front frame assembly mounting is completed at workstation 5. The roller mounting is situated at workstation 6. The mounting roof and hood at workstation 7, and other remaining finishing activities like decal pasting situated at workstation 8. By the arrangement of these activities, the cycle time of all the workstations will be balanced and maintain the takt time of the assembly line.
4. **Simplify –** At this stage, simplify the work element as possible to reduce unwanted movement of the worker from one place to another for pick up any machine component at each and every workstation so that unwanted time can be reduced.

4. Result and Discussion

From the collection data, the production target of the assembly line was identified the six vehicles per day. The production of vibratory compactor has 13 workstations on the assembly line, and the line has one shift with 27/430 workers per shift with proper network time or daily operating time. Therefore, the target takt time for the assembly line is 53.75 minutes/unit. The following are the calculation results obtained through the collection and processing of data. Based on the results of the calculations performed, we obtained a 72% line efficiency value. This value does not reach the company's productivity target of 99.50%. Therefore, the assembly line needs to be improved to increase the value of the productive product. Improvements were proposed by improving the work method of the assembly line. In order to balance the assembly line of the vibratory compactor time study was carried. There were 13 workstations where some operators performed different activities, and classification of activity with timings in minutes presented in Table 1.

Table 1: Unbalancing and Cycle time for all the workstations before line balancing

Station	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13
VA (mins)	14.1	10.3	8.9	6.6	8.1	14.7	14.4	12.3	8.2	11.5	13.1	6.1	12.8
SVA (mins)	1.1	3.4	7.6	4.9	1.1	6.5	6.3	0.4	1.5	1.5	6.1	2.9	3.2
NVA (mins)	29.5	28.2	27.1	35.9	12.3	32.3	15.5	27.6	28.9	22.9	30.6	14.8	16.8
Cycle Time (mins)	46.5	41.9	43.8	47.4	21.4	53.6	36.2	40.3	38.5	36	49.6	16.3	32.8
Takt time (mins)	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7
Unbalancing	25.2	29.8	27.9	24.3	50.3	18.1	35.5	31.4	33.2	35.7	22.1	55.4	38.9

These workstation timings, which are given in the above table, can be better understood with the help of this graph.

Based on direct observation and brainstorming with a segmented head on the assembly line, it is possible to generate a yamazumi graph, as shown in Figure 1. The factors affecting the efficiency of the target line have not been satisfied, especially human factors, machines, environment, materials and methods. Regarding the human factor, there are two factors. Specifically, the moderator handles the defective product because he is less meticulous and talkative while working. As for the mechanical factor, there is a factor called the reliability and quality of the vehicle, which requires inspection during assembling without affecting the work of the line.

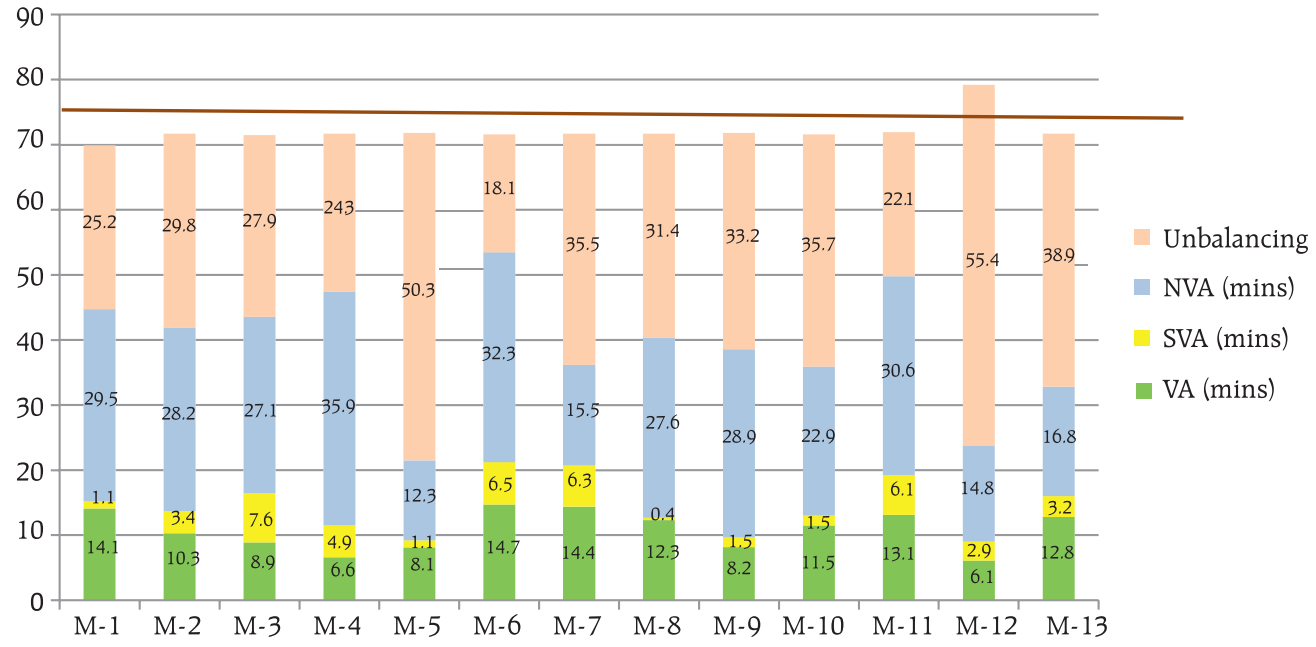

Figure 1: Yamazumi chart before line balancing

The methodological factor is that there are contributing factors. The work takes a long time due to wasted moving elements. There are two factors; the shortage of materials due to the lag in the supply and the lack of materials caused by the poor quality of materials put into the process. Then two elements are environmentally responsible: noisy workspace and small work area. The figure shows the unbalancing of the assembly line due to unproductive factors. The concept of ECRS (eliminate, combine, rearrange, simplify) is one of the methods used to improve the way we work and maintain the balance of our production lines. The proposed upgrade will enhance the efficiency of the line and the productivity of the assembly line. The improvement of working methods based on the ECRS concept is illustrated in Figure 2.

After visualizing the unbalanced yamazumi chart in the assembly line, analyses of the activities carried out depending on the cycle time were conducted to eliminate these tasks. To eliminate workstations in the production line, combine tasks from separate workstations. The following is the calculating part after eliminating and merging activities:

After line Balancing-

After balancing the line number of workstations can be reduced to 8. From the formula, we can calculate what should be the output if the line was balanced.

Total Work Content = Sum of cycle time on all the workstations.

= M1+ M2 + M3 + M4 + M5 + M6 + M7 + M8

= 53.1 + 53.4 + 53.1 + 53.6 + 53 + 53.3 + 52.7 + 32.8

= 405 minutes

The lead time is reduced, then from the formula of the minimum number of workstation output, can be calculated.

$$N_{min} = \frac{Output\ required * Total\ work\ content}{Production\ time\ available}$$

$$8 = \frac{Output \times 405}{430}$$

Output = 8.47 = 8 Vehicle per day

The output of the assembly line should be 8 if some activities are eliminated. Then takt time was also reduced to 53.75 minutes in the modified assembly line. The improved line balancing efficiency is given as:

$$\text{Line balancing efficiency} = \frac{505}{8 \times 53.75} \times 100$$

$$= 94.2\%$$

The observation indicates that the efficiency of line balancing is more significant in the altered assembly line. With the elimination of unnecessary movement, activities are merged into workstation 8 and space-saving has also occurred.

After Line Balancing

From the investigation, the cycle time should be equal to the takt time of the assembly line. It is clear that the timing of the various activities is in Table 2 and in the graph since the number of workstations is reduced by 8 after the removal and combination of tasks in one workstation, which is illustrated in Figure 3.

Table 2 Unbalancing and cycle time for all workstations after line balancing

Station	M1	M2	M3	M4	M5	M6	M7	M8
VA (mins)	15.9	14.52	19.4	14.7	11.1	12.7	14.4	12.7
SVA (mins)	1.2	8.2	2.2	6.5	5.9	1.5	7.1	3.2
NVA (mins)	35.9	30.7	31.5	32.3	35.9	39.2	31.2	16.8
Cycle Time (mins)	53.1	53.4	53.1	53.6	52.9	53.3	52.7	32.8
Takt time (mins)	53.7	53.7	53.7	53.7	53.7	53.7	53.7	53.7
Unbalancing	0.6	0.3	0.6	0.1	0.8	0.4	1	20.9

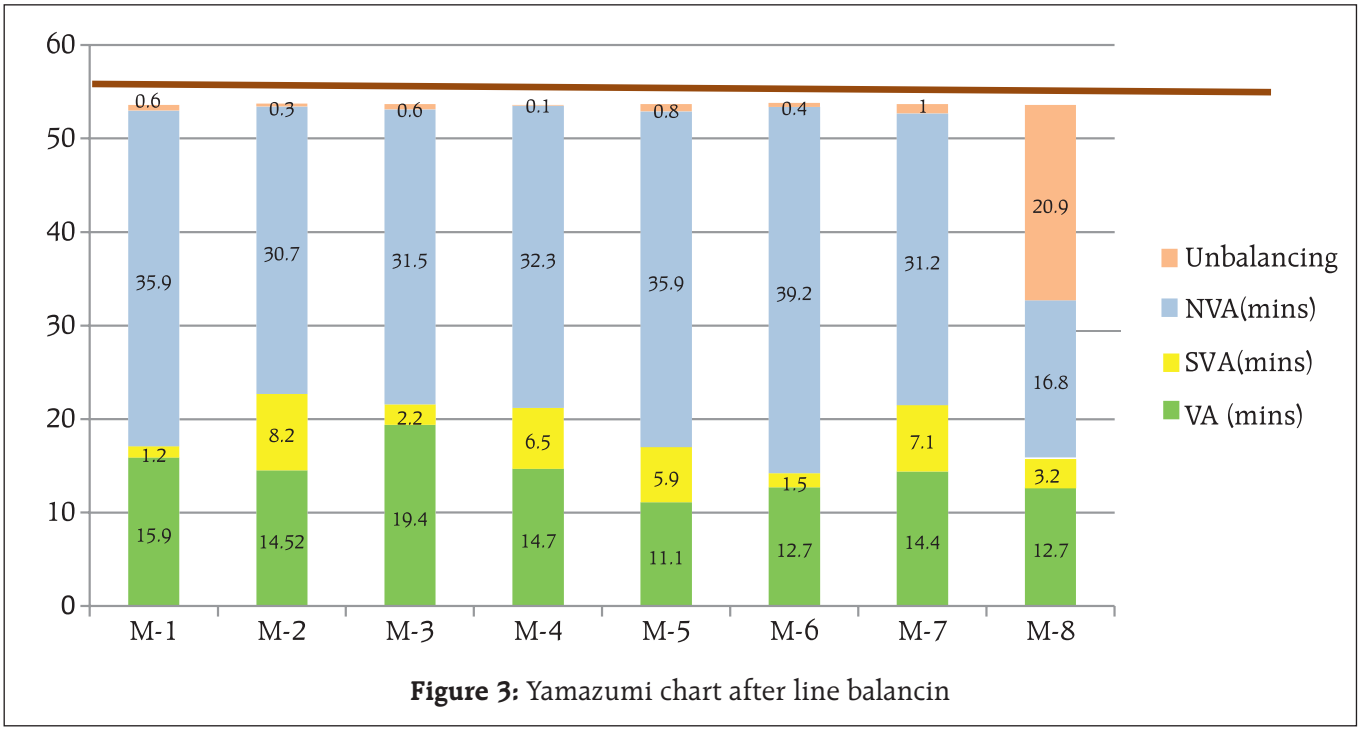

Figure 3: Yamazumi chart after line balancin

5. Conclusion

The main goal of this project was to design an assembly line as efficiently as possible while using as few workstations and operators as possible. There are no idle operators because the operator's usage is optimized. This enhancement has made the production of assembly processes more effective as new assembly lines are created with a minimum labour force and assembly costs.

Table 3: Comparison of Result

Parameters	Before	After	Remark
Production Qty. per hour	6	8	33.33 % Improvement
No. Of workers	27	17	37 % Reduction
No. Of Workstation	13	8	38 % Reduction
Line Balancing Efficiency	72.37	94.2	30 % Improvement
Balance delay (%)	45.87	5.67	87.6 % Reduction
Throughput time	504.3	405	20 % Reduction
Takt time	71.67	53.75	25 % Reduction

From the table 3, we can conclude the data after modification in the assembly line. The outcomes of the improvements can enhance working procedures with trajectory efficiency values of 72% to 94.2%. This means that the ECRS concept can improve the efficiency of the line within the assembly lines. Efforts to raise the production target can be made using the idea of ECRS (Eliminate, Combine, reorganize and Simplify), and line balancing. The concept of ECRS makes it possible to eliminate, combine, reorganize and simplify inefficient and ineffective work elements. After improvements to the ECRS concept were made, several work stations provided reduced mating, relocation and a streamlined set of assembly processes for work elements. In this study, this increase can reduce total working time, improve balancing efficiency, reduce balancing delay, and achieve production goals by reducing overall cycle time or maximum station time and increasing production. It needs to be accompanied by more efficient methods to develop ECRS concepts in other industrial fields through additional research and to adapt to the industrial age 4.0. This study impacts industry managers to recognize the merger of activities and assign activities to operators in an efficient way that no worker will do overtime and should not be overburdened with the work. This assembly line shifting work was proposed in the future, so this work helps them set up their assembly line in a productive way.

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Enigma of Quality and Process Control Tools in a Manufacturing Unit-A case study

Jagdeep Singh[1], Harwinder Singh[2], Jatinderpal[3] and Preetraj Singh Sidhu [4]

Conformance to specifications measures how well the product or service meets the targets and tolerances determined by its designers. This study has been carried out in tools manufacturing Industry for reducing rejections in a systematic way. The rejection of spring pin component is found to be 9.71%. Keeping in view the quality aspect of the company, QC tools and process control tools are being implemented to reduce the defects of spring pin section. The rejection was reduced by total of 7%. After implementation of process tools, total production of 4151per month has been increased.

Introduction

The 7 QC Tools are simple statistical tools used for problem solving. These tools were either developed in Japan or introduced to Japan by the Quality Gurus such as Deming and Juran. In terms of importance, these are the most useful. Kaoru Ishikawa has stated that these 7 tools can be used to solve 95 percent of all problems. These tools have been the foundation of Japan's astonishing industrial resurgence after the Second World War. In successful application of quality tools an implemented quality management system is an advantage. The quality management principles are a starting point for the company's management striving for continuous efficiency improvement over a long period of time and customer satisfaction. A quality management system is based on the integrity of all production and support resources of a certain company. It enables a faultless process flow in meeting related contracts, standards and market quality requirements. Implementation of a quality management system is always a part of a company's development process identification and/or process analysis (Magar and Shinde, 2014).

Quality is broadly supposed that a manufacturing organization's operation or production with a successful quality management system is able to fabricate good quality products and therefore achieve good business results. One of the methods to solve quality issues is Kaizen. Kaizen is a common problem-solving tool and may be applied to any improvement process especially quality. The good quality product or service means that it has the ability to satisfy the customer's needs and expectations (Bergman and Klefsjo, 2003). A study has been carried out at Miranda tools by using QC tools. Defects of Taper shank drills during production process.

Literature Review

Shahin et al. (2010) proposed a map to applied seven basic and new quality control tools and techniques in an integrative framework. They have been analyzed and prioritized through simple comparisons that Quality control seven tends to be mostly precedent to new quality control tools. The questionnaire is designed in form of a 14 by 14 matrix, 14 tools and Techniques are placed in rows and columns leading

[1] Assistant Professor, Department of Mechanical Engineering, I.K.G.PTU, Kapurthala, Punjab, Email-jagdhoor605@yahoo.com

[2] Professor, Department of Mechanical Engineering, Guru Nanak Dev Engineering College, Ludhiana-141006, Punjab, India. Email- harwin75@rediffmail.com

[3] Assistant Professor, Department of Mechanical Engineering, Guru Nanak Dev Engineering College, Ludhiana-141006, Punjab, India.

[4] Research Scholar, Punjab Technical University, Jalandhar, Punjab.

to 196 cells. experts should fill the cell using values of 1; 0.5; and 0 then data has analyzed based on the average values of experts. Two approaches were used to analyze the questionnaires results through simple comparison of their average values and also through permutation. Literature shows that in the majority of the resources used seven quality control tools than new quality control tools. Jadhav (2013) presents the systematic approach to find the root cause of one of the major defect (Cold shut) in an automobile casting produced in a medium scale foundry. The origin of the Cold shut defect was identified by means of Seven Quality control tools. Finally, it was found that the alloy composition and pouring temperature was the root cause for this major defect. The necessary remedial action was made in production of Cylinder block. The major Cold shut defect was reduced by up to 50%.The total rejection from cold shut was reduced to 6.6% from 12.3%. This systematic study proves that by means of effective analysis of tools and processes, it is possible to eliminate/control of the casting defect. Sousa (2013) applied PDCA cycle as a methodology to trigger the use of quality tools in problem solving. It decreases 50% of the most critical defective component and an overall reduction of 29% in the level of nonconformities in the preparation section. *Srinivasan et al. (2009)* claimed that Statistical Process Control (SPC) methods have been widely recognized as effective approaches for process monitoring and diagnosis. Statistical process control provides use of the statistical principals and techniques at every stage of the production. Statistical Process Control (SPC) aims to control quality characteristics on the methods, machine, products, equipments both for the company and operators with magnificent seven. Some simple techniques like the "seven basic quality control (QC) tools" provide a very valuable and cost effective way to meet these objectives. However, to make them successful as cost effective and problem solving tools, strong commitment from top management is required. Statistical process control (SPC) is one of the important tools in quality control (QC). In order to survive in a competitive market, improving quality and productivity of product or process is a must for any company. *Fonseca et al. (2015)* defined that the research focuses on the influence of company sector and size on the level of utilization of Basic and Advanced Quality Tools. The paper starts with a literature review and then presents the methodology used for the survey. Based on the responses from 202 managers of Portuguese ISO 9001:2008 Quality Management System certified organizations, statistical tests were performed. Results show, with 95% confidence level, that industry and services have a similar proportion of use of Basic and Advanced Quality Tools. Concerning size, bigger companies show a higher trend to use Advanced Quality Tools than smaller ones. For Basic Quality Tools, there was no statistical significant difference at a 95% confidence level for different company sizes. The three basic Quality tools with higher utilization were Check sheets, Flow charts and Histograms (for Services) or Control Charts/ (for Industry), however 22% of the surveyed organizations reported not using Basic Quality Tools, which highlights a major improvement opportunity for these companies.

Introduction to Industry and Problem Formulation

The north Indian auto parts industry began its journey in the year 1938 in Ludhiana. The strength of company is its people with their engineering skills, crystallized over a period of five decades this has brought about total customer satisfaction. It is a proud supplier of components to various Indian original equipments manufacturers (OEMs) and has established itself as a reliable supplier for last so many years. The list of OEM customers includes Telco, Volvo India Limited, Swaraj Mazda Limited, Mahindra & Mahindra, Maruti

Udyog Limited., Ashok Leyland, Punjab Tractors Limited etc. The Company has fully flanged with the modern testing facilities, equipments and workshops. Casting shop, machine shop, non ferrous foundry, wire drawing, electroplating, heat treatment, welding, paint shop, tool room, store, packaging and dispatch are the main section of the company. Approximate one thousand employees have been working in the various sections of the company.

The company is producing large number of components for automobile sector in different section. It is being noticed that the rejection of spring pin is 9.71% which is on higher side because of many quality related problems in manufacturing of spring pin. The major causes explored for rejection were wire drawing process was not done on 100% basis which leads to bending of components. Grinding marks were occurring after short interval due to improper dressing time. The depth of cut varies due to shifting of cutter. The length of the workpiece has not inspected after band saw cutting operation. Tool marks observed due to improper dressing of tool and using blunt tool etc in manufacturing of spring pin. The root cause analysis of the problems related to quality has been done on the Tool marks defect, Grinding marks defect, shifting and setting problem to ascertain the important benefits occurred after successful implementation of QC tools. Brainstorming has been done among me and managers of different departments to analyze the problems. The data collection before and after implementing QC tools has been analyzed. The study is an attempt to reduce rejection of spring pin by implementing Quality Control (QC) Tools and process control tools.

Methodology Adopted and Methodology

The process used to collect information and data for the purpose of making business decisions. The methodology may include publication research, interviews, surveys and other research techniques and could both present and historical information.

The methodology adopted for the study is shown below:

- Identification of the Problem
- Data Collection
- Data Analysis
- Preventive and Corrective Actions
- Implementation of QC tools
- Standardization

Identification of the problem: First step is to find the root cause of problem. Defects such as grinding marks, tool marks, setting, diameter u/s and cutter shift are seem in observation

Data Collection: The rejection data has been collected from the machine shop from January to March from the daily inspection reports and rearrange the data defect wise.

Data analysis: The Pareto chart and Fishbone diagram has been used for data analysis in this study. Pareto chart allows the user to focus attention on a few important factors in a process. Fishbone diagram used to associate possible causes with a single effect.

Remedies/actions: Corrective and preventive action has been taken in the casting shop to reduce the rejection of the casting components.

Implementation of Quality Control Tools: On the basis of outcome of previous steps results, Quality Control Tools has been implemented.

Standardization: Standard operating procedure was revised after analysis of the results.

The methodology adopted includes root cause identification of the problem, data collection before implementing tool, taking preventive and corrective actions to the root cause by implementing process

control and quality control tools, and finally standard operating procedure has been followed to ascertain the important benefit occurred and revising the results.

Results and Discussion

A. Rejection Trend of Spring Pin

Fig.1 shows the rejection trend of the spring pin from January to March. The average rejection of the spring pin component has approximate 9.71% which is alarming.

The defects causing rejections are shown below:

- Grinding marks=315
- Shifting and Setting Problem=280
- Dia u/s=252
- Uncleaned surface=231
- Miscellaneous=119
- Nipple thread damage=70

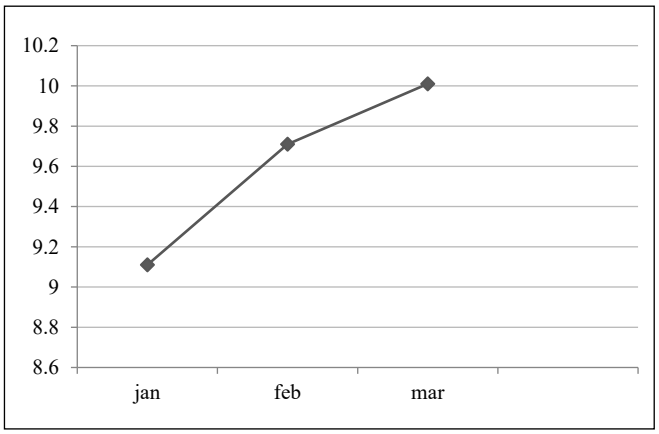


Fig. 1. Rejection trend of spring pin month wise

Root Cause Analysis using Process Control Tool

The Figure 2 shows the maximum possible reasons of grinding marks defect. Grinding marks defect is the marks appear during grinding operation. Man, Method, Machine and Materials are the main elements of the fishbone Diagram.

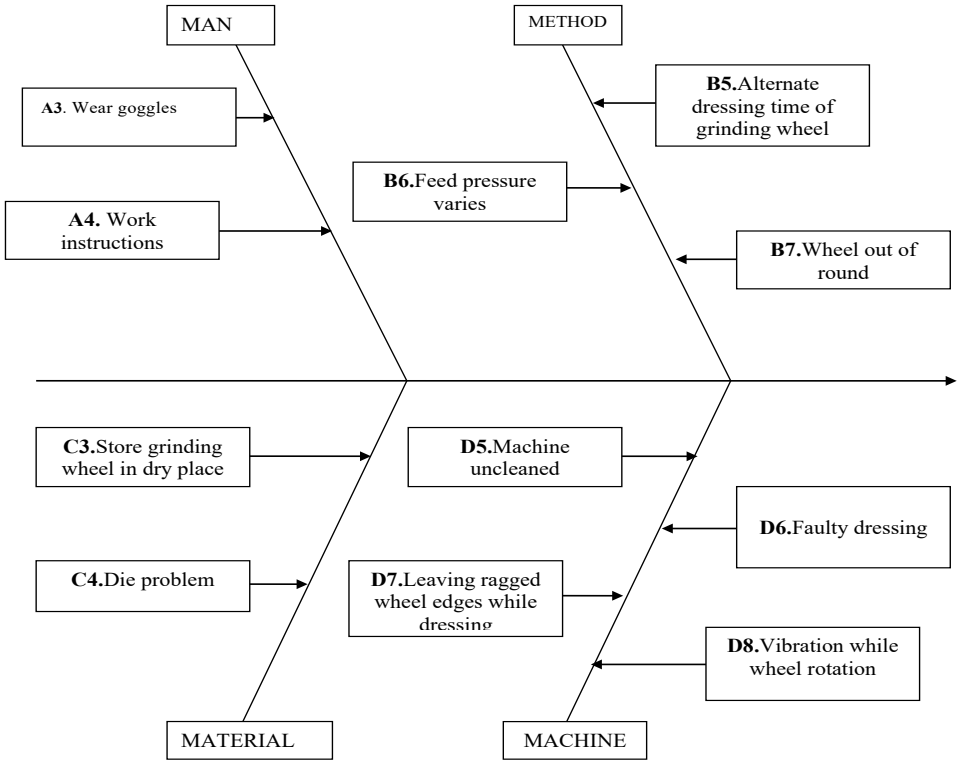
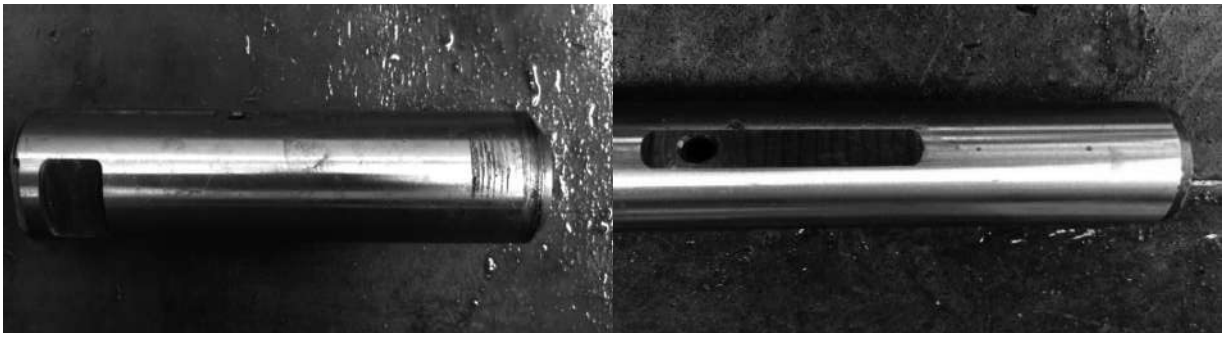


Fig. 2. Fishbone diagram for Grinding marks defect

S. NO.	COUNTER MEASURE FOR GRINDING MARKS(METHOD)
B5.	Basically, grinding marks occur due to improper or alternate dressing time of grinding wheel. By observing the grinding of wheel is done after 200 pieces which leads to the grinding marks. So, dressing of the wheel should be done after 150 pieces to reduce grinding marks.  Fig. 3. Grinding marks before and after
B6.	Feed pressure varies in every operation. So it should be suggested that the operation should be done at constant feed pressure.
B7.	First check the grinding wheel before starting the operation. If wheel is out of round and have sharp edges then it should be quickly replace Or redressed to avoid grinding marks.
S. NO.	**COUNTER MEASURE FOR GRINDING MARKS (MATERIAL)**
C3.	The storage plays an important role to the strength of grinding wheel. It should always be placed in dry place to avoid the problems like rust which adversely affects its strength.
C4.	Die problem results to irregular or faulty shape of dressing wheel which result to grinding marks defects. So quickly replace the grinding wheel if it is irregular due to die problem.
S. NO.	**COUNTER MEASURE FOR GRINDING MARKS (MACHINE)**
D5.	Keep machine cleaned Be certain all station kept properly lubrication When doing feed work, be assure to lubricate all slides in accordance with instruction At the end before stopping machine run grinding wheel without coolant long enough to throw all water out of wheel otherwise moisture concentrated at bottom will cause unbalance.

D6.	Faulty dressing leads to increase the surface roughness of the workpiece. So it must be avoidable by the following methods. Turn diamond to avoid flat spot or replace with new one. Increase penetration of dressing diamond up to 0.001 Check slides on turning attachment, they may be worn low in centre Truing attachment gibes may be loose enough to allow diamond to back off instead of cutting.  **Fig. 4. Dressing of grinding wheel**
D7.	Sometimes the ragged wheel edges should be there. So the measures to be taken:- Dressing should be dine at slower transverse rate Turn diamond frequently Adjust the diamond holder by tightening clamping screw Make final dressing in opposite direction to initial runs
D8.	In grinding process, vibration is the major factor which reduces the surface finish Vibration occurs due to lose leveling screw. So set all the screws by time to time to avoid the vibration occur in process. To balance the grinding wheel insert spindle and collet and remove burrs if present. Use standard paper gasket under each flange. Make sure balancing stand is level both ways before attempting balance wheel. Always balance the w heel in following sequence True wheel Run wheel long enough to throw off coolant Balance wheel on same amount as used for grinder True wheel after mounting on spindle Motor bearing defective or armature out of balance is to be keep away by renew motor bearing or balance armature

S. NO.	COUNTER MEASURE FOR GRINDING MARKS (MAN)
A3.	Wear goggles for all grinding machine operations.
A4.	Specific work instructions provided to operators regarding the grinding marks defect Proper lubrication should be done time to time. It is necessary to cool and lubricate the wheel and work piece time to time. Remove the chips produced in the grinding process It is imperative that the fluid be applied directly to the cutting area to prevent The fluid blown away from the piece due to rapid rotation of wheel. The work piece should be tightened properly before starting the grinding process. Never operate grinding wheel at speed in excess of the recommended speed. Use proper wheel guard on all grinding machine

B. Fish bone Diagram for Defects due to shifting and setting problem

The Figure 5. shows the maximum possible reasons of setting defect. These defects occur due to improper setting of machine. Man, Method, Machine and Materials are the main elements of the fishbone diagram.

Counter Measure for shifting and setting problem:-

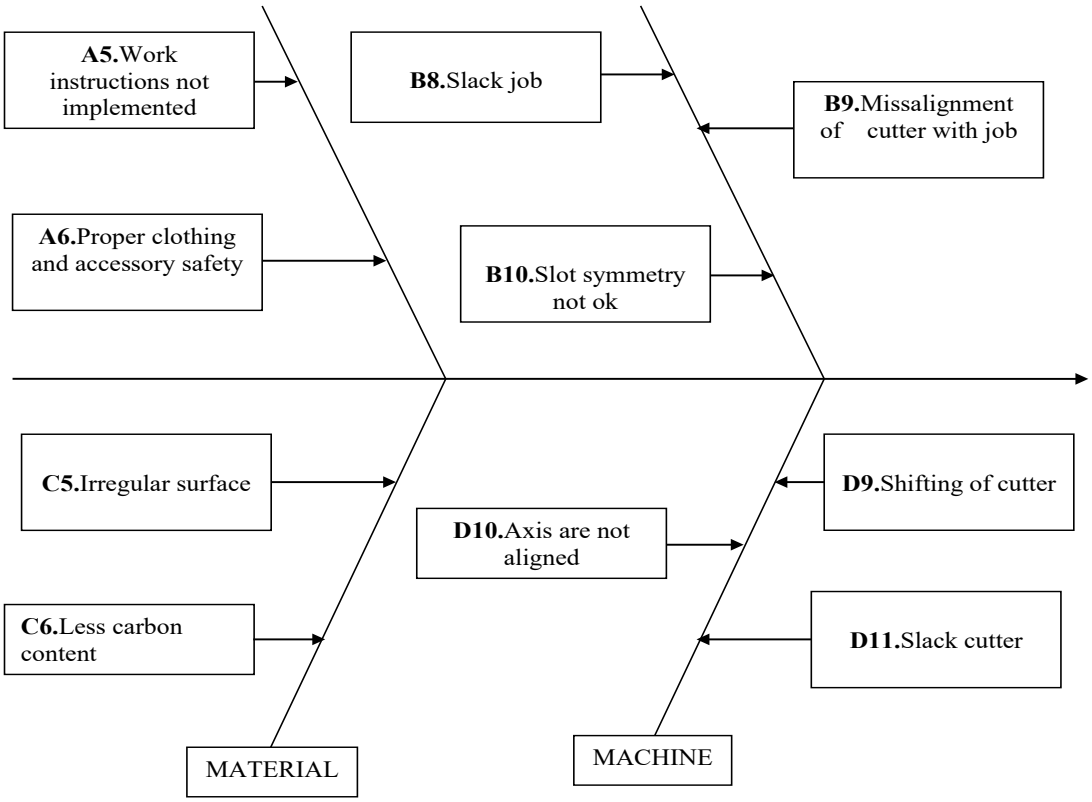
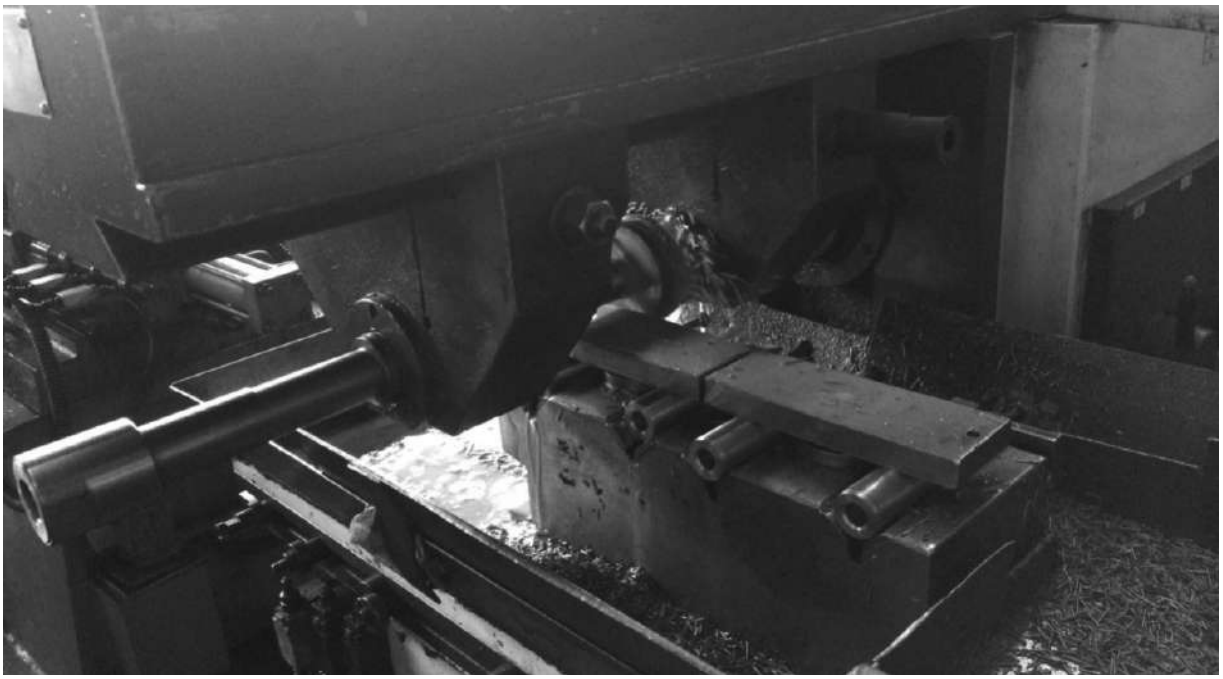
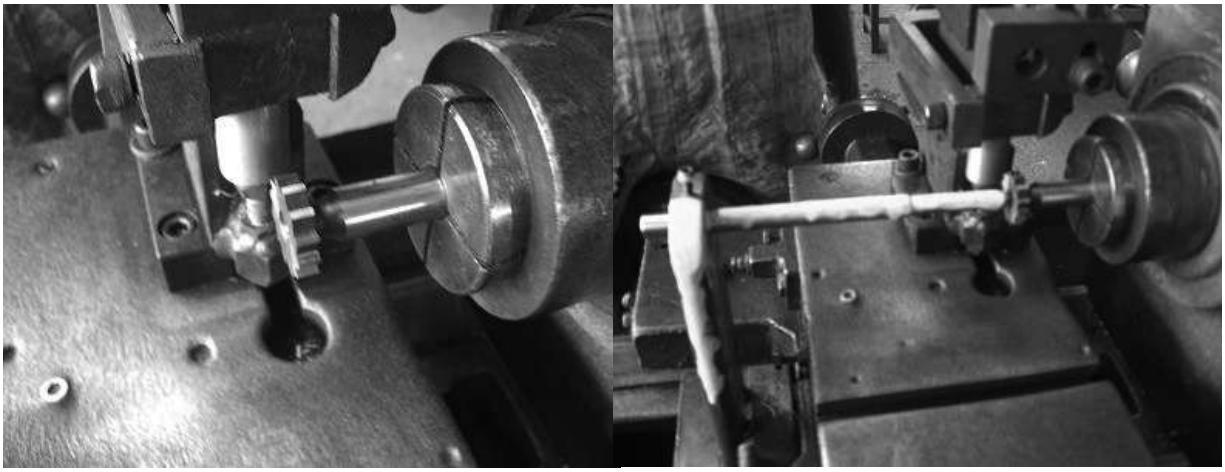


Fig. 5. Fishbone diagram for shifting and setting problem

B9.	Alignment of cutter and the job should be properly done Slack job and loose tool clamping is the major reasoning for misalignment So while inserting the tool it should always checked that there is proper alignment.  **Fig. 5 Hydraulic Clamping**
B10.	Slot symmetry not ok. 100% inspection done with offset checking gauge for 300 parts. Offset tolerance considered 0.25 mm.
S. NO.	**COUNTER MEASURE FOR SHIFTING AND SETTING (MATERIAL)**
C5.	Drilling irregular surfaces can lead to excessive, uneven forces on drill cutting edges, which lead to premature wear. So before doing any operation first inspect the surface where operation should done and make it standard to reduce rejection.
C6.	Less carbon content put a huge impact on strength, ductility and toughness of component It leads to the easily wear out of grinding wheel and produce grinding marks and in some cases wear out of wheel occurs.
S. NO.	**COUNTER MEASURE FOR SHIFTING AND SETTING (MACHINE)**
D8.	Shifting of cutter is the main problem occurs while manufacturing. The worker has to reinstall the cutter which results in lot of waste of time. The wastage of material is too much. So special attention is to be made to avoid this problem. The jig and fixture is designed to avoid the shifting of cutter.

	 **Fig. 6. Stopper to prevent cutter shift**
D9.	Axis of the cutter and the workpiece must be aligned for the fine manufacturing process. Axis must be aligned to be the manufacturing process working smoothly. This reduces the overall rejection of the process.
D10.	The cutter gets slacked after some time in manufacturing. So it must be implemented that the cutter must get tightened after some time. It should be suggested that it should be done at regular basis.
S. NO.	**COUNTER MEASURE FOR SHIFTING AND SETTING (MAN)**
A5.	Specific work instruction provided to the operators working on production lathe. - Place clamp stud close to the workpiece - Use shims between finished surface and clamps - Clamps that are level or with a slight decline towards the workpiece will equalize the clamping pressure - Place support parallels directly under clamps.
A6.	Lathes can easily catch long sleeves and loose clothing. So it is recommended to wear short sleeves or long sleeves with tight cuffs and wear study work shoes to protect legs.

Rejection Analysis

Total no. of pieces from Jan-Mar = 41720

Total no. of pieces from Jan-Mar = 45871

Increase in no. of pieces in Production of 4151 (45871-41720)

Conclusions and Limitations

The results demonstrated that the production of spring pin has been increased by 4151 per month. Quality Control Tools and Process control tools plays a significant role in improving the production related issues of the manufacturing operations. The present study has outlined the significance of both tools towards improving firm performance in a systematic manner. Moreover the dressing frequency of grinding wheel has been fixed after 150 pieces. Root cause helps to predict optimum solution of the problems related to the rejections of critical product. The selection of manufacturing industry is done on the basis of convenient sampling technique. Automation solution can be introduced to reduce the cycle time of operations. The study can be extended to machine shop of the same organization. Analysis can be done on customer complaints in an organization.

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Optimizing Process Scheduling under Lean-Timwood Philosophy: A Case Base Analysis

Projwal David[1] and Supriyo Roy[2]

Construction industry is one of the most challenging industries throughout the world is due to both 'causes of delay and cost overruns'. In the pace of globalization, it is striving towards operational excellence that demands a variety of strategies like 'going lean', automating systems and performing non-conventional ways to add value to their supply chain. Market competitiveness forced to implement 'lean-philosophy' into their operation. Being a labor- intensive industry, proper scheduling is importantly a serious concern. This study primarily highlights the 'ins and outs' of the construction activities and mapping them into lean aspect of scheduling. A real-life case was accordingly developed to show the efficacy of a proper scheduling system under lean philosophy that may significantly reduce project duration time. Outcome of the study significantly contribute to two areas: 'identifying non-value-added activities like scheduling and its optimization, and transformation of traditional mass production into lean aspect following TIMWOOD quality principals'.

Keywords: *Productivity; Process Scheduling; Lean aspect of Scheduling; TIMWOOD Principals; Optimization.*

1 Introduction

In any manufacturing-led organization, two aspects of work principals co-exist: *on-going operations and projects.* Operations systematize any organization's on-going and repetitive activities. Since all such works performed are mostly characterized as operations or projects, all costs must be distributed seamlessly to either operations or projects. On the other hand, projects are initiated by organizations for a variety of reasons which are defined as unique, temporary endeavors with a specific beginning and end (Villafáñeza et al., 2020).

Project scheduling is the essential tool that communicates the collection of works; identifies resources, and the timeframes in which that work needs to be performed. A building block of any scheduling starts with an 'optimal' work breakdown structure; is a hierarchical reflection of all the work systematizes in terms of deliverables. Capturing project cost more accurately provides an invaluable amount of data to strategize decision making in any resource-constrained multi-project scheduling problem (Villafáñeza et al., 2020). Sustainability here depends upon offering products and services at the 'optimal prices' that ultimately catapult economic viability towards organizational growth (Adam et al., 2017).

Construction is mostly found everywhere in our way of life; is considered as basic input to many other industries in a way of business development processes. This industry's operation is spanning worldwide. A nearly seventy percent operation is produced and consumed in the developing countries. With a large base of people's involvement, this industry has successfully operated with a constant trend of growth in the market. However, the recent scenario of the construction industry witnessed tremendous pressure. Factors like high costs of raw materials, market competitiveness, energy, etc. are some of

[1] Research Scholar-Vinoda Bhave University-Hazaribag

[2] Corresponding Author, Birla Institute of Technology-Mesra,Ranchi

the deterrent issues that propelling the market. Due to intensive raw materials requirement and large work-in-progress inventories, productivity is serious concerns (Allahverdi, 2016). Delay of any project causes more risk of inflation and financial liabilities to their clients and stakeholders (Amílcar Arantes et al., 2020). Schedule delay is a common problem that affects project performance and business growth. Project delays create a conflict between the client and the stakeholders which justifies the need for 'optimal' process scheduling and control.

Today, apart from target production, organizations are constantly monitoring non- added values. At this juncture, concepts like 'quality initiatives and its successful implementation' are becoming serious issues (Eriksson et al., 2016). Considering all the issues as discussed above, the obvious question is raised as: '*what strategies are to implement to reduce cost overruns and minimize scheduling delays?*' The situation of not achieving machine utilization and production rates, etc. within the construction production line has motivated operations managers to design an integrated framework in line with 'quality initiatives' (Fundin et al., 2018). Rationale of the study is thus established.

2. Literature review

Literature of scheduling and its application to production is a constant area of research (Blazewicz et al., 2019). Research on the area of time-dependent scheduling problems, single machine based scheduling problems under constraints to time (without assuming a constant rate of processing time) has been witnessed by Arigliano et al. (2017). Scheduling problem with flexibility during maintenance activities are subject to job-dependent machine deterioration. Study on scheduling problem focus on time deteriorating jobs, flow shop scheduling problems with deteriorating jobs on no-idle dominant machines (Grigoriu and Briskorn, 2016). Cheng et al. (2015) developed a two-machining scheduling problem with deteriorating jobs by optimizing the weighted sum of makespan and time.

Researchers use different algorithms for solution to scheduling problems. Research refers to Defraeye and Van Nieuwenhuyse (2016a, b) who have developed a branch-and-bound algorithm for shift scheduling considering stochastic non-stationary demand. Gawiejnowicz and Kurc (2015) discussed the structural properties of time-dependent scheduling problems considering the norm objective. An approximation scheme for scheduling maintenance and proportional deteriorating jobs, the study refers to the work of Kacem and Levner (2016). Application of meta-heuristics in scheduling, research refers to the work of Xu Zheng et al. (2019). They developed solution to energy-efficient scheduling for multi-objective two-stage flow shop by using hybrid ant colony optimization concepts.

Importantly, there are few studies found in literature combining scheduling issues under lean quality aspects. Vamsi et al. (2015) explore an extensive analysis of literature survey of lean production with 546 research articles published from 1988 to 2011 in selected 24 operations research journals. Their study highlights some major findings. These include the dire need of applying more and leaner principles in the field of product development and enterprise solution; also the need to using seven lean wastes instead of specific waste. Bortolotti, Boscari and Danese, (2015) critically discussed lean implementation aligned to organizational culture. Successful implementation of lean manufacturing applied to Brazilian small and medium enterprise and its effect on performance is witnessed by Godinho, Ganga, and Gunasekaran (2016).

Latest research on lean practices implementation in aerospace based on sector characteristics and development refers to the work of Amrani and Ducq (2020). Yujun Lu et al. (2020) published their seminal work on optimization of an angle grinder assembly line based on lean thinking. Integration of lean thinking towards sustainability is another area of continued research (Cherrafi et al., 2016). They provide an extensive literature review and future research direction for model development. Isaksson (2019) provide excellence of sustainability while maintaining the license to operate. Lagrosen and Lagrosen, 2019 witnessed of creating a culture for sustainability and quality in line to lean-inspired thinking.

Summarizing, the construction industry is striving towards operational excellence which demands more to follow (Subramanian and Gunasekaran, 2015): a handful range of strategies is to strategize (like 'going lean', automating systems and inclusion of non-conventional ways) in order to add value to the end-users (Leyer, Reus, and Moormann, 2020). There is a dearth of real study has found in literature specific to '*process scheduling under lean platform'*. Motivation of the study is thus established to address to research statement: *'possibility of adapting lean philosophy that enhances overall productivity'.*

All the above issues as identified, the context and significance of the study is thus established. The remainder of the study is as follows: *Section 3* highlights the aim and objective(s) of the study. Lean philosophy and its viability in specific to TIMWOOD approach are extensively discussed in *section 4.* Case development is discussed in *section 5.* Managerial implications are highlighted in *section 6.* This study ends with a conclusion with limitations and future directions as discussed in *section 7.*

3 Research aim and objectives

In the pace of sustainability, any forward-looking firm always searches for innovativeness in their operation in supply chain (Ramanathan, 2019). Firms' priority targeted to this; regardless of it is mass-produced or custom made. A common approach is to treat this product life cycle development as a project, and managing this project seems to be successful if only it adds value to the end-users (Vandenbrande, 2019). The undertaken study proposes a real-life case base analysis identifying a scheduling problem on the production floor. Considering the complexities associated with quality issues, this study is aimed to be carried out under lean transition following quality aspects of TIMWOOD principals.

Basic objective(s) of this study is thus aimed to:

- *Case base development of a scheduling system*: has been applied to the production floor in order to show economic viability.
- *Efficacy of using Lean concepts in Manufacturing*: a continuous way of quality producing what the customer wants, when they want, at what price they are ready to pay and using the least amount of resources.
- *Lean thinking and mapping to LEAN-TIMWOOD philosophy*: case based implementation with a construction industry problem.

Expected outcome of this case base study may contribute to improving the production line's performance measurements towards 'building lean philosophies'.

4 Lean (Quality) Philosophy

Lean means '*producing components without any waste'*. The domain of waste is anything other than components, materials, and time that are actually required for production and operation. The philosophy of 'leaning' directs to both practical and operational viewpoints. As a multi-dimensional approach, the philosophy of lean encompasses a wide variety of integrated management practices in the supply chain. Research shows that lean manufacturing integrates all these practices synergistically to create a sustainable framework in way of production of finished products at a pace with customer demand with '*little or no waste'* (Cherrafi et al., 2016).

In any system of operation, a lean approach is implemented concurrently with an operation to identify and eliminate waste in a way to continuous improvement (Godinho Filho, Ganga and Gunasekaran 2016). Any production floor initiates two types of activities while in operation: *value-added and non-value-added. First*, confirm the product more resemble in line with end-users need. The *second*, on the other side, do not create any value addition to end-users. In the parlance of operation, anything that is ultimately not adding value is treated to be waste. To make any operation successful, integration of value base activities to be coupled with non-value-added activities. Both should join hands in order to make the operation sustainable. The efficiency of using lean concepts is thus established.

Wastes (Muda) of seven types were initiated and developed as a part of the Toyota Production System by Taiichi Ohno. As per-flow of the process, these seven wastes are identified by the acronym 'TIMWOOD' where each word stands for: *'T-Transportation, I-Inventory, M-Motion, W-Waiting, O-Overproduction, O-Over-processing, and D-Defects'*. The 8th waste of non-utilized talent (or 'Skills') of workers was later added with the seven to rename as 'TIMWOODS'.

Each word stands for a different meaning as described under quality aspects below:

1. *Transportation:* Unneeded movements of materials. In practice, it requires when they are physically distanced and require moving and handling devices to be repeatedly repositioned. Measures to minimize transportation waste includes: creating flow between processes, developing a U-shape production line, and not over-producing work in-process items.
2. *Inventory:* The stock of extra raw materials, etc. without providing value. This is usually a costly means to cover up quality-related problems like manpower scheduling problems, excessive lead-time, rework and defects, etc.
3. *Motions:* Unusual movement of people, product, or equipment that does not add value in making the final product. Measures to safe motion include: practicing quality initiatives like *'3S* principles', keeping equipment near the production line, and placing materials ergonomically to minimize stretching and straining.
4. *Waiting:* Includes unnecessary delays coming from processes, people, or work-in-progress inventory sitting inactive. Measures to reduce waiting includes design processes in a 'best optimal' way to ensure continuous flow, proper scheduling of workload, and developing flexible multi-skilled workers.
5. *Over-processing:* Adding unnecessary features that are not worth value-adding. A simple way to counter this is to understand and design the work requirements from the viewpoint of the customer.

6. *Overproduction*: Making either unnecessary goods too early or too in quantity. Overproduction may be better described as procuring goods 'just-in-case' instead 'just-in-time'. Traditionally, to determine optimal manufacturing batch and lot sizes, manufacturers monitor economic order quantity.

   Overproduction may be restricted by the following ways: *first*, using a 'Takt Time' which ensures that the rate of manufacturing between stations is even, s*econd*, reducing setup times enables small batches or single-piece flow manufacturing; and *last*, developing a pull or 'Kanban' system.

7. *Defects:* is an instance of the item's lack of conformity to specifications. Every defective item thus contains one or more defects and the existence of defective units in any process is the outcome of a poor preventive quality system. When a defect is passed onto the next stage of operation, a loss inevitably occurs.

Defects may be restricted in the following ways:

- First, identify defect which occurs most frequently,
- Second, design a process to detect abnormalities and restrictor in production, and
- Third, redesign the process which does not lead to defects.
- In last, use standardizes a consistent manufacturing a process which is defect free.

Researchers, nowadays, use an alternative to 'TIMWOOD' which is termed as 'WORMPIT'. Each word of WORMPIT stands for: '*Waiting, Overproduction, Rejects, Motion, Processing, Inventory, and Transport*' for dealing with such type of quality problems as a concern. Our present study, however, is restricted to 'TIMWOOD' philosophy.

5 Optimizing Process Scheduling - Case Analysis

Scheduling is considered to be an integrated planning and a powerful tool to model real-world constraints in any operation (Felix Villafáñeza et al., 2020). In today's world of manufacturing, excellence is built on 'best fit' execution. Lean manufacturing gives credence to execution to customer demand in a more sustainable way. It favors a system of visual signals on the shop floor to replace traditional practices. In this juncture, a problem that arises as: *does scheduling is in conflict with best practices of lean and demand-driven production?*

The present study has undergone a real-life case-base study approach. The main motto of this case study is to strategize 'best optimal' process scheduling in line with lean concepts. The parent company where this case study is undergone is a big corporate house that conglomerate of different sectors encompasses engineering construction to a technology solution. It is considered as one of the oldest and largest companies that successfully operate globally for more than seven decades. Customer-centric approaches coupled with the quest for best quality have enabled this company to sustain leadership in its entire business lines globally. A thrust on expanding business globally resulted in overseas earnings significantly. Even today, it keeps continuing global footprint in an expansion mode with offices and manufacturing facilities worldwide. There is an aggressive wide marketing and distribution network that develops a strong customer base globally.

In the primary part of the study, data from various project sites have been collected as per the present productivity trend, against the target or the cost-productivity benchmark. Data have been taken as per the ongoing project trends at an integrated steel plant construction site; specifically, from the project-tendering division. Project tendering for the

future projects will be majorly based on productivity with respect to cost and sales figures. Due to lower productivity, cost figures have moved high and the tendering team has been quoting based on the present productivity trend. This data becomes very crucial because the project schedule totally depends on it. Sample project data has also been taken to compare the agreed project schedule and the present project status.

Data as collected from the primary report is hereby analyzed in the same sheet. There are two cases from the present project sites which show one of the major reasons for the time delay. As per the reduction in project time, an aspect never thought of from the customers' point of view has been the value of time there. Customers need to be communicated the reduction in process time as a benefit for the end-user. The study focuses on the aspects of enhancing labor productivity with respect to the communication gap and construction methodology. The objective is to reduce the total project duration by ten percent, and based on it; initiatives that have been adapted to the present project site. Recommendations are mentioned in the process maps. The study explores the possibility of process improvements that can be integrated into the ongoing project system. There are limitations to the project on- site to site basis. A lot of external factors are beyond the range of control which may affect productivity.

At any project site, industrial construction is a difficult task to perform. It is important to continually monitor the tasks and shift responsibilities accordingly. This type of task can usually be executed with project management. Once a delay starts to happen, the project cost and duration are difficult to contain within the agreed margin. In this particular greenfield site, it was observed that the project delay and cost overruns were very common. Construction companies generally compete for projects by submitting bids with fixed termination dates. Although the termination dates are fixed, the activities to complete are usually stochastic.

Here, it has been observed that, the projects often get delayed beyond the contingency dates. Study reveals that, project delays occurred mainly due to lack of:

- *Project methodology*
- *Knowledge about the project execution, and*
- *Project communication and co-ordination.*

Managing construction and engineering role is outsourced to a leading construction firm which normally works in a consortium. Since the consortium has sufficient experience in consulting lean philosophy effectively, they identified the area to initiate 'lean principles'. The basic aim is to explore out innovative ways to execute the construction process in order to 'minimize cost by reducing waste and lead times'.

Consortium chose the project to be a 'lean pilot project' mostly due to its tight schedule. While in the process of the project scheduling stage, the consortium realized that it was extremely difficult to be able to complete the project on time with traditional execution methodology. Different contractors were responsible separately for construction, electricity, ventilation, and plumbing, each with lean initiatives. The decision to implement lean construction was taken during the design stage. It was initiated to the construction stage. Consortium decided to focus on a lean approach while improving cooperation among different interdisciplinary departments in the process of construction.

5.1 Shop Floor issues

There is a comparison with the erection of two galleries of a conveyor belt of the same length and

similar weight. Both the conveyor galleries were supposed to distribute raw coal to coke oven batteries from one stockyard. Each gallery consists of 14 Sub galleries standing over 15 Trestle columns. To show the efficacy of a lean perspective, measuring the progress in the applicability aspect was monitored. Pilot stretched over 2 months while the monitoring was in progress. To simplify the process, a flow diagram is depicted to understand the sequencing of the work for the pilot project.

The client was running short on time and the project schedules were not in line. To reduce the time and cost the different departments are called to execute process mapping. As per the traditional flow of events, every Gallery erection was taking 6 weeks to complete. Quality managers working on the shop floor are then adapting to apply TIMWOOD method under lean in order to reduce the time frame. The average weight of the gallery was 31 Mt including the final weight of the machinery. The machinery consisted of the conveyor belts and its supporting units. The traditional workflow diagram is shown below in *Figure1.*

The above workflow shows the '*AS-IS*' (Present Work Flow). On an overall basis, first, the drawings are confirmed with specifications and load detail, and civil engineering details are released sequentially for execution. Second in line is the structural drawing, where the structures are required to be fabricated and then assembled on the ground before erecting them. These structures are meant to bear a load of equipment to carry out the processes. The proposed workflow in *Fig. 2* integrates the equipment and the structural erections at site so that the modifications

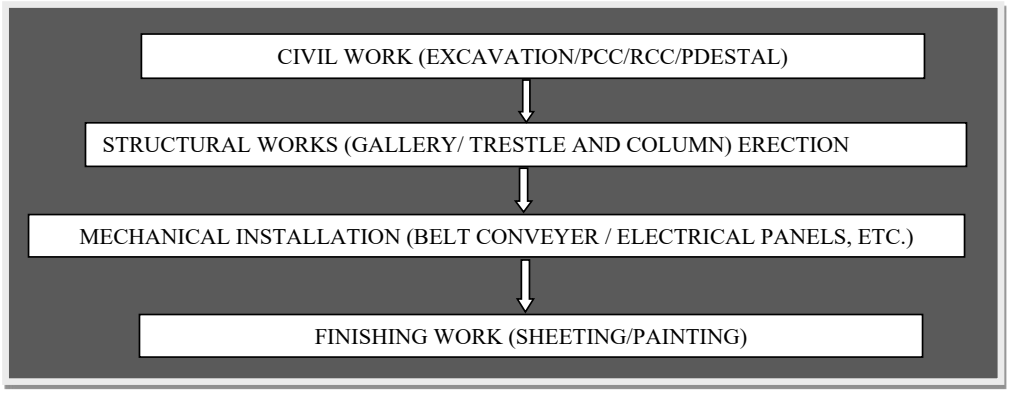

Fig.1: Traditional Work Flow

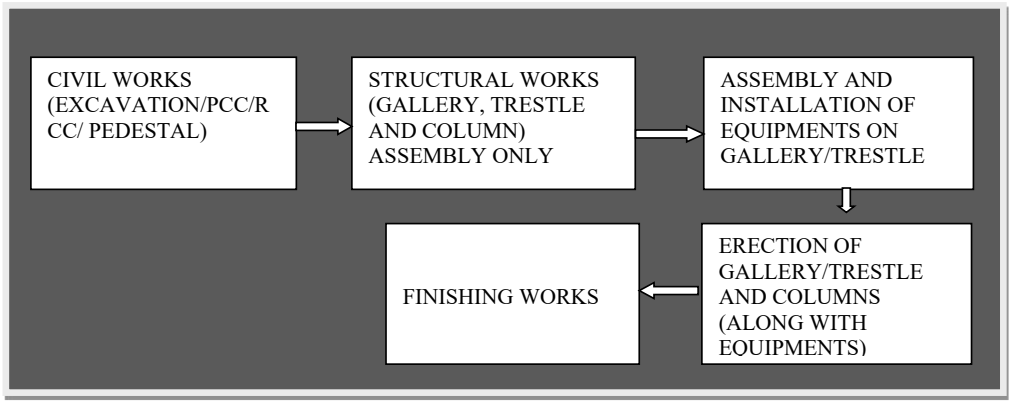

Fig.2: Proposed Work Flow

done on the ground are easier, with less scaffolding and supporting materials for usage.

5.2 Data Mobilization

All relevant data for length of the gallery, structural items weight, equipment items weight, etc. are depicted in *Table 1* below:

Table 1: Data for Gallery No. 1A and 1B

S. No.	Item Description	Gallery No. 1A	Gallery No. 1B
1	Length of the gallery (m)	15.6	15.6
2	Structural Items Wt (Mt)	17.4	17.4
3	Structural Erection (Days)	11	11
4	Assembly Time (Days)	1	1
5	FIT Up /Inspection (Days)	1	1
6	Re Work (Days)	2	2
7	Equipment Items Wt (Mt)	2.34	2.34
8	Equipment Installation (Days)	12	8
9	Assembly Time (Days)	1	1
10	Set Up / Inspection (Days)	1	1
11	Re Work (Days)	2	1
12	Difference in days	5	5

Notation used for the case study is taken as:

W/O: without assembly;

Mt: Metric Tonne;

N_S: Number of day's manpower to be deployed for structural job;

C_S: Total costs;

C_{SW}: Total costs in structural site without assembly;

C_{SA}: Total costs in structural site with assembly; and

P&M: Plant and Machinery.

Other cost calculation with notations are properly clarified and depicted in tabular form.

Table 2 shows below a detailed cost calculation as exercised and highlighting all notations. Significantly, number of manpower deployed in case with 'full assembly' is 11 which is less in compared to 'without assembly' that is 15. This is happening as: in an AS - IS case here, the galleries are erected at a height of 30-40

Table 2: Total cost calculation with variation

Item Description		W/O Assembly (W)	Full Assembly (A)
Structural	*Structural Gallery Weight (**Mt**)*	*31 Mt*	*31 Mt*
	No. of days Manpower Deployed (Structural = N_S)	*20*	*20*
	Manpower deployed for Assembly and Erection (D_S)	*15*	*15*
	Man-day Rate for structural deployment (M_S- INR/per day)	*₹320*	*₹320*
	Total Cost for Structural Deployment (INR) – Cs ($C_S = N_S * D_S * M_S$)	**₹96000 (C_{SW})**	**₹96000(C_{SA})**
	P&M Cost Per day (P_{SE})	*₹29441*	*₹29441*
	Total Cost for the P& M required ($P_S = P_{SE} * N_S$)	**₹588825 (P_{SW})**	**₹588825 (P_{SA})**
Equipment	*Equipment Weight to be erected (**Mt**)*	*3.0(Mt)*	*3.0(Mt)*
	Manpower Rate (M_E- inr/per day)	*₹336*	*₹336*
	No. of days Manpower Deployed (Equipment = N_E)	*15*	*11*
	Manpower deployed for Installation (D_E)	*12*	*12*
	Total Cost of Equipment Erection (INR) - C_E ($C_E = M_E * N_E * D_E$)	**₹60480 (C_{EW})**	**₹44352(C_{EA})**
	P&M Cost Per day (P_{EE})	**₹14644**	**₹14644**
	Total Cost for the P&M required ($P_E = P_{EE} * N_E$)	**₹219660 (P_{EW})**	**₹161084 (P_{EA})**
	Cost per gallery (C_W: C_A) ($C_W = P_{EW} + C_{EW} + P_{SW} + C_{SW}$) / ($C_A = P_{EA} + C_{EA} + P_{SA} + C_{SA}$)	*₹964965 (C_W)*	*₹890261 (C_A)*
	Cost Benefit per gallery: C_B ($C_B = C_W - C_A$)	*₹74704*	
	No. of Galleries (n)	*14*	
	Total Cost Benefit: C_O (Observed: $C_O = C_B$ x n)	**₹1045856**	
	Percentage Savings over Cost Estimate (C_B/C_W x 100)	**7.7%**	

meters. The equipment would then get the clearance for installation, which makes the process very cumbersome. At this height, there are a lot of safety measures to be taken care of, in line a lot of enabling structures need to be temporarily installed for work. Along with the enabling structure installation, the work time at height gets prolonged due to long process for welding, gas cutting etc. This time is considerably reduced if the work is done on the ground with full or complete assembly; it has literally few enabling structures and enables more precision in work. All data are taken from the shop floor measuring in appropriate units. Finally, by putting the data, total cost calculation is carried out.

From the table, it is seen that, there is a significant benefit in total cost as seen viable. Percentage savings over cost estimate is also feasible with the present set of data. The above details mention the cost variance with respect to the actual cost estimate and the proposed cost estimate. The 'W/O work assembly' column has been referred to as 'W' which is the AS-IS situation at site, and the full assembly column has been referred to as 'A' which has been proposed. *Figure 3 and 4* depicted respectively the structural works of Work Breakdown Structure (WBS) (AS-IS) and Equipment erection (AS-IS).

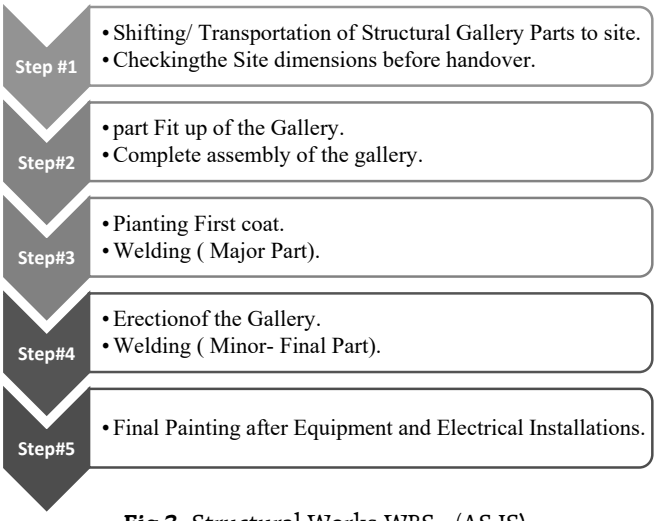

Fig.3: Structural Works WBS - (AS-IS)

5.3 Scheduling to Lean-TIMWOOD Philosophy: Mapping

Lean is basically a management philosophy; is set to be defined as tools, principles, and techniques that identify and eliminate waste(s) through continuous improvements in any work system (Yujun Lu et al., 2020). Scheduling here, may act as a mediator in between identify to operate which endeavor improvement of productivity, customer, and supplier relations to make sure the firm requires '5 L' principles of Less materials, Less space, Less capital, Less human effort, and Less time to procure (Aicha Amrani and Yves Ducq, 2020).

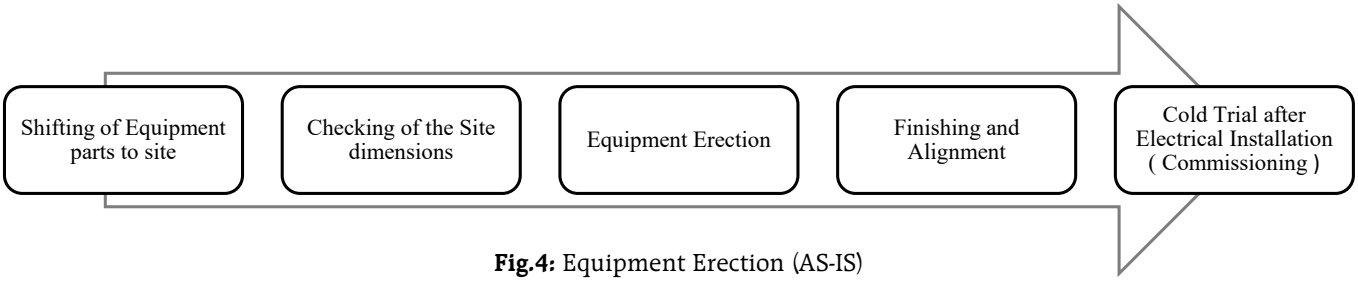

Fig.4: Equipment Erection (AS-IS)

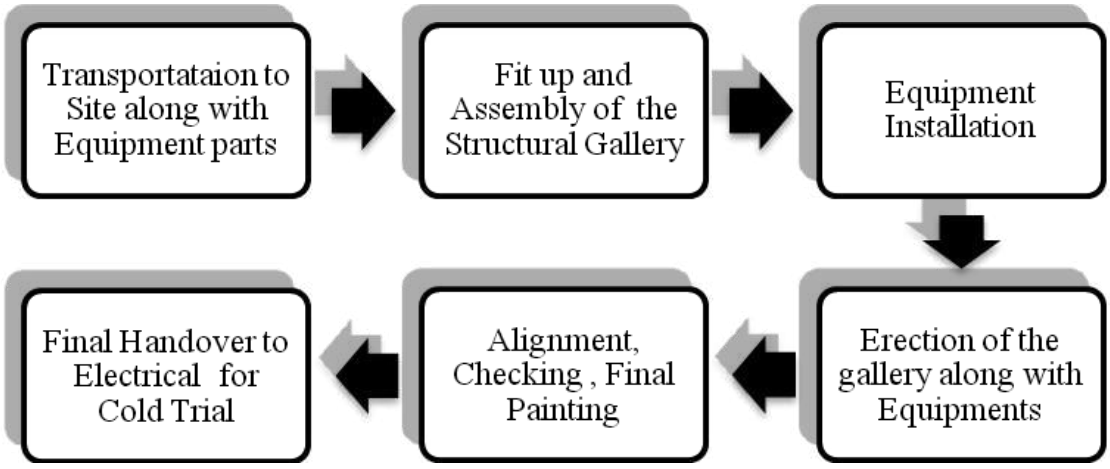

Fig.5: Flowchart: applying Lean and TIMWOOD in the Processes

Setting in line with the above objectives, and after all the necessary works has been initiated in the operation successfully, we try to mapping our Scheduling to Lean-TIMWOOD Philosophy. *Fig. 5* depicted the flowchart of applying Lean and TIMWOOD in the Processes.

With the above flowchart as initiated, description under lean with TIMWOOD policy initiatives for each alphabet is highlighted under certain 'root cause' and description. *Table 3* shows all issues as discussed in a comprehensive way under TIMWOOD Policy initiatives.

Lean application is a new way to manage a construction site with proper scheduling. Here we see that there is a deviation from the normal way the construction is being processed. The Integrated

Table 3: Description under TIMWOOD Policy Initiatives Matrices

TIMWOOD	Issues- As Described	Root Cause Analysis	Solution : SWOT Analysis
TIMWOOD (*Transportation*)	- Material shifting in the construction site. - Occurs due to installations and processes restrictions.	- Improper Resource Planning as well as inefficient transmittal of information. - Number of handoffs, as well stop and go tasks.	- Collaborating with Equipment parts. - Reduces the trips for shifting. - Minimize task switching.
TIMWOOD (*Inventory*)	- Erections of Equipments and Structures: identified.	- As Sequencing is delayed, available spaces get blocked and hence the cause of high inventory.	- Resource planning needs to be strategized and monitored from supplier's supplier view point. - Inventories do not add value; they fix capital and so consume valuable resources.
TIMWOOD (*Motion*)	- Erection of Equipments and Structures – maintaining flow.	- Human movement due to lack of direct access to flow of systems. - Increased welding time due to poor accessibility to efficient welding postures in a high top position.	- Unnecessary safety hazards due to excessive movements to be reduced by making full assembly on the ground.

TIMWOOD	Issues- As Described	Root Cause Analysis	Solution : SWOT Analysis
TIMWOOD (*Waiting*)	- Welding: heart of this type of erection activities – needs proper sequence and thus waiting.	- Value Creation remains static. - Value stream is treated as '*non-flowing*'. - Improper sequencing of Item work.	- Manual welding takes time at oblique angles. - To overcome, the Welding Equipments and machine parts are to be grounded along with Part Alignment.
TIMWOOD (*Over processing*)	- Manpower and other resources utilization.	- Waste inherent to a non-optimized process. - Requires serious concern over quality; thus spoilage over the usage of manpower.	- As manpower is utilized in a sequential and efficient manner, the over processing is heavily reduced.
TIMWOOD (*Over production*)	- Extra distribution of lack of synchronization of processes / tasks.	- Excessive scaffoldings in use which are fixed onto the structures and have to be removed later on.	- Majority of the assembly works done on ground; thus reduces overproduction of items at height level.
TIMWOOD (*Defects*)	- Work out accurate specifications with minimum error functionality.	- Assembling at height. - Welding platforms are at an angle, where it is difficult to monitor.	- Welding on the ground, make it much easier and accessible. Thus reduction in defects.

Authors' (2020).

(hybrid) way using Lean-TIMWOOD saves overall time and cost. Coordination, in general, is adhered to with the help of the main project schedule and details of workflow of the organization, in which the project employees are aware of and support project goals (Leyer, Reus, and Moormann, 2020). As we can see in the above *Table 3*, the Lean-TIMWOOD application forces the attention on how value is generated rather than adhering to focus on completing one activity. In any schedule, engineering construction projects are directive driven, while manufacturing is routinely driven. Hence the applicability of Lean -TIMWOOD in construction projects would vary from project to project.

5.4 Result Outcome

The study has significant outcomes that may be highlighted in these directions:

- Site operations could significantly reduce waste by ensuring that project erection schedule and directions are strictly adhered to and by '*ensuring least or no methodological changes*'.
- Effective reduction of waste, through the integration of processes, helps to reduce extra work, materials, time, manpower, safety, and cost, which in turn is essential to mitigating overall waste disposed of the operation/construction site.
- Planning and budgeting is the place where the decisions regarding the schedule are controlled from, so it is important that integrated assignments between departments are well-coordinated through them. This understanding of lean ensure that even in a complex operational industry like construction, it can be successfully applied.
- Prototyping is a must for any construction industry and hence the proposed way with the Work Breakdown Structure (WBS) is mentioned in the Work Flow of activities.

Most significantly, implementing lean does not adhere to making construction manufacturing by standardizing products. Rather implementation starts by understanding the application of each TIMWOOD principle to various activities in construction and accepting the ideal of perfection offered.

6 Managerial Outlooks

In the era of revolution, companies have to re-engineer various methods to achieve operational excellence. Reduction of waste, improvement in quality, higher throughput, and seamless production system is some of the leading revolutions that should implement in the era of Industry 4.0: needs 'quality choice points with a refreshed urgency' (Bradbury et al., 2019a). Leaving the traditional approach of focusing on economies of scale and return on investment, companies are gradually shifting to 'innovate lean thinking' (Lilja et al., 2017) and thus adding values to the supply chain (Subramanian and Gunasekaran, 2015). This comprehensive approach forced the floor managers to develop newer techniques in order to optimize cost, time, and most importantly, quality in every segment of the business chain.

The managerial outlook of this study is manifold:

- Philosophies of lean manufacturing ensure optimization of operations in trans-domain areas within supply chain. It follows with minimizing work-in-progress inventory, subcontracting peripheral operations, streamlining process flow and most significantly, optimizing process scheduling.
- In addition to best practices, companies are increasingly harnessing cultural (behavioral) changes to improve their operational efficiencies (Michael Leyer et al., 2020).
- With global competitiveness, moving ahead on its way to operational excellence by lean philosophy will more and more resemble 'a norm than a unique feature'.

Outcome of the study, thus, successfully answer our research question as framed. Inline with optimizing process scheduling, the outcomes of this case analysis convey a strong message to business decision-makers that: *'transformation of construction industry from traditional mass production into leaning is obvious in order to be more aggressive in today's competitive market'.* This supports the emergence paradigm of twenty-first century total quality management aspects (Van Kemenade and Hardjono, 2019).

7 Conclusions

In today's competitive market, companies are enforced to look for an edge over their competitors and add value to the customers providing quality services. Companies have adopted concepts of building a continuous improvement policy in every domain in the supply chain (Kamble, Gunasekaran, and Gawankar, 2018). *Significant contribution* of this case development may be highlighted in the following directions:

- The present case study was developed in line with taking a premier construction industry which is accounted for as a process industry. This may direct to transfer of knowledge by identifying non-value added activities and its optimization.
- Considering the mass production system is adopted using machines to produce, transport, and accumulate materials in each working areas; this study uniquely contributes to 'optimal process scheduling' align to 'lean philosophy'.

Novelty of this study is that: this case as developed is based on the concept of lean manufacturing which was initiated towards maximizing resource utilization thus minimizing waste. Any firm irrespective of whether manufacturing or service depends mostly

on its ability to continuously respond to changes in line to add value to the end-users. These propel value-adding concepts to be adapted in entire supply chain. Finally, the study has succeeded a significant message to the decision-maker: *'success of lean philosophy is not constrained to specific domain; however, it can be broadly adapted to trans- specific area of lean thinking'.*

The *limitation* of the study is the case base approach where data-driven analytics are not performed; therefore, it cannot possible to make a generalized inference. Suggested *future studies* can be explored by identifying and implementing the appropriate lean approach in order to optimize each of these wastes; thus resolving the waiting time problem in scheduling. Furthermore, in the future, apart from manufacturing, this approach may be implemented in other broad sectors. Again, besides TIMWOOD, the applicability of other approaches like WORMPIT may work even better. Suitability to explore Six Sigma and its application with this scheduling problem is an unexplored area. Further study is awaited.

To summarize, in the era of Industry 4.0 where every organization is trying to focus more on adding value to customers, this study may act as a significant example of integrating process scheduling under Lean philosophy towards continuous improvement to achieve business excellence.

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Psychological Well-Being, Earnings and Gender Differences

Dr. Dur Khan[1], Dr. Sudhakar Gaonkar[2]

The study attempts to understand the impact of psychological well-being domains on salary package of MBA students. The study uses Ryff's scale of Psychological well-being (1989). Sample comprises of 199 MBA students from different management institutes of Mumbai Region. The impact of high and low scores on these domains on amount of salary package is assessed through Mann Whitney U test. The impact of well-being on salary is assessed within each category of gender. It is concluded that psychological well-being significantly impacts salaries of management students. Further exploration of gender differences revealed that psychological well-being impacts salaries of male students only. The differences in salaries of female students cannot be attributed to psychological well-being.

Keywords: *Psychological well-being, MBA students, Salary, Earnings, Male, Female, Ryff's scale, autonomy, personal growth, self-acceptance, life purpose, mastery, positive relations*

Introduction

Well-being is a multifaceted concept concerning optimal experience and positive functioning. Research on well-being has two broad perspectives: the hedonic approach which focuses on happiness and defines well-being in terms of pleasure accomplishment; and the eudaimonic approach which focuses on a life worth living and self-realization and defines well-being in terms positive functioning. These two outlooks have given rise to diverse research emphases and a body of knowledge that is in some areas differing and in others complementary. New methodological developments concerning multilevel modeling, statistical analysis and construct comparisons are allowing researchers to formulate new questions for this field of study. (Ryan and Deci, 2001).

Well-being plays a very important role in creating prosperous societies and successful individuals. Concentrating on well-being presents a valuable opportunity to benefit societies by helping individuals to feel happy, content, competent, and satisfied in their roles. Well-being denotes the assorted yet interconnected dimensions of physical, mental, and social health extending beyond the traditional definition of just health or wealth. Well-being refers to a sense of accomplishment and fulfilment. (Huseyin and John, 2015). People who achieve good standards of well-being are likely to be more creative and more productive than individuals with low well-being. A focus on well-being considers how people feel and function, and how they evaluate their lives. This can be separated into two key aspects, hedonic and eudaimonic (Ryan and Deci, 2001). The hedonic aspect of well-being refers to people's *feelings or emotions*, such as happiness or anxiety. The eudaimonic aspect of well-being refers to leading 'a life well lived', interacting with the world around you to meet basic psychological needs such as experiencing a *sense of competence* or *sense of meaning and purpose.* There is also an evaluative aspect of well-being refers to the way that people evaluate their lives with regard to their own appraisals of *how life is going*, or particular

[1] Assistant Professor, Jamnalal Bajaj Institute of Management Studies, Mumbai, Maharashtra, Email-durkhan@jbims.edu

[2] Training and Placement Officer, Jamnalal Bajaj Institute of Management Studies, Mumbai, Maharashtra, Email-smgaonkar2004@gmail.com

aspects of their lives, such as job satisfaction; this aspect of well-being is often captured using satisfaction measures.

Despite the huge popularity of the hedonic view in the past, many philosophers, religious masters, and visionaries from both the world have offended happiness as a principal standard of well-being. For example, Aristotle was an ancient Greek philosopher who considered hedonic happiness to be a vulgar ideal, making humans slavish followers of desires. He posited, instead, that true happiness is found in the expression of virtue—that is, in doing what is worth doing (Aristotle et al, 2004). Optimal well-being requires differentiation between the subjectively felt needs whose satisfaction leads to momentary pleasure, and those needs that are rooted in human nature and whose realization encourages to human growth. The needs leading to a perception of human growth produces Eudaimonia, i.e. "well-being". In other words, there is difference between subjectively felt needs and objectively valid needs. Subjectively felt needs may prove to be harmful to human growth and the objectively valid needs are in harmony with the requirements of human nature. (Ryan and Deci, 2001)

The term Eudaimonia is valuable because it refers to well-being as distinct from happiness (Aristotle et al, 2004). Eudaimonic theories believe that not all desires, not all outcomes that a person may value would achieve well-being. Even though they are pleasure producing, some outcomes may not be good for people and may not promote wellness. So from the eudaimonic perspective, subjective happiness can never be equated with well-being. Ryff and Singer (1998) explored the question of well-being in the context of developing a lifespan theory of human flourishing. They describe well-being not as the attainment of pleasure, but as the realization of one's true potential and striving for perfection. They thus spoke of psychological well-being (PWB) as different from SWB. Ryff (1989) presented a multi-faceted approach for the measurement of PWB that includes six distinct aspects of human actualization: autonomy, personal growth, self-acceptance, life purpose, mastery, and positive affiliation. The six constructs define PWB theoretically as well as operationally and they also specify what promotes well-being and emotional and physical health. (Ryff and Singer, 1998). The eudaimonic living as represented by PWB, can influence specific physiological systems relating to immunity functioning and health promotion. Well-being is thus a multi-layered concept. It is often thought of as one of the hallmarks of the liberal arts experience, resulting from educational encounters that both guide students in the search for meaning and direction in life and help them realize their true potential.

Psychological Well-Being

Psychological well-being denotes a state of mental satisfaction rather than just happiness. Psychological well-being is attained by achieving a state of balance affected by both challenging and rewarding life events" (Dodge et al, 2012). Psychological well-being refers to how people evaluate their lives. According to Diener (1984), these evaluations may be in the form of cognitions or in the form of affect. The cognitive part is an information based appraisal of one's life. It is when a person gives conscious evaluation and judgments about one's satisfaction with life as a whole. It is the contentment with the achievements in life.

On the other hand, the affective part is a hedonic evaluation guided by sense of happiness, emotions and feelings and the experience of pleasant/unpleasant moods in reaction to lives. The basic assumption behind this is the point that most people evaluate

their life as either good or bad, they are normally able to offer judgments. Furthermore, people habitually experience moods and emotions which have a positive effect or a negative effect. Therefore, people have a level of subjective well-being even if they do not often consciously think about it, and the psychological system offers virtually a constant evaluation of what is happening to the person. (Ryan and Deci, 2001). Thus the affective evaluation is subjective well-being whereas the cognitive evaluation considers psychological well-being.

Psychological well-being relates differently to different individuals. It is very subjective in nature. Broadly, the ability to cope up with the recurrent stresses of life in an acceptable way can be considered as psychological health. *Ryff Carol (1989)* explains psychological well-being by lying down its different facets. A person with following attributes can be regarded as a psychologically healthy person. The degree and proportion of each facet may vary but an overall positive presence of these can be regarded as presence of psychological well-being. Psychological well-being (PWB) theory and the measurement scales are developed and advocated by Ryff. C (1989). In her seminal paper, "Happiness is everything, or is it? Explorations on the meaning of psychological well-being" she differentiates PWB with subjective well-being (hedonic well-being).

Ryff (1989) explored the meaning of Psychological Well-Being by studying the extensive literature. She laid down six aspects of well-being (self-acceptance, positive relations with others, autonomy, environmental mastery, purpose in life, and personal growth). Three hundred and twenty-one men and women, divided among young, middle-aged, and older adults, rated themselves on these six measures along with instruments prominent in earlier studies (affect balance, life satisfaction, self-esteem, morale, locus of control, depression). Results discovered that aspects like positive relations with others, purpose in life, autonomy, and personal growth were not strongly present in prior assessment indexes, hereby supporting the assertion that key aspects of positive functioning have not been symbolised in the empirical research arena. (Ryff, 1989)

Ryff's study (1989) was based on the fact that there has been negligence in the task of defining the essential features of psychological wellbeing. She argued that much of the prior literature is founded on conceptions of well-being that have little theoretical rationale as a consequence of which, theory on psychological well-being has neglected important aspects of positive functioning. An alternative framework of psychological well-being, based on the integration of several theoretical domains is presented and operationalized in this research. The research also brings attention to the fact that the literature on psychological well-being was not, in its inception, strongly theory guided. Instruments, earlier developed for other purposes, became the standard bearers for defining positive functioning. The six aspects of psychological well-being conceptualized by Ryff (1989) *autonomy, personal growth, self-acceptance, life purpose, mastery, and positive relations* are described below in detail:

Autonomy: Autonomy consist of qualities like self-determination, independence, and the regulation of behavior from within have got considerable emphasis in the prior literature. Individuals with high autonomy are Self-actualizers. These people show autonomous functioning. They can also be described as people having an internal locus of evaluation, whereby one does not look to others for approval, but evaluates oneself by personal standards. The process of turning inward in the later years is also seen by life span developmentalists to give the person a sense

of freedom from the norms governing everyday life. (Ryff, 1989)

Self-acceptance: The most repeated standard of well-being evident in the previous perspectives is the individual's sense of self-acceptance. This is regarded as a central feature of mental health as well as a characteristic of self-actualization, optimal functioning, and maturity. Life span theories also emphasize acceptance of self and of one's past life. Thus, holding positive attitudes toward oneself emerges as a central characteristic of positive psychology. (Ryff, 1989)

Positive relations with others: Positive relations with others considers having warm and trusting interpersonal relationships. The ability to love is seen as a central component of mental health. Positive relatedness comes with strong feelings of empathy and affection for all human beings, being capable of greater love, deeper friendship, and more complete identification with others. Warmth relating to others is seen as a criteria of maturity. Thus, the importance of positive relations with others is frequently stressed in these conceptions of psychological wellbeing. (Ryff, 1989)

Environmental mastery: An individual's ability to choose or create environments suitable to his/her mental conditions is seen as a characteristic of mental health. Maturity and life span development also contribute to this. These theories emphasize one's ability to progress in the world and change it creatively through physical and mental activities. These viewpoints suggest that mastery of the environment is an important ingredient of positive psychological functioning. (Ryff, 1989)

Purpose in life: Mental health is said to include beliefs that give one the feeling there is purpose in and meaning to life. Maturity also give emphasis to a clear comprehension of life's purpose, a sense of direction in life and intentionality. Thus, one who has positive psychological functioning has goals, intentions, and a sense of direction, and the feeling that life is meaningful. (Ryff, 1989)

Personal growth: Optimal positive functioning requires individuals to continue developing their potential to grow and expand as a person. The need to actualize oneself and realize one's potentialities is central to the clinical perspectives on personal growth. For example, Openness to experience is a key characteristic of the positive functioning person. Such an individual is continually developing and becoming, rather than achieving a fixed state wherein all problems are solved. Life span theories also give obvious emphasis to continued growth. (Ryff, 1989). The combination of mental health and life span developmental theories points to multiple aspects of positive psychological functioning. The above six dimensions of well-being constitute to an individual's mental health and positive functioning. The six dimensions The Ryff scale (1989) are valid however, in general, the psychometric properties are controversial. Still, there is no agreement as to what would constitute a better structure.

Objective and Need of the Study

The objective of the study is to understand the impact of psychological well-being on salaries of management students. Further the moderating effect of gender is also observed in determining relationship between psychological well-being on salary package.

The management students or the MBAs are fascinated by and look forward to getting a good placement package or salary at the start after passing out from a Business school, mostly through campus placements. This helps them build a career as generally the salary changes are incremental on the previous

salary package. Thus it is important that a student gets a good package. The concept of psychological well-being deals with a feeling of staisfcation and accomplishment. It describes the mental health of the individual. Positive psychological well-being reflects a positive attitude toward present life and the way it is heading towards future. This research is thus needed to understand how positive psychological well-being is helping MBA students in getting a better salary package compared to peers. And also whteher there are any gender differences in estimating the impact of psychological well-being on salaries.

Literature Review

A study by Kaplan et al (2008) examined the cumulative impact of different income measures on psychological well-being among adults covering almost three decades of research. Data was collected over 29 (1965–94) years from Alameda County Study participants to study the association between income and psychological well-being using variables like average income, income changes, profit and benefit incomes and five scales of psychological well-being namely Purpose in Life, Self-acceptance, Personal Growth, Environmental Mastery, and Autonomy. In age-adjusted models, the psychological wellbeing measures were each regressed on each of the income measures. Potential confounders (sex, education, race/ethnicity, social isolation, depression and perceived health) were also examined. It was concluded that mean income over almost three decades was strongly associated with five scales of psychological well-being; Purpose in Life, Self-acceptance, Personal Growth, Environmental Mastery, and Autonomy. Psychological well-being increased with income increases over time and also with the increase in profit income. For all scales of psychological well-being except Autonomy, well-being decreased with decreasing income over time and by receiving need-based benefit. Overall, Psychological well-being may reveal the accumulation of socioeconomic advantages and disadvantages over the span of life. (Kaplan et al, 2008).

In another research by Grimani (2014), relationship between psychological well-being, work related stress and labor earnings is studied. The paper uses the *5th European Working Conditions Survey* which contains data from 33 European countries and Turkey. The psychological well-being and work related stress are considered as the dependent variables and labour earnings are considered as the independent variable. he main statistical tools used are the ordinary least squares and ordered logistic regressions.The results of data analysis indicated that there is a *strong positive relationship between labor earnings and psychological wellbeing for low paid group, and a non-significant relationship between labor earnings and psychological well-being for well-paid group.* This result supports the presence of hierarchical behaviour. In addition, the Labour earnings for low paid group show an insignificant effect on employees' work related stress, while a highly significant positive effect on the work related stress of well-paid group is implied, highlighting the stress of higher status hypothesis. (Grimani, 2014).

Sacks et al (2010) studied the relationships between life satisfaction (subjective well-being) and income. This relationship is studied across individuals within a given country, between countries in a given year, and as a country grows through time. It was reported that richer individuals in a particular country are more satisfied with their lives than are poorer individuals. It was also established that this relationship is similar in most countries around the world. Turning to the relationship between countries, average life satisfaction is higher in countries with greater GDP per capita. These results together suggest that measured subjective well-being grows hand in hand with money and material living standards. (Sacks et al, 2010)

Kahneman and Deaton (2010) studied the role of income in buying happiness and life evaluation. Recent research has begun to distinguish two aspects of well-being; Subjective well-being or Emotional well-being refers to the emotional quality of an individual's everyday experience—the frequency and intensity of experiences of joy, stress, sadness, anger, and affection that make one's life pleasant or unpleasant, Psychological well-being or Life evaluation refers to the thoughts that people have about their life when they think about it. An analysis of more than 450,000 responses to the Gallup-Healthways Well-Being Index surveyed by the Gallup Organization in 2008 and 2009 to several questions about their well-being reported that happiness and life evaluation have different correlates. Income and education are related to life evaluation i.e. psychological well-being whereas health, care giving, loneliness, and smoking are relatively stronger predictors of daily emotions. Life evaluation rises steadily. When plotted against income. Emotional well-being also rises with log income, but there is no further progress beyond a particular income. Low income aggravates the emotional pain associated with hardships like ill health, divorce, and loneliness. It was concluded that *high income buys life evaluation (psychological well-being) but not happiness (Subjective well-being), and that low income is associated both with low psychological well-being and low emotional well-being.* (Kahneman and Deaton 2010).

In a research by Vera-Villarroel et al (2015), association between indexes of socioeconomic status (satisfaction with income and status) and psychological well-being (PWB) was examined in a representative sample of Chileans. It was reported that there is a *positive association between socioeconomic status (satisfaction with income and status) and psychological well-being.* Associations were stronger with PWB facets related to relational, control and self-esteem processes, and weaker with purpose of life, growth and autonomy. The data analysis using structural equation modeling confirmed a direct significant impact of socioeconomic status on PWB, as well as an indirect significant impact through satisfaction with income and status. Control for satisfaction with socioeconomic status and purchase power reduced the effect of socioeconomic status on PWB but did not completely eliminated it. Results are consistent with a direct effect model of socio-structural position on well-being, but also with the relevance of satisfaction with social position as an appraisal process to indicate high psychological well-being. (Vera-Villarroel et al, 2015). Another research by Bhatt (2017) concluded significant difference in psychological well-being of high and low earner working men. High earners reported high level of psychological well-being (Bhatt, 2017). Table-1 summarizes the Literature Review on Psychological Well-Being and Earnings.

Gap Analysis and Identification of Variables

On the basis of literature review, it can be summarized that many researchers have studied the association of psychological wellbeing with earnings and income, still there are gaps in this area of study. The gender differences in predicting role of psychological well-being on salaries and earnings is not a well-researched area. Also there is paucity of research in assessing impact of well-being on initial salary package of post graduate management students. No researcher has attempted to make a *study assessing the gender differences in impact of psychological well-being on placement package of management students.* Hence, keeping literature review as base, following variables are identified for study. The Independents variables are *Psychological Well-Being Domains namely Autonomy* (the degree of independence and self-determination), *Environmental mastery* (the ability to manage one's life properly and responsibly), *Personal growth* (the

Table-1: Summary of Literature Review on Psychological well-being and Earnings

Author	Year	Area of research	Major findings	Gaps
Kaplan et al	2008	Socioeconomic Determinants of Well-Being	Mean income strongly associated with psychological wellbeing	Gender differences are excluded
Kahneman and Deaton	2010	High income improves evaluation of life	High income buys life satisfaction but not happiness	Gender differences are not studied
Sacks et al	2010	Subjective Well-Being, Income and Economic Development	Life satisfaction grows hand in hand with material living standards	Psychological well-being is not studied
Grimani Katerina	2014	Labor earnings and Psychological well-being	There is strong positive relationship between labor earnings and psychological wellbeing for low paid group	Study on labour earnings
Vera-Villarroel et al	2015	Satisfaction with Income in Psychological Well- Being.	Positive association between socioeconomic status, satisfaction with income and status and psychological well-being	Gender differences are not accounted
Bhatt	2017	Psychological Well-Being among Working Men	Significant difference in psychological well-being of high and low income groups.	Women are excluded

extent of being open to new experiences), *Positive relations with others* (the ability to have satisfying and high quality relationships with others), *Purpose in life* (the degree of goal-orientation, believing that one's life is meaningful and purposeful) and lastly *Self-acceptance* (the degree of a positive attitude towards oneself and one's past life). As the aim is to study the effect of well-being on salary package of business management students, *amount of salary package* is identified as dependent variables. For MBA students, initial salary package plays an important role as further increments and life-long earnings are largely influenced by the initial package of salary. Gender is taken as a moderating variable to test the impact of psychological well-being on salary.

Development of Theoretical Construct and Hypothesis

Understanding the link between various components of psychological wellbeing and salaries of management students is an important area to research on. Figure-I is the proposed model which demonstrates the hypotheses of study by establishing links between independent and dependent variables through a graphical model.

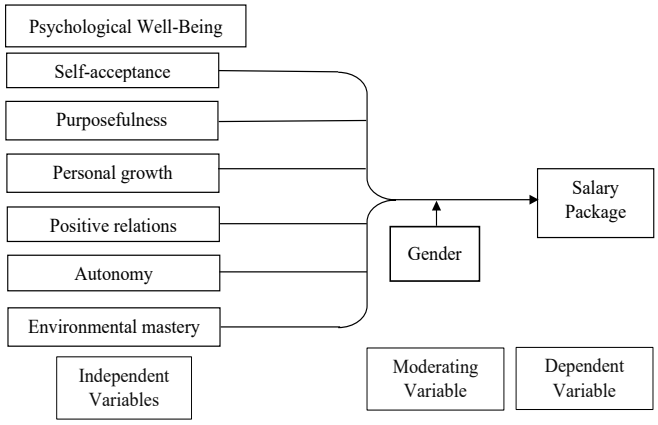

Figure I: Model linking Psychological Well-Being and Salary

It is hypothesized that all psychological well-being domains significantly impact salary package of management students. Literature review also supports that all psychological well-being domains namely 'Autonomy', 'Environmental mastery', 'positive relations with others', 'Self-acceptance', 'Personal growth' and 'Purposefulness' positively impact Salary and earnings (Bhatt, 2017; Kaplan et al, 2008). *It is also assumed that there will be moderating effect of gender on the tested hypotheis.*

Research Methodology

Research Design

It is a Descriptive and Exploratory Research describing the level of psychological well-being among sample MBA students and further exploring the impact of well-being on salary with moderating effect of gender. For our study, secondary research is done to study the existing literatutre on relationsgip between psychological wellbeing, salary and gender. Various national and international research papers are reviewed and gaps in the literature are highlighted to articulate the hypothesis of our study. Further, primary research on MBA students is done through a survey questionnaire to test the hypothesis

Sample Design

Target population consist of Post-graduate business management students of Mumbai region. Sample size drawn is *199 students* studying in second year of MBA/MMS full-time courses. Questionnaires are randomly given to all full-time MBA/MMS students of the management institutes of Mumbai. The survey is restricted to students who have received a job offer through campus placements to make a fair groung for comparison.

Questionnaire Design

The survey draws questions from Ryff's Well-Being Scale (1989) to measure Psychological well-being (Personal growth, Positive relations, Environmental mastery, Autonomy, Self-acceptance and Purposefulness). The questionnaire includes sentences and the respondents have to indicate their degree of agreement on a scale of 1 to 5 (1=strongly disagree, 5=strongly agree). Sample test sentences are; 'I tend to worry about what other people think of me. I feel I am in charge of the situation in which I live.' The exact salary package of placed students is asked, students not placed or not disclosing the salary package are excluded from the survey.

Data Design

The data collected is analyzed through descriptive and inferential analysis. The responses collected are analyzed using the computer software Statistical Package for Service Solution (SPSS).

Results

Since the data is not normally distributed, non-parametric tests are used to analyze the data Mann Whitney U test is done to see the impact of psychological well-being on salary and make meaningful conclusions. Following is the descriptive statistics of scores of sample students on the psychological well-being scale.

Table-2 shows the descriptive analysis of psychological well-being. There is *high level of well-being among majority of students.* Majority of students demonstrate

Table-2: Descriptive Statistics (Psychological Well-Being)

	Personal Growth	Positive Relations	Purposefulness	Self-Acceptance	Autonomy	Environmental Mastery
N	199	199	199	199	199	199
Mean	3.69	3.72	3.92	3.85	3.81	3.78
Median	4.00	4.00	4.00	4.00	4.00	4.00
Mode	4.0	4.0	4.0	4.0	4.0	4.0
Skewness	-.376	-.625	-.602	-.645	-.512	-.559
Std. Error of Skewness	.092	.092	.092	.092	.092	.092
Kurtosis	.298	.130	.773	.829	.331	.739
Std. Error of Kurtosis	.184	.184	.184	.184	.184	.184

high level of Personal Growth, Positive Relations, Purposefulness, Self-Acceptance, Autonomy as well as Environmental Mastery. The score on personal growth is comparatively lowest and Purposefulness is highest among MBA students. The skewness and kurtosis value depicts that this data of trait ratings may not be normally distributed. The median and mode stands at 4, which depicts that majority of respondents are high on psychological well-being. Considering performance indicators of Management students, MBA institutes are looked upon for seizing a high paying job. Students are generally fascinated by the amount of package they receive in the placement process. Hence for this research, Salary Package offer received and accepted during in-campus placements is considered as dependent variable. Following table-3 is the descriptive analysis of the dependent variable**.**

Table-3 shows the descriptive statistics of the dependent variable Salary (in Rs. Lakhs per annum). The average Salary received by management students was Rs. 8.83 lakhs per annum. Median stood at Rs. 7 lakhs per annum. The Salary received by the 199 MBA students ranged from as low as 1.8 lacs per annum to a maximum of 29 lacs per annum. Looking at skewness and kurtosis values, it can be interpreted that data may not be normally distributed.

Table-3: Descriptive Statistics (Salary Package)

Descriptive Statistics	Salary in Rs. (Lakhs per annum)
N	199
Mean	8.8366
Median	7.0000
Variance	36.693
Std. Deviation	6.05744
Minimum	1.80
Maximum	29.00
Skewness	.822
Std. Error of Skewness	.175
Kurtosis	-.277
Std. Error of Kurtosis	.347

Table-4: Normality Test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Salary Package	.160	198	.000	.886	198	.000
a. Lilliefors Significance Correction						

As given in Table-4, the significance level is less than 0.05 for all independent variables (personality traits and psychological well-being domains) and also for both dependent variables (Salary and percentage) hence it can be concluded that *data is not normally distributed at 5% level of significance. Since both independent variables are not normally distributed, Non-parametric tests are done to further test the hypotheses.*

Impact of Psychological well-being on Salary Package

The relationship between Psychological well-being domains and Salary obtained during Placements is tested in this section through Mann Whitney U test. Mann Whitney U test is used because salary data is a continuous data and it is non-parametric in nature and psychological well-being domains are categorised as high and low. Below are the null and alternate hypotheses testing impact of Psychological well-being on Salary.

H_0: Psychological well-being domains (Personal Growth, Positive relations, Purpose in Life, Self-Acceptance, and Autonomy and Environmental mastery) do not impact salary package.

H_A: Psychological well-being domains (Personal Growth, Positive relations, Purpose in Life, Self-Acceptance, and Autonomy and Environmental mastery) impact salary package.

To test the hypothesis, the impact of psychological well-being domains on Salary is calculated using Mann-Whitney U test. Following tables give the results of Mann-Whitney test. Mann-Whitney U test is done

Table-5: Relationship between Psychological Well-Being and Salary

	Salary in Rs. (Lakhs per annum)		
	Mann-Whitney U	Wilcoxon W	p
Personal Growth	3630.500	5841.500	.046
Positive relations	3757.000	6532.000	.026
Purpose in Life	2602.500	4313.500	.000
Self-Acceptance	3134.500	4904.000	.007
Autonomy	3393.500	5104.500	.058
Environmental mastery	3259.500	5275.500	.006

because salary data is continuous data and it is non-parametric in nature i.e. it is not normally distributed. Also the independent variables i.e. the psychological well-being domains are categorical in nature since the scores are categorised as high and low.

v Null hypothesis is rejected and alternate **Hypothesis H_A** (*Psychological well-being domains impact salary package*) is accepted at 5% level of significance for Personal Growth, Positive relations, Purpose in Life, Self-Acceptance, and Environmental mastery. However, autonomy has no significant impact on Salary at 5% level of significance ($p=0.058>0.05$). There is significant impact of five out of six domains of well-being on Salary received during placements. 'Purposefulness' is the major predictor of salary ($U=2602.500$, $p<0.0001$) followed by environmental mastery ($U=3259.500$, $p=0.006$) and self-acceptance ($U=3134.500$, $p=0.007$). 'Positive relations with others' ($U=3757.000$, $p=0.026$) and 'personal growth' ($U=3630.500$, $p=0.046$) also influenced Salary. Students with high purposefulness, high self-acceptance and high environmental mastery received better salary package. Also Personal Growth and Positive relations with others positively impacted Salary.

However, there the impact of autonomy on Salary received during placements is insignificant at 5% level of significance. Bhatt (2017) and Kaplan et al (2008) also reported impact of well-being domains on earnings. A Research by Bhatt (2017) concluded significant difference in all domains of psychological well-being of high and low earner working men. High earners reported high level of psychological well-being and vice versa (Bhatt, 2017). Another research by Kaplan et al (2018) concluded that the Mean income over almost three decades was strongly associated with five scales of psychological well-being; *Purpose in Life, Self-acceptance, Personal Growth, Environmental Mastery, and Autonomy* (Kaplan et al, 2008).

Moderating effect of gender in assessing impact of Psychological well-being on Salary

The role of gender in mediating the relationship between psychological well-being and placements' salary is studied to understand how these relationships change within the groups of male and female students. The objective here is to understand the moderating effect of gender on the tested relationship studied in hypothesis testing.

Table-6: Gender based relationship of Psychological Well-Being with Salary

	Male			Female		
	Mann-Whitney U	Wilcoxon W	P	Mann-Whitney U	Wilcoxon W	P
Personal Growth	1502.000	2492.000	0.008	352.000	605.000	0.711
Positive Relations	1557.000	2638.000	0.009	355.000	733.000	0.548
Purposefulness	922.500	1663.500	0.000	320.500	491.500	0.705
Self-Acceptance	1233.500	2268.500	0.000	220.000	1166.000	0.247
Autonomy	1287.000	2067.000	0.002	299.000	1040.000	0.449
Environmental Mastery	1276.000	2096.000	0.001	346.500	599.500	0.644

From the data analysis summary of table-6, it can be established that psychological well-being domains have a significant impact on salary package of male students only. P values are less than 0.05 for all psychological well-being domains within male students. Thus, it can be inferred that all psychological well-being domains significantly impacts the salaries of male management students. *Male students with high score son Personal Growth, Positive Relations, Purposefulness, Self-Acceptance, Autonomy and Environmental Mastery received better salary package than male students with low scores on these domains.* However, the differences in salary package of female students cannot be attributed to differences in psychological well-being domains.

Discussion

The descriptive analysis of psychological well-being shows high level of psychological well-being among majority of students. This is a good sign as Psychological well-being means the cognitive and conscious evaluation of one's satisfaction with life as a whole. The domains include Autonomy (The degree of independence and self-determination), Environmental mastery (The ability to manage one's life properly and responsibly), Personal growth (The extent of being open to new experiences), Positive relations with others (The ability to have satisfying and high quality relationships with others), Purpose in life (The degree of goal-orientation, believing that one's life is meaningful and purposeful) and lastly Self-acceptance (The degree of a positive attitude towards oneself and one's past life). Majority of students demonstrate *high level of Personal Growth, Positive Relations, Purposefulness, Self-Acceptance, Autonomy as well as Environmental Mastery.*

Psychological well-being has a strong influence on salary distribution of management students. Bhatt (2017) and Kaplan et al (2008) also reported impact of well-being domains on earnings. 'Environmental mastery', 'Positive relations with others', 'Self-acceptance', 'Personal growth' and 'Purposefulness'; all have an impact on Salary received during placements (Bhatt, 2017; Kaplan et al, 2008). A Research by Bhatt (2017) concluded significant difference in all domains of psychological well-being of high and low earner working men. High earners reported high level of psychological well-being and vice versa (Bhatt, 2017). Another research by Kaplan et al (2008) concluded that the Mean income over almost three decades was strongly associated with five scales of psychological well-being; Purpose in Life, Self-acceptance, Personal Growth, Environmental Mastery, and Autonomy (Kaplan et al, 2008).

Figure-II describes the updated model linking Psychological Well-Being and Salary, it is depicted in the model that *all psychological well-being domains impact salary package of male students only.* Male students with high score in 'Personal growth', 'positive relations with others', 'purposefulness' 'autonomy' and 'environmental mastery' received better salary package compared to male students with low scores on these traits, but this type of difference is not observed for female students. *Therefore, Male*

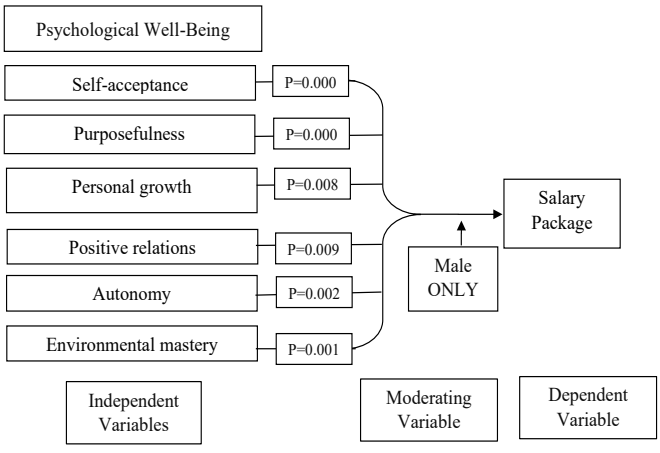

Figure II: Updated model linking Psychological Well-Being and Salary

Students with high psychological well-being i.e. high purposefulness, high self-acceptance and high environmental mastery high autonomy along with high personal growth and Positive Relations with Others receive better salary package as per our study.

In our research as well, '*Personal growth*' *has a substantial impact on salary.* Individuals with Higher personal growth have higher salaries. Personal growth means the extent of being open to new experiences and a positive attitude towards growth and development opportunities. This trait is helping students in getting better salaries. Also, having positive relations with others have a positive influence on salary package, with students high on 'Positive Relations with others' domain receiving better salaries than the rest. Positive relations with others includes the ability to have satisfying and high quality relationships with others. The social nature and positive interpersonal relationships are necessities in a corporate world as the quality of work depend to a large extent on the quality of interpersonal relationships. Hence, this trait is seen getting rewarded in labour market.

There is positive influence of 'Purposefulness' on salary package with students demonstrating high Purposefulness ending up with better salaries. Purposefulness is also a strong predictor of higher salaries during placements. Purpose in life is the degree of goal-orientation, believing that one's life is meaningful and purposeful. The goal directed behaviour and purposefulness is again valued a lot in the job market hence students are ending with better salaries in presence of this quality. Also a significant influence of degree of 'self-acceptance' is observed on salary package. Students showing high self-acceptance are getting higher salaries. Self-acceptance stands for a positive attitude towards oneself and one's past life. This positivity in attitude has helped students get higher salaries compared to others.

'Environmental mastery' also significantly influence the salary package. Environmental mastery is the ability to manage one's life properly and responsibly. This trait is surely helpful in corporate world and hence it is getting rewarded. Though autonomy failed to create significant impact on the amount of salary package at 5% level of significance when all students are taken together, it had a significant impact on salary package of male students. Autonomy is the degree of independence and self-determination. This trait is equally important in corporate world and is rewarded for its existence.

Conclusions

It is also concluded that psychological well-being has a direct and positive impact on Salary package received in placements. 'Environmental mastery', 'positive relations with others', 'Self-acceptance', 'Personal growth' and 'Purposefulness' had an impact on Salary received during placements (Bhatt, 2017; Kaplan et al, 2008). The study also unveils interesting gender based findings. All psychological well-being domains namely Personal Growth, Positive Relations, Purposefulness, Self-Acceptance, Autonomy and Environmental Mastery positively influenced amount of salary but only for male students. The differences in salary package of female students cannot be attributed to differences in levels of psychological well-being. However, for psychological well-being, influence of gender in determining relationship of well-being domains with salaries is a highly under researched area. Thus, this research adds value to the existing literature by assessing the gender specific impact of well-being domains on salaries.

Managerial Implications

This research throws light on how psychological health impacts the placements and salaries of business management students. Findings of research are useful

for students and management institutes. Having a fair idea about the well-being state will help the students to improve their performance. Students can have greater control over their attitudes and behaviors once they have An in depth idea of their psychological well-being state. This understanding will help an individual in improving and developing the state of well-being. Institutes can take up initiatives to help students in their personal growth. Institutes can also device strategies to increase the overall psychological health of students.

Limitations and Scope of Study

The study lays down its foundation on the Psychological well-being model (Ryff, Carol D, 1989). Hence the research limits itself to the psychological well-being domains articulated by the model. Only Eudiamonic well-being i.e. Psychological well-being is studied. The hedonic perspective of well-being comprising of pleasure and happiness is not considered in our study. The primary research involves business management students from post-graduation level across Mumbai. Only fill-time MBA / business management courses are considered and the sample is restricted to Mumbai region. The well-being questionnaire is a self-assessment instruments designed to be filled by the respondent himself. Since self-ratings are involved, there are chance of perceptual biases.

Contribution of Research

The research contributes to the existing body of knowledge by highlighting the gender based diffrences in estimating the impact of psychological well-being on salaries of management students. The existing literature shows relationship between well-being and salary. But there is paucity of research in estimating the gender based impact of well-being domains on salaries. This research is hence beneficial as it explores this relationship and sets out direction for future research.

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