IMPLEMENTATION OF KANBAN TECHNIQUE WITHIN THE TOTAL FLOW MANAGEMENT MODEL

Mosè Gallo[(a)], Teresa Murino[(b)], Emanuele Guadalupi[(c)], Liberatina C. Santillo[(d)]

[(a) (b) (c) (d)] Department of Chemical, Materials and Industrial Engineering University of Naples Federico II P.le Tecchio, Napoli, 80125, ITALY

[(a)]mose.gallo@unina.it , [(b)]murino@unina.it, [(c)]emanuele.guadalupi@unina.it [(d)] santillo@unina.it

ABSTRACT

This work is focused on presenting the implementation of the kanban tool in the more general context of the Total Flow Management model. This imposes to radically restructure, in a lean perspective. internal and external logistics processes, considering the whole supply chain, through which it is possible to get a global optimization of enterprise's operations.

The Total Flow Management model will be explained, analyzing the pillars that sustain it. A simulation based implementation of this model in a typical automotive production plant has been presented.

Keywords: lean production, Kanban, Total Flow Management, KPI, flexible production,.

1. INTRODUCTION

The instability of competitive markets and the strong competitive dynamics represent tough challenges for companies that want to survive and generate the decisive push proposals to new systems of production and management, which often completely overturn the existing reality.

Comes the need to abandon the "old model" to allow management to cut costs and focus on levers of competitiveness, emphasizing the role of the consumer. Change in a clear way the focus management, no longer solely directed to the productivity but also on the quality and punctuality. Western companies began to turn their eyes to innovative production models, born in Japan after World War II when the Japanese industry conditions was exhausted from the devastation of World War II

In this new approach is the customer who defines the volume of production and the timing, the requirements are then determined downstream and "pull" the entire production system. With a view to reducing costs and increasing the delivery precision, one aims to break down any waste and to act in a continuous manner. It then tries to minimize the stocks of both raw materials and finished goods, reduce lead time by coordinating the entire production system, paying particular attention to elements of reliability and quality of both the production process and the product or service to the customer .

The areas of competitiveness to be investigated can be multiple and dependent also on the type of organization concerned. Certainly, in the current context, it is possible to think that the majority of businesses, goods or services, must in any case pay particular attention to these areas:

- Customer satisfaction and on-time delivery
- Efficiency and quality of processes and product
- Innovation and Growth
- Human resources, employee satisfaction, communication
- Economic and financial results

For each "area" defines the Critical Success Factors (CSF, Critical Success Factors) and then extrapolated a number of Key Performance Indicators (KPI Key Performance Indicator). You can then assume different levels of detail related to specific levels of management:

1. Critical Success Factors: are defined critical areas of business and strategic indicators specified at strategic level
2. Key Performance Indicators: identifies the performance-critical business process-oriented control of operations operational level

Through the CSF calibrates the entire measurement system, focusing mainly on all those strategic variables able to determine business success. Identify the strategic variables you need to build the benchmarks that need to make comprehensive information and comply with certain qualitative and quantitative characteristics. Ultimately, a model of analysis of business performance effectively will have to consider, understand and dynamically analyze all the factors that participate directly or indirectly in the performance of the company to provide an interpretative model of primary and secondary processes and the interactions between them, thus ensuring a monitoring of activities. This model also provides a valuable tool to identify the right cause-

effect relationships between the performance recorded as supporting the activities of process improvement and customer satisfaction. In this sense, the measurements are therefore the basis for any attempt to improve the company, especially in optical Kaizen Continuous Improvement, because they offer us a clear idea of the current state and, through the definition of the target, allow you to show the direction to a optimal management, aimed at achieving the objectives.

The goals may be set for each organizational level and monitored through measurements, therefore, can show different levels of detail, from more or less simple (related to operational processes) to measurements consolidated and / or aggregated.

The remainder of this paper is organized as follows. In Section 2 the total flow management model is presented together with a perspective on lean production concepts. In Section 3 the implementation case study is introduced. In Section 4 an analysis on the project's results is conducted. Finally, Section 5 concludes this work.

2. LEAN PRODUCTION FLOW AND PULL

The Lean is recognized as one of the most popular management tools to deal with the strong competitiveness in manufacturing companies or logistics.

In this context, the primary need was to be able to get the maximum output with minimum use of resources, so the goal is to maximize the efficiency of processes, operations. For this to be achieved it is necessary to effectively eliminate all types of waste (muda) and focus on the processes that create value for the customer. It is only the latter that should be concentrated efforts because they are the moments when you generate wealth and competitiveness for the company. The activity of elimination of waste is carried out in the whole production process and follows the principles of Kaizen, a word derived from the Japanese words Kai and Zen (renewal and off, respectively) mutated in the West in "continuous improvement. The strength of this approach lies in the search for simple solutions that can be implemented quickly without the need to resort to strong structural or technological investment.

The focal point of the new organizational model is the creation of a flow that is "pulled" by the actual customer orders and continuously improved. In order to be effectively managed such a system must be complied with the principles:

1. Quality first
2. Elimination of waste
3. Orientation to the Gemba
4. People development
5. Visual standards
6. Observe the processes and results
7. Lean Thinking

Quality management is one of the elements that have more benefits and universally accepted. It was the statistical Deming, Juran and Ishikawa to emphasize how a strategy based on quality could be turned into a competitive advantage and efficiency. The quality has to be defined according to what the market demands, the goal is customer satisfaction which requires certain services at competitive prices. This approach uses a variety of analytical tools based on objective data, so you can better measure and understand the phenomena to be evaluated, and extensive use of statistical tools such as correlation analysis or control charts and introduce, from the methodological point of view, concepts such as cause and effect diagrams and cycles of Deming (or PDCA, plan-do-check-act), which will form the basis of continuous improvement.

The real fundamental concept of Lean to achieve competitiveness and excellence is the elimination of waste, the muda, the causes of variability, walls, and losses, walls, through the Kaizen approach. Excessive volatility is determined by the lack of stability and reliability, resulting in complications for the process control and implementation of timely intervention to limit the damage. For walls are the difficulties that determine loss of time and energy, for example, loss of time can be achieved if the workstations are not ergonomic and therefore cause operators to make unnatural movements may be, energy losses due to lack of satisfactory yields . It is usually placed particular attention to the walls because they may present risks of injury.

The third principle pertains to the Gemba, a Japanese term for the shop floor, or the workshop, in the Kaizen approach the place where the improvements are made. The strength of continuous improvement is to be found in the concrete activities carried out in the field, directly addressing the difficulties identified without deleterious loss of time. A typical resolution of a problem involves the direct observation of the reality on the gemba, the collection of data and information on observed evidence and a search for solutions through the brainstorming group, formed mainly by staff directly employed in criticism. In this way, the improvement comes from below, is not imposed, it is therefore more understandable, shared and achievable. Hence the emphasis on the involvement of individuals in kaizen activities. Working in a team, and invest in the training of people increases the quality of service and reduce costs. The first step to changing habits is enable people to create and manage an improvement, making them aware and conscious of waste and inefficiency where it takes place. Therefore, any person within the company, from top management to the shop floor, must be fully involved in order to obtain a truly efficient.

The visual standard is expressed in the concept that "one picture is worth a thousand words and a standard is the most efficient way to accomplish a task". If an activity is not standardized is exposed to variability, depending on the different ways to carry it out by the various operators. Create a standard with visual support

is more immediate and simple to understand, compared to a standard descriptive. The definition of a standard work involves a study of the methods of conducting business, through a careful analysis of the processes and the establishment of targets for improvement, and represents an optimization of the actions of workers, according to a certain cycle time and line with the flow of materials.

Lean thinking is the real principle at issue. Pull Flow means to organize the whole supply chain (or for simplicity the internal logistic and manufacturing flows) with a view to optimize the flow of material and information. To achieve this, the emphasis must surely be placed on the elimination of muda or the expectations and demands of the customer. The idea of the flow of material, ideally a one-piece flow, is often counteracted by the conviction of economy of the production batch. It may seem absurd to even work on individual orders, consumption, to produce individual units, because they might be too small and synonyms, erroneously, of inefficiency. The experience of the Toyota Production System demonstrates what can be winning the introduction, in a radical way, this new method of organization of operations, in terms of ongoing results.

Lean and Kaizen methodologies learned the issue is to define the sustainability of the model identified. For this to happen its implementation must proceed through a single overview of the entire supply chain, from suppliers to customers, keeping in mind what is the direction and purpose which you want to strive

2.1. Total Flow Management (TFM)

Total Flow Management is a management model for integrated logistics, Lean in optics, applied to the entire supply chain of a given company is manufacturing and services. Applying the model in the first instance you want to create an internal pull flow in maximum operational efficiency and free of non-value added (NVAA), then consider the extension to the valley (the delivery side, ie customers) and upstream (the source side, ie the suppliers). The flow of materials can be considered as a repeated sequence of four types of transaction, namely transport, inspection, waiting and transformation, the only real value added activities. The main objective is the reduction of total lead time, as measured coverage of stocks, eliminating muda process, creating benefits in terms of cost reduction and working capital, increased productivity and quality in order to achieve a higher level of service provided to customers and to improve, therefore, the satisfaction. You reach these objectives through the redesign of logistics and implementation of the one-piece flow loop, driven by actual customer orders, which define the so-called customer takt, quantifying the need for restocking of inventories and production volumes. Therefore orders the production or distribution are no longer based on predictive models, which are still useful for capacity management.

2.2. Logistic Loops

The Total Flow Management model divides the supply chain a loop a series of logistic (logistic pull loop, LL), information and material, by the final consumer to the supplier. Based on a simple supply chain, including manufacturing company with a client and a distribution center warehouse supplier of raw materials, it is possible to identify three main types of logistic pull loop:

- Withdrawal finished products
- Production
- Collection of components and raw materials

The first LL is generated when a customer buys a product and inventory management models of the distribution center identified the need to send a replenishment order by generating a flow of information, which will be sent to the production process, and having tried, and a material flow (control, selection, collection and transport of the product) from the finished goods warehouse. The management objective for this loop is the creation of a flow that eliminates the stages in which the material and information remain pending. The major constraint is the availability of the product at the time of sampling and frequency of transport.

At this point it started the production of LL that can respond to a need to restore inventory levels (make to stock, MTS) or the creation of an ordered product does not exist (make to order, MTO). Processing the information available are reworded as production orders, scheduled times and needs, considering the small batches of production and the BOM and sequencing the operations on the first line pacemaker (the line bottleneck that affects the capacity of production of establishment). Meanwhile the client is meeting their demands by resorting to the warehouse stock. In accordance with the schedules the transport of materials or components and the production must take place within the time and in the right places, and it is at this point that concentrate most of the opportunities for improvement aimed at the pull flow.

The third type of loop logistic concerning the sampling of materials or components, i.e. the supply of production processes. The primary objective is to pick up and supply lines in a synchronized way, restoring the inventory levels at the point of use, using kanban systems, physical or electronic call. For the need of just in time several problems arise when increases the number of different components and materials required. The total flow management model aims perfect synchronization using physical systems supply and standard supply that can provide immediate answers.
An additional loop logistics, intermediate, could be defined by the production of supplied pre-assembled in the correct sequence and in the right time at the final assembly lines.

Analyzing the supply chain as a set of logistic loops you can easily identify the difficulties in

managing the system. For example in the automotive industry a greater complexity is revealed in the final assembly (i.e. the loop of production) and in the collection of materials and components, evidently due to the large abundance of these components and the need of synchronization thrust, given the nature often automated lines. Every industrial has still endemic in dependence of the complexity as well as the variety of materials managed also by the type of distribution flows.

2.3. The Total Flow Management Pillars

The flow of information and materials identified through the analysis of logistic loop can be grouped into three macro flows, the pillars of TFM (Figure 2):

1. Production Flow
2. Internal logistics flow
3. External logistics flow

In a Total Flow Management optics each of these flows must be analyzed and optimized by applying the principles of Lean and Kaizen tools.

The first step is to improve the production flow, which ranks as objectives the implementation of the one-piece flow, increased flexibility by adjusting the setup and an increase in operational efficiency and supply. The improvement actions are divided into these categories: Redesign of the layout and lines in optical one-piece flow; redesign of the perimeter of the line for the efficiency of supply; definition of standard work for operational efficiency; SMED technique for flexibility in setup, low-cost automation to reduce the walls.

The second step is the optimization of internal logistics flows, including all the movements of small containers inside the plant but also the related information flows. In this case the improvement actions are divided into the following areas: supermarkets to increase the efficiency of the material withdrawals; mizusumashi system to simplify and streamline internal transport of the material to the point of use; synchronization as a co-ordination between supply and production leveling productivity of the lines and equipment in relation to the takt time, pull production planning in accordance with the actual customer orders.
Finally, the third step is the optimization of external logistics flows, i.e. the handling of materials and products, generally parceled out in pallet from the factory to customers and suppliers to the plant. In this case, the categories of intervention are: redesign of the stores and warehouses; creation of the milk run, i.e. an external flow of transport; physical flows in (inbound) and outgoing (outbound) through small containers and pallets; planning pull the logistics to handle the material withdrawals according to the royal orders of consumers.
To complete the Total Flow Management model there are two basic pillars:

- Basic reliability
- Supply chain design

The first one is related to the concept also developed in the Toyota Production System of basic stability, for which the creation of a stream cannot do without a certain level of stability in terms of 4M (Labor, Equipment, Materials and Methods). The basic reliability analyzes the reliability of the available resources and how effectively they are compatible with the realization of the total flow. For efficiency is evident the importance of conducting that analysis beforehand, so as to have a basis on which to develop the other pillars of the TFM model.

The supply chain design is the design instead of the entire logistics system, through the standard tools such as the visual stream mapping, which is useful to represent flows of material and information, or spaghetti chart, which is a graphical representation of the physical flows.

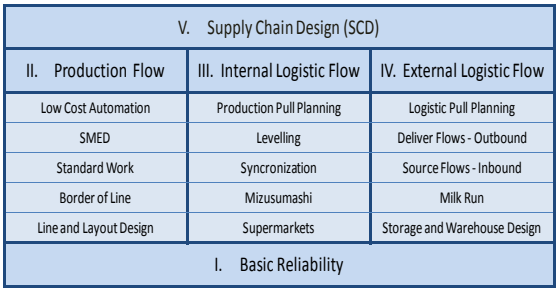

Figure 2: The Total Flow Management model

2.3.1. The Basic Reliability Pillar

The first pillar of Total Flow Management Model is the basic reliability you need, as already mentioned, to develop a stability in terms of manpower, machines, materials and methods (4M). To get a basic reliability is necessary to develop a sustainable capacity for change, the company must initiate a culture that is focused on continuous improvement through the implementation of growth-oriented solutions at the factory (Gemba), in accordance with the principles Kaizen, must i.e. to become a learning organization, or a learning organization. This concept, defined as learning by doing, is expressed in the fact that to get good results is necessary to develop proactive attitude in Gemba in order to try new ideas without bias on the results and judge them only after they have been put into practice, making it valid through 'implementation, so on tangible results and tested. To this end it is essential to the involvement of staff so that the drive for improvement has many sources as possible and often the suggestions of those who are directly involved in the process can be a winner. Before you try to change or improve any activity or process is therefore a clear need to change the corporate culture in a new "mentality Kaizen" and spread awareness of the effectiveness of the tools used.
The first step in the change capability is the development of skills related to a widespread recognition of muda and identify projects, assigned to functional groups, committed to the elimination of

muda critical variables, i.e. the occurrences that define waste or inefficiencies in the various processes.

The critical variables muda for the basic reliability can be divided into four groups (labor, machinery, materials and methods), each of which must be analyzed in order to find the major causes that can block the flow. Among the most common causes, however, that may vary from company to company, can be summarized as follows: punctuality and absenteeism, machine availability, percentage of stock out, percentage of defects, resistance to change.

For the basic manpower reliability aspects are focal punctuality and absenteeism. It is important to monitor these critical variables regularly and pay attention to what's going on, because they contrast sharply the creation of a stream. The lack of punctuality, such as delay in the beginning of the activities of 5 or 10 minutes or long pauses, can pose serious problems in the case of flows of material to a minimum waiting time. Absenteeism do completely unexpected, however, can skip a task flow, so some reliability measures need to be taken into account. Surely the improvement activities of these critical variables must involve supervisors and human resources, so that they can directly identify the root causes of absenteeism, define targets for the reduction and measures to achieve them.

One of the most important tools for improving the reliability of the workforce is the SDCA (Standardize, Do, Check and Act).

First you have to create the standard that goes to solve a particular problem. It is important, fundamental, create the standard listening to the views of employees and operators, because they are the people who are most in contact with the business, who know better. Then you have to transfer the standard (phase do) through the training, lessons, in line with the principle of learning by doing, that it is always better that the activity is taught directly in the field, so that the new habit is established directly . New habits take time to be fully digested, so there is this need to reinforce the theory through practice. To ensure that a new standard is actually implemented is necessary to activate a control stage (check), directly into the Gemba, doing audits at regular intervals so as to monitor the implementation and maybe, where there are deviations, establish actions corrective action. If everything is working you can actually start the task according to the standard defined (stage act) and find the possibility of extension and restart the cycle SDCA with a view to Continuous Improvement (Figure 3).

The use of the standard is also important to create a share of professionalism that are conferred on the farm and as a reference in case they found new problems. When we identify a problem are interviewed supervisors and operators, to verify the existence or not of a standard decisive. If the supervisor and the operator confirm the existence of the standard for the resolution of the problem means that the standard is ineffective and needs to be redone, because despite the fact that it is not applied. If the supervisor confirmation but instead the operator is not aware of the standard you have to start a Coaching. In the case in which the supervisor is not to be aware of the standard, while the operator applies, then it must simply formalize. If both ignore the standard must achieve it.

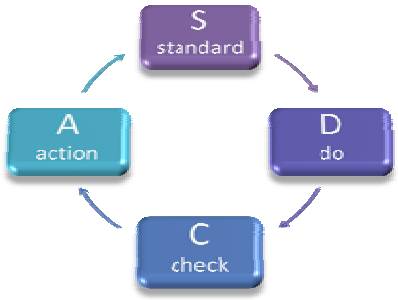

Figure 3: The SDCA cycle

Ultimately, the standard is the first step for the improvement and is the most efficient way to perform an activity.

But when the OEE (Overall efficiency effectiveness, global measure of effectiveness) is very low, it is desirable to carry out projects of basic machine reliability. In this context it is necessary to first define the Equipment Operating Time, or the processing time in which planned and it is expected that the resource work in a day, and is the basis of the takt time (defined as the ratio of operating time / demand daily). The operating time is divided into two aliquots: the time of actual use and losses.

Losses due to the availability are the main causes of inefficiency and may be due to breakage, training, maintenance and cleaning (planned), repairs (unplanned), changeover and adjustments. Certainly if the resource has many stops for breaks or for unexpected stops will have a negative effect on the basic flow reliability. According to the TFM model in order to start a project for Total Flow must start from an availability of 80%, as an average, associated with a low standard deviation.

Other types of detectable inefficiencies are due to leaks for performance, i.e., cycle times slower than in the takt, micro stops (<10 minutes), start up and shut down, or losses for quality, i.e. errors and defects, scrap and rework.

To increase the OEE of the plant is recommended going to act first on that resource pacemaker, or the resource with its capacity is capable of affecting the ability of the entire flow, production or logistics. In optical Kaizen to improve the basic reliability of a machine a quick way is to go through a workshop focused Gemba. We must first identify a list of 10 losses for the machine more problematic and begin to attack the list from the first point. If a significant cause of loss is a specific type of failure must go back to the root cause through the technique of "5 WHY?" Or use

an Ishikawa diagram. Identified and including the reasons you can search for countermeasures through a process PDCA (Plan, Do, Check Act), with the support of a group of people who have full awareness of the problem (the variable muda) and he will work until it is resolved. For faults is suitable search for persons of the group between the employees of the maintenance function, while for the defects will be referred to employees of the function of the production and quality control. In short we must identify professionalism appropriate to the resolution of the problem identified. It can well understand the usefulness of this method, which allows the resolution of big problems without resorting to onerous investments for the renewal or even the replacement of the equipment available.

Problems related to basic material reliability occur if there is lack of supply of components or raw materials needed to begin production activities. The problem may be due to an external supplier, unreliable or late, or a disservice internal logistics due to the unavailability of material where it requires the use. An immediate resolution might be to create the buffer I guarantee a pull flow, however, the buffer can be seen as muda, returning to the general principles of Lean. Very often the problems of procurement of materials are related to deficiencies in internal or external logistics processes that are resolved with the various tools of the TFM dedicated, however it is always useful to seek ties in order to achieve systemic solutions. The various projects Kaizen, based on the top ten list and the PDCA cycle, which are open to attack losses in this area are then assigned to groups that, by the principle of competence, should be formed mostly by staff function and Logistics Planning, directly employed in the management of orders, storage, handling and transportation of.

The last class of the critical variables muda is attacked with projects of basic reliability method, which is closely linked to all the losses that may hinder or stop the flow of material or information especially when you try to remove safety stock or buffer, or when you want to change the methods of managing the flow or replace them. The occurrence of losses by methods usually, however, the problems have to do with constraints on quality or time. A usual loss, severe, linked to quality is due to the high variability that cannot be used for a specific machine (check through the OEE) but random problems which have their foundation in the lack of solidity of the methods adopted. For the validation of the methods we resort to the focused group, with specific skills in a stable phase of the process, otherwise you run the risk of contamination of the data due to the normal fluctuations of the transient.

2.3.2. Production Flow pillar

The second pillar of the TFM model is the production flow that has as its objective:

1. Creation of one-piece flow, ideally one piece at a time a production flow, from raw materials to finished product
2. Minimization of muda of motion of the operators, through a restructuring of the perimeter line and standards work
3. High customization of products, thus high flexibility in relation to small batches using tools such as the SMED
4. Simplification of processes and automation

Achieve the goal of one-piece flow production means redesigning the layout, organizing the resources in such a way as to generate a continuous movement from raw material to finished product, then follow the correct sequence of operation by eliminating all activities that do not add value, NVAA (not value added activities).

The TFM model for the realization of the production flow identifies five areas for improvement: the design of lines and layout; redefinition of the scope of the line; utilization of standard work, SMED implementation, use of low-cost automation.

2.3.3. Internal Logistic Flow pillar

This third pillar of the TFM has the objective of optimizing the flow of transport of the containers inside the plant, such as organization of supply line all the parts needed for production according to the cycle time, linked to the takt time. At the same time must be optimized information flow starting from the actual customer orders, which must be converted into production orders as quickly as possible. The reactivity of the system can only be obtained through an integration of production and logistics flows, in order to proceed in a synchronized manner and fulfill the requirements just in time.

The traditional method of organizing the logistics, the push flow, is based, in summary, on the minimization of transport that involves an internal supply lines with lots of large quantities, the use of forklifts to move pallets and planning of large production orders to minimize changeover time (Figure 4).

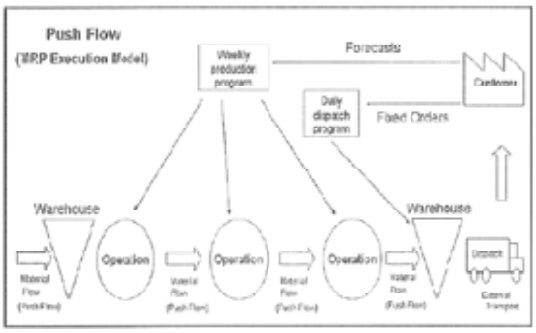

Figure 4: A schematic representation of a Push Flow

By contrast, the method of the pull flow instead aims at supplying the lines of containers of the right size to maximize the efficiency and flexibility, organize withdrawal areas of materials in an efficient manner,

using standardized transport routing with fixed times and plan production according to customer orders (Figure 5). The implementation of this pillar includes five areas: the creation of simple supermarket for the organization of the material withdrawals; mizusumashi that optimizes the transport of containers in the establishment; synchronization between production and supply; leveling as scheduling of production according to the process bottleneck, and finally the pull production planning to set the right production capacity in relation to the needs determined by the customers.

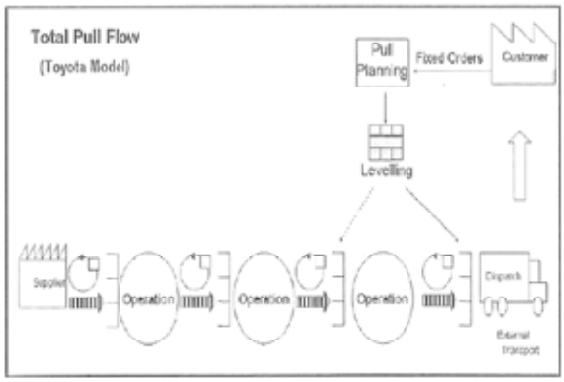

Figure 5: A schematic representation of a Pull Flow

2.3.4 External Logistic Flow pillar

After creating the conditions necessary to pull flow and you have optimized the internal logistics processes will start the fourth pillar of the TFM model focuses on the organization Lean logistics processes external, i.e. the loop logistics delivery flow (cash flow from the factory to customers) and source flow (from the suppliers to the company). In the previous pillar it has been discussed the need to recreate the flows in unique containers along the internal supply chain of supermarkets realizing and managing the movements and orders through the tools described, in order to eliminate muda. In order to integrate the processes of internal and external logistics supermarket there is a final, falling within the defined routing for mizusumashi as an interface with distribution warehouses, from which the withdrawal is made from the customers. A similar argument can be made for upstream suppliers.

The External Logistic Flow in essence is oriented to maximize the delivery precision bringing to 100% the level of service provided to customers and at the same time minimize the amount of stock throughout the supply chain. The traditional approach defines the orders of algorithms based on logical push, ie using MRP schedules, based mostly on assumptions and estimates, and setting high standards for safety stocks. The approach of the TFM model instead complete such a system, however, by placing the emphasis on the importance of physical supermarket, orders and fixed real consumption, optimization of the flow, using standard work reliable.

The proposed objectives are the minimization of stocks and expectations, achieving a delivery on time, on spec and total, complete elimination of muda of movement and handling and the minimization of the total cost of logistics. These objectives can be pursued by acting on the five domains of intervention of external logistics: planning of warehouses and stores; realization of the milk run; resource flows; delivery flows; pull of external logistics planning (figure 6).

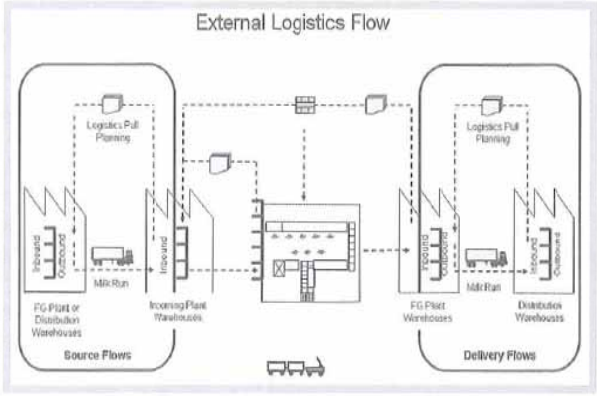

Figure 6: A schematic Logistic Loop.

3. CASE STUDY - IMPLEMENTATION OF KANBAN IN TFM VIEW AT CSA BATTIPAGLIA PLANT

The production company (CSA - production and extrusion polymers for automotive) is framed as Repetitive Manufacturing, i.e. a mass production of a large number of identical units, characterized by families, in a continuous flow of lines and work centers standardized.

Defined the area of supply (supply area), the supply strategy and the cycle control (Control Cycle). In optics Total Flow Management was necessary to redesign the layout of the department in a more functional approach to the new, then create the conditions for an optimal management of the flow of materials. The size of mobile containers is equal to the amount contained in a kanban and the location has been chosen as a result of a proposed Workplace Organization to optimize dosing operations.

Figure 7: A picture of storage area before and after the change

Defined in the storage area of the supply source, one must locate supply strategies most suitable to be adopted and for the control of the cycle are defined tabs of handling, i.e. the kanban sampling, through which you authorize the movement of material between the two logistics centers. The card is associated with a standard container and includes a variety of information: the component code; capacity of the container; card number to keep track of the material; identification of "supply source" and "demand source" cycle, identification of the location in the supermarket.

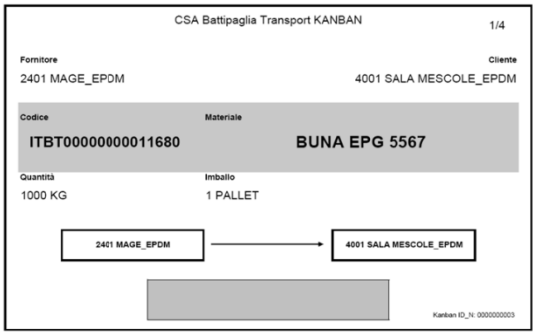

Figure 8: An example of “kanban” label.

The flows of material of this type have therefore to cover such daily production and can be considered constants beyond the processing schedules. Optimizing the application of the consignment stock.si two classes of materials handled according to the classic and the kanban kanban event . The classic kanban is used for small ingredients, divided by the constant and repetitive consumption during production campaigns. In view of this condition, the number of yellow kanban for each code is assumed proportional to the amount consumed in particular in two shifts. The other type of raw materials are managed in a mixing room polimeridi class defined as bulky. Unlike small ingredients depend on the product code, therefore, do not lend themselves to a management with kanban classic, but on them is prepared based on a strategy of replenishment kanban event. The consumption of such materials is not constant and therefore can not be defined control cycles in fixed quantities. The picking list of kanban is sent to the warehouse raw materials through SAP and employees shall supply the supermarket relative Mixing Room.

In the time of withdrawal in order MAGE on tabelliera virtual labels are created to wait for the material (gray) and only when the employee actually kanban delivery in supermarket proceed with the discharge of materials into SAP, which are at this point also accounted for in line with the consignment stock, the label changes to "kanban available" indicated by the green color. When the operator picks up the Banbury Kanban will change the state, passing the empty kanban label in red.

In real time the integrated system controls the actual consumption of the material by the mixer, comparing the amount remaining in the kanban opened with the requirements necessary to shut down the production of the compound produced. If the proposed limit is not respected is sent a warning that immediately initiate a transfer of a kanban to avoid further production blocks. Fixed control loops were defined standard work for picking activities and supply of kanban, fundamental both for the reduction of the time of performance of activities for both the proper operation of the cycles themselves. The strength of Kanban is self-control that determines the requirements according to actual consumption, so the transfer order is sent only upon notice, which in the classical case is represented by the kanban card removed from the container and place it on tabelliera physics, in the case of Electronic Kanban, implemented in CSA, is a virtual input transferred between terminals in the different areas of the plant, according to common protocols. The replenishment process goes through four sequential phases:

1. the replenishment list is transposed by the operator in stock and raw materials is determined by the kanban classic labeled as empty (red dots on the virtual tabelliera) and kanban event labeled as Waiting (gray on tabelliera)
2. the operator picks up the material from the shelves, with the default position and previously studied. According to the principles total each material flow management is located in fixed positions over time, favoring the FIFO and united by frequency of sampling, to minimize movement by the operator
3. the kanban containers are carrying with the aid of forklifts to supermarket kanban, in suitable locations marked with colored labels specific to each code.
4. the attendant after depositing the containers in their rooms at the supermarket pertinent to the interface position Kanban-SAP cult labels gray and red in green, confirming the system the transfer of material from the MAGE Mixing Room. In this phase has the accounting of the materials that are actually sold.
5. For now, the compounds produced are defined by the royal orders scheduled daily by means of MRP II. In the future it is planned to extend the Kanban to downstream processes, in particular a Production Kanban loop through which the extrusion department will regulate the production in mixing room.

4.1 Case study implementation results

The implementation of the Kanban system responds to the need to reorganize the processes of procurement of materials handling and syncing them to the actual production requirements. This transformation aims to apply the principles of the Total Flow Management as the application of Lean methodologies in favor of logistics.

The reorganization of the supply system has allowed a concrete manage orders in Just in Time, fully realizing the expected benefits. Polymeric materials, bulky, are fed in a synchronized manner to the production orders daily scheduled in mixing room, while the feeding of the chemical additives, in quantities less and less expensive, is realized according to cycles kanban for full vacuum. The transfer of materials "pulled" by the orders production allows a reduction of stocks in mixing room, reducing the amount to the size defined by the supermarket planned, calculated on the coverage needs of two rounds. It was therefore moved from a warehouse management of raw materials at a JIT management, with withdrawal from suppliers exclusively in the quantities actually used and consequent economic benefits arising from the type of supply contract in place, namely the consignment stock.

This result translates into a reduction of 57% of the economic value of the stock in the warehouse, by comparing the average value in the range prior to the introduction of the Kanban with the current period corresponding to the first months of activity of the new management. With the old approach was carried in inventory unused material then it would be stuck in storage awaiting consumption and meanwhile other codes had to be replenished more frequently, resulting in an entry and inventory levels undoubtedly higher. With the intervention of the Kanban instead in mixing room comes only what you need and will be consumed at the latest within the next two turns. The resulting material deposited as a stock represents the average amount of kanban in the small tabelliera ingredients out with regard to safety and the amount of WIP EPDM circulating in the mixing room.

The evaluation is made considering the average stock inventory levels before replenishment which, it is recalled, is made one hour and a half before the beginning of the second round daily and covers two rounds, namely the daily production.

The immediate control of inventory levels is possible, as already mentioned, through the use of integrated information systems to SAP. This procedure allows you to undo the need to take inventory, allowing the so-called Zero Patrolling, which translates in lower costs of labor and employment, which in fact can be used for other value-added activities. Other losses of manpower identified and removed or reduced through the adoption of Kanban affecting the movements inside the mixing room and also the activities of picking and warehousing, which has been optimized using Standard Work results from workshops organized on the Gemba. Indirect benefits are the reduction of levy in May MP of the quantity requested is not directly influenced by Kanban, although further improvement by providing a compilation of early material is in the pipeline, but can only be evaluated in the process stabilized. It is good to reiterate, however, that a project of efficient picking was already being realized by identifying the cells logistical grouping of codes for families. The transport of materials for storage in the mixing room is always done in 60 minutes on average, being more or less constant the absolute amount of material to be transported (vary the quantities for the individual codes), and takes place by means of forklifts with a capacity of about 3500 kg. Transport was not able to attend for reasons of layout of the two collection points, which does not allow the use of mechanized systems that could further reduce the time. Before Kanban time of filing and unloading materials employed an additional 60 minutes, on average, during which the products left in the department were deposited on the shelves and then had to be downloaded, and through systems manually before infrared signals as a result, databases MAGE in order to initiate the payment on consignment.

All this has resulted in a reduction of replenishment of 66% and in proportion of labor costs also affected by the activities mentioned above. Ultimately, at the operational level and control the optimization made through the Kanban has enabled better management of flows and control of materials along the loop logistics of supply, by means of inventories more reliable, continuous, in less time, and allowing complete traceability codes handled. Consequently, it is the immediate possibility of an effective FIFO management that eliminates all of the problems such as rework of compounds expired or the difference of the compounds due to the raw materials that do not comply. The stock reduction also results in a reduction of the physical space occupied by the deposited material with consequent improvement to the activities carried out in the mixing room, especially for logistics handling and retrieval of materials. In this direction push the solutions of Visual and Material Management Standard Work adopted, that simplify storage and picking limiting the uncertainty to the timing of implementation and eliminating possible causes of errors. The creation and implementation of Kanban has been achieved without substantial capital investment, in line with the principles Lean and Kaizen methodologies for which the first improvements are those made simply by making changes in the current state attacking and eliminating muda because of all the waste . The application of Total Flow Management for the optimization of the loop logistics supply in Mixing Room, beyond the basic improvements in operational terms then for a broader management Pull-wide establishment, provision would have resulted in a relationship Benefits / Estimated cost approximately equal to 2. Remember that the methodology TFM projects to be considered valid and consistent must propose a relationship between benefits and costs, estimated in the first year of intervention, at least greater than unity. The effective management materialized implementing the project has procured in the early months of the results are more than satisfactory, whose projection on the year portends a benefit / cost ratio of about 2.17, in line with the provisions.

It was decided to simulate the behavior of the system under assessment and implementation through the use of Rockwell Arena simulation software to validate the hypothesis and to make further changes and implementations. The results obtained confirm the validity of the theory of the pillars of sistema. Lo implemented and simulation tool, in particular for the Kanban software Discrete Event Arena, it is useful to be able to test the changes of process and choose the best solution before operating the system in the real world, with a great saving of time and resources. The application of model built has shown, moreover, the reliability of the system and how the environment Arena is reliable and is, therefore, conceivable its use to simulate the entire production process, evaluate the results of the extension of Kanban and optimize the parameters, prior to engage in future improvements of the system.

5. CONCLUSION

In this work we have explored the concept of Lean and its application in logistics. The Lean was born and has grown over the years as the basis for achieving excellence in operations, in particular in the production, attacking waste and eliminating any probable cause of inefficiency, integrating and articulating in a systematic methodologies and "philosophies industrial "rated the quality and efficiency of the processes. Over the years the evolution of the markets in directions increasingly competitive, primarily as a result of globalization, has prompted companies to tighten the focus of more and more businesses around its core business, leading to wastage consider everything that is not directly related to it, thus favoring the use of outsourcing.

This situation has led to the emergence of companies that specialize in providing highly productive services and not, but also created the conditions for a real transformation of productive no longer focused on the company, as an organization of people and vehicles aimed at the production and distribution of goods, but on a network of companies that collaborate and, in a sense, mutually contribute to success. The focus at maximum efficiency therefore extends from internal processes to external relations, namely the processes of coordination, integrated management, with an emphasis on logistics activities that regulate the connections between companies. The Total Flow Management approach fits into this context and through the concepts Lean aims to create Lean Supply Chain, aiming at the optimization of the loop logistic identified within the individual company (such as logistics) and the company to suppliers or customers (outbound logistics). The methodology TFM offers the opportunity of a common "language" for the various actors in the supply chain in order to extend the production flow Lean, based on takt time, the entire distribution chain, from end user to the first supplier of raw materials or semi-finished products. The elimination of the discontinuity in the value chain is needed in order to keep the costs under control and reduce them so as to be competitive on the market and then winning.

REFERENCES

Euclides A. Coimbra (2012), Total Flow Management – Kaizen per l'eccellenza nella supply chain - *KAIZEN INSTITUTE*.

Taichii Ohno (1988). Toyota Production System: Beyond Large-Scale Production, *Productivity Press*

Masaaki Imai (1986). Kaizen: Japanese spirit of improvement,*Japanese Productivity Press*

Frolick, M. N. & Thilini, R. (Š.D.). Business Performance Management: one truth. *Management Business Magazine.*

AA.VV, Criteria for Performance Excellence (2004), *Foundation for the Malcolm Baldrige National Quality Award*

Kaplan, R. & Norton, D. (1996). The Balanced Scorecard: Translating Strategy into Action, *Productivity Press*

Rockart, J. F. (1986). A Primer on Critical Success Factors, *MIT Sloan School of Management*

Womack, J. P., & Jones, D. T. (1991). The Machine That Changed the World: The Story of Lean Production, *United Mechanical Journal*

Maasaki Imai (1986). Gemba Kaizen: A Commonsense, Low-Cost Approach to Management, *Japanese Production Center*

Shigeo Shingo (1989). The Study of the TPS from an Industrial Point of View, *Japan Management Associate*

Taiichi Ohno (1988). Workplace Management, *Productivity Press*

Shigeo Shingo (1985). A Revolution in Manufacturing,*Japan Management Associate*

Rother, M., & Shook, J. (1998). Learning to See: Value Stream Mapping to Create Value and Eliminate Muda, *Lean Enterprise Institute*

Guizzi, G., Chiocca, D., Romano, E.(2012) System dynamics approach to model a hybrid manufacturing system- *Frontiers in Artificial Intelligence and Applications*, 246,pp. 499-517.

Chiocca, D., Guizzi, G., Murino, T., Revetria, R., Romano, E. (2012) A methodology for supporting lean healthcare *Studies in Computational Intelligence*, 431, pp. 93-99.

Gallo, M., Aveta, P., Converso, G., Santillo, L.C.(2012) Planning of supply risks in a make-to-stock context through a system dynamics approach- *Frontiers in Artificial Intelligence and Applications*, 246, pp. 475-496

Converso, G., De Carlini, R., Guerra, L., Naviglio, G. (2012) Market strategy planning for banking sector: an operational model *Advances in Computer Science*, WSEAS Press ISBN:978-1-61804-126-5 , pp. 430-435