Warehousing process improvement through Implementation of Lean: a case studies of optimizing and reorganizing two warehouses in Morocco

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Abstract

The paper aims to explore and identify how the warehousing operation and process can beimproved by usingconcepts and ideas from Lean and Six Sigma. As the value in a warehousing is created by being responsive to customer order and because of that lean warehousing encompasses elements of agile production. Our goal is to identify how effectively the lean warehousing influence the performance of a warehouse processes. Thus a combination of theoretical and empirical through case studies is mobilized. Further data collection was performed through observations and interviews, which were used to acquire understanding about the changing processes, as well as by setting the ground for further research and managerial implication to testing.

Keywords—Warehousing, quality, continuous improvement, Lean, Six sigma, 5S;

Introduction

As many firms have had a very negative view on warehouses on increasing costs, in the new market place and today's business is changing about the value which can be provided by the warehousing operation as mixing and modifying a product in order to meet customer requirements (Bowersox et al; 2013). Numerous researches argue that there has been a shift from the idea of the major role increasing costs by the warehouse to creating the value for firms. Warehouse improvement requires optimizing material flow, order picking, replenishment, and dock operations. Although many traditional lean techniques maybe difficult to apply, the concepts of improving material flow and eliminating waste can be used to make significant improvement in warehouse lead time (Garcia, 2003).

Value in a warehousing is created by being responsive to customer order and because of that lean warehousing encompasses elements of agile production (J de Visser, 2014). In other term the main aims of implementing Lean in the warehouse department is to improve the visibility, material flow, work organization and standardization of processes (SandeepPhogat, 2013).

Thus, research problem underpinning this study is how the implementation of Lean 5S can contribute to the improvement of the warehouse in Morocco.

Our overall strategy in this study is divided into three main parts, part 1 mobilize a review of literature to elaborate the ground theory which develops the concept of Lean, Lean Six sigma, and Warehousing and Organizational changes. The theory presented will support deeper investigation and presentation of some facts about the problem and will try to develop a better insightfulness about the topic.

The second part discusses the methods used for collecting the data further articulated in the case study which makes the bridge between the research done on the problem so far and the particular phenomenon, through the methodological approach used for the case. The elements of analysis supporting the case study include direct observations (visits at the two companies) in order to obtain knowledge about the events being studied, as well as interviews with the personnel involved in the events. Furthermore, documents and artifacts are also useful source of information for this case study.

The third and final part is devoted to a discussion of the results of this research some of the findings and recommendations from this research through the two cases are provided in order to be applied relevantly for some bottleneck processes within warehouses in Moroccan context.

LEAN WAREHOUSE AN OVERVIEW

Lean and Six Sigma

Lean Six sigma can be combined in a business strategy. Lean Six Sigma is a term first coined by George in 2002, and it integrates the approaches from both the Lean and Six Sigma disciplines. Lean aims to reduce waste, while Six Sigma aims to reduce variations in processes.

TABLE 1: Comparison of Lean and Six Sigma

	Lean	**Six Sigma**
Objective	Deliver value to customer	Deliver value to customer
Theory	Reduce waste	Reduce variation
Focus	Flow focused	Problem focused
Assumptions	•Waste removal will improve business performance •Many small improvements are better than system analysis	•A problem exists •Figures and numbers are valued •System output improves if variation in all processes inputs is reduced

Source: Murman et al. (2012)

Shweta et al (2010) argue that Lean six sigma uses a combination of lean thinking and six sigma project methodology called DMAIC (define, measure, analyze, improve, and control) to achieve high performing business results. The DMAIC approach is proven to help organizations achieve on time delivery of the right quality and quantity to satisfy customers. Lean thinking is based upon the reduction of waste and focused on added value. An important decision for an

organization is to choose between lean, six sigma or some combination of these concepts.

Salah et al, (2010) highlight the major characteristics and benefits of both lean and Six Sigma that both work on improving quality with different tools and techniques and have different ways of solving the problem. Six Sigma mobilizes statistics; however lean try with the best possible use of resources. The results of combining the two approaches allow effectively process waste reduction and process variation reduction.

If these two techniques are implemented in stages there can be two ways of doing it-

1) Six sigma is applied first to improve the effectiveness of the process and then lean can help improve the efficiency in the later stage

2) Lean may be applied first, so the resources are utilized wisely and waste is eliminated and process can begin smoothly, more difficult process issues can be dealt with later on and can be dealt with six sigma statistical techniques.

Thus based on this combination lean six sigma is a very powerful tool which can lead to a more superior methodology on solving effectively problems related to quality improvement and indeed the warehouse performance improvement for firms (Salah et all, 2010).

Lean Warehousing

SandeepPhogat (2013) agrees that Warehouse improvement refers to improvement of the material flow, order picking, replenishment, and dock operations. Improvement techniques such as material flow analyses, quality improvement and application of Lean can be applied. Successful application of Lean techniques would lead to reduced lead-time (the unnecessary time part of the order-to-delivery processes), order picking time, and the time for material handling. This can be achieved through reduction of the non-value adding activities, and improvement of velocity and flow in the warehouse (Henrik Christiansen, 2015). Alexander (2015) state, that the use of Lean in warehousing has been lagging compared to the supply chain and manufacturing industries. According to Bozer (2012), this has evidently created a gap of knowledge for Lean warehousing and the success of its applicability.

Garcia (2003) add and state that, “The successful application of Lean techniques (in warehousing) would lead to reduced lead-time (the

unnecessary time part of the order-to-delivery processes), order picking time, and the time for material handling. This can be achieved through reduction of the non-value adding activities, and improvement of velocity and flow in the warehouse." (Cited by Alexander, 2015)). In the same perspective J de Visser (2014) state that "Within a warehouse environment orders are the products assembled. Therefore lean in the warehouse focuses on assembling warehouse orders in the most efficient way, minimizing non-value adding activities in receiving, put a way, picking, packing and shipping". To minimize non-value adding activities warehouses have to identify wastes. The seven wastes of lean production have be converted to a warehouse environment:

1. Defects: handling and shipment of defective products.
2. Overproduction: replenishing, packing and picking products not yet needed.
3. Waiting: Picked goods waiting for inspection, shipment or packing.
4. Unnecessary motion: unnecessary movement of pickers and packers due to inefficient routing.
5. Unnecessary inventory: storing to many inventory, having inventory on the shop floor as a consequence of batch system.
6. Transporting: inefficient movement of products through inefficient layout and routing.
7. Inappropriate processing: unnecessary inspection of picked orders and unnecessary packing.

Toward a model of Lean warehousing

According to Mustafa (2015) the most of the lean concepts can work well in warehouse, especially 5S, VSM, team building, kaizen, problem solving and error proofing, kanban/ pull system, line balancing, and cellular applications and general waste reduction. Indeed it has been concluded that the lean improvements have reduced the order processing time by 50%. The applicability of the model of lean warehousing proposed by Mustafa et Al (2013) and mentioned below (see the figure) means that the model of lean warehousing should be applicable to all types of warehouses.

FIGURE 01: Model of lean warehousing

Source: Mustafa et al. (2013)

Bozer (2012) states that: "There is no doubt that Lean warehousing is gaining momentum both in terms of academic research and industrial applications. And that available resources and information on Lean warehousing is limited compared to well-established areas such as Lean manufacturing and emerging areas such as Lean healthcare". Phogat (2013) agrees that Lean in warehousing further leads to waste elimination and creating more value to the customer.

Method of Data collection and analysis

The motivation behind this research by using case studies is to investigate the implementation of Lean 5S in two different warehouses: W1 "Temasa factory (KUNERT company) in Tangier" and W2 "OCP group in JORF LASFAR. Accordingly Sobanski (2009) agrees that there has been limited academic research on Lean warehousing. So our aims is expected outcome is to get an process improvement by the deployment of lean tools as lean six sigma in order to contribute to optimization of warehousing process. According to Welman et al. (2005) the units of analysis include individuals, groups and institutions. The analysis of our research is based on empirical data collected in two

companies' one in JORF LASFAR and the other in Tangier. The date collection includes direct observations (visits at the two companies from the early March to late June 2016) in order to obtain knowledge about the events being studied, as well as interviews with the personnel involved in the events. Furthermore, documents and artefacts are also useful source of information for this case study. We tried our best to have the most efficient and fruitful interviews and questionnaires with the heads and operational employees. The interview guide and questionnaire are presented in Appendix.

Findings and discussion of the two cases studies

This section summarizes the potential estimate savings identified along the warehousing process associated with Lean Practices. Based on the research concluded by Mustafa (2015) in which the principles lean are encompassed and listed above, we will focus on waste control as lean principle "work place organization 5S" and Six sigma as lean method. Lean 5S being chosen as an adequate tool for improvement of the warehouse processes by the Six sigma.

As mentioned and explained in several books and reports, the 5S is of great important to the visual management in an organization. The main purpose of 5S practice is to provide a safe, organized and efficient workstation, resulting in a reduction of waste and improvement of performances of workers and in processes. The name of this 5s technique is composed of the initial letters of five Japanese words – Seiri (sort), Seiton (orderliness), Seiso (cleanliness), Seiketsu (standardize) and Shitsuke (self-discipline).

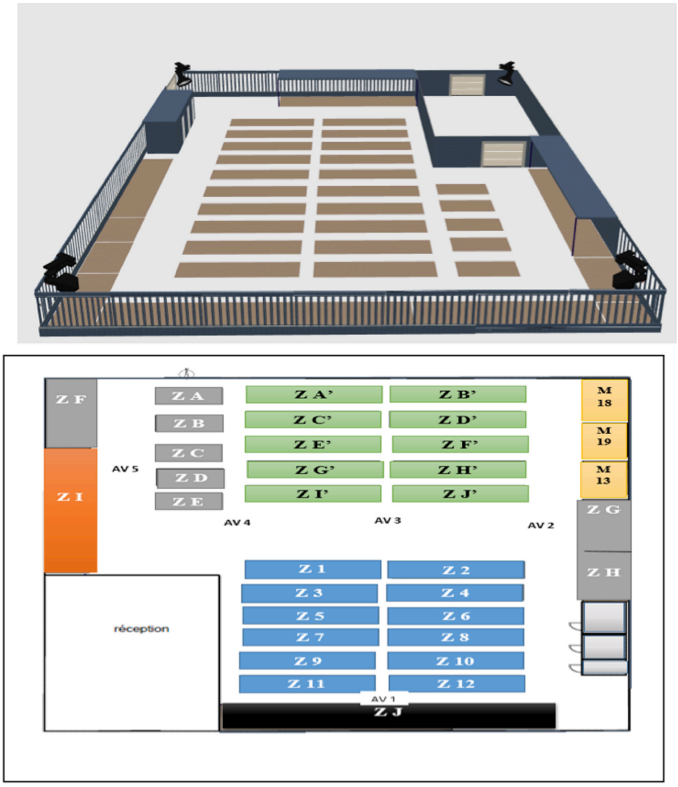
Case 1: Implementation of Lean 5S in W1 a necessary step of the reorganization.

To bring closer to reality, we present real photos of this warehouse that present the situation of the articles, its storage methods as well as its positioning, soles situation.as shown below.

PICTURES 1: The current layout which decrease the productivity in the warehouse W1

To improve the current warehouse we propose the fundamental elements to be taken into consideration when building the new warehouse (as shown below) in order to obtain a high-performance in the warehouse that meets the requirements of internal customers.

FIGURE 2: Suggested new layout which would increase the productivity of the warehouse W1.



A 5S implementation should follow the steps outlined in the below to achieve the goals expected;

Seiri (sort) : all unnecessary items should be removed. In the context of the warehouse, this means sorting through and identifying any unnecessary stock. As

• Obsolete items (J0413): These items are oils and greases, according to the authorization of director, that they must be burned.

• Surplus items (J0418): have a surplus or an overstock. The surplus of stock is unnecessary, costly and an overhead for the business because it requires more surface, insurance, more management, etc. To get rid of these items, the managers put them in the ORACLE system in order to be requested by the other zones of the OCP group (KHOURIBGA, SAFI, YOUSSOFIA ...);

• Items to be settled (J0419): or unusable, in our case, these are offered for sale.

Seiton: The second pillar should organize everything in a logical and efficient manner. In W1, we distance the references with low rotation and those requested infrequently this shows one of the more efficient manners of organizing and storing items.

Seiso (shine) or Scintillation: To shine in a W1 context does not only include tidying and cleaning, but also clearly marking labelling, locations and specific zones so that they are immediately visible to anyone, its consists of removing dust, causing the floors to shine. The waste is sorted in separate bins.

Seiketsu: Safety rules are regulated and non-negotiable; Determination of cleaning and control schedules. As the warehouse has reduced inventory levels and cleared out any unnecessary items, procedures should be updated to reflect and maintain this. It should be clear to anyone what inputs are required, what steps are to performed and what inputs are required, what steps are to performed and what the outputs are.

Shitsuke: To follow and to evolve: To be self-exemplary with respect to the execution of the rules; To not pass a breach of the rules.

Control: After discussing with the project manager, the achievement of this reorganization goal depends on the performance monitoring and change management which implies a good willing. This does include involving all employees, and it relies on the employees understanding the concept of 5S and how it can improve their workspace and daily work. This will require training, education and inclusion of all employees.

Case W2 : Implementation of Lean 5S in order to improve the current process

-in order to articulate the Implementation of the 5S method in warehouse 2, we have followed the steps as made in the W1 to achieve the goals expected: pursuit of well organised process.

Thus to identify and implement possible and realistic solutions we have proposed solutions to improve the aspects related to the optimization of the paths of Picking and improve the performance. In order to eliminate the wasted time and to increase the efficiency, we re-examined the organization of the workspaces.

Improve the process:

So we have proposed solutions to improve the aspects related to the optimization of Picking paths and improve the performance of the latter. We have suggested a set of solutions related to our subject using a Brainstorming which is a creative technique used to generate concepts and ideas as shown in the table below.

TABLE 02: The improvements

Main causes	Improvement
Sharing non-computerized information	The implementation of management software involves computerization of purchase orders, in which case the Picking lists become automatic. So the Picker is not obliged to move and interpret the necessary information to the Picking.
Using the paper support	The interface between the two programs eliminates any interpretation of the operating program. The software automatically suggests the Picking list
Manual processes	The automatic interface between the two programs eliminates the old manual process

So the management software receives the operating program automatically every day. It suggests, based on the planned commands, the list of samples to be used. Poor interpretations of the operative program are no longer possible, unless the operating program is wrong. More than thanks to this interface the updates and the modifications linked to the commands can be easily seen for the Picker and consequently the Picking errors will be less than before. (See the comparison between the old and the new process of picking below).

FIGURE 3: The old and the new process of picking

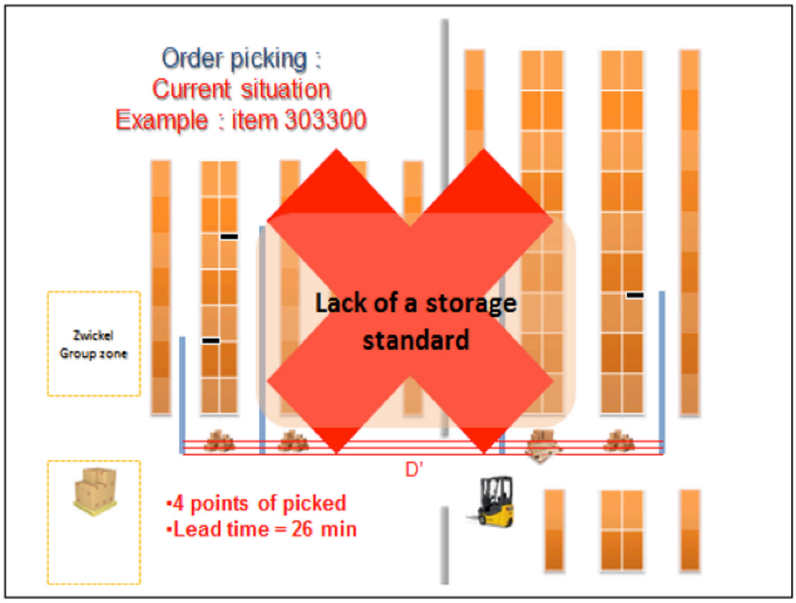
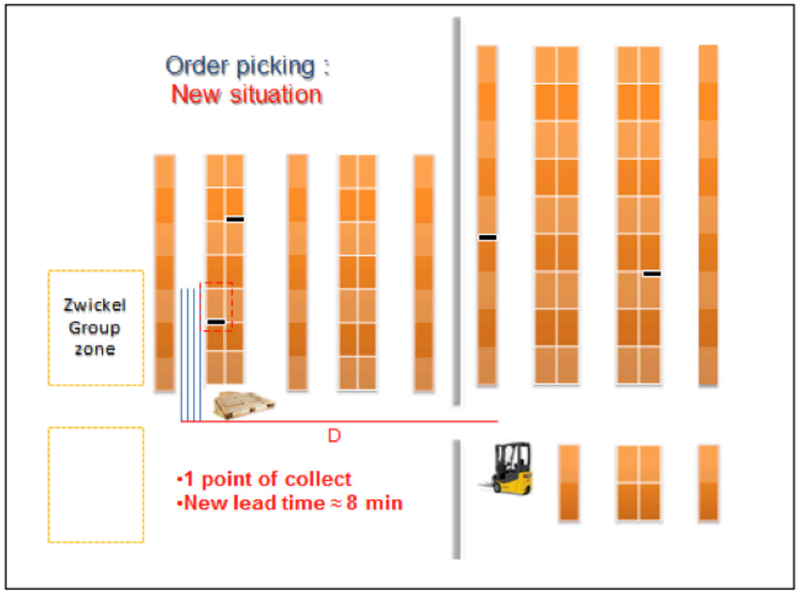


FIGURE 4: The old and the new process of picking W2



The benefits from this improvement

This grouping action consists of gathering articles of the same reference in the same storage location in order to optimize both the collection time and to eliminate empty movements. So everything that is useless must be eliminated and henceforth there is "a place for everything and everything in its place". Since this action allows a reduction in collection time from 26 min to about 8 min:

As illustrate above the comparison between the new process and the old process of picking shows a gap of 20 minutes.

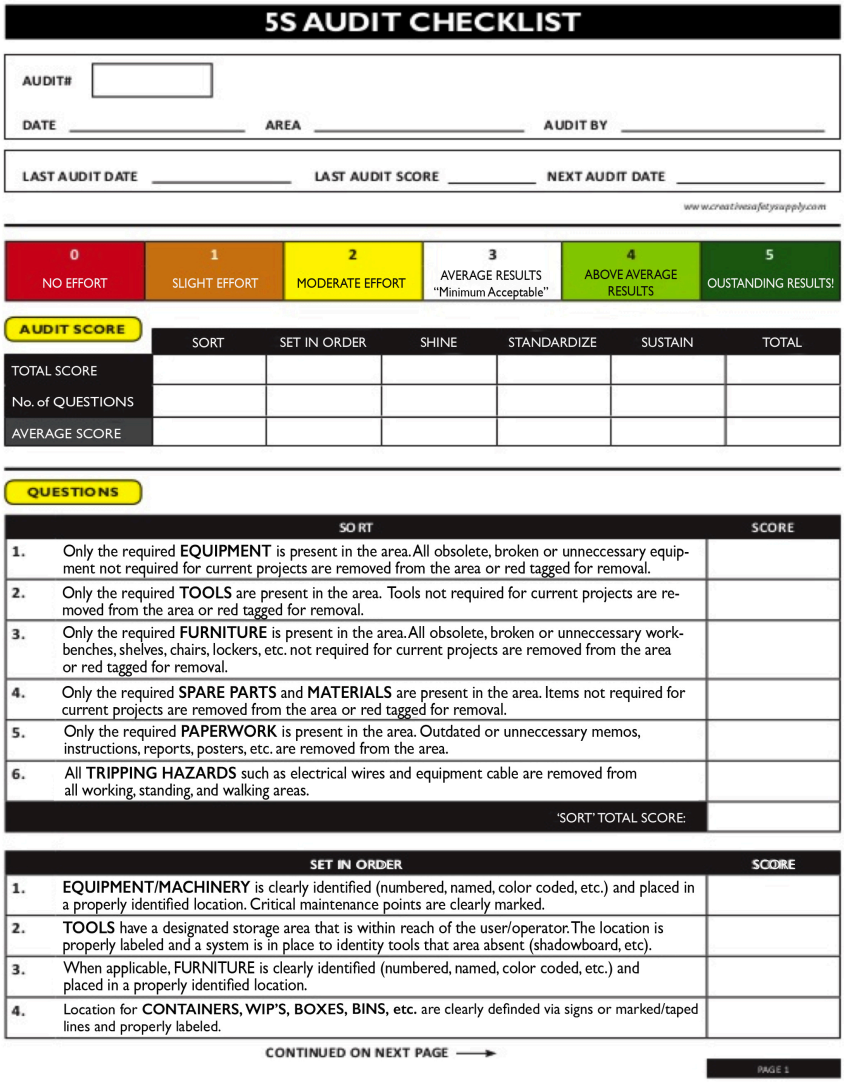
Others benefits:

- Respect of the principle FIFO: first in, first out.
-Control of facilitated dates expiration.
- Reduction (or suppression) of errors.
- Considerable shortening of journeys.
-Good overview of all items in stock.
-Higher productivity thanks to the separation of the replenishment aisles and of the sampling.
- Suppression of superfluous paths.

The 5S audit in W2 : As a result of the 5S implementation, all the staff will be trained on the 5S methodology and reminded that this exercise is never finished and that it is up to them to continue it and especially the maintain. We have developed a management dashboard to allow the manager to monitor and measure the evolution of results. It also helps to check that bad habits have not returned. The dashboard called "audit 5S" is a series of questions to which the manager responds by a visual inspection of the premises.

Using this scorecard, the manager can measure for each step whether the methodology is maintained. It can carry out monitoring at each control and establish corrective actions if necessary.

FIGURE 4: 5S audit checklist



5S AUDIT CHECKLIST

AUDIT# ____

DATE _____ AREA _____ AUDIT BY _____

LAST AUDIT DATE _____ LAST AUDIT SCORE _____ NEXT AUDIT DATE _____

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0	1	2	3	4	5
NO EFFORT	SLIGHT EFFORT	MODERATE EFFORT	AVERAGE RESULTS "Minimum Acceptable"	ABOVE AVERAGE RESULTS	OUSTANDING RESULTS!

AUDIT SCORE

	SORT	SET IN ORDER	SHINE	STANDARDIZE	SUSTAIN	TOTAL
TOTAL SCORE						
No. of QUESTIONS						
AVERAGE SCORE						

QUESTIONS

	SORT	SCORE
1.	Only the required **EQUIPMENT** is present in the area. All obsolete, broken or unneccessary equipment not required for current projects are removed from the area or red tagged for removal.	
2.	Only the required **TOOLS** are present in the area. Tools not required for current projects are removed from the area or red tagged for removal.	
3.	Only the required **FURNITURE** is present in the area. All obsolete, broken or unneccessary workbenches, shelves, chairs, lockers, etc. not required for current projects are removed from the area or red tagged for removal.	
4.	Only the required **SPARE PARTS** and **MATERIALS** are present in the area. Items not required for current projects are removed from the area or red tagged for removal.	
5.	Only the required **PAPERWORK** is present in the area. Outdated or unneccessary memos, instructions, reports, posters, etc. are removed from the area.	
6.	All **TRIPPING HAZARDS** such as electrical wires and equipment cable are removed from all working, standing, and walking areas.	
	'SORT' TOTAL SCORE:	

	SET IN ORDER	SCORE
1.	**EQUIPMENT/MACHINERY** is clearly identified (numbered, named, color coded, etc.) and placed in a properly identified location. Critical maintenance points are clearly marked.	
2.	**TOOLS** have a designated storage area that is within reach of the user/operator. The location is properly labeled and a system is in place to identity tools that area absent (shadowboard, etc).	
3.	When applicable, FURNITURE is clearly identified (numbered, named, color coded, etc.) and placed in a properly identified location.	
4.	Location for **CONTAINERS, WIP'S, BOXES, BINS, etc.** are clearly defined via signs or marked/taped lines and properly labeled.	

CONTINUED ON NEXT PAGE →

PAGE 1

Source: Developed by Author

Research Limitations and suggestion for Further Studies

As we mentioned early our research problem underpinning in this study is how the implementation of Lean 5S can contribute to the improvement of the warehouse in Morocco.

Indeed our study is limited: a) to a general recommendation and in alignment with the goals of Six Sigma which consist improving processes through measuring and analyzing, so the new processes recommended in this study should be measured; b) the study of lean tools and techniques in a warehouse was both challenging and rewarding. Further efforts should be made to deepen the understanding of the lean concept and to improve the understanding of lean thinking in warehouse operations.

Our research perspectives can be oriented in one hand to present the Key Performance Indicators (KPI) which can demonstrate and measure the real contribution of lean warehousing implementation to improve and optimize the global performance for companies; in the other hand to mobilize a benchmarking which can further support performance measurement in the warehouse and identify areas of improvement. By comparing and benchmarking against best-in-class warehouses, the effects of the suggested improvements can be measured.

Conclusion

To conclude, we have developed a study of the reorganization of processes of warehouses as a mode of improvement while presenting the various environmental elements ... learning in general to ensure the quality and value of the product. But is still insufficient because, at the sum of the reorganization, the company has to act and react on other elements: overproduction that generates excessive stocks: excess material, equipment waiting processing generating use of Space and costly and time consuming inventory management. Thus, on the reorganization of unnecessary transport processes because any transport is essentially a waste and must be minimized. We have seen that the Lean Six Sigma philosophy can claim an important place in all sectors. In this case, what obstacles still need to be overcome in order to ensure that hunting for waste becomes a part of morals?

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