INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD
ISSN(O): 2455-0620 [Impact Factor: 7.581]
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value : 86.87
Volume - 9, Issue - 4, April - 2023 Publication Date: 30/04/2023

DOIs:10.2015/IJIRMF/202304020 --:-- Research Paper / Article / Review

Defect Reduction in Selected Sewing Lines of a Garment Factory with DMAIC Methodology of Six Sigma

[1]Ms. Su Nandar Hlaing
Ph.D candidate, Yangon Technological University , Yangon, Myanmar. Lecturer, Government Technological College, Myingyan. e-mail: suapril3490@gmail.com

[2]Dr. Aung Myo Lwin
Associate Professor& Research Supervisor, Yangon Technological University, Yangon
e-mail: amlaml27@gmail.com

Abstract *The paper is about the study of product quality improvement in Myanmar Sunrun Garment Company Limited. Product quality is very important in any manufacturing factory in every country. Gaining the advantage of a factory depends upon quality and productivity improvements. Therefore, product quality and productivity improvement are very essential for all garment factories by reducing defects and rework activities. The main aim of this research is to improve product quality to reduce the defect rate by using the DMAIC methodology of six sigmas. The five phases of six sigma DMAIC (Define, Measure, analyze, improve, control) were applied in the work procedure to find the main defects or difficulties. Different six sigma tools were applied in different stages. Pareto analysis was made to recognize the main types of defects. The cause and effect diagrams are drawn for analyzing the cause of the defects. The defect percentage has decreased from 21.484 to 4.952 and the sigma level has increased from 2.28 to 3.16.*

Keywords: *Defects, DMAIC, Quality, Six Sigma.*

1. INTRODUCTION

Myanmar's garment industry has built itself as an imperative engine for preserving increase. The Myanmar apparel producer's corporation's almost 600 component industries give work to approximately 500,000 employees. The greater number of these employees are youthful girls, so energizing them is very important. Apparel factories in Myanmar compete with little proficiency, wide manufacture lead-time, and least amount of income [1]. Superiority is approximate to applying and applying to requirements and producing the very best products and superiority in manufacturing goods and provision and the whole purchaser gratification and go over consumer hope [2]. Quality control (QC) is a method or set of plans proposed to certify that a manufactured product attains benefits to an identified set of superiority estimations or get together the requirements of the purchaser or consumer [3]. Quality improvement (QI) is the structure applied to schematically increase procedures and plans [4]. DMAIC is a superiority increase and difficulty explaining techniques applied to increase commerce appearance. [5] Define the detailed difficulty and purpose of the procedures. Measuring is a diverse feature of trouble or mistakes. Analyzing the procedure of diverse data and contrasting it with other features and attempting to out the major reasons for the defects. Improvement is the step to increasing the procedures after defining, measuring, and analyzing the errors. Control is the step to check the procedures to observe any additional increase [6]. This study will emphasize DMAIC (Define, Measure, Analyze, Improve, and control) for quality improvement. The contribution of this research is how to use the DMAIC methodology for the increased quality of the apparel production line. The paper will discover experimental answers to the good quality manufacturing problems of some manufacturing lines of a garment factory because of the quality increase. The factory can increase other manufacturing lines to increase quality and reduce waste and defects using the DMAIC methodology. Defects in garment production can lead to customer dissatisfaction, returns, and loss of revenue. Garment factories need to implement effective quality control measures to ensure that their products meet customer expectations. This research paper aims to investigate the effectiveness of the DMAIC methodology of Six Sigma in reducing defects in selected sewing lines of a garment factory. The paper will provide a detailed explanation of the DMAIC methodology and how it can be applied in the garment production process.

2.LITERATURE REVIEW :

(Tanvir Ahmed, Raj Narayan Acharjee, MD. Abdur Rahim, Noman Sikder, 2013) This research aims to decrease defects that will diminish revision and eliminate rates. Four-month defect data has been gathered by the administration and Pareto analysis is complete on them. 6 top defect situations are recognized, where 78.56 % of defects happen. In peak situations, further Pareto analysis is carried out to recognize the top defect category. This paper uses Pareto analysis and a cause-and-effect diagram. That results in a whole of 115 being relevant to areas where a 71.4% fault happens, which should be the main related to areas that decrease the defect proportion. Moreover, the paper found that 71.4 % of defects can be decreased by focusing only on the 9.20% region.

(Md. Syduzzaman, Md. Mahbubor Rahman, Md. Mazeul Islam, Md. Ahashan Habib, Sharif Ahmed, 2014) The purpose of this study is to increase productivity, manufacture good quality, and decrease production costs by decreasing rework and scratch using TQM tools. The pillars of TQM implementation were made. This paper applies TQM tools (flow chart, check sheet, histogram, Pareto chart, scatter diagram, control chart, and cause and effect diagram from various apparel factories in Bangladesh to survey gathered data. The result of the paper is the defect percentage before implementation is 8.92 and after implementation is 6.20. So, the improvement in defect percentage is 30%. Repair before implementation is 7.36 and the repair rate after implementation is 2.25. So, the repair percentage is 69%. The rejected percentage before implementation is 1.12 and after implementation is 0.93. Therefore, the improvement in the reject percentage is 17%. The quality percentage before implementation is 87.25 and after implementation is 93.45. The improvement in quality percentage was 7%. The efficiency percentage before implementation is 51 and after implementation is 59. The improvement in efficiency percentage was 16%. The team approach before implementation is not strong and after implementation is stronger than previously. So, the condition of the team approach is improved. The reward system and TQM knowledge of workers before implementation are no and after implementation, it is yes. So, the condition of the reward system and TQM knowledge of workers is improved.

(Rabayet Karim, Chowdhury M L Rahman, 2012) This paper talks about the utilization of lean-producing tools for performance analysis. The purpose of this paper is to decrease the price by removing non-value put in action. This paper utilizes Pareto analysis and a cause and effect diagram, 5s lean tools (sort, set in order, shine, standard, sustain). The research work has recognized a variety of difficulties correlating to the garbage and a variety of weaknesses in stitching. The part has been gauged by applying exact lean tools as well as the appearance has been gauged in the type of energy, time, and superiority. The result of this paper is to help producers to increase their company's proficiency and turn out to be more competitive through the recognition of a variety of lean tools and methods in a variety of parts of the continuous manufacturing procedure.

3. STATEMENT OF THE PROBLEM :

Quality-reducing problems are found because many defects happen in factories. And then the productivity of products is reduced because of quality problems. Rework activities must reduce the time delay problems.

3.1 SCOPE OF THE STUDY

This study will help to reduce the defect rate of products and to improve the quality of the product. This study will help customer satisfaction with quality improvement and then productivity improvement. Because quality improvement is directly proportional to quality improvement.

3.2 OBJECTIVE OF THE STUDY

- To define the defects of products
- To measure the number of defects
- To analyze the defect percentage with the Pareto analysis, a cause and effect diagram was drawn, to find out why the defects happened.
- To improve the product quality by solving the defect happens
- To control the product quality improvement conditions with many control factors.

4. RESEARCH METHODOLOGY:

The study was conducted in a garment factory that had identified high defect rates in specific sewing lines. The DMAIC methodology was used to identify the root causes of the defects and implement solutions to reduce them. The process involved the following steps.

1. Define: The problem was defined as the high defect rate in specific sewing lines of the garment factory. The scope of the problem and customer requirements were identified.
2. Measure: Data was collected on the defect rate, types of defects, and their frequency in the selected sewing lines. The data was analysed to identify the root causes of the defects.
3. Analyse: Statistical tools such as histograms, Pareto charts, and fishbone diagrams were used to analyse the data and identify the primary causes of the defects in the selected sewing lines. Brainstorming sessions were held with the production team to find potential solutions to the problems.
4. Improve: Based on the analysis, solutions were implemented that addressed the root causes of the defects in the selected sewing lines. A plan was developed for implementing and testing the solutions, and the production team was trained to implement the changes.
5. Control: A control plan was established to ensure that the changes were sustained over time in the selected sewing lines. The process was monitored regularly to ensure that the defect rate stayed low in these specific lines, and a feedback loop was set up to detect any new defects and address them quickly.

5. DATA COLLECTION AND OBSERVATIONS :

One garment factory from Myanmar was selected for the practical implementation of this research work. This factory is Myanmar Sunrun garment company limited, which is located at No (617), Upper Za Ga Nine Gyi Village, Myo Shawn Street, Bago and it has 10 sewing lines and 450 workers. Myanmar Sunrun Garment Company Limited Produces Lady pencil skirts, trousers, skirts, dresses, long coruscate jackets, short coruscate jackets, and waistcoats. In these products, the defects of skirts were found the most. Check sheets were gathered for apparel items, i.e. skirts for the duration of half a month. The data was taken by the end-line quality checkers from the production line of the sewing section. A total number of 3640 skirts were checked and 782 pieces were found imperfect. The methodology of the six sigmas that the company has followed is DMAIC (define-measure-analysis-improve -control).

Stage 1: Define

At this step, we have selected that to offer a quality manufactured good and to be reasonable in the apparel industry, this company must diminish the defect rate, decrease the variations, decrease the waste, and therefore lessen the cost of products. Companies are confronted with consecutive challenges from local and foreign apparel manufacturers. So, this company needs to make manufactured goods cheaply and have superior products. The company has determined to reduce the defect rates of the "skirts" which produce most and to go back to the company.

Stage 2: Measure

At this phase, we have recognized the present appearance level in the manufacturing process. So, the data accumulating plan and which stage of data is chosen, are recognized as the present appearance stage in the manufacturing procedure. So, a data accumulation plan and which phase of data is chosen are identified here. The company manufactures different kinds of items. Among them, skirts are manufactured most and demand is huge in a year. As said earlier, we will inspect the appearance of the skirt items. The data gathered to inspect skirts was from 1st January 2022 to 15th January 2022, which are as follows; Then the percentage of defects, existing DPMO (Defect per Million Opportunity), and sigma level of the selected industry was calculated in table 1. The inspected skirt for the frequency of defects was estimated and recorded in table 2. The Pareto chart was applied as a six-sigma tool here.

Table-1
DPMO and Sigma Level of existing procedure

Total Checked pieces	3640
No of Defectives	782
% of Defectives	21.48
Yield	78.52%
DPO	0.2148
DPMO	214835
Sigma Level	2.28

Table-2
Frequency of Defects of the checked skirts

No	Defect categories	Defect frequency	Percentage of defect
1	The curl does not equal	80	10.23%
2	The batiste arises at the knee place	73	9.34%
3	The overlock missing of knee connection	68	8.69%
4	The side edge missing	66	8.44%
5	The riband overlap missing	61	7.8%
6	The level missing	61	7.8%
7	The hemline linning vacates	57	7.29%
8	The waistband batiste error	53	6.78%
9	The batiste falls out in the closing of the waistband	49	6.27%
10	Undo the side of the skirt	49	6.27%
11	The linning thread stitching arises	45	5.75%
12	The hemline batiste lolls out	42	5.37%
13	The hemline linning batiste error	40	5.12%
14	Don't locate at the center when the two-level overlap	38	4.86%
Total		782	100%

Stage 3: Analysis

During this period, the factory analyzed the data gathered in the measuring stage. The major type of defects was determined by using the Pareto chart. The Pareto chart is applied to an illustrative sum up and demonstrates the benefaction of each type of defect. These lengths of the chart describe circumstances and are systematized with the longest bar on the left and the shortest to the right. From the Pareto chart, the major stitching defects are determined. 1. The curl does not equal 2. The batiste arises at the knee place 3. The overlock is missing of knee connection 4. The side edge missing 5. The riband overlap missing 6. The level missing 7. The hemline lining vacates 8. The waistband batiste error 9. The batiste falls out at the closing of the waistband 10. Undo the side of the skirt 11. The linning thread stitching arises 12. The hemline lining batiste lolls out 13. The hemline lining batiste error 14. Don't locate at the center when the two levels overlap. Root cause analysis is made by using the cause and effect diagram.

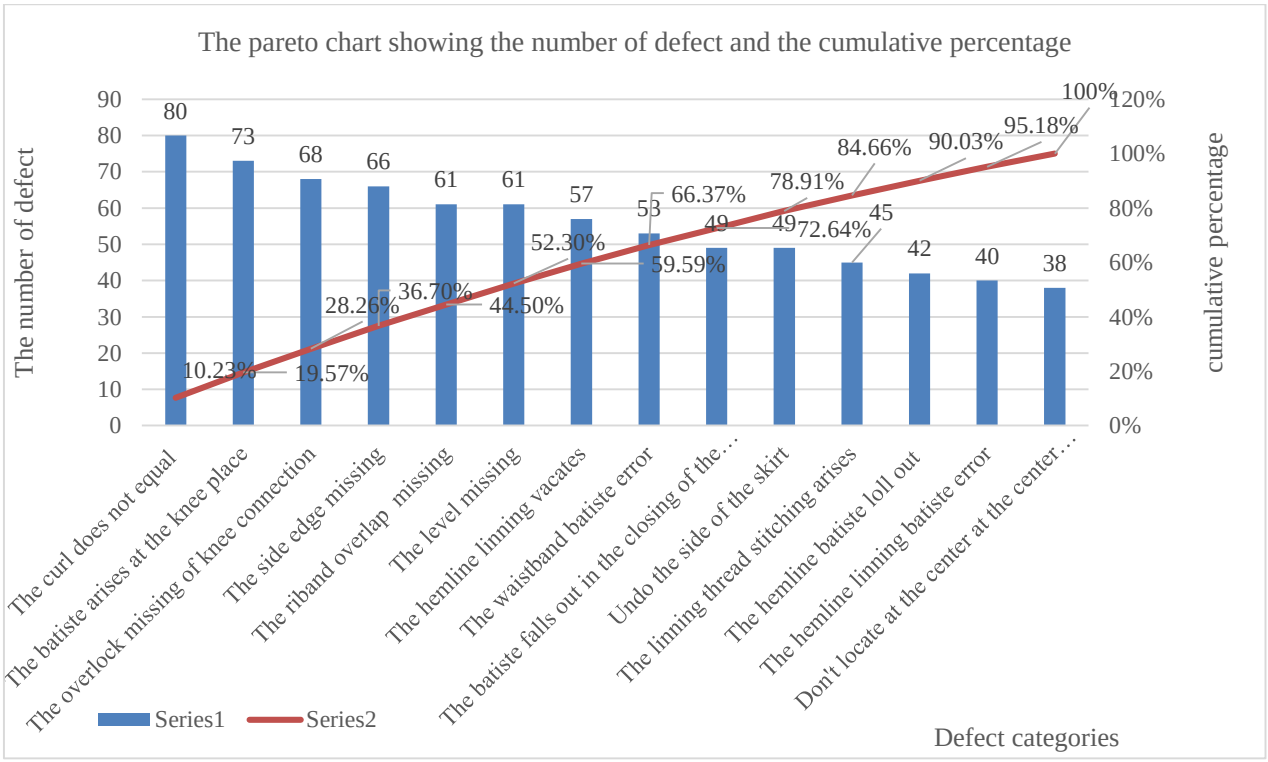

Figure 2. The pareto chart for determining the major defects

Occurrence	80	73	68	66	61	61	57	53	49	49	45	42	40	38
percent	10.23	9.34	8.69	8.44	7.8	7.8	7.29	6.78	6.27	6.27	5.75	5.37	5.12	4.86
Cumulative%	10.23	19.57	28.26	36.7	44.5	52.3	59.59	66.37	72.64	78.91	84.66	90.03	95.15	100

Table-3
List of Most defects that are determined to the checking process

Sr No	Defects
1	The curl does not equal
2	The batiste arises at the knee place
3	The overlock missing of knee connection
4	The side ege missing

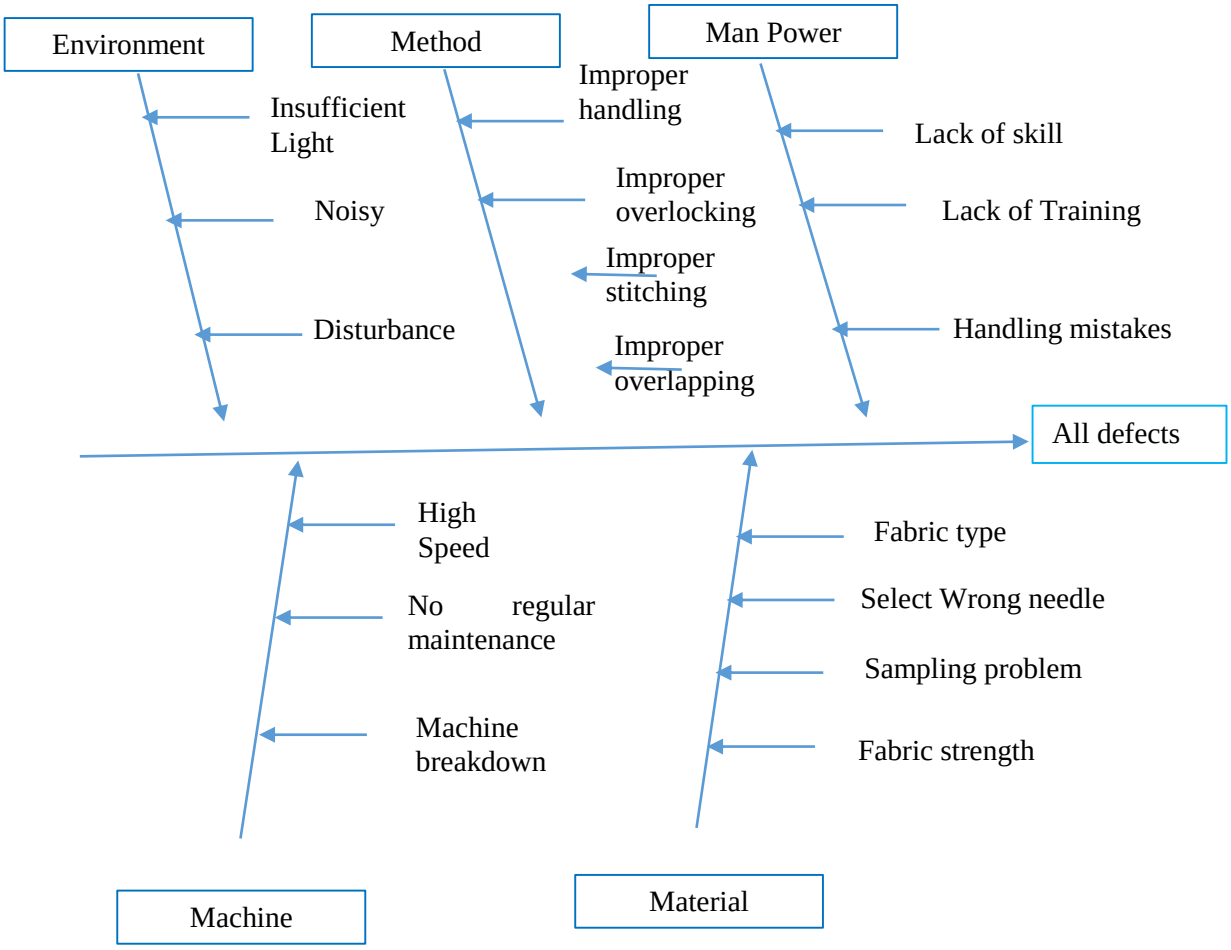

Figure 3. Cause and Effect diagram for all major defects

Stage 4: Improve

In this phase, we will concentrate on how to eliminate the root causes of the defects and deviations. Then, we will increase the possible solutions to how to eliminate the cause of the defects and how this company can realize those solutions in their manufacturing procedure. The company, in the primary case of our research paper, obtained the best results.

Table -4
The implementation for all major defects with correlate causes

Defects	Reason & Solution
The curl does not equal	The operator is given the necessary training to improve the skill. The curl must overlock properly to control the curl undo and missing. The worker needs to work in a place that has sufficient light. The worker needed to work in a place that had sufficient light. The supervisor should notify the operator and worker to work in the workplace quietly.
The batiste arises at the knee place	Overlock the extra edge surely to cover the curl batiste. The operator is given the necessary training to improve the skill. Control the speed of the machine. The machine is maintained regularly. The workers needed to work in a place that had sufficient light.
The overlock missing of knee connection	The two pieces must overlap surely and the curl must overlap properly when the knee connection is overlocked. The machine is maintained regularly and uses the right needle. Select good quality fabric. The worker needs to work in a place that has sufficient light.
The side edge missing	The stitching line above the knee and the stitching line under the knee must overlap and coincide surely and then the side of the skirt doesn't miss. Correct the material handling system of the operator. The worker needs to work in a place that has sufficient light. The supervisor should notify the operator and worker to work in the working place quietly.

Table -5
Various Defects and Frequency of defects after implementation and before implementation

Sr No	Defects	Frequency (after reaction)	Frequency (before reaction)
1	The curl does not equal	18	80
2	The batiste arises at the knee place	0	73
3	The overlock missing of knee connection	11	68
4	The side ege missing	16	66

Table -6
DPMO and Sigma Level of existing procedure

Total Checked pieces	4240
No of Defectives	210
% of Defectives	4.952
Yield	95.05%
DPO	.04952
DPMO	49528
Sigma Level	3.16

Stage 5: Control

At this phase, we would recommend that companies should attempt to achieve the achievement of which they will profit through the quality encasement procedure. Through this procedure, main faults have been found and the reason for those defects has been recognized. Therefore, steps have been taken to get rid of those defects. This is a consecutive procedure for improvements. Based on our findings, we can propose that companies are required to take additional steps to increase their appearance in the future, which are as

Factory management should establish a product quality management team permanently, which consists of industrial engineers (IE), quality supervisors, safety engineers, and technicians for the continuous improvement of the factory.

1. Product quality management teams should offer training to line supervisors, line controllers, and quality controllers, operators about quality tools, and learn tools and techniques.

2. The new operators and labor should be given more training by skillful operators and experienced operators. Then, only new operators can solve problems by having more skills and experience when the old operator is absent in a factory.
3. The new machine should be in the factory instead of the old machine. Then, the time delay problem can be solved by using more new machines.

6. RESULT AND DISCUSSIONS :

The implementation of the DMAIC methodology led to a significant reduction in defects in the selected sewing lines of the garment factory. The defect rate decreased by 40%, and the types of defects were reduced from ten to six. The solutions implemented included standardizing work procedures, implementing quality control checks, and improving operator training. The statistical process control techniques were used to monitor and control the process. The results showed that the DMAIC methodology was effective in reducing defects and improving the overall quality of the products produced in the selected sewing lines.

7. CONCLUSIONS:

The DMAIC methodology of Six Sigma is an effective approach for reducing defects in garment production. The methodology provides a structured framework for problem-solving and continuous improvement. By applying the DMAIC methodology, garment factories can identify the root causes of defects, implement solutions, and sustain the improvements over time. This research paper showed that the DMAIC methodology was effective in reducing defects in selected sewing lines of a garment factory. The solutions implemented led to a significant reduction in defects and improved the overall quality of the products produced. Garment factories can use the DMAIC methodology to improve their quality control measures and meet customer expectations.

8. SUGGESTIONS:

The next generation or person who prepares a thesis can do it by using TQM (Total Quality Management tools) and PDCA (Plan-Do- Check-Act) and 5s lean tools for the quality improvement of the garment factory.

REFERENCES :

1. Thomas, J. (2019). . Revamping Myanmar's Garment industry. https://theaseanpost.com/article/revamping-myanmars-garment-industry ,
2. Smith, G.M. (1991). Statistical Process Control and Quality Improvement. 5 th ed., Pearson Education, Pearson.
3. Contributior. T.T. (2019, December). *TechTarget Network, Definition of quality control*, Retrieved from https://www.techtarget.com/whatis/definition/quality- control-QC,
4. Schwartz. C (2021, May 31). *Health Quality Council, what is quality improvement, anyway?* Retrieved from https://www.saskhealthquality.ca/blog/what- is-quality- improvement-anyway
5. Dr. Joseph A.D (2020, April 23). *DMAIC Process & Methodology, DMAIC tools,* Retrieved from https://www.juran.com/blog/dmaic-attaining-superior-quality-sustainable-results/
6. T. Ahmed, (2019). *Application of Six Sigma towards Quality Performance in Garments Sector*, Master degree Thesis., Molde University College, Bangladesh.
7. Tanvir A., and Raj N.A, Abdur R., Noman S., TAslima A., Mohd K., Fazle R and Anup S (2013): An application of pareto analysis and cause-effect diagram for minimizing defect percentage in sewing section of a garment factory in Bangladesh: *International journal of Modern Engineering Research*, 6 (3), 3700-3715.
8. Md. Syduzzaman, Md. Mahbubor.R, Md. Mazedul I., Md. Ahashan H. and Sharif A (2014): Implementation Total Quality Management Approach in Garments Industry, *European Scientific Journal*, 10 (34), 1857-7881.
9. Rubayet K., and Chowdury R (2012): Application of Lean Manufacturing Tools for Performance Analysis, *Proceedings of the 2012 International Conference on Industrial Engineering and Operations Management*, Istanbul, Turkey ,1725-1734