Global Journal of Engineering Science and Research Management

THE IMPACT OF THE IMPLEMENTATION OF THE CONCEPTS OF LEAN MANUFACTURING ON THE COMPETING PRIORITIES IN INDUSTRY

Jaouad Kazmane [*1], Anas Chafi [2], Abdelali En-nadi[3]
[*1]Industrial Engineering Department, Laboratory of Industrial Technology, Faculty of Sciences and Technologies, Morocco.

KEYWORDS: Lean manufacturing; the approach of implementation; agility; robustness; competitive priorities.

ABSTRACT

An In a context of strong competition and market uncertainty, the optimization of resource consumption, the agility and robustness of the supply chain constitute more than ever the challenges of first priorities of the survival of businesses today.

In this sense the concepts of lean manufacturing present the levers that allow the development of supply chain strategies of the company through reduction of the duration of production cycles, the inventory reduction, the increase of productivity and the optimization the quality of finished products.

In this paper, we propose an explanatory model of the impact of lean manufacturing concepts on the competitive priorities through the development of strategies SC in term of agility and robustness, the approach of implementation of the concepts of the lean manufacturing, then the main works of the Lean transformation in particular for the extrusion process. . Finally a comparative study of the impact of lean manufacturing concepts on three different extrusion units.

INTRODUCTION

Globalization requires a new culture of the industrial relationship which affects as both the internal operation of a company and its relations with the outside. In recent years, several approaches and tools have been introduced (such as Six Sigma, TPM, Kaizen, etc.) and many advancements have been made. Unfortunately, these suites of tools can not alone be enough to face the consequences of the competitiveness of emerging countries. To meet the new ever more competitive market, highly competitive sectors must innovate and implement quickly and effectively a culture of improvement to support their initiatives [1].

The interest of lean manufacturing, both in academia and business, recorded a continuous increase in recent decades. Part of this interest is justified by the significant results that lean generates in relation to reducing costs and improving quality standards in the organization [2].

The establishment of a secure workplace, organized with standards of working, the orientation of the state of mind and behavior of staff toward the reduction of waste and the motivation are the necessary conditions for a successful integration of lean manufacturing [3].

In this article, we propose through a model, the impact of the implementation of the concepts of lean manufacturing on the competing priorities, the most appropriate to the extrusion processes. The model is constructed based on the empirical results, findings from theoretical framework and analysis. For building the model properly, the process of implementation is detailed initially, then the relationship between lean factors and the development of the strategy of supply chain are illustrated. We also presented, the main works of the lean transformation and the approaches recommended for the implementation on the three separate extrusion units whose process is different (extrusion double walled tube, a film extrusion and extrusion smooth mono layer tube). Finally a comparative study of the impact of lean concepts on the performance of these three units is depicted.

DEFINITIONS AND PRINCIPLES

During the past decade, Lean was developed as the dominant model of development production processes not only in industry but also in the health sectors, administration and general services [4]. It was invented in the seventies by Toyota Motors. The concept applies to the original in production industries but Americans have extended to all of the support functions of the company and now to all the support functions of the company.

ISSN 2349-4506
Impact Factor: 2.265
Global Journal of Engineering Science and Research Management

The lean philosophy aims to eliminate waste where they are in the company, the continuous improvement of the production, the optimization of the basic resources and the establishment a corporate culture whose mission is to identify and constantly promote customer satisfaction [5].

According to Taiichi ohno a lean production system, is a system that obeys the principles TPS, that seeks to eliminate waste tirelessly (Muda), variabilityies and rigidities in the entire production system and to develop the principle of the right in the first time, in order to continuously reduce costs.

The system of Lean production has for objective to satisfy his customer and to reach there it rests on two principles (pillars) and foundations “fig. 1,”. The house of the Toyota Production System [6] “fig. 1,” is a symbolic Representation of a temple built with the main tools which uses the system of production Toyota, Imagined by Fujio cho in 1973. To produce more values, with fewer resources by developing culture of the elimination of the wastes, in an environment favorable to the quality of the work, to the safety of the staff, and to the respect for the discipline. Just in time and JIDOKA are both pillars of the system of lean production. On the other hand the standardization, the continuous improvement and the dialogue of performance are the foundations of the system lean production.

Just in time allows optimizing the use of the resources, to manufacture and to transport the necessary product, when it is necessary, in necessary quantity and with the shortest lead time [7].

JIDOKA is a production process that stops when a problem appears, the goal is to improve product quality, improve productivity and reliability of the equipment [8].

A standard is a visual reference document which defines and organizes the way of working to guarantee the quality, the safety and the productivity; it is developed in common with the people who make the codified task and is respected by all the collaborators.

Fig. 1. TPS House. Toyota Way

The performance of dialogue assures that the anomalies or the ideas of improvement are taken into account, and lead to actions through goals reviews and the corrective action plans [9].

The continuous improvement (Kaizen) allows to improve non-stop the way of working by looking for the innovation.

The continuous improvement asks to handle the cause’s sources and not just to apply a temporary solution [10].

The implementation of the lean philosophy is an ongoing and long-term and its implementation may not reach its destination if the commitment is short-term [11], objective incorrect, poor planning, lack of involvement of employees, methods of training and transfer of knowledge are inadequate [12].

Global Journal of Engineering Science and Research Management

Extrusion is a shaping method widely used in the thermo-mechanical industry. This process comprises passing continuously a molten polymer through a die to obtain a given shape of constant section. We so obtain a large number of finished or semi-finished products, (films, plates, sheets, tubes, cables, profiles).

THE PROCESS OF IMPLEMENTATION

The success of an operational transformation lean manufacturing is guaranteed through the approach based on the three fundamental dimensions [30] which are:

- Operational System: the diagnosis of existing operational systems and future vision, the Establishment of appropriate operational excellence tools (SMED, JIT, TPM…);
- Infrastructure and Management : a working group dedicated to the operational transformation, allocation of dedicated resources, improvement of the management in direct and regular contact with the field (introduction of cascades of meetings, thematic committees);
- State of mind and behavior: development of a corporate culture turned towards operational excellence, development of skills management system (setting up internal training plans), development of oral and written communication elements around the change.

Planning of execution

The methodology is not random, like any continuous improvement project, the approach of lean manufacturing implementation takes place in six phases according to the schedule below "Tab. 1," with particular deadline for extrusion process, according to our experience during the setting-up and the deployment on three production units. Apart the unity smooth tube, the deployment Phase lasted more than other units because the size of the unit and the number of Machines. Other deadlines are average deadlines for the three units still specifically for the extrusion process. The phase duration depends on the nature of the process.

Table 1. Planning Deployment of Lean Project

<table>
<tr><td>3 Weeks</td><td>1 month</td><td>1 month</td><td>1 month</td><td>3 months</td><td>-</td></tr>
<tr><td>Preparation</td><td>Diagnosis</td><td>Vision</td><td>Planning</td><td>implementation</td><td>Sustainability</td></tr>
<tr><td rowspan="3">Constitution of the team, communicate, gather the data</td><td colspan="2">Operational System</td><td rowspan="3">Develop plans of implementation by identified levers</td><td rowspan="3">Implementation on of levers</td><td rowspan="3">Ensure the sustainability of change and improvement</td></tr>
<tr><td colspan="2">Infrastructure and Management</td></tr>
<tr><td colspan="2">State of mind and behavior</td></tr>
</table>

Preparation Phase

It is very common that the steps of continuous improvement start with little preparation. The phase diagnosis risks then to take place in the stress and the haste, what can end in a mediocre implementation. It is therefore essential that certain key activities are carried out before the beginning of the diagnosis phase, for that the project and the team start in the best possible conditions.

In preparation phase there is the establishment of the project team, communication with the operational team on the project, the approach and the objectives referred, finally the data collection (Productivity, Machine speed, time series change, space analysis, Non-availability machines, No quality, Customer complaints, Stocks finished goods, raw materials inventories, displacement analysis).

The essential aspects of the preparation phase to take into account:

- The teams are in place and able to work together;
- The team includes business need;
- The team devotes time to developing relations with key decision makers on site;
- The team spends time in the workshop to understand the existing operational system;
- A working draft plan must be set for the entire project, with details of the first three weeks;
- The logistical elements such as tables for the smooth running of the establishment.

Diagnosis Phase

For the diagnosis phase, we worked on three major objectives, first have a factual transparency on the production tool, its performance by identifying the main dysfunctions, building an integrated view of the perimeter to

ISSN 2349-4506
Impact Factor: 2.265

Global Journal of Engineering Science and Research Management

transform (production system, management infrastructure and state of mind and behavior). Then identify the potential and the main levers, by a definition in a factually way the practicable objectives and to sketch the main levers which allow to reach the goals. Finally align the management and operational team on a factual basis.

For tools of diagnosis, we used the value stream mapping (VSM), analysis of implementation, the graphic in cascade OEE and cost analysis for the operational system. For the diagnosis of the state of mind and behavior as well as the management infrastructure we used investigation social fieldwork.

Vision and Planning Phase

Both Phases vision & planning based on the diagnosis made in the diagnostic phase through the three dimensions (operational system, infrastructure and management and state of mind and behavior). Two workshops of vision (the first one with the operational operators of the production unit and the second with the steering committee) for the design of an improved VSM, the planning of a macro-planning with the levers to implement to achieve this vision, by prioritizing the various suggestions from the participants.

Phase implementation

The implementation phase, consists the implementation of Lean tools recommended to combat waste and operational improvement (see the main works of transformation in relationship with extrusion processes).

Phase sustainability

For the sustainability of the transformation, we have set up a permanent audit schedule assured by a rotation of the project committee in order to ensure the sustainability and improvement of the existing.

THE MAIN WORKS OF LEAN MANUFACTURING TRANSFORMATION

The main works in the implementation phase which correspond better to extrusion processes according to the diagnosis phase are [13]:

Performance management

Performance management project which is to put in place performance management through the establishment of indicators for monitoring the performance as well as the animation of the performance reviews for the handover of instructions, the gone back up of the information as shown in "Fig. 2," and finally the resolution of problems.
In addition to the weekly technical meeting which has was already existing, we have introduced three other meetings; the first is the meeting of the end of post, which has for objective the gone back up of the problems, give feedback on the monitoring of production. The second meeting is the daily meeting of performance which has the objective to analyze the performance of the previous day (D-1) and ensure equity of treatment, the third meeting is the meeting of resolution of problems and monitor medium-term actions.

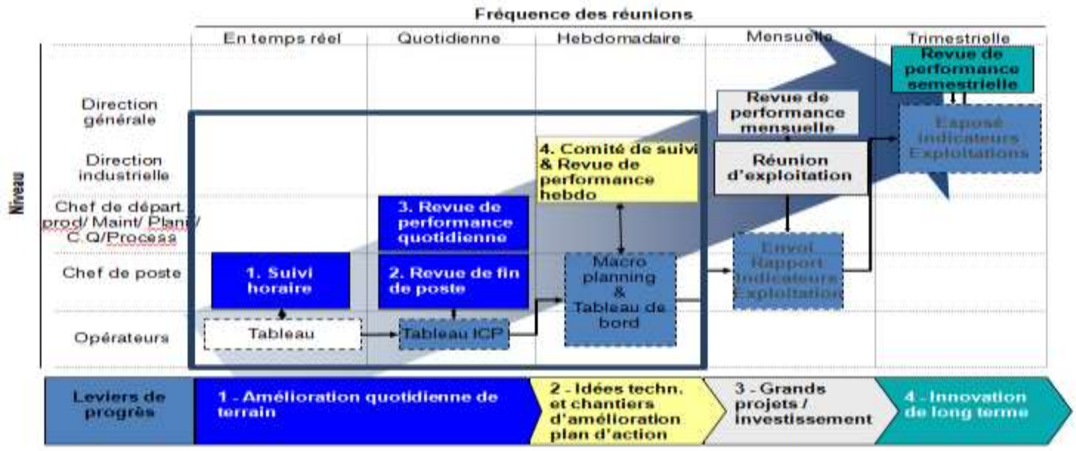

Fig. 2. the declination of the performance reviews

ISSN 2349-4506
Impact Factor: 2.265
Global Journal of Engineering Science and Research Management

SMED

For a reduction in a systematic way the time of change of series with a quantified objective. With the production team we have analyzed the different video of the series change operations and we have implemented action plans (standards, reorganization of staff and infrastructure) to achieve the goals established in the vision phase.

Table 2. Action Plan SMED Project

Action	Commentary
Reorganization and identification of the racking storage production tooling	For a maximum exploitation in more a more rapid access to the tooling designated
Organization, identification of crates of tooling	For a good management and preservation of the tooling, reduce the time of preparation and research.
Organization, identification and inventory of clamping screw	A good management, mastery of the change and reduce the time of change, sometimes 2 to 3 h of research of screws
Achievement standards of serial change in collaboration with the team leaders after analysis	-Control and training of the team to the spots of change -Standard in the form of Gantt diagram for a better management of tasks in order and in effective (the tasks in parallel and successive)
Manufacture the brackets of tooling, cages, table of change	-Protect the state of tooling and facilitate the handling. -Achievement of external tasks (change of the inserts with the table)
Audit of change	Ensure the follow-up, the proper conduct of the change and the proposal of improvements for the standards achieved
Use tools handling	Secure and facilitate handling

Table 3. Table Showing the Organization Before and After the Implementation of the SMED Project

Before	After
	
	

Spare parts

For a better management of spare parts, we realized a database with data sheets for management, monitoring and identification, in order to avoid out of stocks (improved availability and therefore OEE).

Standard

Global Journal of Engineering Science and Research Management

Standard project, for the generalization of the best practices and the optimization of resources used, we have achieved standards of working in two forms, The first type concerns the standards of organization with the illustration and the second in the form of Gantt diagrams for a good mastery of the chronology of tasks and the allocation of resources, as well as training sessions for the production teams, also the fact sheets audit for the monitoring and improvement of these standards.

Numéro	Emplacement	Désignation	Qté	Outils de serrage	illustration
1	Caisse N° 1 ID 200 J 5	Poinçon interne	1	Clé BTR N° 17 avec douille / visseuse pneumatique	
2		Poinçon externe	1		
3	Rayonnage K5	Filière	1	Clé BTR N° 19 avec douille	
4	Caisse N° 1 ID 200 J 5	Buse matière couche externe	1	Clé BTR N° 6	
5		Buse matière couche interne (1)	1	Clé plate N° 13 + clé entrefer	
6		Buse matière couche interne (2)	1		
7		Pièce de serrage de buse matière couche interne (2)	1	Clé de serrage entrefer	
8		Clé de serrage	1		
12		Support de maintien et fixation (conduite eau, air et vide) avec(8)	1	Clé BTR N° 6 et N°2	
9	Support mandrin rayonnage K5	Porte mandrin	1	Clé BTR N° 8	
10		Mandrin	1	Clé BTR N° 8	
11	Caisse N° 1 ID 200	Punch (relié avec (10))	1	Clé BTR N° 6 et N°2	

Fig. 3. Standard of Tools Organization

5S

For an optimization continuously working conditions by ensuring the organization, the cleanliness and safety.

Global Journal of Engineering Science and Research Management

Before 37%	After 15%
	

Fig. 4. Figure Shows the Space Gained (22 %) after the Implementation of the 5S to the Inside of the Production Unit

Planning

Planning project, in the face of the volatility of markets the planning of activities of the company has become an extremely difficult exercise. An upgrade and integration of the PIC/PDP, in order to improve the visibility and the optimization of the changes of series to increase the time of functioning and consequently the OEE.

PROPOSAL FOR AN EXPLANATORY MODEL OF THE IMPACT OF LEAN MANUFACTURING CONCEPTS ON SUPPLY CHAIN STRATEGIES THROUGH THE COMPETING PRIORITIES IN THE INDUSTRY

Model construction

As part of the implementation project and deployment of lean manufacturing concepts in the various functions of a Moroccan company specialized in plastic extrusion and as project manager lean manufacturing, we have highlighted the concepts of lean manufacturing the most suitable for extrusion processes, the positive impact on SC strategies in terms of agility and robustness through the competing priorities [14].

With the operational team we implemented the lean manufacturing concepts in a first time in the manufacturing unit of double wall tubes, then manufacturing unit of plastic films after the manufacturing unit of smooth tubes, in order to generalize these concepts in all these industrial units and subsequently the different function of the company.

From the different implementation phases explained above and the experience required during the phases of implementations we have highlighted the following intersections & relationships especially for plastic extrusion:

Relationship & Intersection "extrusion process - lean manufactruring" the most appropriate concepts:

The lean is an organization of continuous improvement very interesting, offers several types of concepts, among these we have selected the concepts which provide the best solutions for the problems raised during the phases diagnostics for the three units:

- Performance Management: Monitoring snapshot of key performance indicators and the resolution of problems, awareness and integration of operational teams on the levers of reducing waste, establishment of three meetings, meeting of end of each post 8h, for the gone back up of the problems and feeding the necessary comments on performance, daily meeting of performance for the analysis and monitoring of the performance of the day before (D-1) in the presence of all the departments, weekly meeting of problem solving for the treatment of medium-term actions, analysis and reflection on the improvement projects.

Global Journal of Engineering Science and Research Management

Based on the experience during the deployment phase, we found that the performance management tool is one of the tools that have given more added values for the three production units, especially in the level of piloting, decision support and the resolution of problems in the short and medium term. The weight of impact is big because it does not exist before at the operational level, only at the management level. This positive impact can be generalized to all types of industry, to all services and also for small and medium enterprises, the fact of the flow and relevance of the information that guide the strategic level.

- SMED: In the Diagnosis phase, we found that the change of series constitutes the major part of NOEE, for example the double wall pipe unit where the change of series constitutes 35% of NOEE, while the unit smooth pipe unite it presents 11% of NOEE, by against the FILM unit the change of reference is done without tooling change, only changes to the level of the parameters of the machine. With these values, we have been led to use the SMED tool. The latter allowed us to reduce the time of change of series for the two units (35 % a 19 %) and (11 % a 7 %). In the continuation phase, we found that the SMED tool in addition to the reduction in the time series change, it allows the improvement of the know-how and the mastery of the series change operation by exploiting the concept of external and internal tasks. Finally we re-confirm the impact of the SMED on the OEE according to the results realized on the processes which the series change constitutes a considerable part in the NOEE, for the other industries, the tool SMED has already showed in the automotive industry, as the example of Shigeo shingo to MAZDA, MITSUBISHI and TOYOTA.
- Standard: The operational teams of the three units have participated in the achievement of the standards which we standardized the best practices generated by the tools used in the deployments of Lean concepts such as SMED, 5S and JIT. We have noticed a great interest to the standards achieved compared to the other documents of the company; firstly the latter are made afraid themselves, under forms of visual reference, they touch the bottom of their activities and they respond better to the daily needs in good practices, in more they incorporate the safety flap in the manipulations. For the updating and the improving the standards achieved, we have associated sheets of audits with each standard.
  The standards are essential for the process which are characterized with manipulations non-automated by machines and that require the manual intervention of operators as the series change for our case, in order to have a mastery of the chronology of operations, the reliability of the acts performed and the safety for the personnel. We consider that the standards present the hold of the PDCA wheel to prevent the Lean system to go back.
- Just in time allows to adapt the planning and the management of spare parts, through pushing the coordination between the various actors in the planning and maintenance during the meetings of resolution of problems, in order to update the PDP. Thing that not done before and which gives no vision on the planning of series change, our major problem (35% NOEE for double wall unit). With the JIT mode, an adaptation of the planning of the series changes, has enabled us to promote the scenarios of articles which have a large number of elements in common with the aim of optimizing the number of items to change and therefore the time and the number of series change. Also at the level of consumption of energies, the planning of the heating of the extruders during off-peak hours to optimize the energy consumption (which is characterized by a high consumption) and at the same time advance in the internal stains. For the spare parts, the continuous update of the preventive maintenance plan, in order to avoid the prolonged stoppages because of breaks in spare parts, proposal of plans of action following the anomalies observed in the inspection sheets remplient by the people of production service make management of maintenance service more efficient.

  The JIT allows to overlap the Lean tools with a good orchestration in the time and the space, in the optical of optimization and rationalization of the resources, as in our case study, the number and the time of change of series, energy consumption and intervention of maintenance service.

  Just in time allows optimizing the use of the resources, to manufacture and to transport the necessary product, when it is necessary, in necessary quantity and with the shortest lead time [7].
- 5S: the 5S method offers efficient working conditions, secure, excellent image reflects to the outside and a favorable environment for the development of the concepts mentioned above.
  For our case study, in the three units, the 5S method has allows to make enormous positive changes in terms of gain in space, the culture of collaborators such as the accumulation of objects ((useless)) under the slogan (this can serve a day)).

The 5S method has already demonstrated its values in the TPS system and according to our deployment in the different units, the 5S method is the first method to implement for the introduction of the other methods and continuous improvement tools.

The relationship & intersection « concepts of lean – OEE » Improving the OEE and the key performance indicators (which will be after presented in the calculated impacts):

The Overall equipment effectiveness is certainly indicator of performance the most used in the industry. In a single value it gives a severe indication, without concession of the performance, hence its qualifier of «synthetic". To better analyze the positive impact of lean, it must nevertheless analyze the impact on different components as shown in "Tab. 4,".

Table 4. Impact of Lean concepts on OEE constituents

	Performance	Availability	Quality
Performance Management	Increase the performance by capturing the full potential of continuous improvement	Increase the reactivity	Highlight the non-compliance with standards
SMED	Increase the capacity to Respond more quickly to demand	Increase the frequency of adjustment	batch size reduced, increase the quality
Standard	Ensure productivity	Ensure the safety of personnel and equipments	Ensure the quality
Just in time, planning and management of spare parts	Stabilize the process, reduce the time to change	Reduce the variabilities	Reduce the risk of obsolescence of the stock
5S	Environment which entraine the improvement of the safety of the ergonomics and framing the behavior	- Put back the installation in its original state; - Ensuring the presence of appropriate working tool ; - Improve the reliability of installations by eliminating the sources of soiling	Respect for the instructions of conduct assures the obtaining of the quality

The relationship & interaction « constituent of the OEE - Développement of the strategies SC (Agility & Robustness) » :

The improvement of the OEE and its constituents engender a positive impact on the concepts of robustness by the creation of a stable environment with reliable actors as well, on the concepts of agility, the capacity to respond quickly and appropriately to changes in the short term [15]. See "Tab. 5,":

Table 5. Impact of the OEE and its constituents on the development of SC strategies (concepts of agility and robustness)

	Robustness	Agility
Performance	- Certify and accredit reliable and efficient suppliers; - Produce in small batch with very frequent changes; - Add the volume (safety stock) without additional investment.	- Respond quickly to the request; - Ensure the productivity; Make available the capacity
Availability	- Ensure a stable environment; - Win the maintenance costs and energy	- Choice of tools adapted to the types of waste and use them in strict accordance with the method; Reduce the opening hours of the lines; - Move the staff according to demand ; Eliminate the work of night/ weekend.
Quality	Standardize the detection	Adjust the line speed to the needs for optimum load balancing

Global Journal of Engineering Science and Research Management

The relationship & interaction « Développement of the strategies SC (Agility & Robustness)- the competing priorities » :

The agility and robustness concepts are participating in their towers in the developments in SC strategies through the creation and strengthening of competitive priorities to capture them at the earliest opportunity and minimize the exposure of the business to threats [14],[15] and [16], see the calculated impacts in the extrusion industry.

Table 6. The impact of agility and robustness concepts on creating competing priorities

	Cost	Lead time	Order quantity	Quality	Stock level	Flexibility
Robustness and Agility	reduction	short	small batch	From source	reduced	high
Cases of the industry plastic extrusion which practices the Lean manufacturing	-Reduction of the scrap rate, the rate of waste, energy consumption ; -Logistics cost by the availability of the full range.	-Reduction of the series change; -Optimal planning of the series change to win in common elements; -Improvement of the performance and availability	High level of efficiency which allows the mastery of performance, availability and quality	- The establishment of standards; - Perfor mance Manage ment and Problem solving	Availability of the full range	- High level of the rate of compliance schedule; - Mastery of change of series.

The model

From the theoretical and empirical results, it can be inferred that there are many factors linked to the other and they have different relationships. As mentioned before, the objective is to give a brief understanding about the relationships and the influences between the factors. In addition, the integration model also serves as a pre-study frame work & prototype model for the industries which focuses on the integration and can be done in industry specific contextual scenario of their supply chain. The work of Carvalho et al., (2011) is an inspiration for the model

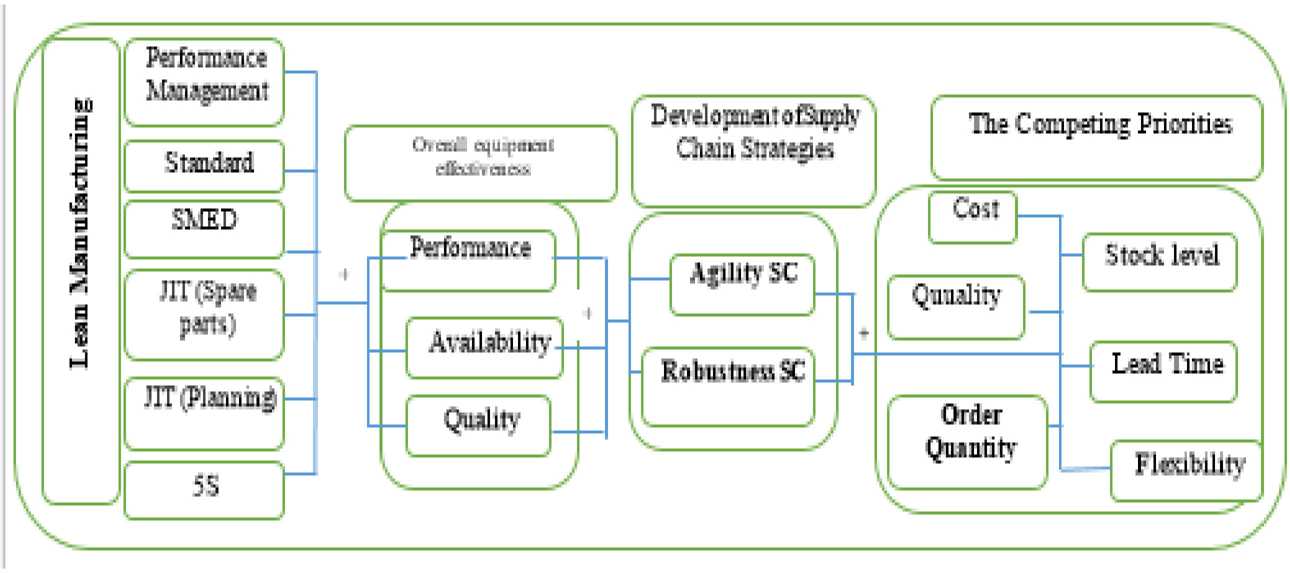

Fig. 5. Modelling the impact of the concepts of lean manufacturing on strategies Supply Chain through the competing priorities

Global Journal of Engineering Science and Research Management

Quantified impact in the industry: plastic extrusion case; Comparison of the impact of lean manufacturing on the three units

To ensure the development of its activities and obtain a better position in the market, the company must put in place an improvement at the level of its organization and especially of its production system, in order to cope with these new challenges. This is the purpose of this project which was launched in a first time in the double wall pipe unit, currently in sustainability phase, then in the Film unit is currently in phase of sustainability and after in smooth pipe unit, currently in the final phase of the implementation of lean manufacturing. This project has established all the works mentioned above to ensure the optimization of resource consumption, fight the wasting to create and upgrade the competing priorities as shown in "Tab.7,".

Table 7. The calculated impact of the lean manufacturing on the three units before and after transformation

Key Performance Indicators	U1 : double wall pipe unite		U2: Film unit		U3: Smooth pipe unit	
	Before	After	Before	After	Before	After
OEE [%]	33	67	72	85	76	88
Schedule compliance rate [%]	37	79	83	88	78	92
Change of series [h]	[42 , 71]	[29 , 47]			[4 , 8]	[3 , 7]
Number of change of series per month	[3 , 4]	[2 , 4]			[8 , 10]	[8 , 12]
Scrap rate [%]	0,44	0,2	0,63	0,54	0,35	0,24
Waste rate [%]	3,42	2,2	4,8	3,7	2,3	1,95
Energy consumption [kwh/kg]	0,85	0,75	0,49	0,37	0,32	0,29

In "Tab. 7,"., we see the positive impact of Overall equipment effectiveness OEE for the three units, especially for the unit U1 (new unity which was installed recently, in more the changes of series which present approximately 35 % of the NOEE) this last has recorded a net increase in the average value of 33% to 67 %, This increase is assured by the good results generated by all works that have been taken at all levels and in all mutual intersections for mastery, improving the skills and acquire the appropriate tools. For the unit U2 which already recorded a good level of the OEE seen the special feature of the manufacturing process(the changes of references are realized without tooling change, changement of width only, Thickness and the wording which corresponds to the finished product request) the big works has been done at the level of the improvement of the formulation of mixtures of the raw material, the latter has improved the performance of the machines to the level of the output speed and therefore the machine flow rate. These recent interventions and in addition the works of lean have allowed for an increase of 72% to 85 %. Finally the unit U3, the OEE has recorded an increase of 76% to 88% knowing the transformation is in the final phase of the implementation of the tools SMED.

An increase more meaningful at the level of the rate of compliance schedule for the unit U1 because of the improvement of the OEE, The reduction of series change, and the updating of the PIC and PDP by favoring the scenarios which have a large number of elements in common in order to reduce the operations and consequently the time of series change. "Fig. 6," [13], illustrates an impact among other which concerns the regular adjustment of the PDP (weekly) in the planning project, which in turn gives better visibility to the SMED project, to anticipate in external actions for the reduction of time and the number of series change, the latter enters the gear with other projects such standard, 5S and management of spare parts to improve availability and reduce NOEE and so on. Knowing that in the implementation phase, we found that the series changes constitute almost 19% of NOEE instead of 35% of NOEE during the diagnostic phase for the double wall pipe unit.

The performance management project, especially the meetings of end of post and the daily meeting of performance allowed more monitoring and sensitization for the reduction of waste and scrap of material. In the end the planning of the heating of the extruders (operation that requires more energy consumption) in the hollow time, the improvement of the productivity allowed the reducing the cost of consumption per kilogram.

Fig. 6. Mechanism for reducing NOEE

Finally this increase in OEE and compliance schedule rate has a positive impact on the concepts of robustness, by creating a stable environment with reliable actors and on the concepts of agility, by the ability to respond quickly and so adequate to short-term changes. These concepts offer commercials advantages in particular to this area of activity.
A particular characteristics regarding pipe manufacturing and which makes the difference between the suppliers, is that the client requires the availability of the entire range, i.e. the smallest up to the largest (in order to put in the operation of transport and storage, the references the smaller in the larger who follow them and so on, telescoping principle) to ensure optimization at the level of logistical costs.

Finally, “Tab. 7,”.of the calculated impact of lean manufacturing transformation shows the benefits generated by the projects proposed by the lean manufacturing at the level of production cycles, inventory levels and the optimization of resources of the company.

CONCLUSION

In this work, we have tried to show that the lean is in the heart of the development of the strategies of the company by the continuous elimination of all the waste and the activities to non-added values to the customer, by the use of a set of tools and methods which aim at the agility and robustness of the Supply chain. We have concluded that the company of today has a great interest to extend the lean practices throughout the supply chain seen the relationship that exists between the latter, for the improvement and strengthening of competitive priorities.

Then, we have presented the works headlights recommended in the diagnostic phase and who presented solutions to the issues raised during the workshops of vision to succeed and improve the whole of the organization and the key performance indicators, then a proposal of an explanatory model of the impact of the lean manufacturing concepts on the supply chain strategies through the competitive priorities in the industry of plastic extrusion and finally a comparison of the calculated impact of lean manufacturing for the three production units.

Finally the Lean manufacturing has evolved into complete system, whose effective implementation involves cultural changes within the organizations and new approaches to the management of links with all interfaces of the company.
This work is part of the current trend of lean manufacturing, which aims to provide elements of a response to the design and implement the essential mechanisms of the LSC and finally put in phase the concepts of lean manufacturing the most suitable to the industry.

REFERENCES

1. E. Arnheiter, J. Maleyeff, “The integration of lean management and six sigma”, The TQM Magazine, Vol. 17, 2005
2. A. Furlan, Vinelli and G. Dal Pont, "Complementarity and lean manufacturing bundles: an empirical analysis", International Journal of Operations & Production Management, 2011, Vol. A247, pp.835 – 850,

3. Rivera L., Chen F. F., « Measuring the impact of Lean tools on the cost–time investment of a product using cost–time profiles », Robotics and Computer-Integrated Manufacturing, 2007, Volume 23, Issue 6, , pp 684-689
4. T..Ikram., C. Abdelghani, "Role of cognitive ergonomics in the design and successful implementation of a Total Lean Environment", International Journal of Research and Reviews in Mechatronic Design and Simulation, , 2011, Vol. 1, No. 4, pp.79
5. Abdulmalek, J. Rajggopal, "Analyzing the benefits of Lean manufacturing and value stream mapping via simulation: A process sector case study", International Journal Production Economics 107, 2007, pp 223-236,
6. J. P. Womack, T. D. Jones, D. Roos, The machine That Changed The world,Vepuriswar, www.vedpuriswar.org, 2007
7. M. Holweg ," The genealogy of lean production", Journal of Operations Management, Vol. 25, No. 2, 2007,pp 420–437, http://dx.doi.org/ 10.1016/j.jom.2006.04.001.
8. Ballé M., "Jidoka, le deuxième pillier du Lean", working paper n°2, projet Lean Entreprise, 2004
9. M. Robert., R. David, "From Lean Manufacturing to Lean Supply Chain:A Foundation for Change", CFPIM, LAWSON, 4-13
10. S. Shingo, " A Study of the Toyota Production System from a industrial Engineering Cambridge, MA, 1981
11. N. Kindler, J. Krishnakanthan, and R. Tinaikar, "Applying lean to application development and maintenance", The McKinsey Quarterly, 2007, pp.1-5
12. R. Cigolini, M. Cozzi, M. Perona, "A new framework for supply chain management: Conceptual model and empirical test", International Journal of Operations & Production Management, 2004, Vol. 24 Iss: 1, pp.7-41
13. J. Kazmane, A. Chafi, I. Tajri, A. Ennadi, "The impact of the concepts of lean manufacturing on strategies of the supply chain", Internationnal Journal of Engineering & Technology, Vol. 4, No. 1, 2015, pp.35-47
14. J. Kazmane, A. Chafi, I. Tajri, A. Ennadi, "The mechanisms and the measurement of the performance of the ecosystem lean supply chain management", CIGIMS, 2015 "in press"
15. Baromètre Supply Chain Agilité et Robustesse, Capgemini Consulting France, Supply Chain Magazine, l'Ecole Centrale Paris et l'ESSCA Ecole de Management, 2011
16. Martha Cooper, M. Douglas, Lambert, D. Janus Pagh, "Supply Chain Management: More Than a New Name for Logistics ", The International Journal of Logistics Management, Vol. 8 Iss: 1, 1997, pp.1 – 14
17. N. Slack, " The Manufacturing Advantage: Achieving Competitive Manufacturing Operations", Mercury Business Books, 1992
18. K. Demeter, Z. Matyusz, "The impact of Lean practices on inventory turnover ", Int. J. Production Economics, 2009
19. R. Shah, T. Ward P, " Defining and developing measures of Lean production", Journal of Operations Management, 25 (4), 2007
20. S. Arawati, Mohd ," Lean production supply chain management as driver towards enhancing product quality and business performance", International Journal of Quality & Reliability Management, Vol. 29, No. 1, 2012, , pp92-121
21. M. S Rathje, T. A Boyle,P. Deflorin, " Lean, take two! Reflections from the second attempt at Lean implementation". Business Horizons 52, 2009, pp 79-88
22. R. Shah, T. Ward P, " Lean manufacturing: context, practice bundles, and performance", Journal of Operations Management, 21 (2), 2003
23. D. Everton, E. Sergio., P. Edson, W. Heliore,"lean supply chain management: Practices and Performance Measures", Industrial and systems Engineering Research conference,(2012,pp1-13
24. A. Cox ," Power, value and supply chain management", Supply Chain Management: An International Journal, Vol. 4 No. 4, 1999, pp 167-175
25. C. Chandra, S. Kumar," Supply chain management in theory and practice: a passing fad or a fundamental change", Industrial Management & Data Systems, Vol. 100, No. 3, 2000, 100-114
26. R. Cuthbertson., W. Piotrowicz.," Performance measurement systems in supply chains: A framework for contextual analysis", International Journal of Productivity and Performance Management, Vol. 60, No. 6, (2011),pp 83 – 602
27. Y. Wu," Lean manufacturing : a perspective of lean suppliers", International Journal of Operations & Production Management, Vol. 23, No. 11,(2003),pp 1349-1376

ISSN 2349-4506
Impact Factor: 2.265

Global Journal of Engineering Science and Research Management

28. N. Stephen," The scope of supply chain management research", Supply Chain Management: An International Journal,Vol. 2, No. 1, 1997, pp 15-22
29. M. Paul," Lean Supply Chain & Logistics Management", McGraw-Hill Professional, 2012
30. J. Drew, B. Accallum, S. Roggenhofer, “Objectif Lean Reussir l’entreprise au plus juste: enjeux techniques et culturels “ Edition d’organisation, 2004