IMPLEMENTING CONTINUOUS IMPROVEMENT METHODS OF INDUSTRIAL MANAGEMENT

Florina-Cristina FILIP
Transilvania University of Braşov, Romania

Abstract. Based on the current situation regarding driving mode of production systems, the company management constantly seeking to implement a methodology for continuous improvement of customer satisfaction level and improve the level of delivery performance. For this the industrial companies established strategies of reduction the intermediate inventory, reducing the products crossing times from one production process to another, a continuous improvement of production planning and management processes. This paper aims to analyses in an automotive industrial company, the current situation on work pieces in the grinding-polishing sector and the milling-montage cell. Also, is analyzing the current situation on correct registration of pieces in the system and achievement handover-reception operation of pieces between sectors. This analysis led to implementation of improvement methods manufacturing activity held within the company, monitoring how are respected and fulfilment the methods proposed.

Keywords: flexibility, continuous improvement, overproduction, waste, work in progress (WIP)

1. Introduction

Making change is only the beginning, making that change sustainable is much harder. Having systems in place that assure procedures are performed consistently is one major asset in sustaining change. Procedures and other controls should not be a hindrance to continuous improvement. Once the standard is established, organizations should follow these practices as defined. More than 60 per cent of manufacturing industry in Europe is devoted to small to medium batch production in which the product variety is often high.

Manufacturers face increasing pressure to broaden their product mix and to reduce their lead times. To survive, manufacturers must meet the demands of globalization, which include truncating manufacturing lead times and increasing product range while raising quality and lowering cost. As a result, they can ill afford to waste time, material or production capacity. That's why a new type of manufacturing system – the flexible or reconfigurable system – may be exactly what they need to increase responsiveness and to keep costs down and quality up [1].

Manufacturing flexibility has during the last decades become a very important aspect on the competitive arena where production oriented companies work. Many researchers consider manufacturing flexibility as a competitive priority together with cost and quality. Although many researchers have identified the benefits and the importance of flexibility there are still problems to evaluate and measure flexibility in an appropriate way. Many of these measures are one-dimensional, e.g. measuring the number of parts that can be produced in a system. It is hard for a company, based on these measures, to get an idea of the value of flexibility because there is no relationship between the companies' actual need for flexibility and the measures. If a company faces no uncertainty at all, there will be no value of holding flexibility to cope with uncertainties, and vice versa, and this is a relationship that a measure should take into respect.

Numerous authors have earlier valued "operational" flexibility in manufacturing, have evaluate process flexibility in a given, fixed capacity equipment as a complex option. During one period, only one product type is produced with respect to the inventory available. There are many approaches to increase flexibility: reductions of set-up time at installed equipment, multipurpose stations, parallel assembly lines, flexible work force. The first three approaches are dependent on production equipment and the last on personnel [2].

Volume flexibility of a manufacturing system is defined as its ability to be operated profitably at different overall output level. Volume flexibility permits a manufacturing system to adjust production upwards or downwards within wide limits prior to the start of production of a lot. In a volume-flexibility production system, as the

production rate is increased, some costs such as labour and energy costs are spread over more units while per unit tool costs increase [3].

2. Improvement methods

Continuous improvement process is more than just a series of improvement projects. The process must be cohesive and aimed at achieving established enterprise goals. The process must also involve the entire organization in the process. This does not mean that all parties are involved in every process, but that roles are established, contributions are valued, and all employees are aligned towards common goals. Using the principles of Kaizen is one approach to achieving the goals of continuous improvement [4].

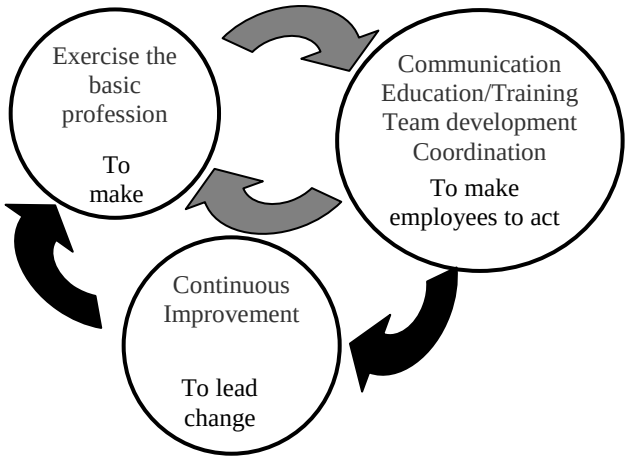

Figure 1. Management activity and continuous improvement

Production process begins with human resources, installations and raw materials and ends with finished products. Productivity increases when the same amount of initial resources generate more finished products at the end of the process, or, conversely, when less initial resources are required to produce the same volume of finished products. Increasing quality level of working process means reducing the number of errors, repairs and rejects.

Every time a task is performed we can verify that the person doing the task is capable of executing it correctly and that the work sequence and content produce the expected results. It is the foundation for continuous improvement at the shop floor level. Effective processes must be standardized and controlled. Current methods are analyzed using observation and videotaping. Then procedures and forms are used to document standard work. Standard work is the formal sequence of human tasks required to make a product using the best methods currently known to minimize waste. It identifies the work sequence to improve methods and balance work content [5].

Communication is the glue that binds organizations together and can be the engine of change.

Visual systems provide effective tools to support performance management with a self-reporting and self-reinforcing workplace. Visual systems communicate schedule and performance data to the total workforce. These mechanisms help to synchronize production to the customer beat (takt time), clearly display load vs. capacity, control the rate of material flow, communicate linearity, and involve each person in achieving plant goals. Out of control situations become clearly visible for corrective action. Visual systems include such things as color-coding, labelling tool positions, marking inventory locations, posting schedule boards – tracking production, workplace identification signs - flow paths, and kanban – queue controls [6].

Waste is defined as anything that does not add value to the final product and is everywhere in many different forms. Every organization wastes majority of their resources. These wastes are categorized in eight categories: overproduction, waiting, work in progress (WIP), transportation, inappropriate processing, excess motion or ergonomic problems, defected products, under-utilization of employees. Although in different groups, each one of these is interconnected. Therefore one change will affect the total system.

Over-production describes a type of waste which is in most of the places and we never think this as a waste. This is producing something before it is actually required. In the bigger picture, this is equivalent to create a product or a service before it is actually required [7]. In the much smaller picture, the word over production might mean producing a part of a product before it is required by the assembly line or the process after that.

In conventional batch processing, some studies show that 90% of the time goods are waiting to be processed. Some even say this is higher as 99%. Even a single minute lost in waiting can not be recovered in the process there after. This is one big contributory factor for the higher lead times. This simply means we take 100 hours or more to complete work which is worthier only 10 hours. Ninety hours or more is lost and added to the lead time. No waiting means we can deliver the goods within 10 days which actually took 100 days earlier. This will also reduce the WIP and tons of related

problems. Also considerable savings on the production space and reduction in work in capital can be achieved [8]. Work in progress or WIP is a direct result of over production and waiting [9].

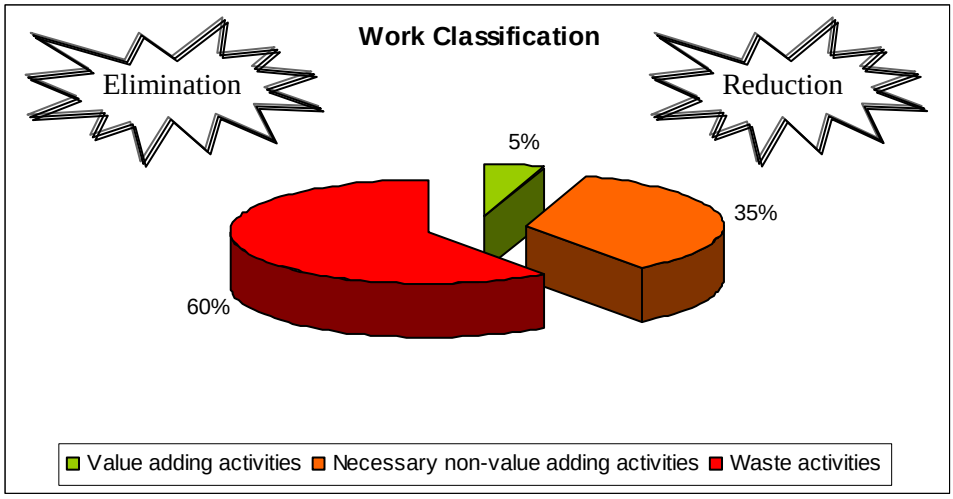

Figure 2. Work classification [10]

Every imperfection in the system will create a requirement for the WIP. Therefore WIP also known as the mirror of the wastes that system has. But WIP it self becomes a waste due to many consequences. It blocks money in the form of not finished products. It also reduces the flexibility of the production facility by increasing the change over time between different styles. It hides quality damages, and will only be revealed when a considerable damage is done. Higher WIP also requires larger floor space. This will also affect the appearance of the work place badly.

No matter how well we do transporting because it does not add value to the end product. Therefore simply transportation is one of the wastes that have to be eliminated from the production system. This accounts for the quality defects, maintenance of a higher WIP, and additional cost of transporting the goods. Transportation often caused by poor work place organization. Inflexibility of the layout plays a big role here. This can be avoided with careful re designing of the layouts [8].

3. Case study

This chapter presents a case study which aims to identify measures for ensure the FIFO principle to the work piece in the grinding-polishing sector and the mill-montage cell, and identifying measures for ensure proper recording of parts in the system and correct delivery and reception of pieces between the sectors. This study was conducted to an automotive industrial company from Brasov, in the manual grinding-polishing sector.

3.1. Current situation

Current situation on work piece in the grinding-polishing sector and the mill-montage cell:

- to the beginning of exchange in the grinding-polishing sector exist an idle time for operators, because pieces are not prepared in time;
- to the end of exchange in grinding-polishing sector is chaos, disorder and in the last two or three hours is attempted to recover everything wasn't done throughout the entire exchange;
- inadequate organization of the workplace and inconsistent work methods;
- communication and coordination inadequate;
- inadequate placement of workstations, these are located too far from each other, which lead to large time between operations;
- no exists one person designated to carry pieces between sectors or workplaces;
- pieces storage places are not well defined and are not properly marked (in sector you hinder of boxes and do not know if they place is there or not, if operators store boxes of pieces in those places because there must be stored or simply because there it is better for operators).

Current situation on correct registration of pieces in the system and achievement handover-reception operation of pieces between sectors:

- there are more people who operate and enter data into the system and at the end of the exchange is "crowding" to recording system of data, fact which can lead to incorrect recording of pieces in the system or to a double records of their;
- when are inserted dates in the recording system,

window "Order processing" remain open throughout the entire exchange, sometime existed even two windows open at once;
- operators do not perform last operation necessary for recording pieces in the system, by closing the "Order processing" window by typing "Ending" option, operation that must always be done;
- operators working with the recording system does not know and does not respect exactly the instructions of its;
- instruction for using recording system data is not very clear because it is not specified clearly that after introduction in the system good pieces, remedies or scrap pieces, the operator must close the "Order processing" window by "Ending" command.

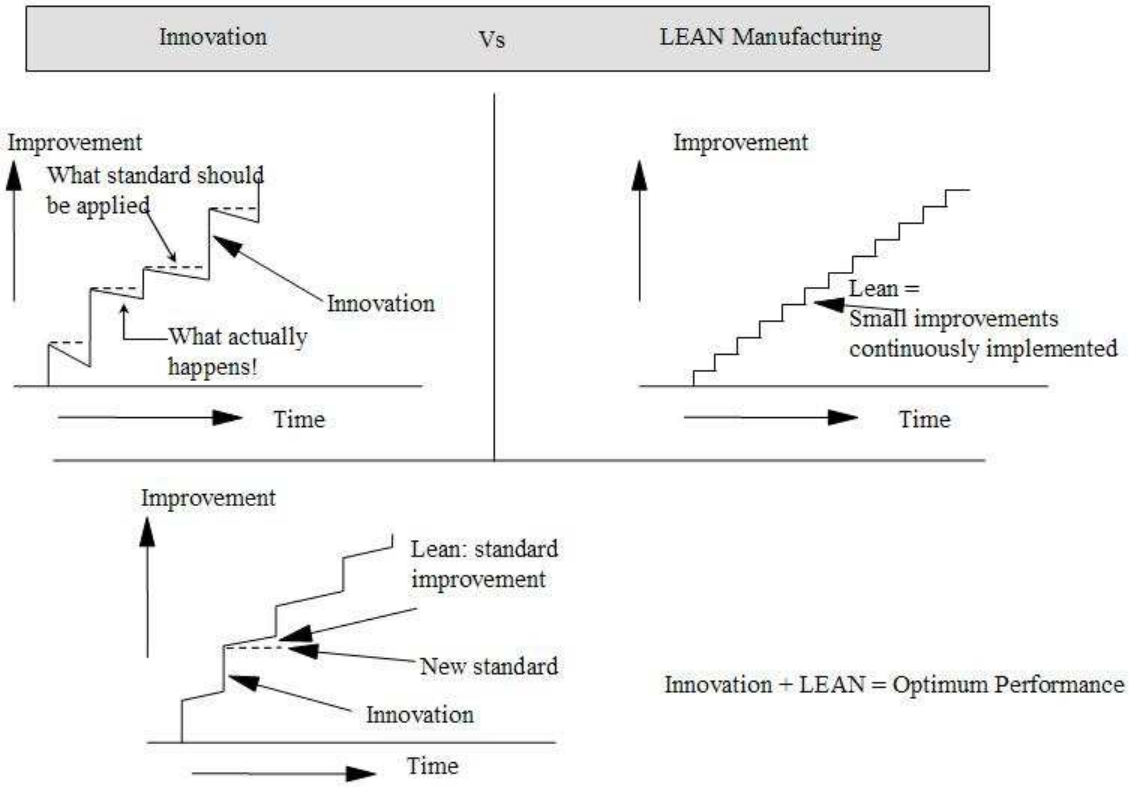

Figure 3. Continuous Improvement and Innovation

3.2. Implemented improvement methods

Improvement methods on work piece in the grinding-polishing sector and the mill-montage cell:
- highlight pieces by drawing a sheet registration which follow up the batch from the first operation until the final operation, sheet by which is highlight product circuit and is tick the workstations by which have passed pieces, thereby eliminating errors regarding handover-reception operation of parts between sectors;
- clearly and properly delimitation and marked of intermediate storage areas;
- QS inspection by staff in the grinding sector, before the parts reaches to the milling operation.

Improvement methods on correct registration of pieces in the system and achievement handover-reception operation of pieces between sectors:
- because the operators considered normal that after introduction dates in the recording system does not close the "Order processing" window by typing "Ending" option, should be made a retraining on use of the IPS or an information on this;
- clear specification on user instructions of the recording system, that after registration in the system of good pieces, remedies and rejects, the operator must close the "Order processing" window by "Ending" command;
- precise description of operators which making the pieces handover operation between sectors, thus eliminating confusion about the people who must carry out this operation and is formed discipline between sectors;
- in each sector must be a person who carries out the pieces handover, thus observing if the pieces quantity received and processed in that sector corresponds with quantity that follows to be transferred to the next sectors or operations;

- if the operator responsibilities are too high for implementing the handover operation, then are appointed two operators for this operation: one for handover operation and another for reception operation of pieces;
- a periodic physical inventory of pieces for follow if the pieces quantity that exist physically in production, corresponds to pieces quantity reported in the operation system.

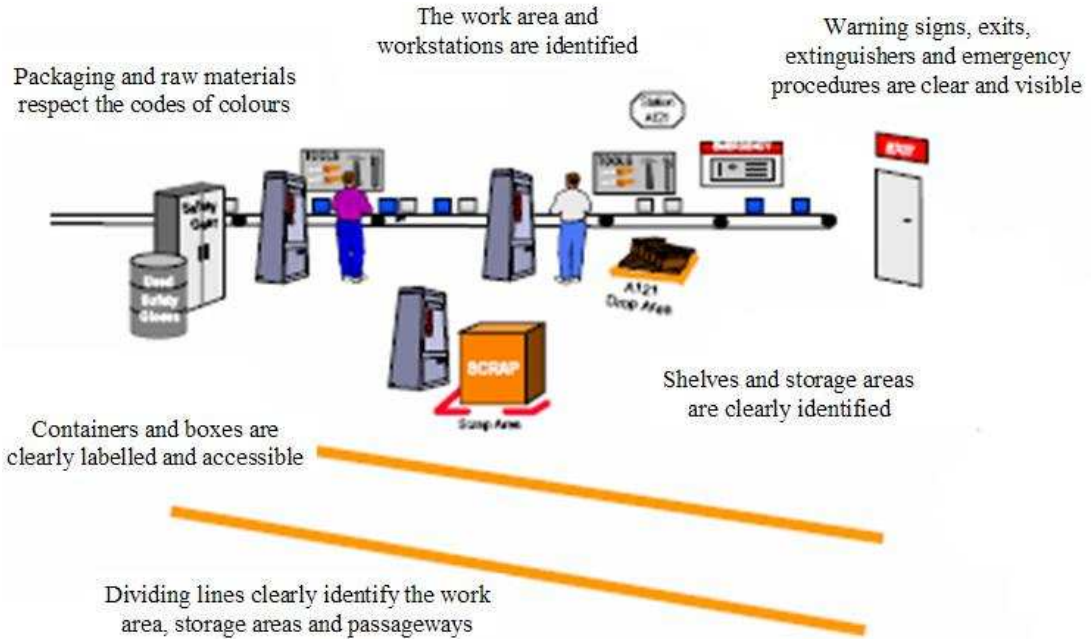

Figure 4. Perfect Vision [6]

This analysis led to implementation the improvement methods of manufacturing activity performed in the company and pursuit of respecting and fulfilment mode of the proposed methods.

4. Conclusions

Improvement is considered to be a continual process to discover and eliminate the causes of problems. Our goal is not to blame people for problems or failures, but simply make sure we improve on our service. When we engage in process improvement we discover the cause and utilise this knowledge to improve customer satisfaction [11].

All improvement methods must be continuously supported by the general management. For implementation improvement methods, is necessary permanent tracking of the implementation process, permanent discussion of problems that occurring and their causes. No-discussion about issues existing lead to conclusion that they not exist and where are no problems, there are no improvements. When appears a problem, if we don't look good to cause that generated it, improvement methods applied may be ineffective.

Change must occur with the approval and participation of employees. Part of the implementation process is capacity building. The process of making change should invest employees in the process so they understand the reasons for change, the process that was followed, and potential risks that may be associated with the new conditions.

Benefits of continuous improvement methods [5, 6, 12]:

- standard work ensures process consistency and reduces operator-introduced variation;
- methods continuously improved and documented for efficiency, quality improvement and cost reduction;
- statistical process control improves quality by appropriate response to variation;
- visual systems support standard work for more consistent results;
- performance feedback and reinforcement support continuous improvement;
- clean and orderly workplace yields more efficient and higher quality results;
- visual controls support rapid observation and response for effective outcomes;
- ability to reduce lot sizes and queues to improve responsiveness and reduce lead-times;
- more predictable and reliable setups improve quality and reduce waste;

- more reliable and responsive order commitments and on-time delivery;
- reduced inventory for improved cash flow;
- tracking qualitative production not only quantitative production;
- flexible and adaptable workforce, a permanent work teams for implement improvement methods;
- culture and mindset for continuous improvement;
- all improvement methods must be continuously supported the general management;
- for implementation improvement methods, is necessary permanent tracking of the implementation process;
- permanent discussion of measures, problems that arise and their causes;
- culture and mindset for continuous improvement;
- no-discussion about issues existing lead to conclusion that they not exist and where are no problems, there are no improvements (issues are mountains of treasure);
- when appears a problem, if we don't look good to cause that generated it, improvement methods applied may be ineffective;
- exist a permanent work teams for implement improvement methods;
- tracking qualitative production not only quantitative production;
- adaptable workforce, flexible and balanced work teams.

So, the improved process is supposed to reflect a change from 10 to 30 directly to the bottom line. But in absence of good daily management, processes are not stable through time and they degrade without systemic monitoring and improvement.

Acknowledgements

This paper is supported by the Sectoral Operational Programme Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number POSDRU/88/1.5/S/59321.

References

1. Arabe, K.C. *Achieving Manufacturing Flexibility*. Available from: www.news.thomasnet.com/IMT/archives/2004/03/achieving_manuf.html, Accessed: 18/04/2011
2. Bengtsson, J. *The Value of Manufacturing Flexibility: Real Options in Practice*. Annual International Conference organized by Real Options Group, Available from: www.realoptions.org/papers1999/bengtsson.pdf, Accessed: 18/04/2011
3. Feng, D.Z., Yamashiro, M. (2004) *Optimal production policy for a manufacturing system with volume flexibility in a supply chain under lumpy demand*. The International Journal of Advanced Manufacturing Technology, Vol. 25, No. 7-8 (October 2004), p. 772-784, ISSN 0268-3768
4. *** *Principles of Clean Manufacturing.* Available from: www.mamtc.com/lean/story02.asp, Accessed: 08/04/2011
5. Hart, G. *Standard Work – Process Control*. Available from: www.hartinnovations.com/Standard_Work.pdf, Accessed: 20/04/2011
6. Hart, G. *Visual Systems and 5S*. Available from: www.hartinnovations.com/Visual_System_GL.pdf, Accessed: 20/04/2011
7. *** *Production Methods – Lean Manufacturing.* Available from: www.scribd.com/doc/12487283/Lean-Managment, Accessed: 15/04/2011
8. Badurdeen, A. (2007) *Lean Manufacturing Basics*. Available from: www.leanmanufacturingconcepts.com, Accessed: 28/04/2010
9. *** *The 7 Manufacturing Wastes*. Available from: www.emsstrategies.com/dm090203article2.html, Accessed: 08/04/2011
10. Kotelnikov, V. *Lean Production - Doing More With Less*. Available from: www.1000advices.com/guru/processes_lean_producti-on_vk.html, Accessed: 18/04/2011
11. *** *Continuous Improvement*. Available from: www.kaybridge.com/page2017/continuous-improvement.aspx, Accessed: 08/04/2011
12. Hart, G. *Setup / Changeover Optimization*. Available from: www.hartinnovations.com/Setup_Reduction.pdf, Accessed: 20/04/2011
13. Aft, L. S. (2000) *Work Measurement & Methods Improvement*. Wiley Publishing House, ISBN 0471370894, New York, USA
14. Yan, H.S., An, Y.W., Shi, W.W. (2009) *A new bottleneck detecting approach to productivity improvement of knowledgeable manufacturing system*. Journal of Intelligent Manufacturing, Vol. 21, No. 6 (February 2009), p. 665-680, ISSN: 0956-5515