

A STUDY ON WASTE CONTROL AND MANAGEMENT BY USING LEAN TOOLS IN SPINNING INDUSTRY

Manojkumar S¹, Kavitha Rajayogan²

¹ Student, School of Business Administration, Sathyabama Institute of Science and Technology, Chennai, Tamil Nadu, India

² Assistant professor, School of Business Administration, Sathyabama Institute of Science and Technology, Chennai, Tamil Nadu, India

Abstract - Organizations today have started incorporating methodologies for reduction or elimination of wastages in various forms thereby focusing on waste management and controlling them in the effective way. one of the powerful methodologies through the implementation of Lean management within the production process. Through the various types of lean tools like 5s, kaizen, Root cause analysis, organization can eliminate the various forms of waste. Generally there is a different form of waste in the company. They are in different forms like over production, waiting, transport, movement, process, stocks, defects, non-utilized talent, by eliminating the waste by implementing the lean manufacturing process. . To analyze the overall production process by using the lean tool to identify the waste and root cause of the waste generating. waste which is generated in the company, it may be the raw material for the other product in the same market. by analyzing the waste to reuse in a way, to promote productivity, reduce the manufacturing cost. Through the lean tool implementation, company can improve the working environment, reduce waste, increase productivity, improve employee safety, and finally the company can be continuously improved.

Key Words: waste control and management , lean management, continuous improvement, 5S, Kaizen, Root cause analysis.

1. INTRODUCTION TO WASTE MANAGEMENT

Waste management is the impact full and essential process, which leads to promoting the productively and reduces the environmental impacts. by using the waste management principles along with lean management to control waste and management in an effective way to increase the company revenue and improve the overall company development through continuous improvement. by using the lean manufacturing and management concepts in the process happen within the company to reduce the waste generation, improve the overall efficiency, promote the revenue percentage, improve the product quality, improve the culture within the company.

1.1 LEAN MANAGEMENT

Lean management and its principles are generally derived from the Toyota production system. However , Fredrick Taylor and Henry Ford documented their observations and experimental process relating to this topic, and Shigeo Shingo and Taiichi Ohno applied their enhanced thoughts on the subjects at Toyota in the 1930s. this lean manufacturing process which helps to promote continuous improvement in the overall process. Through the lean we are able to improve the productivity, efficiency of the production process by eliminating the different forms of wastes in different points of the production process. by implementing the just-in-time inventory management which results in less warehouse space, fewer forklifts, reduces the unnecessary space etc. once the flow of labor are often interruption free, freed from materials sitting, standing and redo-loops, waste eliminated. Lean is the elimination of different types of waste, to continuous improvement processes.

1.2 WASTE MANAGEMENT IN THE SPINNING MILLS

In the production economics of a spinning mill, yarn realization plays an important role . To illustrate , in the prevailing cost and yarn selling price, even an 1% improvement in the yarn realization and waste reduction lead to save some huge amount of money in the production process. In the yarn manufacturing process, generally various measures necessary to improve yarn realization and control waste .Besides controlling process wastes such as blow room and card droppings, flats stripes, comber noil, sweep waste and yarn waste, equal important should also be laid on the control of reusable waste(soft waste) such us lap bits, sliver bits, roving ends , pneumafil and roller waste. This is often because of, aside from loss in production, reprocessing of soft wastes involves extra handling and deteriorates yarn quality. Spinning mills should pay attention to waste management in order to improve the productivity and profit of the mills.

1.3 OBJECTIVES OF THE STUDY

PRIMARY OBJECTIVE

The major objective is to study waste control and management in the spinning industry through lean tools analysis.

SECONDARY OBJECTIVES

- To analyze the waste control and management by using lean tools like 5s, Root cause analysis, Muda.
- To manage the waste in the proper way to improve the employee's safety and working condition by using the Kaizen (continuous improvement).
- To evaluate the waste control and management of spinning industry, and offer suitable suggestions for the improvement of waste control and management.

2. REVIEW OF LITERATURE

Marko Milosevic Etal (2013) This paper explains the methods and implementation techniques of lean management concepts, which is used to increase the efficiency of all processes within the company. It can conclude the large companies concentrate much on lean implementation, they attain productivity and employee satisfaction

George L. Hodge et al(2011) conducted research to identify a suitable lean tool for textile industries to eliminate non-value added activities and eliminate waste from the production process in the US to enhance the customer satisfaction It can conclude the lean implementation improves the efficiency in textile industries..

Neha Verma et al (2015) conducted a study to identify waste related problems like cause of equipment failure, low productivity, high wastage, bottleneck problems and rectify them in lean manufacturing implementation in small scale industries.

Ramune Ciarniene et al 2014 This research reveals the challenges and barriers to be faced while implementing lean concepts in the system .Lean handling is the utilization of assets for any work other than the production of significant worth for the end client, as waste, and hence an objective for disposal. Concluded remarks from this research- specific value to the customer, Value stream mapping, waste elimination, Continuous improvement, continuous flow and pull driven system.

Naga Vamsi Kishna Jasti etal 2014 This research identifies the existing lean product development framework that is helpful in implementation of lean management systems. Research done reliability and validity analysis using questionnaire surveys. Respondents for this research are from top and middle level management determined through cronbach's alpha value.

Gulshan Chauhan et al(2012) This research depicts the implementation of , Elimination of waste, Just in time, and

Continuous improvement. Various driving parameters towards Lean Management are vertical information system, integration of functions, decentralization, multifunctional teams, Pull, Just In Time deliveries, zero defects, Continuous improvement and Elimination of waste. Just In Time is top priority, then Continuous improvement.

3. RESEARCH METHODOLOGY

It is a logical and precise approach to take care of the exploration issue. It is perceived as a study of concentrating how examination is done experimentally. The researcher has to use information or facts already available and analyze that data and information to make critical evaluations of the waste management the data collection is based on both primary and secondary data for analysis are taken from the company record books and reports. Tools and techniques are used for analysis Lean tools like 5S, Kaizen, Root cause analysis, Muda.

3.1 RESEARCH DESIGN

The research design used in this project is both analytical and descriptive research, In the Analytical research researcher has to use the various facts and information already available and analyze these to make a critical evaluation of the efficiency and performance. In the descriptive research design to describe the phenomenon as it exists in the organization in order to understand and describe the characteristics of the various variables and factors of the situation. it will take the description of the waste control and management techniques.

3.2 LEAN TOOLS USED IN THIS STUDY

- 5s audit analysis
- Root cause analysis
- Kaizen (continuous improvement)
- Muda

3.3 SOURCES OF DATA COLLECTION

In this project, both primary and secondary collected is collected from the following sources.

- **Primary data** is collected from the various departments within the company.
- **Secondary data** is collected from the production reports which are maintained by the company. Data are collected from the websites, books, journals pertaining to this topic.

4. DATA ANALYSIS AND INTERPRETATION

After the data is collected from the various aspects of this study. This data is analyzed in both analytical and descriptive ways. For the representation of the data use of various charts is made. After data analysis is done, the

obtained information is interpreted and various inferences are made and conclusions are drawn related to the objective, Which have been listed in the beginning of the project. Tools used in the analysis

- 5s analysis
- Root cause analysis
- Kaizen
- Muda

4.1 5S METHODOLOGY

The 5s lean strategy is in reality significantly more than a cleaning method. It assists with taking out squander that outcomes from an inadequately coordinated working region inside the association.

Table -1: 5S PERFORMANCE INDICATOR

S no	5s SCORE	INDICATION
1	1 - 20	Very Poor
2	20 - 40	Poor
3	40 - 60	Fair
4	60 - 80	Good
5	80 - 100	Excellent

Sort - some old machineries and repaired equipment are stored in the work space. waste materials like used cones, packing covers, green straps are stored

Set in Order - All the Machineries and equipment are neatly arranged, walkways and work areas clearly outlined. Everything in its specified place.

Shine - All the work area and equipment are kept clean, but waste cotton are near to the electric line cables. it may cause an accident.

Standard - All the standards are known and visible, but checklists for cleaning and maintenance are not placed in the workplace.

Sustain - All the stock controls , inventory management, and all the activities are regularly reviewed. but lack of safety measure training for employees

Table - 2: 5S AUDIT RESULT

5S AUDIT	
SORT	12
SET IN ORDER	15
SHINE	13
STANDERTIZE	16
SUSTAIN	15
TOTAL	71

INTERPRETATION

The above table represents the 5S audit checklist of the overall manufacturing unit. which helps to audit the 5s Sort, Shine, Set in order, Standardize in the organization . Through this organization is able to identify the area which they have to improve.

The above checklist shows that organization overall total for 5s is 71. They need to concentrate more on the Sort and shine in the organization to improve the efficiency.

4.2 KAIZEN

A strategy where both management and employees work together proactively to achieve regular , continuous improvement in the manufacturing process, by continuously eliminating waste from the manufacturing process. The continuous improvement is adapted by using the Plan-Do-Check-Act method, it is also known as Deming cycle.

4.2.1 KAIZEN 1: occupancy of old machineries and repair parts

In the production unit, there are lots of old machineries and in the inventory there are a lot of old and repaired parts are stored.

PLAN: Analysis the condition repair parts and old machineries are stored in the inventory and work space. categories the old machineries and part according to the needs. Reuse the part if they are in good condition.

DO: Develop and implement a solution. The possible suggestion were given for the identified problem.

Table -3: KAIZEN 1 SUGGESTION

	PROBLEM	IMPACT	IMPROVEMENT
1	Work space is occupied with old machineries	It reduces the material and workers movement.	Remove all unnecessary old machines from the work space.
2	Lots of old and repair parts are stored in the inventory	It reduce the storage space in inventory	Repair the part for the better usage or sort the parts from the inventory

CHECK: Once the implementation has been started, the performance of the implemented solution is tracked over for the particular period of time.. The problem is compared before and after implementation. check the inventory and work space , if the old machineries and repaired part clear from the particular place.

ACT: If the solution gives good improvement, the suggestions are implemented or else PDCA cycle is carried out from beginning with different solutions. By organizing

the old machines and parts in the separate area. With the given suggestion , old machines and repaired parts are removed and organized in the proper way . It helps to organize the work space in an effective way.

4.2.2 KAIZEN 2: Employees are not provided with safety gadgets

In the spinning mills, employees are highly affected by the micro dust while managing the raw materials and clean Automatic waste evacuation system. spinning machine operators are affected by the high sound from the machine. but employees are not provided with safety masks and ear buds.

PLAN: Understand the importance of the safety gadgets like face mask, ear buds while handling the waste material. provide the safety gadgets to the needed employees

DO: Develop and implement a solution. The possible suggestions were given for the identified problem .

Table -4: KAIZEN 2 SUGGESTION

	PROBLEM	IMPACT	IMPROVEMENT
1	Safety gadgets like face masks and ear buds are not provided to the employees who manage the waste and operators in the spinning department	Micro dust from the cotton waste which causes high level lungs and breathing problems to the employees. high frequency sound which affects the hearing sensitivity of the operators	Providing them with good quality face masks and safety measures to reduce the health problems. Providing them with suitable ear buds to the operator. implement the strict rules to wear all safety gadgets during the work time.

CHECK: Once the implementation is started, continuously monitor the employees whether they are wearing the safety gadgets during the waste handling and production process. Check the quality and efficiency of the safety gadgets.

ACT : If the provided safety gadgets and measures are good enough for employers safety, the implantation is good or else we have to improve the safety measures. with the given suggestion employees are safe from the micro duct while handling the waste.

4.2.3 KAIZEN 3 : Cotton waste material are not recycled and not stored in proper way

In the yarn manufacturing process, for the 20, 30, 40 count almost 15% is generated and for the combing process 25% - 30% waste is generated. From the waste only a small percentage of the waste is mixed with the raw cotton material in the bale breaking process. remaining waste is not

reused or recycled. Various other waste like cones, packing straps, packing covers are not stored in the proper way.

PLAN: Calculate the waste% from all different departments. Segregate the waste in the proper way. Increase the reusability of the waste in the production process. Implement the recycling process into the production process. Allocate the proper place for the storage of the waste materials

DO: Develop and implement a solution, the possible suggestion were given for the identified problem.

Table -5: KAIZEN 3 SUGGESTION

	PROBLEM	IMPACT	IMPROVEMENT
1	Cotton waste materials are not recycled in the efficient way	It highly impacts the efficiency of the production process. increase the manufacturing cost	Categories the waste in a proper way. implement the open end spinning machine to recycle the waste into low end yarn count products.
2	Various other waste like cones, straps, packing covers are not stored in proper place	Waste occupies the most space. it affects the cleanness of the production units.	Segregate the waste in the proper way. stored the waste in the proper place and disposed of it in regular time interval.

CHECK: Once the implementation is started, check the utilization and efficiency of the open end spinning machine and monitor the production level of the yarn from the OE spinning machine. Regularly check whether the waste are segregated and stored in the proper way .Finally dispose of them in the regular interval time period.

ACT : If the solutions are good improvement, the suggestions are implemented, or else we have carried out the different PDCA cycle to improve the process. With the given suggestion, the cotton waste is segregated and recycled with the help of an Open end spinning machine to produce low count yarn counts. and various other waste are stored and disposed of in the proper way.

INTERPRETATION

The above table shows three kaizen improvement attempts were made in the production process of the spinning mills. through the PDCA cycle , suggested the solution for good improvement in the manage the work space efficiency, improve the safety measure for the employees , suggest the implement the open end spinning machine to recycle the waste cotton in to low count yarn product, and suggestion to

organized the waste in effective way. This improvement helps to increase the efficiency of the production process.

4.3 MUDA

The elimination of waste is the primary focus of lean manufacturing. anything in the manufacturing process that does not add value for both company, customer.

Poka-Yoke - It is the process of Error Proofing to achieve Zero defects in the production process. The various error proofing techniques used in the spinning mills are Metal detector, magnet path to remove the metal from the raw cotton, I- scanning process, Fire sensors throughout the plants to avoid fire accidents. These are various error proofing techniques used in the process to reduce waste and improve quality and efficiency of the production process.

Visual Factory - In this spinning mills various visual indicators , displays and control panels used in the plant, Color light indication in the machineries like Red and Green, which indicate the production status and defects in the production process. Various color cans are used in the production process to differentiate the yarn counts. 60 K - Green color can, 20's - Pink color can, 30's - Blue color can, 60c, 40's and remaining counts are identified by the physical marks in the can.

JIDOKA - It means Automation. Design equipment and system to partially automate the manufacturing process and to automatically stop when defects are detected. They implement various automated production systems and waste management systems into the production process.

- Blow room with bale breaker, which automatically breaks the bale and cleans the cotton according to the further requirement in the carding machine.
- Automatic waste evacuation system, which automatically collects the waste from the blow room line, carding machine, and separates the waste according to the quality and size.
- **OHTC** - Over head traveler cleaner in simplex and spinning machine are used to collect the waste around the machine.
- Automatic cone winding machine, which helps to improve the production efficiency by reducing the waste and high production ability.

In the above lean tool analysis (5s Methodology, Root cause analysis, kaizen , layout design and efficiency analysis, Overall equipment efficiency , poka-yoke, Jidoka (Automation), Visual factory, company are able to control the different forms of waste like unwanted movement, waiting, in efficient inventory, overproduction, transport. To remove the defects (waste) from the spinning mills by implementing the lean management into the production process. To reduce the waste percentage and electricity waste,

which help the organization to reduce the overall manufacturing cost.

Table -6: WASTE PERCENTAGE ANALYSIS

Department	Salable waste %	Usable waste %
Blow room	3 - 4%	-
Carding	5 - 7 %	0.5 %
Drawing	0.5%	0.5 %
Simplex	0.5 %	0.5 %
Spinning	2 %	1 %
Cone winding	1 %	-
Auto cone winding	0.075%	-
Combing	18 - 20 %	-

Total waste % for carded yarn = 13.50 % - 15

Total waste % for combed yarn = 28 % - 30 %

To reduce the waste percentage and improve the production efficiency of the spinning mills by

- By improving the cleaning efficiency of the blow room line to reduce waste, maintain the standard setting and beater speed according to the required yarn count.
- By improving the cleaning efficiency of the carding by 5 to 7 % to reduce the waste percentage , Higher flat with high cylinder speed can be used for better removal of seed coats and also reduce neps thick places.
- Analysis and segregate the different types of waste .Weight that waste and record that section wise person and shift wise. always compare with standards.
- Optimal utilization of humidification plant to maintain the suitable humidity in the production plant to improve product quality, maintaining product weight, reducing machine downtime and improving employee comfort. Optimal Relative humidity for the spinning mills is 35 - 65 % RH. In this mills they maintain the RH is from 40 - 50 %, and temperature is from 35 - 40 degree Celsius
 - Maintaining the product weight, up to 3.5 % increase in product yield. by reduce the invisible loss
 - Improve the yarn product quality, by reducing the breakage of the fiber.
 - Reduce the static build-up, to reduce the machine jams and employee discomfort.
- By reducing the electricity waste in the spinning mills, which helps the management to save manufacturing cost. To reduce the electricity waste by

- Cleaning has to be done in peak hour from (6.00 am to 9.pm) to save 20% of electricity cost
- Frequently check the working condition of all the machines.
- Avoid running of empty spindles in simplex and spinning machine
- use an appropriate compressor line for cleaning purposes, not in the main compressor line.

INTERPRETATION

From the above Table 4.11 and other Lean tool analysis, In this spinning mills waste percentage of the carded yarn is 13.50% - 15%, and waste percentage of combed yarn product is 28% - 30%. In the production process, they implement various Error proofing, Visual indicators, Automation in the system to reduce the various forms of Muda (waste) to improve production efficiency and reduce manufacturing cost.

4.4 ROOT CAUSE ANALYSIS

A critical thinking philosophy that centers around settling the basic issue as opposed to applying handy solutions that lone treat quick indications of the issue. A typical methodology is to inquire as to why multiple times each time drawing a stage nearer to finding the genuine hidden issue.

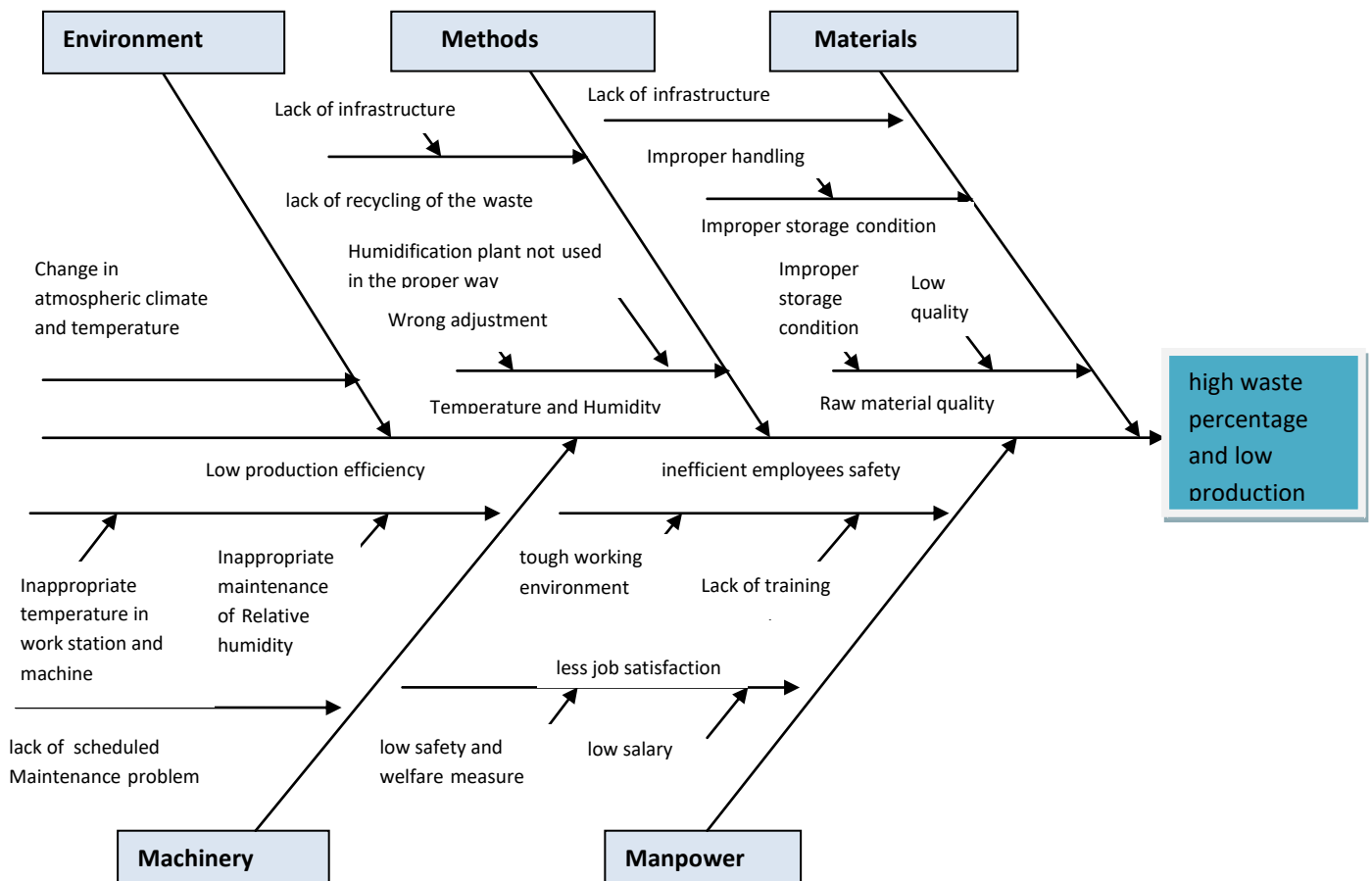
Materials - High percentage of impurities in the raw cotton, which leads to high percentage of waste in the production process. Low quality of the raw materials, improper storage condition and improper handling of the raw material are the factors which cause low production and high waste percentage.

Methods - Cotton materials and production process should be maintained in the proper humidified workstation to produce the cotton from the loss of weight and reduce invisible loss, improper use of humidification plants which cause high wastage in the process. Waste cotton is not reused in the proper way.

Environment - Atmospheric conditions like temperature and climate, they plays an important role in the production efficiency .

Manpower - Because of the tough working conditions, lack of training , low salary for contract workers, low safety and welfare measure these major reasons which cause the employees to be more inefficient.

Machinery - Inappropriate maintenance of relative humidity, lack of scheduled maintenance, Inappropriate temperature in the workstation and machineries which affect the machinery to cause breakdowns, low quality of the products.



INTERPRETATION

The above Root cause analysis diagram shows the various factors which cause the high waste percentage and low production efficiency during the production process. by identifying the root cause in five important categories like Materials, Methods, Environment, Machinery, Manpower. which help us to rectify and improve the process.

5. CONCLUSION

The waste management in the production process helps the organization to maintain the efficiency and reduce the manufacturing cost. For that implementation of lean management into the process helps to control the all form of waste within the organization. Various lean tools which help the organization to measure and understand their problems in the process. It helps us to improve efficiency, reduce all forms of waste, improve the working environment, and reduce the manufacturing cost. Through this research spinning mills, It is concluded that waste control and management which improve the efficiency of the overall production process and reduce the manufacturing cost.

REFERENCES

1. Ministry of textile - <http://texmin.nic.in/>
2. Government of Tamil Nadu, Ministry of handloom and textile, policy note, 2019-2020.
3. Bhamu, J., and Sangwan, K. S. (2014). Literature review and research issues on Lean Manufacturing. Published in International Journal of Operations & Production Management, 34 (7), 876-940.
4. Fawaz, Abdulmalek, Jayant Rajgopal (2007) A Study on implementation of lean manufacturing in to the system, analyze the value stream mapping via simulation and done a process sector case study Int. J. Production Economics, 107, pp. 223-236.
5. Green, J., Lee, J. and Kozman, T. (2010). Analyzed the importance of implementing and Managing lean manufacturing system in material handling operations within the manufacturing industries, Published in International Journal of Production Research, 48 (10), 2975-2993, 2015
6. Piercy, N., and Rich, N. (2015). Study and analyzed the connection between lean operations and sustainable operations. Published in International Journal of Operations and Production Management, 35(2), 282-315, 2015.
7. Gurumurthy A. and Kodali R. (2011): A case study on Design of lean manufacturing systems using value stream mapping with simulation. Published in Journal of producing Technology Management. Vol. 22 No. 4, 2011, pp. 444-473.
8. Irfan Ahmed Mohammed Saleem, Dr. S. Jaisankar(2018), A Study On importance of Kaizen Based Soft-Computing In Electric Vehicle Manufacturing Processes, Published in International Journal Of Innovations In Scientific and Engineering Research, Volume5,no5.
9. Michalska J and Szewieczek D(2007). A study on implementation of 5S methodology as a tool for improving the organization and reduce the waste in the manufacturing industries, J. of Achievements in Mat. and Manufacturing Engineering Vol. 24, pp 211-214.
10. Zuashkian A, Rahmandad H, Jardine A.K.S.(2011)A study on Mapping the dynamics of Overall Equipment Effectiveness (OEE) to reinforce asset management practices. J. Qual. Maint. Eng., Vol. 17, pp 74-92 .
11. Shah, Z.A. and Hussain, H. (2016). An Investigation of Lean Manufacturing Implementation in Textile Sector of Pakistan to improve the productivity , Proceedings of the 2016 International Conference on industrial management and Operations Management, Kuala Lumpur , Malaysia, March 8-10, 2016.
12. G. L. Hodge, Kelly Goforth Ross, J. A. Joines and K. Thoney, (2011) A study on implementation and adapting to lean manufacturing principles and tools in to the textile industry, Production Planning & Control, vol. 22, no. 3, pp. 237-247 .
13. A. R. Mukhopadhyay and S. Ray, "A Case Study on Reduction of Yarn Packing Defects in the manufacturing and packing process Using Six SigmaMethods"QualityEngineering,vol.18,p.189-206