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Strategies for implementing Lean: The 3M Brazil case study

Rogerio Ceravolo Calia - FGV Business School

Av. 9 de Julho, 2029 - Bela Vista - 01313-902 - São Paulo-SP, Brazil

calia@gvmail.br 55-19-9612 7332

Francisco Miguel Barbeiro -3M Brasil

Via Anhanguera, km 110, CEP 13.181-900, Sumaré, SP, Brazil

fmbarbeiro1@mmm.com 55-19-3838 7464

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ABSTRACT

The paper presents a case study of how 3M Brazil implemented Lean Manufacturing and became a benchmark for other subsidiaries. The case study is based on interviews with key professionals involved in the Lean implementation, in order to understand the strategies and resources that resulted in significant improvements in service level, inventory turns and cost metrics. Firstly, the paper reviews academic researches on Lean implementation and organizational change. Secondly, the paper presents the case study analyzing the strategic choices and the operational challenges of implementing Lean in a company with large amount of different products and high demand variability. Finally, the paper discusses the synergic role of the Six Sigma and the Theory of Constraints methodologies in this Lean implementation.

LEAN MANUFACTURING IMPLEMENTATIONS

Lean Manufacturing (Womack and Jones, 1996; Womack et al., 1990) is an integrated system of multiple management practices, including just in time, quality controls, work teams, cellular manufacturing, supplier management (Shah and Ward, 2002) and the Value Stream Map (Rother and Shook, 1999).

The success of implementing Lean Manufacturing tools may depend on contextual issues as unionization and firm size. Based on a sample of 1748 Lean Implementations in USA, Shah and Ward (2003) found that unionized plants are less likely to implement Lean practices as cellular manufacturing, cross-functional work-force, cycle time reduction, maintenance optimization, process capability measurements, and self-directed work teams. In the other hand, the researchers also identified that large plants

are likely to implement twenty Lean practices more extensively compared to small plants.

Lean Manufacturing was created in the automobile sector, so that implementations in other sectors may be perceived as more risky. Analyzing Lean Manufacturing implementations in the aerospace sector in the United Kingdom, Crute et al., (2003) found that Lean capabilities are not firm specific, but are plant specific, since each plant of a same firm has a different implementation approach and a different rate of progress. In addition, in this aerospace study, the dissemination of Lean practices among plants is dependent of 'Lean Champions' between sites. Finally, this research found that results are faster, when Lean implementation focus improvements in multiple aspects of a single product value stream rather than focus on specific functional departments.

The manufacturing type is also an important driver for Lean adoption. Implementations of Lean Manufacturing have been less frequent in the process sector, due to the perception that the Lean techniques may not be applicable in process manufacturing. Abdulmalek and Rajgopal (2007) found that, in the steel industry the cellular manufacturing is probably not applicable, while setup reduction, just-in-time, production leveling and total productive maintenance are partially adapted for process manufactures. Moreover, 5S, value stream mapping, and visual systems are universally applicable.

Another relevant factor influencing Lean Manufacturing deployments is the mix of Lean techniques that are implemented. A recent empirical research by Shah and Ward (2007) concluded that it is the complementary and synergistic effects of ten different inter-related elements of Lean Manufacturing that provides its ability to obtain multiple performance goals. This research identified that the main elements of sound Lean Manufacturing implementations are: supplier feedback, JIT delivery by suppliers,

supplier development, customer involvement, pull, continuous flow, set up time reduction, total productive/preventive maintenance, statistical process control and employee involvement.

CHANGE MANAGEMENT

Lean Manufacturing is not implemented in a static corporate environment, but it is deployed in organizations under a change process imposed by the dynamic business landscape. In fact, Lean implementations could easily be limited to short-lived events interrupted in the short-term, if these implementations would not be organically aligned to the organizational change process phases.

Based on empirical research in more than hundred companies along ten years, John Kotter, a Harvard researcher, identified the main phases necessary for an effective change process in the companies (Kotter, 1996):

The first change management phase consists of creating a ‘sense of urgency’ in the organization to motivate the change. For this purpose, it is necessary to analyze the current competitive position of the company and the technological trends, in order to confront this information with the actual performance of the organization.

In the second phase, the successful companies in the change process created an integrated group of leaders committed to really improve the performance of the company.

The third phase aims to define a clearly stated vision, an image of the desired future easily communicable to the company employees and investors, so that all involved understand which is the company’s future trajectory. The vision is an important element, because it enables that multiple specific projects and actions be integrated

towards a synchronized change process. In this sense, it is the well-written vision text that creates the collective understanding and interest for the change.

In the fourth phase, the companies that successfully managed the change also communicated their vision effectively. This communication must be both broad and without contradictions. It is a broad communication, because it utilizes multiple complementary communication channels and non-contradictory, because it is also expressed in the behavior of the company leaders.

In addition, in the fifth phase, the company identifies and removes the organizational obstacles blocking the implementation of the vision. The leaders gain the required credibility to obtain the commitment of the organization by demonstrating that they have effectively removed the main obstacles.

In the sixth phase, the change process becomes tangible, due to the systematical planning and execution of actions for short-term results, in order to clearly show to the organization that, although the desired change requires a long and difficult trajectory, it is possible to obtain early improvements. Thus, the successful change process proves its legitimacy with fast results in indicators as, for example, productivity, market share, profitability or new products launching.

In the seventh phase, the company searches for bigger goals to ensure that the performance remains improving beyond the achievement of short-term goals. By doing so, the organization does not interrupt the commitment with the new organizational systems, due to the false perception of having already reached the victory.

Finally, in the eighth phase the organization incorporates the achieved changes into its culture, into the company’s dominant work stile. For this purpose, it is necessary to make evident that the achieved results are an effect of the undertaken changes and it is

also necessary to show that the company leaders adopt entirely the new work approach resulting from the change process.

RESEARCH METHODOLOGY

To conduct this analysis, the case study research methodology was chosen. The case study is suitable for researchers to answer questions as “how” and “why”, whenever the empirical analysis focuses on a real life context phenomenon (Yin, 2005).

Since the present work aims to identify how 3M Brazil managed the change process for implementing a new methodology for operations, it will be necessary to conduct an explanatory study to understand how and why 3M Brazil leaders created the requirements for a sound implementation of Lean Manufacturing.

For Yin (2005), research protocols define standardized procedures, in order to ensure the reproducibility of the case study conclusions, even when different researchers follow those same procedures. The case study procedures should define the main research question, the information sources and the specific question that should be answered by the research.

a) Unity of Analysis - The theoretical focus of the research is the theory of organizational change management, while the unity of analysis is the implementation of Lean Manufacturing at 3M Brazil.

b) Research Question - In which manner did the strategies for organizational change enable 3M Brazil to soundly implement Lean Manufacturing in its operations?

c) Specific Questions

- What motivated the implementation of Lean Manufacturing?
- Was the Lean implementation a top-down or a bottom-up initiative?
- Which was the organizational structure for the Lean implementation?
- On which Lean Manufacturing tool was the focus of the implementation?
- Which were the main resources utilized for the Lean implementation?
- How did the company implemented Lean Manufacturing in plants with high products variety and high demand variability?
- Which was the relationship of the Lean Manufacturing implementation to Six Sigma and to Theory of Constraints?
- Which were the performance results of the Lean implementation?
- Which were the intangible benefits of the Lean implementation?

This paper is based on data provided by interviews with the leaders of the Lean implementation at 3M Brazil and is also based on internal documentations of Lean projects and of implementation results.

CASE STUDY

3M Brazil operates multiple plants in four different locations in Brazil: Sumaré, Itapetininga, Ribeirao Preto and Mairinque. Moreover, a fifth new site will operate in Manaus in 2007.

The Brazilian subsidiary is composed of 34 business units and manages more than ten thousand finished goods items (items with demand in the last six months). In addition, 43% of those finished goods are make-to-order items.

The Lean Manufacturing methodology enabled 3M Brazil to double inventory turns in five years, while service level increased 20% in the same period. Moreover, the Lean approach integrated to the Six Sigma methodology decreased direct costs in five percentage points.

Those results were only possible due to the paradigm changes that followed the Lean Manufacturing implementation.

The former CEO challenged 3M Brazil to double inventory turns. A performance change of this magnitude would not be possible to achieve by managing the plants with the current methods, with which the company was familiarized.

Thus, the Supply-Chain Director and the Materials Administration Manager decided to search outside the company a completely different new methodology to improve inventory turns. For this purpose, they joined the Brazilian Lean Summit organized by the Lean Institute Brasil and they also visited six companies that implemented Lean Manufacturing. At this time, among those six companies, the worst inventory turns performance was more than twice the inventory turns of 3M Brazil.

Although 3M Brazil plants are much more complex than these visited companies and has more products to manage and higher demand variability, the company leaders clearly visualized opportunities to improve inventory turns and service level, by implementing Lean Manufacturing.

The first implementation was in a plant with potential for considerable financial benefits from adopting Lean Manufacturing. In a relatively short time, this pilot implementation became an unquestionable success case that contributed to convince other plants managers of the benefits of Lean Manufacturing.

The plant workers were especially satisfied, because the Lean methods are visual and simple.

The implementation of Six Sigma provided the engineers and production planners with tools for continues improvements. However, more than 80% of the supply-chain areas employees are not engineers or planners intensively qualified in formal education programs, but the majority of the employees are shop floor workers. The Lean Manufacturing methods enabled also those workers with the means to utilize their thinking power and provide numerous and sound contributions to continuous improvements.

The integrated implementation of both Lean and Six Sigma is positive, since it combines the flow and speed of Lean with the consistency of Six Sigma. In addition, the Lean Manufacturing Value Stream Map is a very useful tool to see the whole picture of flow and to identify the inefficiencies in the plant and, then, the Six Sigma methodology and the remaining Lean techniques are focused to conduct the specific improvements for the opportunities indicated in the Value Stream Map.

In the past, the continuous improvement programs triggered results, but those results were not maintained. The main merit to integrate the Six Sigma methodology to Lean implementations is also that Six Sigma, in fact, maintains the results in the long-term.

It is not possible to implement exactly the whole Toyota manufacturing model at 3M Brazil, because its business model and organizational culture is different from those of Toyota. However, to benchmark Toyota and other companies with mature Lean Manufacturing implementations is a useful approach to mobilize the internal leaders to adapt the concepts of Lean Manufacturing.

It is difficult to implement a new management methodology, when the implementation is not top-down, when in the first moment it is not a formal initiative of the CEO. In the 3M Brazil case, the Lean implementation began in 2002 and it started as an initiative of the Brazilian subsidiary.

The implementation approach was democratic in nature, by achieving consensus with the managers and supervisors involved.

For every single implementation of a Lean methodology new for 3M Brazil, the main implementation strategy was not to deploy Lean simultaneous in all the plants, but to focus on pilot implementations to demonstrate results. Thereafter, many simultaneous projects were conducted in other plants to replicate the pilot implementation.

This implementation approach of generating a pilot implementation to proof the benefits of each Lean Manufacturing method was an effective means to minimize resistance to change.

In this process, the sponsorship of the Supply-Chain Director was a key factor for fast and sound implementations, both by motivating employees to face the challenges of the new implementations and by making the required resources available.

An important external actor in the implementations was Taktica, a local Lean Manufacturing consultancy firm proficient in the methodologies and flexible to support the required adaptations needed for 3M Brazil especial operational characteristics.

The Lean consultants were assigned to specific implementations and not just to conduct educational trainings. This was important, because 3M Brazil manufacturing process is different from most of the companies that implemented Lean Manufacturing. In fact, for 3M Brazil, demand is highly concentrated in the last days of the month and the

operations follow the mass production model, in which the machines usually operate with big batch sizes.

The Six Sigma methodology project managers (Black Belts) were also important resources, because they leaded most of the Lean Manufacturing implementation projects, ensuring the results in the due date and implementing measures and controls to maintain the improved performance in the long-term.

Thus, external Lean consultants and internal Six Sigma project managers worked together to implement the specific Lean Manufacturing techniques. While Lean consultants were responsible to adapt to the 3M Brazil's reality the specific Lean concepts as, for instance, the Hijunka scheduling, the Six Sigma project managers were responsible to manage each single project that effectively implements this Hijunka scheduling adapted concept.

The implementation of Lean Manufacturing was not based on the creation of a supporting organizational structure. Instead, the Materials Administration department manages the Lean implementation by defining priorities, allocating consultants, and promoting networking for knowledge exchange with internal and external benchmarks, by organizing participation in the Lean Summit and by controlling the operational indicators for service level and inventory in all plants.

Today, the Lean implementation is concentrated in manufacturing, although some effective Lean projects improved the speed and consistency of the engineering department processes to deliver new machines and equipments for the plants. Moreover, Lean office projects are active in the finance department and in the sales department.

In the past, quality tools as TPM, 5S and others were already frequently implemented in 3M Brazil. Differently from implementations in other companies, since 2002, the Lean deployment in the Brazilian subsidiary started by implementing pulled production and supermarkets. This decision was based on the fact that the plants processes were sufficiently stable, what enabled the pulled production implementation, as a means to achieve improved inventory turns quickly. Thus, the company started by pulling production as near to the costumer as possible. The following replication projects then implemented pulled production in the processes near the suppliers.

The pulled production for plants with high number of products and high number of make-to-order items was implemented utilizing as electronic kanban, a production-scheduling software with Theory of Constraints algorithms (the algorithms drum-buffer-rope) (Goldratt, 1984). By doing so, it was possible to protect production orders due dates with time buffers. This was an important approach to replace materials inventory by time protections and also as a means for production control, since production orders that consumed the last third of the time protections were expedited. Moreover, the causes for those delays risks were analyzed, in order to define improvement projects to solve the main problems and increase the process reliability.

In addition to the Value Stream Map and Pulled Production inside the plants, 3M Brazil also implemented Extended Value Stream Maps (for process integrating customer or supplier value streams), setup reduction, 5S, kaizen events, pulled purchase, delivery routes, andon and visual controls.

Conclusions

The Lean Implementation in 3M Brazil followed many of the steps defined in the change management theory, although the implementation was not a top-down initiative, but was driven mainly by participative middle management support.

The Lean Implementation was motivated, when the CEO created a sense of urgency by demanding the Brazilian subsidiary to double inventory turns. Moreover, the sense of urgency was reinforced as the subsidiary leaders joined the Lean Summit and visited other companies with much better inventory turns performance at that time.

As a second phase, the Supply-Chain director, the Materials Administration Manager and the Site Manager of the plants at Sumare formed a cohesive leading group committed to improve inventory turns by implementing Lean Manufacturing.

In the sequence, the implementation group envisioned to turn the Brazilian subsidiary into an internal benchmark for Lean Manufacturing inside 3M worldwide.

For this purpose, the implementation-leading group intensively communicated to the production managers, production planners and workers the ambitious goals for inventory turns and the clear prioritization of the Lean Manufacturing methodologies, starting with the Value Stream Map and Pulled Production.

To remove the organizational obstacles to the Lean implementation, 3M Brazil utilized the Six Sigma project managers (Black Belts) to identifies the specific drivers for successful implementations, to define the new work procedures resulting from Lean Manufacturing adapted to the 3M Brazil operations features and to follow-up the actions needed for the full implementation.

The Lean implementation at 3M Brazil also resulted in a mix of short-term benefits and lasting improvements to convince the managers of the usefulness of the Lean methodologies.

Differently from the theory of change management, the Lean Manufacturing implementation in 3M Brazil was not a result of a top-down initiative, but was the result of the initiative of the local Supply-Chain director of the Brazilian subsidiary and the local Materials Administration manager, who achieved support from managers in the middle of the hierarchy.

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