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THE APPLICATION AND IMPLEMENTATION OF THE KAIZEN MODEL

CASE LANTECH

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ABSTRACT

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The focus of the chosen theme arises from personal attention to the functioning of the company in its most intimate organizational and functional dynamics. Today more than ever, in fact, there is a need to know how to master and understand the business complexity, both in terms of resources used and organizational models and strategies. This translates not only into a careful assessment of performance, but also in constant monitoring of the processes that lead to defining the final output.

In this way it is possible to affirm and guarantee an effective and efficient system not only in terms of economic sustainability, but also and above all capable of determining the layout of a production activity, of identifying problems in the activities inherent to production and of how to intervene in order to correct these imperfections and obtain a fluid process.

Finally, the purpose of this thesis was to highlight how a relatively dated case such as that of Lantech (1995), can still serve as a starting point and inspire contemporary companies in the search for the best solutions to be undertaken to improve, rationalize and innovate their own production process.

Keywords[1] Lean thinking, stimulation, and research methods

CONTENTS

1 INTRODUCTION

The following paper aims to highlight and expose the considerable dynamics that allowed the adaptation in the West of the "Kaizen" methodology, which originated and developed in Japan. The relevance of this issue is in fact verifiable in both economic and organizational behavior since the adoption of the aforementioned Japanese methodology had a notable impact on the production processes within companies and their main dynamics.

In the first chapter, the key concepts that, within companies, allow to implement a strategy of constant improvement and the processes that must be followed in order to implement full organizational maximization will be presented. Therefore, the following concepts will be highlighted with particular attention:

- the definition of flow of value
- the 5S method and its use
- what and which are the most important "Muda"2 with a focus on what can be done to eliminate them.

In the second chapter a case study will be analyzed, featuring the American company: Lantech. The case company bases its production activity on the construction of machines for the wrapping of transport loads, Lantech was characterized by a production process quite complex and complicated, and due to the specific nature of the product, delays were frequent in production and delivery.

The case study was implemented in order to explain and demonstrate the application of the Kaizen methodology within the company. The Lantech company will be analyzed over a period of about 15 years, during which will be illustrated the

[2] Japanese word that identifies an action that does not create value for the company and for the final customer. In general, it could be translated with the English word "waste".

main organizational dynamics from the year of its foundation in 1972 until the conversion into a lean company which took place between 1991 and 1995.

In particular, in the first part of the second chapter the company will be presented in its own widespread characteristics, its history and its production method, arriving later to the reasons that made its transformation necessary. In the second part, the process of conversion into a lean company will be examined. The focus will be on actions undertaken by the founder Patrick Lancaster, which made it possible to implement and supplement within the corporate culture, the principles, and techniques that they formed the foundations of the Kaizen methodology.

Finally, in the third chapter, thanks to the data collected in the case study, the effects and consequences of the organizational revolution promoted by the Kaizen methodology will be analyzed. In particular, the effects will be mainly analyzed and commented on the company structure, on the layout of the factory, on the quality and timing of both production and delivery of the product, and the effects on the turnover and costs incurred by the company.

2 LEAN THINKING: HISTORY, CULTURE AND DIFFIUCION

2.1 Mass production: Origins and Imperfections

Lean Production is a production philosophy that aims to maximize the company structure in terms of effectiveness and efficiency, in order to launch a product on the market, which value perceived is the maximum possible for the final customer. More specifically, the Kaizen methodology is the basis of this philosophy and, in general, of the organizational process corporate. Originating in Japan, where it was first introduced by Toyota, the Kaizen methodology has made it possible to transmit the Japanese culture on the subject of to the West production and organizational principles, distorting and innovating the dynamics until then known. (Yang, 2021)

In the period following the introduction of mass production and the advent of large factories the widespread belief among them was represented by the exploitation of economies of scale, economic policy which consists in using large volumes of inputs in order to obtain the maximum yield within the factory, while reducing the average unit cost of the production. The pioneer who brought this innovation was Henry Ford, at a time when the car was a luxury item produced in small quantities and specialized on the basis of customer requirements.

In particular, at the beginning of the twentieth century Ford launched the now famous model T on the market, characterized by being the cheapest car model of all cars competitors. Such a competitive advantage was due to several factors:

- The car consisted of a single standardized model
- Its components were perfectly interchangeable and simple to assemble, so to allow even the most inexperienced driver to easily solve the resulting problems from the use of the vehicle without necessarily resorting to consultancy and assistance from a specialist.

In addition, the introduction of the assembly line and the use of large amounts of input unskilled workers, who were assigned a simple and easy-to-reproduce task, allowed Ford to achieve maximum production efficiency, thus gaining the majority market share in its sector for the following fifty years. (Editors, 2020)

However, following the relocation of the production of many components of the Model T, Ford encountered quite a few logistical problems: in fact, despite having a good part of the pieces produced abroad, reducing the costs of production and assembly, the final product was to be assembled at the main Detroit factory. Further problems were then created due to the lack of a true organizational structure and centralization of every decision in the figure of the owner. The main consequence of this was a certain rigidity towards the possibility of change and the possibility of growth of each business unit.

In contrast, about seven years after the introduction of Ford's Model T, Sloan, CEO of General Motors, proposed a structure for the first time multidivisional. Decentralizing the majority of decisions to individual divisions and giving the latter greater autonomy, creating managerial figures capable not only of leading the single division but also being able to control them and allowing them to fully exploit their potential. Thanks to the combination of Ford's production techniques and Sloan's managerial techniques, mass production reached its stage of maturity in 1955, reaching the apex of its diffusion in various countries of the world. (J.P. WOMACK, 1990)

However, this method was widely criticized during the 1950s and therefore changed to a new current of thought, "Lean Thinking". (J. P. WOMACK, 2003) One of the most incisive actions operated by this organizational philosophy was going to identify a series of wastes, which up by that time they had considerably reduced the value produced by companies, also allowing to highlight the policies and strategies to run such waste.

2.2 Taiichi Ohno: Muda and the concept of JIT

Taiichi Ohno was the father of the Japanese-style managerial philosophy, called Lean Production. He was vice president of Toyota Motors, in which he developed concepts of notable relevance, such as: the muda and the JIT (Just in Time). In particular, during his work he tried to develop operational and organizational strategies that were capable of fighting the so-called muda, or the waste that occurred in the production process. (Ohno, 1978)

The strategy chosen to fight the muda was precisely that of Lean Production: Ohno in fact, it aimed to achieve the most efficient use possible of the resources belonging to the company. In other words, the Japanese entrepreneur aspired to achieve maximum results thanks to the correct use of inputs and the reduction of the processes and tasks envisaged in the productive process.

According to Ohno, there are three main types of actions within a production company:

- actions that create value (such as, for example, the transformation of a piece of steel in the chassis of a car).
- actions that do not create value, but which cannot be eliminated given the technologies and the current production facilities (these actions concern quality inspections and tests that a product or service must overcome. According to the Japanese entrepreneur, these they are defined as type 14 muda).
- actions that do not create value and can be eliminated immediately (These actions are defined by Ohno as muda of type 2).

In the preceding lines, the concept of value was mentioned: in economic terms, the value of a product (or a service) is identified in the value perceived by the customer. In particular, if the consumer does not believe that there is a correspondence between the value considered and the value attributed by the producer to

the product (or service), the consumer may decide not to make the purchase or, in an economically worse scenario, it may not be satisfied with the use of their resources. (Ohno 著. 大.-T., 2001)

Going forward in the discussion of this theme, it is also necessary to mention what is identified with the expression "value flow": this identifies the set of actions taken to create a product or service, therefore the set of the actions that contribute to creating its value.

Once the flow of value has been identified and all its passages analyzed, all the muda type 2 must be eliminated and rearrange it so that the value flows and type 1 muda come transformed into actions that create value. Aiming to achieve this goal internally of the company, it was necessary to carry out a skimming of business operations and create a small team with a charismatic leader on command, capable of solving everyday problems without the need of top management.

A further innovation brought by Lean Production was the use of the JIT method (Just In Time) and of a pull-type logic for inbound and outbound logistics and inventory management. The JIT aims to produce exactly the quantities required by the customer and in the times defined by them: with the application of this method (which is often confused and misidentified with the concept of lean manufacturing) we obtain the decrease and the elimination of muda. According to the JIT, in fact, the waste is distributed along the entire chain of value - upstream with suppliers, downstream with customers - and above all in the management of stocks of raw materials, semi-finished and finished products that fail to meet the needs of the end customer within the times and quantities specified. (Toyota Motor Corporation, 2021)

The most common techniques used to implement this method are:

- the decrease in production batches.
- the containment and control of the times of the production cycle.
- the improvement of the timing of the retooling of machinery.

The following results are consequently obtained from the application of these techniques:

- the reduction of inventory management costs given that production is not anticipated, which was based on a forecasting process of final demand, there will not be unnecessary stocks in the warehouse.
- the optimization of the production process, given by the approach of the production phases and the downsizing of the lots.
- a considerable improvement in the quality and reliability of the product.

Originally, in order to introduce the JIT, the "kanban[3]" was used; However, this system is nowadays rather obsolete, although still used by some companies. In fact, with the increase in company information systems and the creation of increasingly powerful databases, the control board has lost its usefulness and has been replaced by MRP systems (Material Requirements Planning), designed to feat algorithms that allow to calculate the requirement of the company based on the final demand.

Most of all, this system allows to avoid the risk of recording a high inventory average of semi-finished and finished products. Furthermore, MRP systems are part of ERPs (Enterprise Requirements Planning) a software that contains all the necessary information for the management of the company, and which can be exchanged internally at run-time.

[3] Translated into English it means "card": these control cards identified the product or component and marked where they came from and where they had to go for each step of the production system. In this way, the risk of overproduction was reduced, since only the requested product was produced, in the requested quantities and within the requested delivery times.

2.3 Kaizen: general characteristics

Among the bases of Lean Production there is the Kaizen methodology, a term composed of two words Japanese: "KAI", which is translated as "improvement", and "ZEN" which is translated as “Continuous,” therefore “continuous improvement.” This philosophy was aimed, in fact, to implement a series of small constant progress over time, which would allow to maintain high production standards and to optimize times and product quality. This methodology was one of the factors that granted the Japanese a competitive success. (Imai, 2003)

In order to introduce this philosophy, top management must be able to understand its points key, the systems, and their role in the implementation phases, to ensure that the strategy of continuous improvement is effective. The pillars of the Kaizen methodology can be summarized in the following points:

- improvement of the production process.
- follow the PDCA and SDCA cycles.
- putting quality first and, consequently, introducing TQM systems (Total Quality Management) and TQC (Total Quality Control).
- the JIT (Just In Time).
- have a good database and a solid company information system.
- consider “the following process as the final customer.”
- set a specific and sustainable goal to be achieved.
- create teams that deal with small groups of activities.

In order to implement a Kaizen strategy, the management first has the task of maintaining current operational, technological, and managerial standards, without lowering them. Furthermore, has the task of trying to raise them through activities that aim at improving processes and that could lead to innovation.

The PDCA (Plan-Do-Check-Act) cycle or Deming cycle is one of the first steps to follow to be able to introduce a Kaizen strategy. In the denomination of this cycle, we can identify the meanings of the different parts that make up the name:

- “plan” indicates the process of selecting an improvement target and it is essential that such an objective is set for the strategy to work.
- "do" indicates the implementation of the plan designed to achieve the desired target.
- "check" indicates the control activity that must be conducted regarding the introduction of this plan and makes sure it leads to improvement.
- "act" means implementing the established plan and trying to standardize it so as not to risk going back to making the mistakes prior to its introduction and try to set new improvement goals.

The following figure shows the Deming cycle:

(J.P WOMACK, 2003)

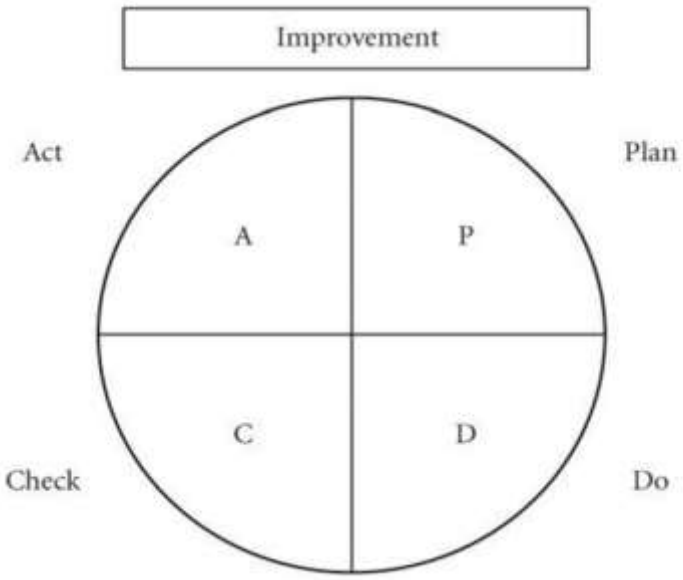


Figure 1 - The PDCA cycle

However, before being able follow the Deming cycle, all activities of the company need to be standardized in order not to create mistakes that would hinder improvement, and it is precisely this is the goal of the SDCA (Standardize-Do-Check-Act) cycle. According to the Japanese, quality is the most important factor to consider in order to implement an improvement strategy that is continuous and competitive; followed then by the cost and delivery times (Quality-Cost Delivery). Precisely for this reason, Japanese managers have begun to use the TQC / TQM system, the first focused on the quality of the production process, while the second focused on all activities controlled by management.

The "T" of total does not refer only to the activities carried out, but indicates that each person within the organization is involved. The "Q" indicates quality as a priority of the company, but without forgetting to take into consideration the cost and delivery objectives. The "C", instead, it refers to the control of the process to the analysis of its performance and possibilities for improvement; while the "M" stands for the activities carried out by management to be able to implement plans that lead to the improvement of processes and consequently to an improvement of results.

The axiom "the process following is the final customer", if observed correctly, can make many qualitative and productive improvements for a company that wants to implement lean manufacturing. Before a product is actually delivered to an end customer it must pass through a large number of processes: in fact, this axiom considers two types of customers: internal customers and customers external to the company. Whereas the majority of individuals who work within the company have relationships especially with the first type of customers, if the axiom is shared and followed by everyone, a level of attention and control of each production step, obtaining the best possible result and, of consequently, being able to make the final customer perceive the greatest value that he could attribute to the product. (Imai, 2003)

In order to succeed in a Kaizen strategy, autonomous teams are usually created internal to the company who have the task of managing small groups of activities that allow to achieve more quickly the goals that the company has set for itself. An example of these groups are the "quality circles" that do not exclusively deal with quality related problems of products or processes, but also of cost, safety, and productivity problems. Therefore, quality circles support the main activities of the company and allow the various areas companies to achieve their maximum performance.

2.3.1 The 5S

The methodology for improvement called "5 S" is a methodological approach, born within the philosophy of Lean Production which aims to initiate and maintain a process reduction and elimination of waste present within an organization, raising in a continuous way the working standards and the quality of the product.

Hiroyuki Hirano, who made it famous, calls it the pillar of "visual work" control visual that allows to have the situation of a department under control at any time productive. In fact, today this methodology is used in many realities. His application, in fact, may involve a reorganization of equipment and tools work, materials, files on our computer and so on. (Hirano, 1995)

1st S: SORT. The first thing to do is to carefully observe what there is within the company and identify what is really useful for the company. In practice it is necessary to eliminate all those objects and documents that accumulate occupying space unnecessarily and create disorder. In essence, this first phase must be followed in order to distinguish what is really useful for the company and what is not.

2nd S: SET in ORDER. In the second phase after defining what are the documents, objects, and essential tools to be able to continue working activities and finish business processes, have everything in order, so as not to waste time and concentrate on work on continuous improvement of the company's performance.

3rd S: SHINE. In this phase of the model, the goal is to keep it clean and tidy, and the equipment provided, the places and the materials are in good working order. Every employee is responsible for their workstation. An environment that follows these rules allows not to create waste and to be able to reason and solve any problem that we can present.

4th S: STANDARDIZE: the standardization of tasks is one of the fundamental base necessary for the introduction of any kaizen strategy. Establishing a standard allows to have a yardstick regarding business performance and sets the stage for to

be able to begin an improvement process. The goal of this phase is to keep the work areas organized and functional, without creating confusion or misunderstandings that lead to the emergence of waste that would be harmful to the company.

5th S: SUSTAIN: in the last phase of the model, attention must be paid to the people belonging to it, to the organization and management. The management in this phase has the task of monitoring employees and set the goal of being diligent in the workplace, trying to align the individual objectives of the workers with those of the company thus achieving maximum cohesion of the group and maximum efficiency from the point of view of production.

2.3.2 The 7 Muda of Ohno

The seven wastes of lean production, defined muda in Japanese, represent the ways in which companies waste their resources and are: overproduction, time, stocks, transport, movements, defects and finally the processes.

1. Overproduction: if it is produced with a system of lots and queues, not following a logical pull type, and therefore resorting to advanced production, there is a risk of having inventories of a variety of products. Lean production is based on the management of the final demand so as not to constitute a full warehouse that leads to increased inventory management costs.

   To avoid running the risk of overproduction, it is necessary that the structure and business processes are not rigid but on the contrary very flexible, to cope with any sudden changes in demand. Also, program correctly production in order to calculate the necessary requirement of products to be produced for being able to satisfy the orders received within the established times, is an additional capacity necessary to be able to introduce lean manufacturing.

   Overproduction is certainly the most important and most difficult muda to have manage or delete. Moreover, to ensure optimal production management it is necessary to have an IT support capable of updating in real time all employees on the progress of the production process. A good example are ERP systems.

2. Time: in the absence of good coordination between the workers and the phases of the process production, which can lead to downtime along the production chain, therefore long waiting times and a general slowdown in production. These wastes of time lead to a general inefficiency of the business system and absolutely must be eliminated.

In this case we need to study a valid strategy that can eliminate all those delays unnecessary in the production flow. Not a simple operation even in this case, but very performing if implemented correctly.

3. Inventory: The costs of managing inventory are one of the biggest problems that a company has to face. A company that has a warehouse that is too full shows that the latter does not have the necessary skills to meet customer requests and therefore a lack in the management of the final demand which is reflected in an inefficiency of the production process, and consequently run the risk of a possible overproduction.

4. Transport: the waste related to transport concerns all those operations that require the movement of a raw material of a semi-finished product or of a machine from one department to another and which lead to a slowdown in the production process and that therefore they involve a waste of time and resources. Precisely for this according to the lean production it is optimal to approach the various stages of the production process and consider carefully which transports are needed and which are deemed additional, and which can safely be avoided.

5. Movements: one of the most common waste that does not add any value to the product final are the movements within the processing cycle, that is, the waste due not to the transport of resources, but the movements of the workers of the machines and of the product same that they are superfluous and that if they were minimized correctly would cause a considerable increase in productivity and efficiency of the company considered.

6. Defects: Production defects lead to customer dissatisfaction and consequently a possible loss of confidence on the part of the latter in the ability

of the company to produce a better product or service than the competition. The only tool available to identify the origin of the defect is the analysis and meticulous control by part of the employees of the entire production cycle step by step, so as to identify in at which point in the process the defect occurs and what actions can be taken in place to try to reduce or directly eliminate the problem.

7. Processes: through the analysis of the entire production process, it is possible to identify the phases that are inefficient and do not add value to the product. And it is only through constant monitoring of all the activities that make up the resulting process It is possible to isolate and eliminate those phases which as opposed to bring a gain cause an increase in costs or possible waste of time.

All of these wastes are present in all businesses and constitute a loss in value for each of them. The only weapon available to a company that wants to fight and defeat the muda, is the focus on business flexibility and pay more attention to needs and the value perceived by the customer. (Fujisawa, 2022)

3 THE LANTECH CASE

3.1 Methodology

The sources selected and used for the drafting of this thesis are varied and diversified: in fact, they are cited from the more traditional texts on the subject to images, diagrams, and tables, in order to support the discussion of the chosen topic. Mover, the interest in the Lantech company was created due to a conference from the “Lean Enterprise Institute” on said company that was held in 2017. In addition, a large number of resources used are directly related to the author background as they are traditional Japanese articles and books references.

3.2 Lantech: History of the company and study of the original production method

Lantech is a US company founded in 1972 by Pat Lancaster, at the height of a serious energy crisis. The main activity of the company is to combine pallets of products for shipment. Billions of pallet loads are being stretched to date every year. The preparation and the capabilities that distinguish the core business of this company have made it possible to offer ever better products; furthermore, Lantech has led to a culture of innovation that it has generated some 277 patented inventions, which have enormous benefits for businesses that have used them, while eliminating waste from their supply chains.

Lantech currently manufactures suitcase handling machines in the Netherlands and machines for wrapping and packing transport loads in the United States. Moreover, having sales and technical support offices in most countries around the world, as well as a global network of independent distributors and service technicians, the company manages to be very present for all their types of customers. As for the mission, this is noticeably clear: Lantech aims to reduce or eliminate the enormous amount of damage and waste created by the shipping that occurs when products move from the factory to their point of destination. (Lantech, 2022)

In light of the great success that had been found by Lancaster's product, the latter turned to an experienced manager to be able to manage the operational activities. The person in charge of operational activities therefore introduced a system, based on the division of each of the phases fundamentals of building a Lantech wrapping machine in multiple departments. Concluded the final assembly the machines were transported and there they remained, waiting to be purchased from the customer concerned.

Given the nature of the product, customers usually buy one machine at a time: therefore, when requested by a customer, the car was cleaned and repainted. Furthermore, in order to satisfy the specific requests of the customer, the machines are usually passed on by the final assembly department, in order to complete the

changes requested by the customer and change the initial equipment of the machine. The last step before the expedition concerned the packing department. The initial layout of the factory and therefore the production path of the Lantech machines is shown in the following figure.

(J.P WOMACK, Lean Thinking: Banish Waste and Create Wealth in your Corporation, 2003; WOMACK, 2003)

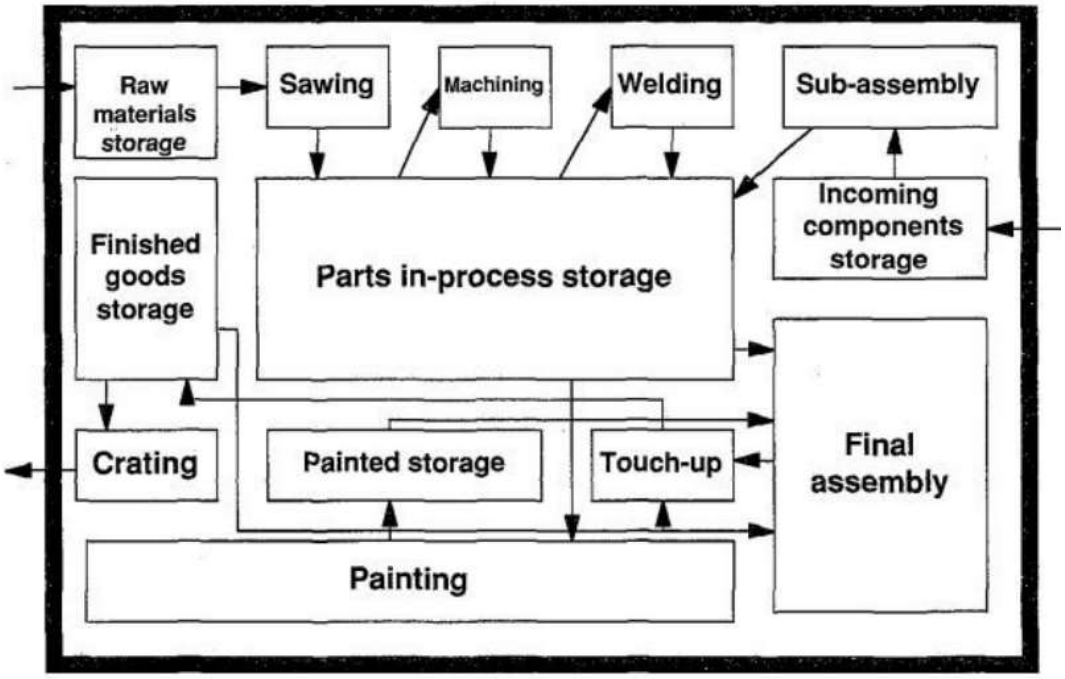


Figure 2 - Physical production in Lantech

Given the choice to produce large volumes of these wrapping machinery, trying taking advantage of economies of scale, Pat Lancaster had to pay more attention to management of orders, due to the high customization of the product offered to customers. It was decided not to establish standard prices, and consequently the price was defined by the sales office following a cost analysis; once the negotiation was concluded, the order was sent to the company for the schedule production. When the order arrived at the office in charge, the latter took care of it to pass it through all the necessary departments, so as to be able to organize production

and set up a bill of materials, that is a list of all the components necessary to build the machine.

These mandatory steps for a number of different offices cause delays in production and, therefore, in the delivery of machinery. Finally, the order went to the programming office which, in close contact with the operational production activities, defined the flow of production in the plant and defined the lead time of the product and any production stresses if there was a delay in delivery. The path taken by the orders is shown in the figure below.

(J.P WOMACK, Lean Thinking: Banish Waste and Create Wealth in your Corporation , 2003)

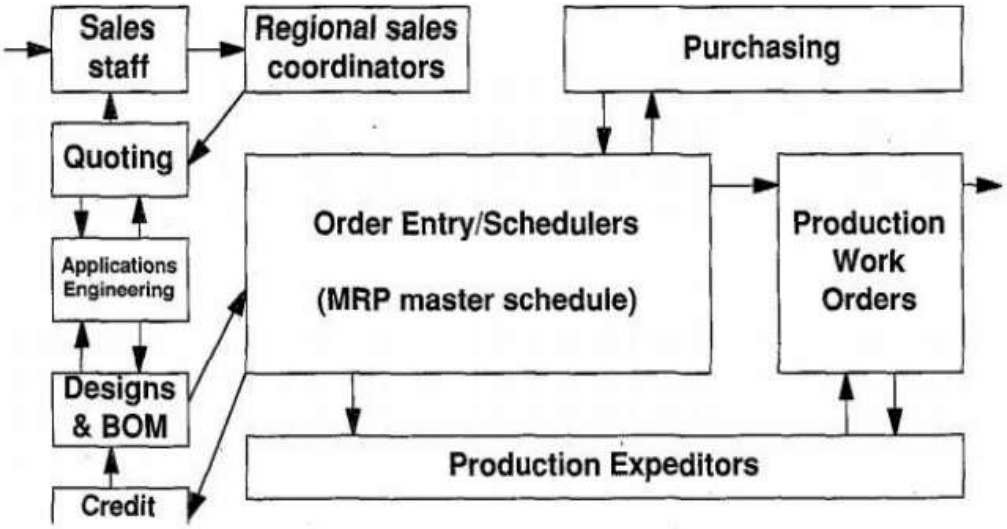


Figure 3 - Order flow in Lantech.

In order to correctly plan production and obtain reliable forecasts on sales, the programming office relied on MRP software. This system allowed to send the tasks of the day to each department every day. However, with this system it was inevitable to create some confusion when customers asked for some particular specifications for the purchased machine. Consequently, Lancaster decided, in conjunction with his head of operations, that to obtain economics scale should have begun to work in batches: this intuition allowed minimize machine downtime related to retooling.

Unfortunately, the level of complexity of the production and the long transfer times of components from one department to another always caused many delays in the delivery of the finished machinery. For these reasons, the company had to try to manage the orders more efficiently that were received by the sales office, to try to satisfy customer demand, keeping up with the times and not producing obsolete machines. In this regard, Lantech tried to devise new projects in the shortest possible time and in the most efficient way, since up to that moment the conception of a new project required many steps between the different engineering offices with the support of the marketing department (such as shown in Figure 3). The development of these new projects and better management intelligence operations led Lancaster to great success. Ten years later, in 1989, due to a lost cause relating to the alleged violation of patent by a competitor, a breach was opened in the market, and this allowed competitors manufacturers to overcome the barriers to entry of the industry.

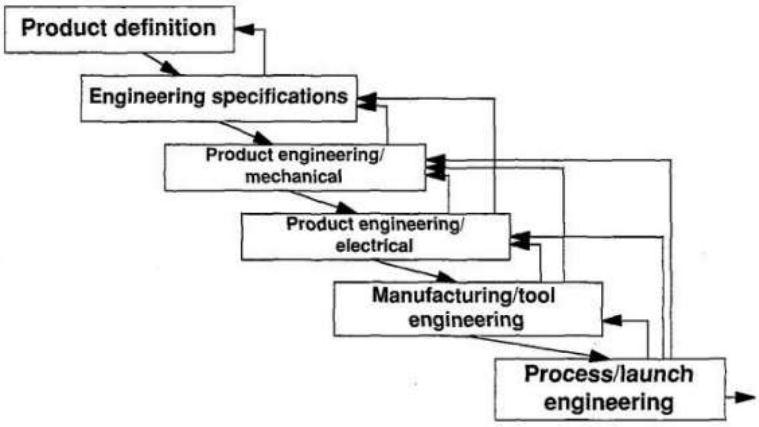


Figure 4 - The Lantech product development system.

Lantech's loss of market share forced Lancaster to use one downsizing strategy. In order to revive the fortunes of Lantech, Lancaster began to follow the Total Quality Management movement that rather than focus on economies of scale, suggested optimizing business processes to offer greater value to the end customer. To implement this system Lancaster made a generational change in the board of

directors and instead of following the usual pattern of a type of command style top-down, he formed a team of managers willing to give feedback and teamwork.

With the inclusion of these innovations Lancaster was able to introduce a new production method defined "max-flex", through which he managed to drastically reduce production times, creating in advance the stocks of the most requested components, so as to be able to combine the different parts of the product more quickly and making them conform to the specifications of the machines purchased by customers immediately after confirming the order.

Lantech tried to compensate for the price disadvantage through faster delivery of customized machines. The implementation of this new production system then did drop lead time dramatically; however, the costs incurred by the company appeared really high, since the early establishment of warehouses - based on forecasts fictitious - caused the cost of managing stocks to soar, and the constant changes required by the customers regarding the specifications of the machines caused a slowdown in production and consequence of the delivery of the final product.

Moreover, despite the attention paid by Lantech in the planning of production cases of shortage of key parts in the warehouse began to increase completion of the machine, and to solve this problem the enterprise turned to production solicitors, specifically for the parts that were missing. Afterwards a further attempt to get out of the crisis in the nineties was the update of the system production planning using the latest generation MRP software.

Unfortunately, this decision turned out to be fallacious, as the new system allowed every worker to know their work arrangements through the computer in their workstation, but not being as accurate as the previous system, rather than helping to recognize errors and solving them in time, causing inexorable waste and inefficient management of information. On top of that, the changes made made the computer very slow. All that I brought Lantech in 1991 to almost nothing to make

up for and respond to fluctuations in demand, despite the reduction in prices: a condition that made it necessary structural intervention. (Leaper, 2017)

3.3 From traditional to Lean

At a time of this crisis in 1992, a turning point came for Lantech with the hiring of Ron Hicks as the company's vice president of operations. The latter had learned the techniques and methods of lean philosophy working for the Hennessey Industries of Nashville controlled by the Danaher Corporation, which towards the end of the eighties managed to convince some of Ohno's disciples to outsource operational activities in the United States with the aim of educate revolutionize their businesses.

Ron Hicks first came across lean production during a visit to Bloomfield's Jacobs Brake Company, also belonging to the Danaher group. There he was amazed at the applications of the principles dictated by Ohno; therefore, following this visit, he realized the enormous possibilities for improvement for companies and the optimization of all production phases. He was able to put into practice what he learned in 1992: when he was hired by Lantech he revolutionized the layout of the production plant. In addition, he created teams to reconstruct the value flow of wrapping machines and to make the value of all the factory's products flow, introducing new strategies for the management phases of product development.

3.3.1 New layout of the company

Like Jacobs, Lantech aligned the activities essential to the design, order management and production of a machine so that they could be executed in sequence, one at a time in the precise order. In general, lots were banned, back flows and waste of all kinds. To achieve this, Hicks implemented a plan, which is to disaggregate the four types of basic machines that passed through the various departments of the production system, and organized by batches, constituting production cells for each type of machinery, and consequently realigning within each cell all the activities necessary for the production of a machine, and carry them out following a continuous flow. This phase of reorganization of the company's production plant is called kaikaku[4]. He soon also changed the model of the car from the T / V model to the newer Q model. The following figure shows the flow of the Q model.

[4] Japanese term which is translated as "revision of the production system". This concept is used during a Lean construction site that faces a global and transversal process of the company

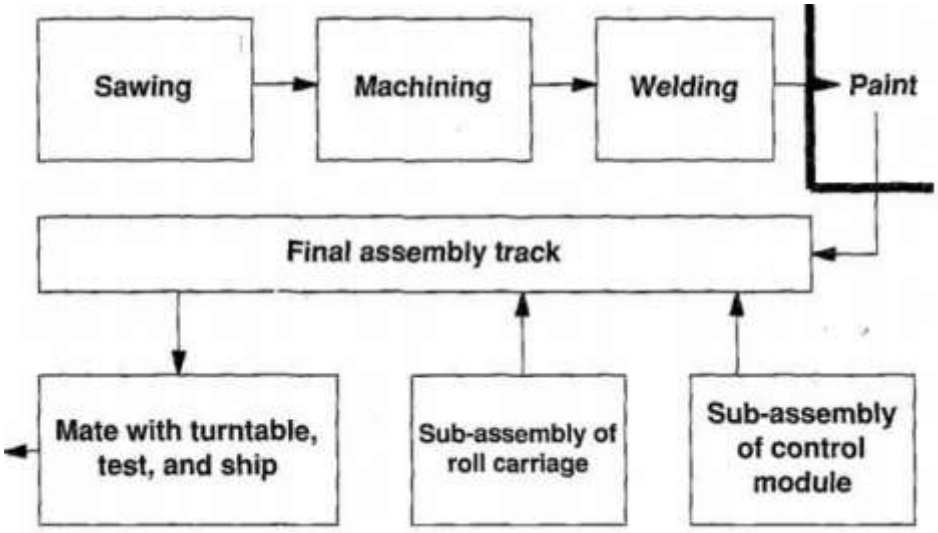


Figure 5 - The flow of the Q model

Consequently, the mechanical processes that were sequenced to the welding operations, while the painting was applied for all four models of machines in the huge plant used. Then the continuous flow continued towards the pre-assembly and final assembly phases (as shown in Figure 5).

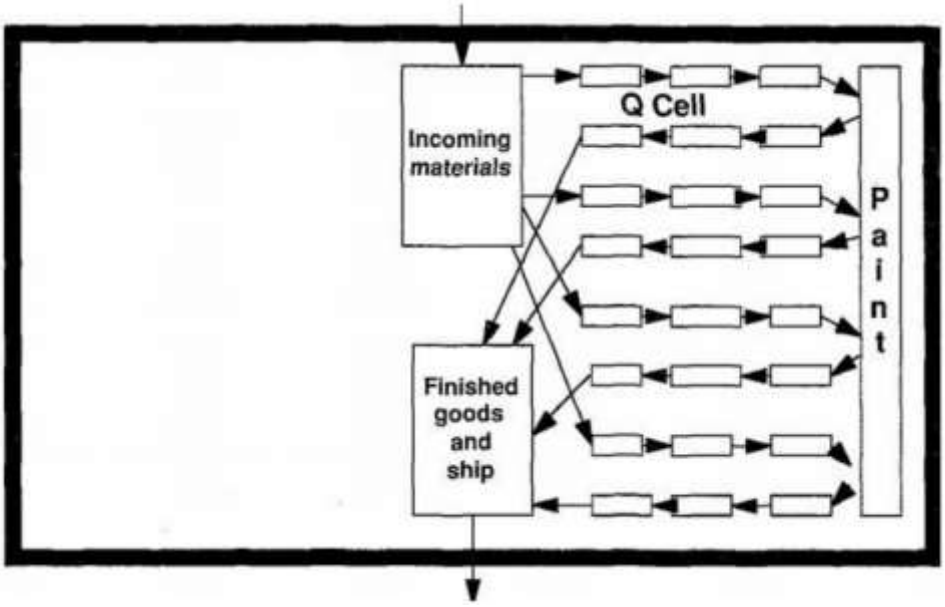


Figure 6 - The new layout of the factory in Lantech

Furthermore, the testing and packaging phases were placed at the end of the path. A great innovation was the introduction of a conveyor belt that kept itself

constantly in motion, defining the timing of the activities. Thanks to this new internal organization, the production time for a single machine dropped to about 15 hours.

Once the specific order for production had been defined, it was necessary to start thinking in terms of standards to be respected in order to correctly carry out all the operations without making mistakes. Furthermore, the concept of “takt time” was introduced, which represented the number of machines that had to be produced daily in order to satisfy the orders received by the company and dividing di by the number of working hours on the day in question.

This implied that if the quantity of orders did not require the full use of all the machines and operators, this takt time had to be raised, since it aimed at maximum exploitation of the plant without creating stocks. Two other innovations were made by Hicks, namely the downsizing of the equipment and machinery used in the production plant to adapt them to the production cells.

This made it possible to introduce rapid retooling of all machinery thus reducing the downtime of the various parts of all machines, from one step to the other in the production chain and maintaining a certain variety of options. At the beginning this new system did not work due to the many problems, the lack of standardization of the activities and moreover due to a lack of maintenance of the plants by the workers present in Lantech up to that moment.

However, later thanks to the head of production the system began to mesh. Towards the end of '92, Lantech's production system had been converted from batch and queue production to a continuous and unitary flow. The results obtained from the application of this new organization of the production plant, despite the fact that the number of employees remained unchanged between 1991 and 1995, doubled the number of machines delivered; the production plant had 30% more free space in the warehouse despite the doubling of production; the number of

different defects detected by customers went from ten per machine in '91 to about one in '95.

Moreover, in 1995 the production time as already explained passed from 4 months to more or less 15 hours; moreover, the percentage of machines delivered by the date established with the final customer increased by 70%. Having accomplished this revolution Lancaster in '92 set up a Kaizen team made up of workers left without a specific task whose task was to design, plan and implement improvements in the various activities. Following the introduction of each improvement, the best worker in the reorganized process was transferred to the Kaizen team, in order to stimulate and motivate all employees, and to obtain higher wages as soon they would all be more specialized and capable. (Lean Leaper, 2017)

3.3.2 New system for order management

The techniques introduced to revolutionize the layout of the factory were applied in the same way as reorganizing the offices and specifically the order management process. First, an additional Kaizen team was created, made up of the workers involved in the affected process, the company's technicians, the factory's Kaizen team workers and an external consultant. This group was able to trace a new flow of value by identifying and eliminating all waste and wasted time

The consequences of implementing this system were very positive, so much so that the time required for order management was lowered from about 3 weeks to 2 days. Thanks to this innovation, computerized programming systems became obsolete. An MRP system was maintained to be able to manage the orders of materials in the long term, while the daily scheduling was carried out thanks to a blackboard placed in the sales office (this is an example of visual control), on which the day was divided into certain sections. from takt time.

At the end of each working day, a list of the machines to be produced the next day was transcribed and brought to each production cell. Each cell was given the name of the customer and the machine ordered as well as the delivery date, usually a couple of days after the start of the production process.

As a result, the information management office was eliminated since the information relating to the product and the product itself could be monitored simultaneously, without the need to contact an office in charge. The following figure shows the path of the new system.

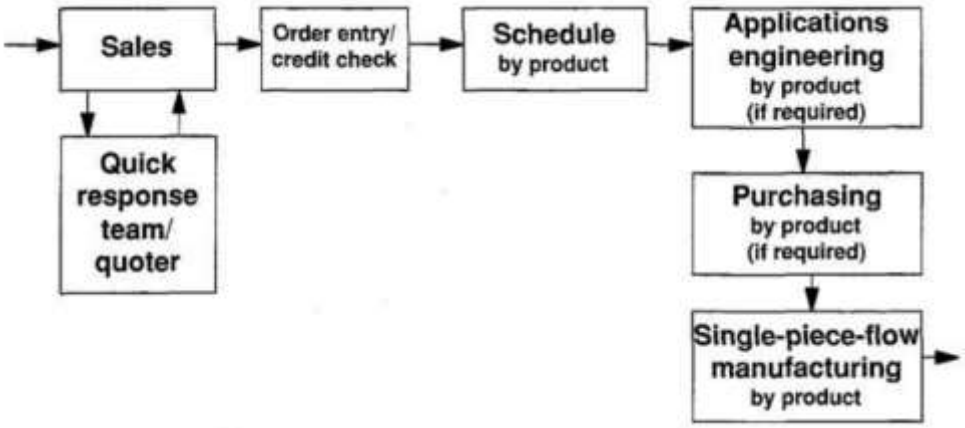


Figure 7 - New Production Flow in Lantech

The main problem is that Lantech had to face this revolution was the fact that both the distributors and the buyers of industrial equipment were not at all accustomed to fast and on-time deliveries.

3.3.3 New system for product development

The last step necessary to transform the company into a lean company was the reorganization of product development. Lancaster, knowing that it did not have time to find a new business and did not have enough liquidity to be able to detect competitors, was forced to innovate and try to reinvent its product range so as to be able to expand into an already established market.

Knowing that it would benefit from the redesign of its products, from the point of view of lowering costs and raising quality, Lancaster's goal was to create a unified flow also for product design, as had happened both for orders and machines. Originally a limited number of projects were entrusted and conducted by a leader who played the role of solicitor, or on other occasions teams were created with non-authoritarian leaders at the head who tried to coordinate the work of the various technical specialists, of whom the knowledge was necessary for the development of the project.

However, each of them had their own times and priorities. The problem was identified in the fact that both an authoritarian leader and a weak leader were in no case responsible for the final results of the project, so it was not possible to establish a priori whether the product really corresponded to what a client was looking for and had about. need. Therefore, it was not possible to determine whether or not that project would generate profits.

In 1993, Lantech implemented a new system based on defined “dedicated” teams headed by a person who was personally responsible for the fate of the project, and therefore less responsible for the success of the product during its life cycle. Defined an annual planning process at company level, which is the determination of which were the most relevant projects, and which absolutely should have been developed during that year.

A dedicated team of specialists was created for the two projects identified as the most important. This consisted of men of marketing, mechanical engineering, electronic engineering, manufacturing engineer, purchasing, and finally manufacturing. These groups were focused and had to work tirelessly on the assigned project, while the multitude of smaller projects that previously slowed down the engineering office were completely eliminated as they would never start or be completed in any case.

This continuous improvement of the prototyping process within the company made the presentation times of a working prototype faster, and therefore allowed to be able to quickly notice any construction and performance problems that the mechanical engineers could have quickly solved.

Despite some criticisms leveled against their activities, it turned out that the members of the dedicated teams were actually the most competent and the most specialized in solving the problems presented by a prototype, or the possible problems of flow discontinuity that could arise. They also realized that with a little bit of careful planning, and by transferring a small number of specialists from one team to another and vice versa, the problems that needed to be addressed could be resolved more quickly.

Proof of the goodness of the new system was the launch of the new S series in 1994 developed in one year. Moreover, for the production of this machine only half of the resources that were usually used previously were required, and moreover the number of defects found by customers was an infinitesimal percentage

compared to previous models. The steps for designing a new product are shown in the following figure.

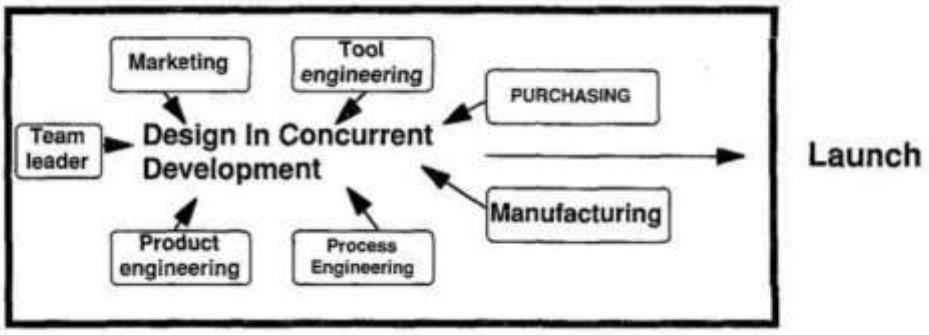


Figure 8 - The new design flow from Lantech

3.4 An example of new products

One of the greatest successes for Lantech following the accomplished lean revolution was the new S series given low production costs and remarkably high performance. The invention relates to the elastic wrapping of a load with packaging material and more particularly the control of the tension of the packaging material during the wrapping process.

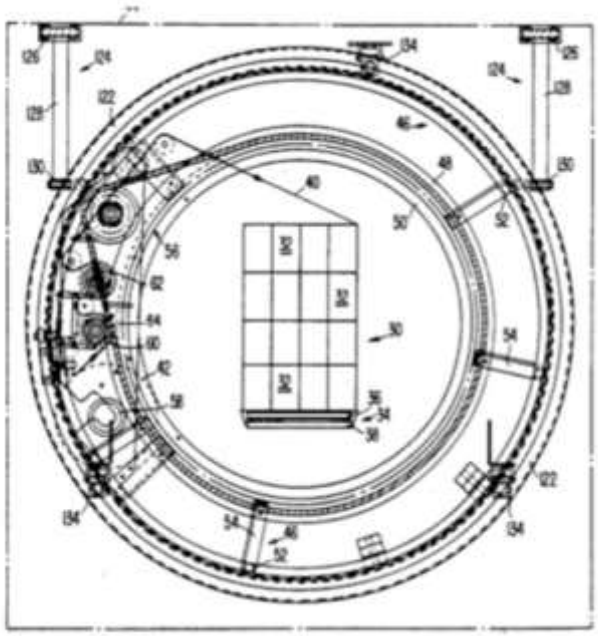
Elastic winding devices were used with the aim of wrapping a tape of packaging material stretched around a load to be transported, through a rotation between the load and a distributor of packaging material. In some places the dispenser includes pre-stretch rolls which rotate at different speeds to stretch the web before it is placed on the load and a movable roll which was used to control the dispensing of the film and to stop dispensing.

The wrapping and stretching process begins by loading a roll of packaging material, such as elastic film, into the dispenser. After loading the roll, the front end of the film tape was threaded through the pre-stretch rollers around the mobile roll, and consequently fixed to the load.

This tension can be provided by a brake which holds the roll of film while it is being dispensed, or by a roller placed between the roll of film and the load, connected to a brake. The voltage applied to the packaging material can only be provided by a mechanical interconnection between the upstream and downstream pre-stretch rollers.

Thanks to the skills from the knowledge learned during the conversion into a lean company, Lantech was able to optimize the product as soon as it came out in such a way that the risk of any deficiencies in the packaging method, or the risk for the safety of the load to be transported was lowered. by about 30% over time. By acting in this way, Lantech was able to make the customer perceive a higher quality and increase the latter's confidence in the seriousness and skills of the company.

Even today, the S series is one of the best-selling models and one of the leading products for Lantech. The following figures show the S-300 model of the current S series, and the images belonging to the patent obtained by Lantech in 1994 that laid the foundations for the design and construction of today's models.



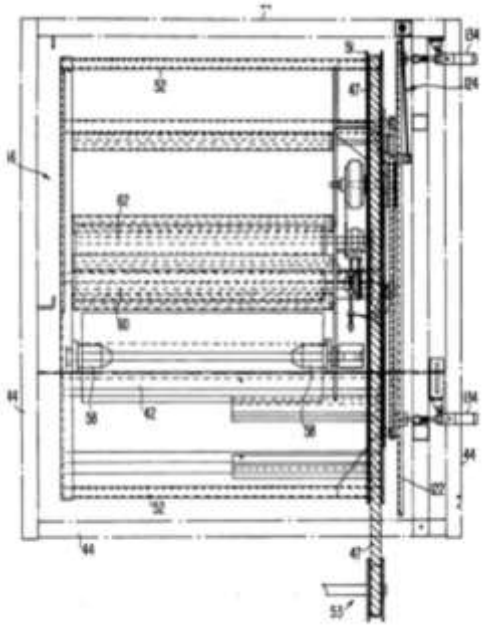


Figure 9 - Basic designs used for the construction of a Lantech S series wrapping machine

4 EFFECTS OF THE KAIZEN REVOLUTION ON LANTECH

4.1 Impact on the company and its revenue

The transformation of the traditional production company using lean techniques has brought improvements both from a production and an economic point of view. During this chapter, the results obtained by the company following the adoption of the Kaizen method will be presented.

First of all, the development time of a new family of products has been reduced from about three to four years to one year, thus making it possible to respond more easily to possible changes in the environment outside the company and not be lagging behind possible competitors. The reorganization of the factory has drastically reduced the man-hours required to build a machine. By lowering them by 50%, this reorganization of production machinery has made it possible to bring the phases of the production process closer, recovering forty-five square feet of space and previously unused.

The new specialization for employees and the increased expertise reflected their effects on the quality of the machines: in fact, undetected defects per machine dropped from 8% to less than 1%. The new order management system introduced between 1991 and 1995, which followed specific rules, decreased the amount of inventory in the warehouse by more or less 50%, since it no longer referred to advance production and a push logic, thus saving millions of dollars.

Overall, the greater competence, the approximation of the various processes in the production phase and the downsizing of the machinery led to a decrease in waste of time, managing to lower the production time of a single machine from 16 weeks to less than 24 hours. There was also a decrease in product delivery times (lead time): this decrease ranged from the initial four to five weeks to only one. In general, the continuity of the flow was the greatest capacity acquired by the company.

These continuous improvements overall also affected the company's earnings, which soared. Moreover, the investments required to implement this organizational revolution were quite low: the equipment was moved and reconfigured by employees of the company who previously took care of inefficient production tasks.

The impact of the "new Lantech" on the market was impressive, so much so that their market share in the field of wrapping machines increased by almost 15% in the space of three years and the losses that followed in the previous crisis period of the company. They soon turned into earnings and, consequently, into new investments and a real workflow. Once the transformation took place, it was possible for each employee to follow the flow of value from the purchase of raw materials to the delivery of the finished product. The standardization of the tasks, the subdivision of the working day according to the takt time and the exploitation of the visual control allowed for immediate feedback on the activities in progress. The following table shows the results obtained from the analysis of the case.

	BATCH-AND-QUEUE/1991	FLOW/1995
Development time for a New Product Family	3–4 years	1 year
Employee hours per machine	160	80
Manufacturing space per machine	100 square feet	55 square feet
Delivered defects per machine	8	.8
Dollar value of in-process and finished goods inventory*	$2.6 million	$1.9 million
Production throughput time	16 weeks	14 hours–5 days
Product delivery lead time†	4–20 weeks	1–4 weeks

Figure 10 - Improvements obtained by Lantech following the conversion into a lean company.

The improved skills also due to job rotation and exchanges between different teams then gave the opportunity to make the most of the skills of all employees of the company, since each one in the process of continuous improvement could actively give their own contribution as regards the job design.

In addition, the constant search for organizational perfection and the elimination of muda with each improvement in business processes, motivated all workers to do their utmost to raise company standards, offering the best possible quality to the end customer. Thanks to this general sharing of the company's objectives and the acquired experience of the work potential of well-executed groups, interruptions related to production line stoppages or emergency situations dictated by unexpected events rarely occurred.

4.2 Impact on the employees of Lantech

The effect of this transformation was the same in the offices thanks above all to the visual inspection technique. As regards the management of orders, this methodology made it possible to verify the position of Lantech at any time, as well as to immediately update the system for entering orders, so as to be able to correctly carry out the sequence of all other activities.

Finally, the redesign of the development activities of new products guaranteed immediate returns, since the people involved in the realization of a new project, working closely in the same place and therefore being able to compare continuously, were able to identify and resolve even in progress errors or problems that would have occurred later and which in a rigid structure would have been fatal. In addition to this, employees were stimulated by the opportunity to acquire new knowledge and further improve the skills they had always employed.

Of particular importance was also the high communication and sharing of ideas within the various teams, in order not to create slowdowns or interruptions regarding the times established for the development of the new product. However, creating a continuous flow of work activities was not without risk, as it simultaneously required constant monitoring, as well as continuous improvements and changes in order to keep up with the flow itself.

This revolution, however, led Lantech to become and consider itself a lean company. In particular, the application of the principles of continuous improvement was not excessively difficult to manage, since the first fundamental point of this philosophy had always been respected (even before the actual transformation). Thanks to Lancaster's intuition and the innovation brought by the tension wrapping machines, customers were satisfied in terms of purchase price, performance and services offered.

Consequently, the implementation of the Kaizen philosophy turned out to be quite simple, not having to dwell on the analysis of the value and quality of one's

product, but only having to face the reorganization of the Gemba (The Gemba which translated means "the real place" is identified by Masaaki Imai in his book "Gemba Kaizen", as the place where value was actually created within the company.), the downsizing and relocation of the machinery necessary for production. This made it possible to introduce a layout that would allow for a continuous flow and that could quickly eliminate and identify the molds created by the previous batch and queue production system.

Nonetheless, it was not only for these factors that Lantech was able to easily use and introduce these changes: the small size of the company allowed it to take all the necessary steps to convert into a lean company rather quickly, given that the company structure was not rigid compared to any traditional large-sized enterprise.

Furthermore, the product range, made up of four variants of the same basic idea, did not create confusion in the phase of setting up the production cells used for the different machine models. This does not mean that it is not impossible for a large company to transform itself into a lean company; however, the path would certainly be longer and more complex.

5 CONCLUSION

The results obtained from the analysis of the Lantech case show the radical changes that the introduction of lean manufacturing has made possible. Although the case is quite famous and renowned, its dynamics can still be considered current; especially with regard to countries that are still trying to manage the necessary changes due to the transformation into a lean company.

An example of this could be referred to the Finnish reality, mainly characterized by small and medium-sized enterprises, for which the value perceived by the customer and the quality offered of the product or service is particularly important. Despite the considerable strategic success found in the US reality, the Kaizen philosophy took root in Finland several years late. This was also partly due to the rigidity and outdated conception of the way of doing business, which did not allow to acquire new knowledge and aspire to greater competitiveness in the chosen market.

However, to date, the Lantech case can still give ideas to small businesses offering high-end products and seeking to make a qualitative leap, both in terms of productivity and in terms of earnings. The case of Lantech is intended for all those organizations that intend to convert from a traditional company - which considers the production of large volumes of products to be more important, which allows them to exploit economies of scale and, consequently, which bases their competitive advantage on a cost advantage - in a lean company, focused on the creation of a continuous flow of value, on the constant contribution of improvement in business processes, in order to be ready to face sudden changes in final demand and interruptions or slowdowns and waste.

These innovations allow the company to acquire a more solid and cohesive structure, which manages to maintain considerable flexibility towards customers and their requests and allows to acquire new skills through the continuous exchange of information and teamwork. and knowledge, while consolidating its core

competences. In addition, thanks to Kaizen strategies, the innovation processes have made great strides, allowing us to keep up with the times and to be able to respond quickly to the multiple agents of change that can operate in the internal or external environment of the company.

Lantech is therefore an excellent example of an organization that manages in its darkest moment to abandon the old obsolete schemes, reinventing itself and succeeding in achieving success, subsequently maintaining high standards and immediately filling any gaps found in the continuous monitoring of activities. To conclude, the Kaizen methodology is a tool that, if you can manage and follow it correctly, can make a company capable of maximizing its potential, while also giving it the necessary skills to improve day after day and thus achieve increasingly important goals.

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