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**LEAN MANAGEMENT AND INNOVATION IN OPERATIONAL
EFFICIENCY: THE EGR PROJECT IMPLEMENTED BY PIRELLI TYRE
BRAZIL IN SANTO ANDRÉ PLANT**

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SÃO PAULO

Academic Year 2012-2013

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Abstract

This thesis aims to analytically describe and assess the implementation of lean manufacturing practices by Pirelli Tyre within its Latin American Industrial complex. In addition to a structured and vast description of Toyota production principles and lean thinking theoretical foundations, a special emphasis will be devoted to the EGR project (Especialistas em Gestão da Rotina), as a strategic tool to be used by the Italian multinational company in the upcoming future, so to achieve a more effective and efficient results in daily routine management. This project, representing a significant component of Pirelli Manufacturing System (PMS) and primarily geared to plant supervisors and coordinators, mainly consists of helping the firm to develop the corporate ability to correctly evaluate the potential gap existing between actual and expected results, in order to both understand deviations as well as underlying causes, and continuously improve company performance through process standardization and waste reduction. Those goals can be pursued by acting on two essential means: technical skills and behavioral leadership to support each project team; enhanced effectiveness in managing performance indicators across the different factory units, in accordance to KPIs set at the Head Quarter level. Furthermore, the research will be focused on the peculiar experience of Santo André plant, where EGR has firstly kicked off, with the aim to capture the relevant changes (on the organizational and economic side) brought to the company, through the conduction of field research and interviews, which are oriented to gather evidence, considerations and insights from all the organizational actors involved.

Keywords: Lean management, Operational efficiency, Toyota Production System

Resumo

O trabalho tem como objetivo avaliar e descrever analiticamente a implementação de práticas de manufatura enxuta pela Pirelli Pneus no seu complexo industrial da América Latina. Além de uma descrição estruturada e ampla dos princípios de produção de Toyota e fundamentos teóricos do Lean thinking, uma ênfase especial será dedicada ao projeto EGR (Especialistas em Gestão da Rotina), como uma ferramenta estratégica para ser usada pela empresa multinacional italiana no futuro próximo, de modo a alcançar um resultado mais eficaz e eficiente na gestão da rotina diária. Este projeto, que representa um componente significativo do Pirelli Manufacturing System (PMS) e, principalmente, voltado para supervisores e gestores de plantas, consiste principalmente em ajudar a empresa a desenvolver a capacidade empresarial para avaliar corretamente o gap potencial existente entre os resultados atuais e os esperados, para tanto entender os desvios, bem como as causas subjacentes, e melhorar continuamente o desempenho da empresa por meio da padronização de processos e redução de desperdícios. Esses objetivos podem ser perseguidos, atuando em dois meios essenciais: habilidades técnicas e comportamentais de liderança para apoiar cada equipe de projeto; uma maior eficácia na gestão de indicadores de desempenho nas diferentes unidades de fábrica, de acordo com KPIs estabelecidos no nível central pelo Head Quarter. Além disso, a investigação será focada na experiência peculiar da planta de Santo André, onde o EGR começou como piloto, com o objetivo de captar as alterações relevantes (no lado organizacional e econômico) que este projeto trouxe para a empresa, através da realização de pesquisa de campo e entrevistas, que são orientados a recolher provas, considerações e opiniões de todos os principais atores envolvidos.

Keywords: Lean management, Eficiência operacional, Sistema Toyota de Produção

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1. INTRODUCTION

1.1 Introduction

In the current economic scenario, it's definitely critical for each firm to develop and consistently adopt a leading change approach. In fact, the challenging struggles all the firms have to cope with, turn to definitely be a function of a rapidly growing landscape, mainly characterized by a worldwide integrated communication, continuous technological advancement and widespread competition. In this sense then, even the way a firm is managed can vary over time and according to the economic environment at any period of time. Generally speaking, in fact, the real lasting value of a company really lies in its capacity to both change year in and year out and strive to adapt itself as much as possible to the surrounding context, so to achieve a sustained competitive advantage, not so easily replicable by other players.

For all these reasons, lean thinking can therefore prove to be a valuable mean, for a given company, to stay competitive in the long term by strongly evolving its managing methods, in order to achieve a better efficiency, productivity and high quality standards in services and products. All the practices and techniques that will be explained later on were successfully tested by companies like Boeing and Toyota and deeply investigated by researchers as Womack (1996), Jones (1996) and Liker (2004), among all. Initially started as a breakthrough in factory management and aimed at pursuing great efficiency by reducing wasteful non-added value activities, lean thinking moved soon to be a companywide approach, oriented to trigger the overall firm improvement at any level process.

1.2 Analytical approach and objectives

The thesis has the chance to practically experiment and apply the described practices and techniques to a real case study, represented by the EGR implementation by Pirelli Tyre Brazil. In fact, the emphasis is focused on the vivid interest of describing the sequential steps of the project realization, underlining peculiar challenges and criticalities faced in progress, and finally portraying the results deriving from EGR entrance within the daily factory routine. Besides, a further essential aspect of the analysis regards the chance to understand whether lean approach, in operations, can effectively represent a feasible alternative to be implemented by those manufacturing firms which would hope to play a significant role in their industries and achieve steadily growing results in the market environment. In particular, the ultimate goal consists of accurately assessing both the actual impact of EGR project on the organizational and economic sphere of the firm, and especially gathering evidence about the potential sustainability of the improvements and benefits entailed by such lean based project on a medium-long term horizon.

1.3 Structure of the thesis

Because of the special orientation to operational issues, this thesis primarily focuses on lean manufacturing practices, drawn from the outstanding performance of Toyota in the automotive sector and theoretically postulated by Taiichi Ohno (1988), the father of Toyota Production System. Considering then lean approach as a systemic *modus operandi* within a certain business, the most relevant goal of the first section consists of firstly addressing the prominent features of Lean manufacturing theory, by underlining the most important values and principles: from one-piece flow concept to the various waste typologies, from roll-out practices to employees' engagement within the enterprise.

Thus, in the second section the thesis addresses two fundamental issues and preliminary steps which turned to be critical and strategic to Pirelli Tyre in walking the challenging path towards a lean identity. More specifically, the Italian enterprise firstly adopted the Total Productive Maintenance system in all its factories worldwide, and afterwards renewed the entire manufacturing system by launching the PMS (Pirelli Manufacturing System), therefore showing a true expression of commitment to the absorption of lean practices.

In their third section, the paper goes through the description of the specific analytical methodology used to conduct the investigation on EGR project. Indeed, the fourth section is

oriented to analyze the Pirelli case study through the conceptualization and subsequent implementation of EGR Project. In so doing, the thesis then moves to evaluate the impact of such initiative on the whole organizational structure, conducting a field research on the shop floor, and finally explaining not only if and to what extent EGR project actually worked out, but also highlighting challenges and difficulties encountered during the course, and supporting the investigation with the valuable contribution of employees' personal experience.

The fifth and sixth section aim to discuss the results attained from the research conducted, and provide considerations and insights about both the results of EGR experience in Santo André plant and possible solutions for future improvement.

2. THEORETICAL BACKGROUND

2.1 The Lean way in Manufacturing Companies

According to prominent researchers like Jones and Womack (1996), the lean approach represents a serious attempt to radically transform the manufacturing world, by then embracing and involving each of its aspects, from consumers' preferences to sectors' profitability, up to the traditional idea of work. Likewise, it also turns to be a valuable weapon for company social improvement, by addressing crucial issues such as the quality of workplace environment, the leadership and diversity management, the employees' sense of accomplishment and their commitment to firm's activities, policies and goals. Indeed, lean is about trusting and believing in people by investing in their improvement, creativity and empowerment, regardless the hierarchical position of belonging (Liker, 2004).

Soon come to light in the early 80's, the Toyota way in manufacturing quickly showed up its originality and gave to sector specialists the feeling of a very stable and consistent model to be followed from that moment onwards on how to both efficiently manage plant daily activities, achieve world class quality excellence in products and increase the company's degree of responsiveness to final customers (Liker, 2004). The so disruptive impact of this

approach is mainly due not only to the adoption of valuable practices and tools such leveled workload (*heijunka*), one piece flow operational process, kaizen and pull production systems, but especially to the striking cultural transformation which involved the company as a whole. (Liker, 2004). In fact, even though the former are means whose utilization is critical to achieve a lean based business format, they are by far more easily managed and practically implemented when compared to the latter, as powerful levers of a revolution realized within the company's identity and intimate nature (Liker, 2004).

In addition, performing a strong initiative to cultural change throughout a manufacturing firm involves the need to interface some sensitive and crucial dimensions like corporate philosophy, employees' integrity, engagement and commitment to work. In fact, differently from practical tools and techniques, whose functionality is easier to directly learn and transfer, (even across different plants or companies), properly understanding the employee's values and, if necessary, intervening for the better, requires a deeper effort in developing a forward-looking strategy, growing a leadership spirit and feeding the conviction of a firm devotedly oriented to learning and continuous improvement (Liker, 2004).

2.2 The Toyota way: Differential features and success factors

Since its birth, Toyota has always been striving to carry forward and cultivate over time a well structured and distinctive business model, not only by pursuing satisfactory economic and financial results but especially creating positive externalities and providing considerable benefits to its surrounding community as well as final consumers. Thus, in addition to daily working to make its competitive advantage sustainable on the long run, the Japanese firm concentrates a relevant emphasis on the priority of establishing practices, beliefs and methods to the extent that they can vividly represent the real engine of such outstanding performance and shining success. As a matter of fact, the effective operation of all these mechanisms and tools to be set up, definitely depends on their users, people (Liker, 2004).

Undoubtedly, are the employees, no matter what the hierarchical level, to firsthand activate and manage the functionality of such practices by often interacting with one another, constantly feeling a sense of urgency in tuning any irregularity within the plant, fastly resolving problems arising from time to time and sharing a feeling of continuous growth and incremental improvement within the enterprise (Liker, 2004). Hence, since representing a

renewed cultural mentality, and not merely a practical reliance on technical devices, Toyota way underlying principles definitely entail an higher, and not lower, degree of people involvement throughout the whole company; in so doing, their role and responsibility turn out to be essential and absolutely crucial for the final result of the whole challenge.

Going forward in this direction, it would be useful to mention that, differently from previous manufacturing business models, the lean enterprise turns out to be far more dependent on each of its employees, because of the remarkable importance covered by human resources, from executives to equipment operators, in mastering firm current progress as well as future improvement paths. In this way, an employee-oriented company, carefully managed by motivated and committed people, can easily develop some of the most important skills in order to both ensure steady growing outcomes and also go well beyond the targets set by manufacturing companies in the past. Those required capabilities include: sense of continuous urgency in detecting and immediately settling problems into the factory, substantial focus on product quality and its preservation over time, strong and tireless attitude to problem solving, orientation to work-in-team and, at last, widespread tendency to the drastic removal of inventories, possibly replaced by smaller buffers located close to work-cells.

All in all, the entire Toyota way has been evolved around fourteen different principles (Figure 1), which together represent the real secret and the strategic infrastructure of such a lasting success in automotive industry. Those principles, testifying the serious enterprise commitment to build up a new type of organization based on continuous improvement and efficient problem solving, support the Japanese company through four broad dimensions: *Long-Term Philosophy; Process; People and Partners* and *Problem Solving*.

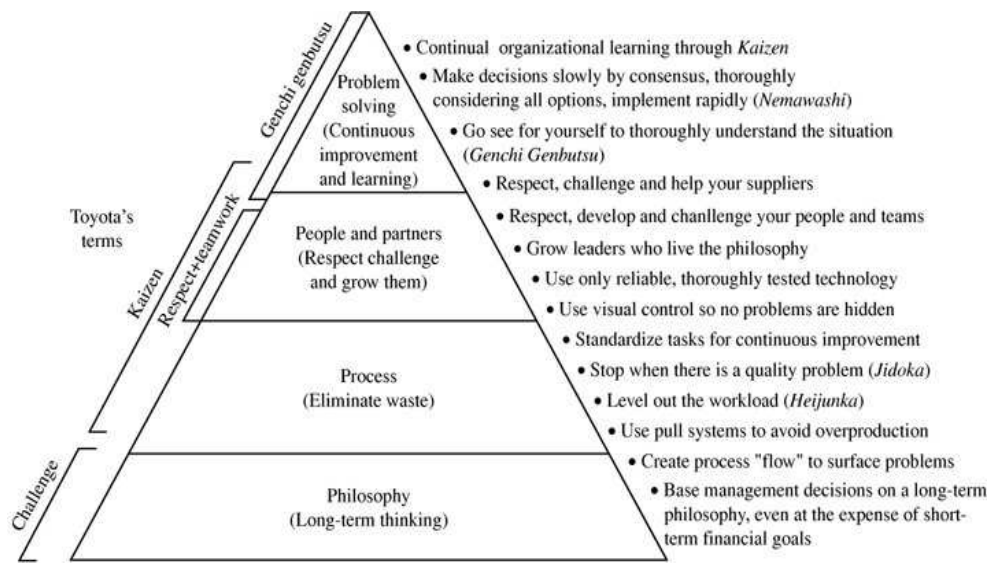


Figure 1 - The Toyota 14 Management principles

Source: Liker (2004)

2.3 The impact of Lean thinking on manufacturing: The Toyota Production System

On the other hand, the TPS (Toyota Production System), represents the Toyota shop floor approach to manufacturing and can be generally identified as the complementary structure of Toyota way in order to ultimately frame and figure out the company skeleton. In other words, it depicts the most effective and high-performance model of plant that a firm can pursue by strictly following practices and rules underlying the Toyota way. (Liker, 2004). Moreover, applying some or all of the Toyota principles does not necessarily guarantee a company to achieve the satisfactory lean targets it expected, since its most effective of such manufacturing approach definitely depends on several causal drivers, such as firm environment, type of industry, employees' commitment, etc. (Liker, 2004)

Developed after the Second World War, in Japan, this manufacturing system quickly became famous all over the world for its flexible operational system, quality and astonishing efficiency. Such production approach, still legitimately holding a vivid sense of uniqueness, can rely on a smoothly process chain, which is pulled by consumer demand and mostly based on cellular manufacturing. Thus, the strong emphasis put on flow turns to be the very differential feature of such an innovation breakthrough, whose two main spotlights are characterized by a "demand sensitive" operational process and a fervent corporate culture, constantly oriented to incremental improvements and fruitful challenges (Liker, 2004).

Therefore, the lean mission to waste removal, beyond being included into the company bearing structure (the TPS) shows up its vivid potential by contributing to value creation and improved efficiency within each plant. Those last two goals can be achieved by following the TPS house diagram, legitimately recognized as the frame of reference of Toyota's perspective (Liker, 2004). The reason for such domestic architecture in representing Toyota's attitude to manufacturing, has to be found out in one significant interpretation: the strength and stability of the house, as well as the effectiveness of the Toyota way, depend on its foundation and pillars. In these terms, a place of special relevance is assumed by lowest cost, shortest lead time and best quality in product, along with high employees' morale and satisfactory results in safety (Liker, 2004). Two other fundamental and necessary columns for the overall consistency of Toyota's mission lie in just-in-time approach to production scheduling as much as the employees' goal of making the product right the first time, in such a way as to prevent defects go through the production chain. Further elements that definitely enriched the quality of Toyota's value proposition are then given by tension to standardization (in processes as well as in metrics), long-term philosophy, visual management and leveled production volumes (as a result of scheduling activities).

2.4 Lean Thinking at Toyota: What really makes difference from the other firms

According to McBride (2008), many firms have been largely attempted, over time, to adapt its operational policies to Toyota's lean practices. In fact, the most common solutions have been regarded the reliance on the assistance and helpful support of an outside source as well as a kaizen event or training session. Those initiatives, beyond trying to facilitate the firm's approach to lean manufacturing, have been accomplished through the implementation of 5S standards, tool boards on the shop floor and some further valuable drivers. In the mean time, the quality and effectiveness TPM programs was enhanced, by constantly updating the schedules for preventive maintenance. Therefore, although a considerable number of companies has been tried so far to pursue an efficient lean identity, the very crucial obstacle to such ambitious achievement has been represented by managers' lack of ability in creating an authentic lean cultural framework within the firm (McBride, 2008).

In fact, even though a certain company tries to replicate as much as possible the operational patterns developed by Toyota Production System, it still does not grasp the intimate nature of the combinations among its underlying components (Liker, 2004). Hence, lean dimensions are not simply stand-alone entities, but they trigger a satisfactory improvement as a result of their joint interrelation and fusion. In the same way, as loosely happens, the firm only mechanically put in place some of the lean pillars, thus failing to achieve the vivid comprehension of the most powerful principle: the continuous improvement as the driver to sustain lean production philosophy on the long run. (McBride, 2008)

Shifting the attention toward the best lean practitioner, it would be convenient to point out that, at Toyota, regardless the hierarchical level of belonging, every employee is deeply committed to work and learn, by daily figure out practical solutions as much as creative ones. In other words, within the Japanese firm, every person is constantly trained to both adopt a pragmatic perspective toward problems and concurrently lay the foundations for a fruitful creativity on the shop floor (McBride, 2008). Furthermore, in setting up the production chain, Toyota accurately select the most talented and brightest employees, and frequently challenges them to rise up throughout their career paths. In so doing, the entire organizational infrastructure and all functional branches, from human resources to sales, from finance to marketing, are then shaped in such a way as to ensure the faithful adherence to corporate identity and foster significant commitment to improve internal processes and the level of responsiveness to final customers. For all these reasons, strongly investing in this direction, Toyota definitely proves to be a learning organization, whose cardinal points are represented by teamwork, discipline, high employees' motivation and tireless tendency to improvement. Indeed, in contrast to firms' traditional attitude to quickly move across different operational standards, Toyota clearly shows up to be a suitable example of learning company, which does not only carry out a continuous improvement mindset but it is especially focused on sustain it over time, thanks to the involvement and full participation of the whole workforce (McBride, 2008). As a proof of what stated so far, the natural result of a corporate entity which is continuously oriented to encourage and reward innovation and improvement, is actually testified by the fact that 90 percent of the ideas provided and brought by Toyota's employees are effectively implemented (McBride, 2008).

2.5 Lean thinking: Much more than merely acting on the shop floor

If applied to manufacturing sector, lean thinking seems to assume the semblance of an innovative spirit striving for applying simple and cost effective solutions to factory shop floor, by observing the entire value stream flow, directly from the final customer perspective (Liker, 2004). In fact, only doing it this way, it would be feasible to both properly distinguish value adding activities from non-value adding ones, and take the correct countermeasures in order to rationalize and efficiently clean the whole enterprise operational process. As a matter of fact, lean thinking came out of the intention to change the route so far used in manufacturing and firmly establish a new way of both looking at the production cycle, so to keep distance from craft and mass production (Liker, 2004).

More specifically, the former approach bases its own functionality on skilled and experienced employees, relying on essential but flexible tools to exactly meet customers' needs, whereas, according to the latter, big volumes, by far much higher than required, are made by unskilled employees through costly and inflexible means (Liker, 2004). Thus, counteracting and opposing the two positions described above, it would be also interesting to point out how the paradigm of lean was not framed as a well structured and methodical concept since its birth, but it has only undergone the appropriate adjustments and improvements over time, up to assume the most suitable shape to current industrial parameters and production metrics (Liker, 2004).

Hence, going forward on this issue, it is worth describing the crucial evolution that has seen lean thinking as the absolute protagonist on manufacturing stage. Most of the emphasis will be then focused on the shift of lean concept from a technical tool for factory improvement up to take on the traits of an overwhelming hurricane that involves the entire company infrastructure. In fact, such transformation path is made up of four subsequent stages (Hines, Rich and Holve, 2004), that are supposed to be taken by the firm throughout its industrial storyline, so to ensure the effective accomplishment of a steady growth path. Indeed, those steps turn to be also related to the increasing development, inside the company, of a learning attitude as the underlying base for long-term success. Such four steps, describing the substantial evolution of the company from a very early stage up to touch the corporate culture and acquire a lean identity, are described as follows:

- *Knowing organization*, based on the awareness that there is only one optimal way to succeed in manufacturing and it coincides with lean approach, achievable relying on the introduction of work cells and waste removal from the shop floor
- *Understanding organization*, mainly characterized by a strong attempt to reinforce and enhance the culture of the firm, by defining the most relevant corporate values and managerial principles. Anyhow, within such improved organizational infrastructure, lean thinking maintain its role merely on the operational side yet
- *Thinking organization*, where lean begins to take on a larger surface of usage and application, becoming a crucial tool for making the enterprise rethink valuable and feasible solutions for the effective improvement across the entire production chain.
- *Learning organization*, that definitely comes out from the combination of the useful statements underlined so far and finally contributes to shape the daily company improvement according to the appropriate reliance on lean practices in core business areas: in this case, the emphasis will be not only focused on assembly line, but on those fields which reveal to be fundamental for sustaining competitive advantage in the up coming future.

At all times, thanks to the effort towards one piece flow implementation, Toyota has been proven to successfully pass throughout those four steps, consistently incorporate the ideal model of the lean enterprise and root out the totality of waste from its factories' shop floor (Liker, 2004). Moreover, up to now, a negligible number of firms has attempted to take, with partial and debatable results, such ambitious path which will turn out to be a relevant guideline to achieve a lasting success in a future economic juncture marked by aggressive, fierce and variegated competition, widespread tendency to cost reduction and continuous product innovation. In the following sections, the paper will go through the analysis of the core features which are at the base of lean thinking, by considering it not only as a new attitude toward operations but primarily as a new road map for overall firm improvement. In this way, the one-piece flow dynamics can then leave their exclusivity of use in manufacturing and act on various business fronts, from product launch to design, from order taking to delivery.

Therefore, a so brightening approach as lean thinking entered the industrial environment with some principles that deserved to be correctly and consistently applied on a daily basis so to purify as much as possible the value-added flow from all those activities that slowed down and hindered the transfer of materials from upstream to final customer downstream. As a matter of fact, the described wastes are deeply harmful to firms and need to be radically removed, in order to pursue a better effectiveness and a faster flow of materials within the plant. To do this, it would be important to rely on the concept of one-piece flow, as the revolutionary idea of optimizing all factory productive drivers (from people to machines, from facilities to materials) to the extent of achieving substantial results in terms of remarkable performance, higher product quality, cost reduction and resources saving (Liker, 2004).

For all these reasons, instead of being adopted by a single branch of the tree, it should be appropriate to approach lean thinking as a companywide dimension which could definitely achieve its deep functionality when applied to the whole firm, therefore making all its functional pieces work out and getting a satisfactory outcome in terms of total effectiveness. In other words, lean thinking can turn to strongly embrace all the company fields by shaping innovation and change within the corporate infrastructure, from back office activities to delivery management, from order taking to products development (Liker, 2004).

Moreover, such innovative attitude towards the way of manufacturing proves to underpin strong cultural transformation inside the firm itself, since it both involves the active role of all elements that make it up and mainly entails a radical change of mindset.

2.6 How to become lean: A five-step process

Making a firm become lean requires a serious commitment to change and a natural abandonment of the previous perspective, represented by the mass production thinking. Then, the adoption of such new path can be better splitted up and developed by following five sequential stages (Lean Enterprise Institute, 2009):

- Assuming the final customer standpoint, while carefully finding out the real value for him and separating it from wasteful elements within the entire production chain.
- Figuring out, for every single product and service a given firm is supposed to market, the complete set of phases lying between the product concept to its physical realization, passing

by the activity of information management, particularly critical to orders collecting and delivery scheduling. Most of the time, the act of properly investigating, alerting to wasteful elements inside the value stream shows up countless weaknesses inside the manufacturing system and therefore underlines worthy chances of improvement.

- After detecting all the aspects that are worthy of being removed, the next step refers to ensure the purified value adding activities to flow. Of course, to achieve those results tends to be a function of a peculiar attention paid to every single detail into the entire production process, so to pursue the expected elimination of some barriers to fluent flow such as downtimes, waiting and some others.
- Moving forward, it would be worth establishing pull-based production systems, aiming to provide customer with desired products only when he places the order. In so doing, further sources of waste, like inventories and obsolete parts among all, can be easily cut out. As a matter of fact, this cleaning initiative definitely enables the firm to free up resources which can be wisely used in a logic of greater efficiency.
- Having achieved such significant gain in efficiency, the firm can then move along the path to quality excellence and perfection, attainable by continuously promoting the zero defects policy, focused on the steady and incremental improvement of each cause of defect.

2.7 From mass production to lean production approach: Reasons for transition and the evolution of lean concept

It would be also worth saying how lean concept evolved and changed from its initial theorization. In particular, before starting exploring into detail the lean theoretical framework, it would be convenient to build up a structured description of the older traditional mass production thinking, in such a way as to evaluate the main differences, criticalities and valuable features of the described production model (Liker, 2004). Thus, while lean thinking finds its real significance in the Toyota Production System as a vivid example of one-piece flow effective functionality, until a short time ago the mass production approach represented the ultimate standard for most of manufacturing firms and loosely consisted of grouping and collecting equipment as well as employees according to a dimension of similarity. Therefore,

according to Liker (2004), the expected benefits of such operational framework can be summarized as it follows:

- *Great flexibility* observed in scheduling activities, in a way that the plant is able to afford and cope with unpredictable variations in production volumes.
- The chance to gain *economies of scale*, due to company desire to achieve both maximum equipment utilization and minimum cost per unit, therefore complying with productivity optimization policies and best practices definition.

Beyond all the valuable contributions stated so far, one more aspect worthy of being analyzed, refers to the fact that, given a clear separation between areas and departments of the mass production-based factory, concurrently with each cycle time, materials as well as informative resources would be supposed to flow very frequently from one department to another, up to the point of necessarily establish one more field of employees specialized in products handling, material transportation and information transmission.

Nevertheless, according to efficiency metrics, the material transportation mode across department would only correspond to once-a-day single batch, so to cut out the overall cost of material transfer as much as possible (Liker, 2004). Thus, although all apparent benefits obtainable from mass production approach, having a look to such production system through lean eyes suddenly allows highlighting a huge rate of WIP (Work in Progress) inventory, mainly due to overproduction waste and long waiting times for material inside the factory area. All these factors considerably decrease the delivered value to the final customer, prevent the production chain from flowing regularly and conceal some drawbacks into the factory, like big batches, that are positioned in spaces which could have been more efficiently managed otherwise. All in all, as described so far, the high volumes to produce, the low unit cost and the effort to standardize necessarily require a company to rely on a large amount of space as well as financial resources, low quality products, extreme standardization. All these factors obviously make the company quite inflexible to the variance of demand preferences and almost reluctant to the new (Liker, 2004).

Indeed, differently from traditional mass production thinking, lean thinking provides the one-piece flow concept, according to which every single product does not have to necessarily go

through different departments during the cycle, since this only makes up non-value adding activities and lengthens the lead time of plant processes, above all. As a matter of fact, the natural result of such a disruptive innovation in manufacturing is represented by the creation of work cells, differentiated by product (Liker, 2004). In so doing, the vivid attention of plant managers definitely moves from traditional mass production focus on process to a deep emphasis recognized to the real lever of company results, the product and its value delivered to customers. Thus, cellular manufacturing, as one of the most prominent innovations brought by lean thinking, therefore represents an effective strategy, for a given firm, to firstly get rid of those wasteful operations within the production chain by modifying the plant layout and, secondly, remove all cost items due to the existence of inefficient stock takings (Liker, 2004). As done with mass production features, the same will be done with regard to lean thinking and one piece flow framework, so to briefly show up the most relevant strengths and impressive peculiarities of such waste-free attitude. Therefore, according to Liker (2004), to work in factory by following one-piece flow dimension means:

- *Ensure quality production*, by constantly monitoring and controlling the entire process, as well as detecting immediately eventual product irregularities and nip root causes in the bud, so to prevent them from occurring again in the future.
- *Lay the foundations and support a higher productivity*, by looking at a waste-free operation flow within a single cell and more easily evaluating the correct allocation and utilization of work force, on the basis of an estimated level of production.
- *Provide tangible flexibility to the whole system*, by producing exactly what the customer asked and better reactively responding to unexpected and potential variations in terms of production mix, as a function of final consumer preferences.

In addition to the significant benefits described above, other valuable externalities attainable both by assuming lean perspective and by removing waste, are related to the chance of making available more space into the plant to be best fixed up so to create value, strongly reducing inventory costs, ensuring greater safety in the workplace and, finally, improving the quality of work environment, employees' satisfaction, engagement and commitment to firm (Liker, 2004).

Going in depth of lean dimension, one more distinctive feature within the model is related to takt-time. Such indicator basically sets the most efficient pace of production, obtained by dividing the monthly volume by the time actually worked per month, in such a way as to determining the approximate rhythm at which final customers acquire company products (Liker, 2004).

Thus, according to takt-time, an effective one piece flow based process should be supposed to run at a certain speed in order to comply with the estimated volume pulled by demand, therefore preventing the entire operational chain from the risk of overproduction and bottleneck. In other words, to make a company capable of performing the desired takt-time means to put it in a position to deeply streamline its operational cycle, by purifying it from countless wasteful activities, to discover and quickly fix points of inefficiency, and finally to more easily achieve satisfactory results in terms of cost per unit, lead and delivery time, high quality standards.

As a demonstration of what was said earlier, it is definitely disarming the truth that, only a few decades before the operational revolution brought by lean thinking, almost all of the business processes had only a meaningless and negligible quote of value adding activities (about 5%), whereas the big portion was represented by non-value added ones (about 95%). (Liker, 2004). The main reason for that refers to the adoption of an awkward production system, better known also as batch-and-queue model in traditional mass production approach. By applying such operational dynamics, considerable intervals of time, due to materials waiting between different factory departments, turned out to be unnecessarily wasted and the overall outcome can be inexorably summarized by the loss of value, both in terms of time and effort.

2.8 The Lean Way: A crucial driver for lasting success and steadily growing results

In the current business landscape, efficiency in operations tends to be a key element in such a way as to remain firmly in the market and primarily avoid unpleasant and downward economic trends (Liker, 2004). Together with this, yet, it is worth claiming that, in order to take the right path for achieving both long-term success and lasting competitive advantage, there are some relevant variables which are definitely critical and absolutely useful:

continuous improvement in processes and incremental innovation in products, above all. Both goals can be achieved by paying great attention to the following elements: improving processes and activities as much as possible, working for best quality in work environment, seeking for functional and cost effective solutions for technological improvement, sowing a company concept which is daily oriented to learn, and, lastly, banishing any nature of waste, in terms of resources, time and effort (Liker, 2004). As a matter of fact, although most of the companies would instead concentrate their daily emphasis on the highest return on investments and cost reduction on the short run, all those purposes described above are grown by Toyota on a long-term perspective, according to which it is by far more profitable to bring to success a company model, that incessantly strives to actively involve its employees, push them to the maximum result, and create value for all its surrounding stakeholders, from the economy to society, from customers to suppliers (Liker, 2004).

2.9 Waste in management work: How to root it out and create value

In Toyota workplace, waste can assume three different forms (*muda*, *muri* and *mura*) and attempting to remove all of them is not only a plant's current priority but also a fundamental duty for a better future improvement in the operational activities of the whole company. In particular, it would be convenient to go in depth of each of these three typologies and explore their most relevant features. Firstly, *muda* represents the most significant category of waste, which most negatively impacts lead time, space for inventory, long waiting times and unnecessary movement of material within the plant area.

A further typology is depicted by *muri*, which regards the effect of maximizing the utilization rate of both machinery equipment and human resources, by pushing them up to the limit, so to result in unpleasant results in terms of low-quality products and lack of safety. Moreover, the third important source of waste is given by *mura*, whose peculiarity can be traced to the instability of production system towards the fluctuating trend of demand, sometimes leading to overproduction while sometimes to bottleneck effects. Being also the major root for *muda*, such irregularity can be mainly due to either internal production inefficiencies (high downtime, existence of defects, etc) or company inability to forecast future volumes. In this sense, it would be a reasonable solution, for the firm, to rely on a set of productive resources

that can be functional to effectively meet a peak of maximum demand, so as to be also sufficient in easier circumstances.

Indeed, since the primary focus of Toyota lies in seeking for waste, detecting and banishing it, from the depths of its experience within the factory, the Japanese firm found out and theorized seven main typologies of muda, namely as non-value adding activities, which are listed below:

- *Overproduction*: it basically means to produce more than what results from customers orders. It then triggers the creation of storage areas as well as the higher cost of transport of material across inventories and inside the factory
- *Waiting*: include all those time intervals that are not used for the realization of products, then delivered to final customers. Such wasteful dimension can be due to a number of potential factors such as machines downtime, bottleneck or overproduction occurrences, and other negative cases like delays in process flow and stock-outs.
- *Unnecessary transport*: is particularly due to the huge effort made to carry out the entire production process and, at the same time, move resources (raw materials, semi-finished and finished products) along the chain.
- *Over-processing or incorrect processing*: it occurs when a set of activities, although clearly wasteful for the purpose of final product, is implemented anyway, or alternatively, when the process turns to be imperfect and inefficient, owing to poor equipment and tools available in the plant.
- *Excess inventory*: it arises from a series of criticalities ranging from high transportation costs and risk of obsolescence to process potential delay, production instability toward demand variations and massive storage of materials.
- *Unnecessary movement*: regards the execution of useless efforts by employees within the factory and during the production cycle, such as walking, waiting and many other non-value adding attitudes.

- *Defects*, whose creation is reflected on a series of tasks (like rework and replacement) and their execution involves spending further kinds of effort, so that the firm would succeed in effectively recovering the quality of its products.

According to Liker, it would be worth adding one more type of waste, namely as the *unused employee creativity*, which can be framed as a large period of company life, spent without properly taking into consideration, valorizing and benefiting from both individuals' creativity and countless chances for learning and profitably improving the enterprise as a whole. Such company's lack of ability in effectively taking the best out of human potential can then generally lie in various causal factors such as high workforce turnover, clumsy hiring techniques, demotivating work environment, inadequate or inexistent orientation to on-job training, weak workflow.

Moreover, the source of waste that is evaluated as the most critical to root out, is represented by overproduction, because its occurrence automatically requires the company to take corrective actions and initiatives in terms of new inventories construction and freed up areas provision, inside the factory. Indeed, such induced countermeasure, beyond building up storage buffers between production processes, plays a crucial role in undermining the organizational atmosphere and gives way to a significant reduction in employees' motivation and commitment to make continuous improvement constantly happen in the operational field. In so doing, people within the firm tend to be content and satisfied with the current situation, good but not optimal at all, rather than rolling up their sleeves and striving to improve the daily life of the factory. All in all, waste removal necessarily represents the starting point to rethink value delivered to final customer, since the highest quality in products flows naturally from a better efficiency in processes and then a successful attempt in the reduction of operational costs.

2.10 Standard is the way: Creating value basing on daily routine management principles

In Toyota's perspective, standardized information as well as standard managerial tasks represent important drivers to ensure not only the achievement of the objectives set by the company but especially keep the firm on a path of continuous improvement and growth. Indeed, a necessary and sufficient condition for the proper functioning of these dynamics, is

given by the full awareness and belief, on the part of company users, about the usefulness of such standardization practices, which are supposed to be framed as a crucial tool for achieving high efficiency, quality excellence in products, prevention of accidents inside the factory.

Thus, being standardized in Toyota seems to assume a different meaning from the common acceptance of a fix set of activities that have to be faithfully followed in a certain order of execution. In fact, according to the Japanese firm, a standardized task is basically made up of three prominent features such as stocked amount of products, defined sequence of processes and takt-time, which was previously described. In addition, a strong relevance tends to be taken by positive externalities and the propulsive thrust exerted by standardization factors towards the company employees, in terms of a more empowering and collaborative workplace rather than a conflicting and degrading corporate environment.

As a matter of fact, a standard in Toyota has not to be merely framed as a vehicle to achieve efficiency through repeatability induced on the shop floor, but, on the contrary, it actually belongs to each of its employees' daily attitude to work, by taking on the traits of a key lever for achieving a defect-free production, and so in this way, high quality results reflected in the final product. In addition, implementing standardization practices on the shop floor, as well as in factory equipment or product design, shows up its great significance in properly setting down the process flow within all its features and underlying components, so to create a solid surface of operational structuring and technical expertise that will turn to be valuable in triggering constant improvement and important initiatives for the better state of the whole firm. In this sense, after having accurately ensured the definition of all the standardized dimensions of reference, there will be the chance to both make interesting upgrades to the organizational architecture and take corrective actions when potential shortcomings or inefficiencies are detected in the system.

Yet, the major drawback of relying on standardize metrics and principles for company daily management mainly lies in the risk of freezing the enterprise excessively, due to the creation of inflexible bureaucracies, top-down control systems and weak communication flow existing between hierarchical levels. As a consequence of such uncomfortable constraints, the resulting firm profile would turn out to be reluctant to change, deeply static and suitable only in contexts of great stability and low technological advancement. Differing from those unpleasant consequences, Toyota has proven over time to both successfully bear with the possible dangers related to the implementation of standardized components inside the

company, and on the other hand, position itself in the middle of a continuum between organic and mechanistic organizational identity.

Besides, Toyota appears to be a self-balancing company in the surrounding environment and competitive landscape, since it well succeeds in coping with those two contrasting dimensions in such a way as to foster company improvement and enhance organizational identity, by consistently relying on bureaucratic and standardized metrics as much as more flexible levers for its daily management operations. In fact, being evaluated on two analytical criteria such as nature of bureaucracy inside the social infrastructure and rate of bureaucracy found out on its technical side (Adler, 1999), Toyota Production System can be framed as a “enabling bureaucracy”, since it constantly triggers employees’ empowerment and self-reliance, makes rules work as guidelines rather than imposing barriers and, finally, allows hierarchy to facilitate and promote company orientation to learning. Thus, enabling procedures practically serve to support the daily duties and tasks of each employee, by involving workforce in setting best practices, monitoring and checking their own activities in the enterprise.

Therefore, assumed the existence of such a dual inner identity inside the company, another long-standing and relevant issue, however critically related to company performance in the current scenario as well as in the short-term future, refers to the crucial decision on how to properly define a favorable compromise between rigid standardized metrics for employees to be followed and bursts of boundless creativity, although always linked to appropriate and feasible targets of quality and cost. Moreover, with regard to the effectiveness of standardization within company operations, standardized practices should be rather conceived both as useful guidelines for employees and necessarily adjusted according to the typology of process or company department to bring under a single parameter of execution and evaluation. In this sense, a most repetitive or static task would be differently regulated from a more flexible one, since company purposes still remain those designed to achieve overwhelming results, but through a constant adaptation to some peculiarities and distinctions observed within the organizational engine.

Indeed, even though workers are the ones supposed to frequently check and update standards within company processes, in some companies they have no time available to afford such task and so it follows that standards are set by third parties and automatically imposed to workers. Nevertheless, dropping the fallacy of this aspect, the crucial point for standardization

effectiveness lies in the firm ability to shape a collaborative work environment, within which employees reciprocally compare their ideas, provide personal insights and suggestions, feel deeply involved in a real change initiative. Farther, since the single employee starts taking an active role into the organizational infrastructure, imposition criteria and top-down decisions tend to fall into disuse, while the possible sources of contrast and friction can be concurrently replaced by a cooperative work environment, where individual motivation encourages fruitful knowledge exchange and sharing of best practices and ideas. All in all, each employee's empowerment is the very starting point for ensuring the implementation and maintenance over the years of a corporate identity based on continuous improvement, personal growth and innovation (Liker, 2004).

2.11 Visual Management, Control and Discipline on the shop floor

Moving forward, another feature to be underlined in Toyota operational model is given by the development of a visual control approach, as a way to regularly keep under control all company features as much as performance indicators, educate employees at best practices and easily detect problems and irregularities on the shop floor as well as anywhere else throughout the firm. In other words, visual management devices deeply contribute to value creation by figuring out a comprehensive company road map, through which each employee can seek and obtain accurate information on how activities and operations have to be properly executed (Liker, 2004).

Besides, an higher clarity of the displayed information may thus allow not only to monitor over time the state of operations, equipment utilization rates and trend of factory indicators, but especially to find out possible performance gaps very quickly and take timely countermeasures to prevent future misalignments and deviations from the set standard.

Such Japanese attitude to the effective and detailed monitoring of business activities has its roots in 5S, which consist of a set of initiatives aiming at achieving quality excellence and efficiency through waste removal (Liker, 2004; Womack & Jones, 1996). Such program is then made up of the following five types of actions to be fulfilled in order to increase value significantly and make process flow more fluid:

- *Sort*: consists of making an ordered list of everything available, then select only what is really needed and throw out the rest. There is a bunch of things that only take up space that could be better managed otherwise.
- *Straighten*: achieving order in the organizational infrastructure, by properly repositioning value-adding activities and cutting out the wasteful one.
- *Shine*: while cleaning and tuning the available space, it would be possible to detect and underline possible defect and irregularities inside the plant. The latter represent serious sources of equipment failure and quality loss.
- *Standardize*: Set up systems that would be geared to examining and checking company processes, by establishing uniformed best practices and, in doing so, outlining potential distortions and improvement solutions
- *Sustain*: Foster the maintenance of such procedures, strengthen their understanding by employees and never stop triggering continuous improvement and growth. In such a way, it is possible to build up a workplace tailored to the defined standards. At this stage, it is necessary to make sure that every single procedure is so automatic as to seem completely natural in its occurrence

All in all, 5S program attempts to lay fruitful roots for incessant company advancement and represent a critical tool for making such enhanced orderliness a source of competitive and operational sustained advantage. Besides, the direct benefits deriving from 5S implementation are listed as follows:

- Make mistaken behaviors visible and clearly identifiable by any employee throughout the factory
- Reduce, as much as possible, unnecessary losses of time and use the space optimally
- Develop, in people mindset, the habit of both keeping the workplace tidy and clean, as well as the natural orientation to create small but continuous improvements in working conditions

- Radically cut out equipment downtime and breakdowns
- Keep the workplace more orderly means therefore to increase its own safety

Doubtless, the way in which to ensure the achievement of this challenging goal lies in building up a cooperative environment, that should be mainly focused on both employees teamwork and frequent auditing inspections led by managers either on a regular basis or randomly. Of course, it should be noted that 5S, visual control principles and any other communication tools used within the factory do not embody, on their own, the full essence and the unique key-factor for the outstanding success of lean thinking, but definitely need to be integrated with all the other tools, so to make production flow smoother and the Toyota way a truly reliable attitude to manufacturing.

2.12 The diffusion of lean practices as a knowledge transfer process

Beyond the implementation of lean manufacturing system, whose underlying and prominent features have been described so far, a further point of fundamental interest is represented by the activities put up by the firm, multinationals above all, for rolling-out the lean approach in various plants of their industrial complex (Camuffo, Paolino, Secchi, 2012). In fact, lean thinking has recently begun to entering the factories of an increasing number of players in manufacturing sector and such tendency was strongly intensified by modern competitive dynamics, mainly dictated and driven by global economic downturn, widespread boost to globalization and business consolidation. Indeed, settling the conditions for the transfer of this disrupting notion of production across the several company subsidiaries has lately turned out to be a very little investigated issue so far, and, because of its enhanced relevance, worthy of greater interest. In fact, the dynamics related to knowledge transfer process, in this case just referred to diffusion of lean thinking within a given MNC multi-plant infrastructure, reveal a discrete level of inner complexity and can definitely influence, in different ways, the final outcome of the entire proceeding.

Besides, as stated above, the ultimate and significant success in the implementation of a lean production system is not due to the careful and strict application of its underlying devices and tools, but especially to the vivid and deep adoption of a massive breakthrough in the way of conceiving manufacturing, growing work environment and leadership, strengthening employees' morale and engagement, facilitating a long term strategy and, lastly, keeping alive a strong inclination to continuous improvement.(Womack and Jones, 1996; Meier and Liker, 2007; De Menezes, 2010; Fine, 2008). Therefore, as mentioned, there is a plenty of factors, in such a complex environment, which contribute somehow to the implementation of lean thinking in one company plant as much as into the other factories belonging to company's industrial complex. As a matter of fact, relevant operational phases as the initial introduction of the lean way in one company's plant, its effective implementation and functioning, and its subsequent attempt to establish it within its complex, can be all framed as the sequential stages of a knowledge management process, where the crucial trajectory of interest is given by the connecting bridge between the MNC and its industrial subsidiaries. Thus, the stability of such bond ends up to depend on the accurate management of this procedure between the two reference parties and determines most of the success of the entire lean implantation project. Farther, considering such procedure as a wide network of knowledge streams, mutually interchanged between firm's headquarter and its controlled branches, definitely entails a deeper reflection on two core performance indicators, such as process efficiency and effectiveness (Argote and Ingram, 2000; Szulanski, 1996; Minbaeva, 2003; Perez-Nordtvedt, 2008; Ciabuschi, 2011).

In fact, efficiency consists of the total amount of effort and time spent to carry out the transfer process into a given subsidiary, while effectiveness regards the chance of definitely succeed in ultimately achieving a satisfactory adoption of the new implanted knowledge within the host party. Thus, effectiveness proves to be a very challenging target to achieve by the company, since it does not merely depend on an accurate balancing in the utilization of available resources, but absolutely requires the general acceptance by company's subsidiary and the positive feedback pursued within its inner environment (Szulanski, 1996; Lin, 2007). Moving forward on this issue in detail, another aspect of great relevance is assumed by the act of replicating specific knowledge and practices across physically different and geographically dispersed organizations. Hence, according to Winter and Nelson (1982), companies can implement and fulfill such initiative by complying with two drivers: principles and templates.

The former are set at headquarter level in agreement with the outlines of a particular expertise to expand, whereas the latter ensue from daily work experience and up to the point to represent a sort of company routines. In fact, by triggering knowledge development, the replication of templates builds up a set of optimal behaviors and practices that, mainly because of their nature of ideal patterns, can then be more easily transferred and applied into firm's subsidiaries. Yet, most of the recent literature in this field disagree with the idea of relying on template in rolling-out lean production approach in multinational firms, since using such best routine practices do not effectively contribute to achieve a satisfactory result in knowledge transfer but, on the contrary, it does not only act as a significant barrier to local adaptation but also hinders actual assimilation and full understanding by each local branch (Zaheer and Kostova, 1999; Ghoshal and Bartlett, 1989; Doz and Prahalad, 1987). Furthermore, another enabler factor, raised by Levinthal and Cohen, relates to the necessary existence of knowledge background or notable absorptive capacity within the hosting subsidiary, as underlying condition to better facilitate proper follow-up and ultimate realization of the whole implantation process.

Besides, it would be convenient to assess a further dimension that is certainly worthy of attention: the degree of autonomy held by the subsidiary and its impact on the level of roll-out procedure effectiveness. As many researchers claimed, a higher level of autonomy, therefore corresponding to a decentralized decision-making, positively impacts on the wealth of knowledge, knowhow and expertise that can be developed inside each of company's controlled branch (Van Wijk, 2008; Gupta and Govindarajan, 2000). In other words, shifting the ownership of authority from MNC center to the suburbs enables subsidiaries to take its own autonomous steps on the path of growth and, especially, feel much more engaged within a company-wide plan of knowledge generation and expansion. In addition, a further influential variable in determining the overall outcome of knowledge transfer process is represented by Headquarter discretionary decision on the amount of resources to provide, so to accomplish the whole set of described proceedings. Of course, the higher the quantity and conformity of resources made available at HQ level, the more likely the subsidiary's absorptive capacity will be improved and supported by enhanced commitment and deeper effort of the involved parties.

Moreover, great significance in running both well structured knowledge transfer processes and shapely implantation procedures, is definitely assumed by head quarter's internal

involvement, whose critical role consists of frequently monitoring the whole process trend and fostering subsidiaries' efforts by providing crucial contributions through its proficiency and prowess. Thus, sharing useful recommendations and practical tips for the better conduct of the various steps, head quarter's intervention proves to be particularly critical in the overall transfer process satisfaction, since its balanced presence on stage aggregates value to company daily operations and generates positive externalities for the entire business environment.

2.13 Organizational ambidexterity: The importance of adapt to change and align capabilities

In the current economic landscape, it is undoubtedly critical, for any business entity in the market battlefield, grow an actual sense of adaptability to the fast and unpredictable changing of surrounding context. Hence, quickly taking appropriate and responsive countermeasures to competitors' moves, investing in new disrupting opportunities and continuously striving for a better result or a more challenging goal, are the three main abilities, which a company can not do without in order to maintain long-lasting results and remarkable performances in its business industry. Indeed, this priority need of reactivity to market fluctuations must be also associated to an equally significant level of alignment shown by the company. (Gibson and Birkinshaw, 2004). Put differently, the latter stands for the firm's capacity to clearly grasp the sources of created value, in terms of the internal configuration of activities to be built up carefully, in such a way as to both effectively deliver lasting value to customers and entail commendable results in the inner integration of company engine.

Therefore, to shape the company according to an ambidextrous identity, basically means to narrowly balance those two described dimensions: in other words, it entails company orientation to concurrently implement present strategy and take into account possible future improvements and long-term projections, resulting from the constructive observation of the highly dynamic context.

All in all, as largely investigated by many scholars such as Birkinshaw and Raisch, ambidexterity can be loosely interpreted as the firm's ability to efficiently meet current demand conditions and, in the same time, react quickly to sudden and unpredictable changes within the economic landscape.

Going further to analyze the underlying determinants and devices that enable the firm to be ambidextrous, structural and contextual are the two peculiar typologies of firm ambidexterity:

- *Structural ambidexterity*, according to which those business units intended for exploitation are distinguished from the ones, instead, geared to exploration, in such a way as to separately allow the accomplishment of both goals of knowledge generation and development. Hence, in this case, much exploration as exploitation are kept apart and do not require individual's discretionary decision on how to engage and deploy resources on the two fronts.
- *Contextual ambidexterity*, however, stems from a fully integrated process design, within which activities are connected and interrelated to such an extent as to enable each individual to take its own decisional path, in terms of time and effort to be allocated at each performed procedure. Indeed, such attitude naturally leads to a tough trade-off between the need of meeting market preferences and, on the other hand, the difficulty of acting in an unstable and constantly changing environment.

More in deep, the former, largely considered as the standard type, consists of creating distinct structures for the different activities to be undertaken during the company's daily life: for example, the department devoted to research and market development would be kept separate from core functional branches, which are, instead, more directly connected to product cycle and its inner value proposition. However, an element of risk is represented by the fact that such serious attitude to disjunction among company's components may inevitably lead to their extreme internal isolation, so as to impede and hinder the acceptance of decisions that should be fully supported and shared by the organization as a whole.

On the contrary, contextual ambidexterity calls for workers to deploy their efforts between alignment based activities and adaptability focused tasks. Hence, if structured in this way, any ambidextrous business entity tends to both be more flexible and encourage every employee's ability to independently decide to organize its own daily work schedule. Acting more on the individual sphere than contextual ambidexterity actually does, considerable attention should be paid to the human component of the organization itself.

What stated so far has to be then enriched and complemented by March's inferred considerations on the notions of exploration and exploitation, whose mutual balance, inside the firm, showed to be essential in acquiring the ambidextrous traits (O'Reilly and Tushman, 1996; Gibson and Birkinshaw, 2004). In fact, in 1991, March claims the critical and endless trade-off, existing within the organizational learning process, between the exploration of new horizons and future possibilities, and the exploitation of current tools and certainties. Farther, the former, mainly characterized by a risk-taking attitude, flexibility and experimentation, drives to long-term but uncertain results, while the latter, embodying higher propensity to efficiency and cost-efficiency, is more likely to lead to sub-optimal solutions, certain benefits and marked inability to adapt to a rapidly changing context.

March also emphasizes that, in competing for market leadership and lasting competitive advantage, a discrete number of companies opt for adaptive procedures that, departing from an exploitation based approach, tend to end up being fruitful in the short-term but hostile and counterproductive in the long run.

2.14 People: The driver to continuous improvement and long-term success

Moving forward on the analytical route drawn up to this point, this section aims to address traits and features of the most relevant architect of lean success within an enterprise: people. They firsthand activate and effectively run the lean engine throughout the organizational infrastructure, by constantly moving the levers of this disrupting operational system and, at the same time, cultivating a vivid propensity to tireless improvement and learning. In fact, like all breakthroughs and innovations carried out within a company, lean thinking strongly enters the enterprise in depth, until it touches its inner philosophy, principles and core values. In so doing, the corporate skeleton naturally perceives such attempt to substantial change and therefore people turn out to be both the direct recipients of such renovation and, simultaneously, the real protagonists of it. As a matter of fact, to establish a new manufacturing approach finds out the major difficulties and arduous criticalities in putting employees in a position to constantly work, operate, behave and think in accordance to such a new way of conceiving factory management and its priorities of irrepressible improvement.

Indeed, the secret for this goal achievement lies in company's ability to make its people follow a renewed manufacturing philosophy: anyhow, the thus described workforce, necessarily suited to the new firm's identity, would require considerable effort and time to be properly planted and then developed. In effect, relying on valuable, motivated and effective human resources is not even remotely comparable to investments in production, logistics or marketing, while it is anything but a ready-made issue, mainly because the tricky aspect lies in acting on the columns that support the whole firm architecture both now and in the upcoming future. Furthermore, the new company's attitude ends up assuming a twofold significance: on one hand, the underlying managerial modus has to be based on education, training and group work, whereas, on the other hand, such system has to necessarily integrate the social sphere with the technical one. Only in this way, concrete advantages and tangible benefits drawing from lean manufacturing, may ultimately reach a size of full objectivity, consistency and feasibility, by logically and sequentially relating the implementation of new practices, the development of standard behaviors and, finally, the establishment of a motivation-oriented conduct by employees.

According to Toyota's perspective, people definitely symbolize the most strategic weapon for company's daily operation as well as incremental improvement, and therefore all programs and practices devoted to manage them need to be well structured and assessed both at head quarter level and on the shop floor. Besides, a further demonstration of such an accurate and forward-looking attitude to people management, is depicted by firm's orientation to breeding in-house leaders rather than recruiting them from outside. Thus, trying to detect and remove the nature of waste causing unevenness (namely as *muri*), the Japanese firm relies on a policy which is mainly geared to always replace vacant managerial positions with suitable profiles internally found out. In this sense, the recipients of these high responsibility tasks are necessarily people who have been familiar over time with company's daily routine and core dynamics underlying its overwhelming culture.

Going deep on this issue and concentrating on a clear observation of current company's context, the leader, according to Toyota paradigm, is the one who gives evidence of a deep practical knowledge at shop floor level and, only through this experiential and empirical know-how, he can deftly master a decision making process as well as lead their subordinates towards full adoption of corporate identity and its foundational principles. Therefore, Toyota's uniqueness lies in the effort of building up a permanent core framework by

following a criterion of consistency and durability, which could undoubtedly represent the natural starting point from which to begin to boost innovation and change. In the same way, differing from most companies' high turnover rate, the long period of stay and the proven loyalty to firm, automatically enable these pragmatic professionals to preserve inner culture, structure and grow lasting relations year in and year out among workers, foster discipline and ensure a stable ground for consistent improvement and companywide learning.

As a further proof of the absolute centrality of people for the proper functioning of Toyota's engine, it would be important to remind what was stated by Gary Convis, first American president of Toyota Motor Manufacturing, in 1999. Toyota's operational excellence depends on three key dimensions, such as technical techniques and tools, "hands on" managerial approach and strong corporate philosophy. Thus, all these drivers, although apparently irreplaceable, inexorably lose their meaning and inner value if mistakenly handled. One more time, Toyota managers are not merely skilled people, but they embody the vivid orientation to depict culture as permanent motivational factor for maintaining a significant commitment to work with quality on a daily basis within the whole factory.

Moving forward on this issue, Toyota's approach to leadership holds some differential aspects than reported by most of the market players. In fact, the assessment of the leadership typology implemented within the company, stems from the observation of two analytical criteria: the nature of the directive style adopted by leaders in managing decisional processes within the hierarchical ladder (bottom-up based or top-down oriented, giving respectively more and less autonomy to employees in decision-making circumstances); the degree of mastering the work practices or merely relying on a general basic knowledge of plant dynamics.

Farther, while many firms are directed by bureaucratic managers who control subordinates' tasks and impose countless rules without really knowing the meaning of the governed actions, according to such described frame, Toyota's leadership style can then take on the traits of facilitator in developing a learning enterprise (Figure 2), within which managers behave like coaches and mentors rather than inflexible and rigid bosses. Furthermore, they rarely exercise command, whereas trigger the employee's empowerment, by leading him to the most fitting solution, developed through autonomous critical reasoning.

Lastly, a further important dimension can be depicted by the significant result achieved by the ideal lean company, Toyota, in properly balancing team work organization and each employee's work practices, in such a way as to pursue effective team results along with outstanding individual performances. In effect, teams are the crucial drivers for firm's ultimate success, acting as a glue of separate individual contributions, promoting a mutual exchange of personal experience and professional expertise among peers, enhancing motivation inside the workplace, shaping innovation and disrupting solutions for the upcoming future. In doing so, building up effective teamwork brings out the inner essence of individualities, increases the interaction between team performers, constantly feeds that valuable and virtuous cycle made up of challenging group dynamics and full respect for each employee, within the organizational infrastructure.

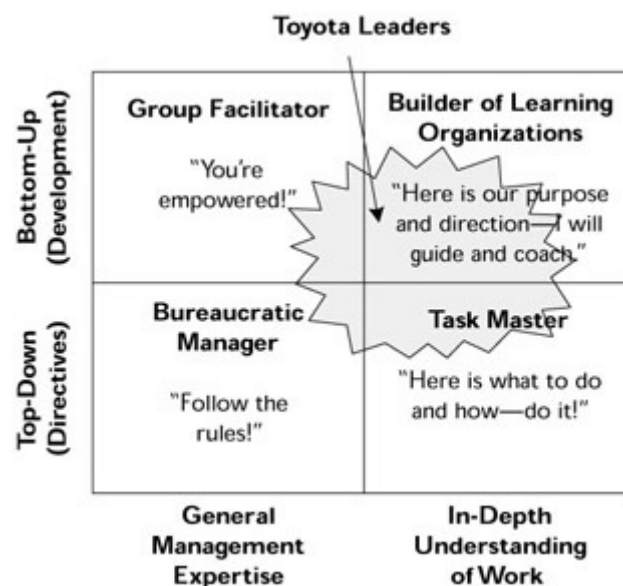


Figure 2 – Toyota leadership model

Source: Liker (2004)

2.15 How do managers behave in lean environments: Literature overview and insights

According to modern trends emerging in industrial operation management, lean approach to manufacturing represents a great dimension of interest and academic research. For this reason, each company does not only find it essential to best accommodate such dynamic and

innovative thinking, but should also effectively count on strategic levers such as highly motivated and skillful people, valuable tools, and appropriate managerial behaviors.

In fact, departing from what claimed by Womack, Jones and Ross (1990) on the relevant and influential variables, drawn from Toyota Production System guidelines, that particularly impact on a high-level company performance, the interpretative scheme, used up to that time, has undergone a substantial evolution. In other words, most of the emphasis at the base of a satisfactory lean adoption, seems to have lately moved from the mere and uncoordinated utilization of some tools to the ultimate and integrated reliance on a structured set of techniques and devices as well as organizational and managerial practices (Bowen and Spear, 1990; Ward & Shah, 2003; MacDuffie, 1995).

At the same time, it would be worthwhile to argue that greater relevance has been by far assumed by lean foundational principles rather than the instruments for their practical configuration within company factories. In addition, complementing what was asserted so far, a further crucial role is played by the need of such new dynamics to be effectively embodied and implanted within any organizational paradigm, thus following a companywide approach for both the multinational headquarter and its subsidiaries (Jones and Womack, 1996; 2005). Therefore, according to Anand (2010) and Fujimoto (1999), to deeply master those principles and properly manage those practices over time turn out to be a fundamental capability and a core weapon for enhancing and ensuring company long-term success into the marketplace. Moreover, a considerable attention has been gradually paid to the crucial importance and precious chance of relying on suitable managers, whose nature, attitude, leadership abilities and differential features could strongly make a difference in the long run, and facilitate lean thinking adoption, overall corporate transformation, standardization of practices and subsequent expertise transfer process from the firm centre to subsidiaries (Liker, 2004; Womack, 2011; Liker and Houses, 2008).

Nevertheless, given the large gap, in terms of research effort, existing between the plenty academic investigation conducted on best lean company examples (Liker in Toyota, 2004; Spear in Alcoa, 2009; etc) and the negligible attempts in theorizing and modeling specific behavioral traits that would more easily entail lean change, it ought to be definitely found out the inner cause-effect relation underlying both dimensions described. As a result, the latter appear to be thoroughly separated, since, on one hand, it is possible to look at the direct

impact of processes improvements on results, while, on the other hand, the potential significance of managers' conduct in well coordinating human resources, production flow and ultimate goals, still stays unclear and doubtful.

As a matter of fact, it would be then interesting to understand and describe whether and to what extent a determined set of managerial behaviors, practices and attitudes practically affects the countless firm perspectives: from business strategy to organizational structure, from leadership identity to lean orientation. In fact, some significant research has already been conducted in the past about the crucial relevance of managerial techniques, artifacts and tools for the company lean advancement and its final result attainment.

A prominent contribution was provided by De Menezes (2010), whose research, carried out in the British manufacturing sector, mostly focused on highlighting the powerful and intimate relation between company operations and human resource management within business philosophy, in such a way as to impact work practices as much as lean techniques implemented throughout the whole enterprise. Likewise, Ward and Shah (2007) point to the role of manager as the one who comprehensively deals with the various dynamics connected to lean environment and ensure their actual functioning (Spearman and Hopp, 2004; Antonakis and Treville, 2006). In addition, as largely proposed over the years, managers can also be depicted as the rightful interpreters (Bhashin and Burcher, 2004; Bateman, 2005; Liker, 2004) and legitimate executors of lean practices and artifacts, so far adopted by their organizations of belonging (Cousins, Hines, Lamming and Rich, 2000; Meier and Liker, 2006). As a result, if not properly devised and applied, those lean techniques are about to mislay their functional essence, thus losing inner value (Health and Browning, 2009). Moreover, if complemented by weak leadership abilities maybe existing inside the company, such causal factors can strongly hinder future horizons of sustainability of the lean model (Harvey and Found, 2006; Hines, Lucy and Baterman, 2005).

Although representing key determinants for the success of the organizational change plan, as Toyota best demonstrates, those managerial behaviors are undoubtedly hard to be replicated (Ross, Womack and Jones, 1990; MacDuffie and Pil, 1996; Safayeni, 1991; Liker, 2004). Therefore, assumed lean approach as an integrated system operating concurrently on an operational, social and organizational sphere (Birdi, 2008; Bowen and Spear, 1999; Liker and

Lander, 2007), those explained managerial practices, prove to encounter some problems or constraints, such as:

- They are far more difficult to observe, analyze, so to be then replicated
- Given their high social complexity as well as relevant causal ambiguity, they differ for the fact of being hardly relatable to the very concrete lean dimension, drawn by its practical tools and devices.
- They are more familiar, in terms of academic stems and contributions, to human resource management and industrial operations issues, rather than leadership and organizational theories.

Therefore, the aspects connected to the remarkable behaviors and actions to be effectively put in action by company managers during both the lean transition process and its sustainable preservation over time, have lately acquired increasing attention and academic interest, as proven by the countless research projects conducted so far (Hansen and Roggenhofer, 2008; Van Lieshout, Wilderom, Van Dun and Hicks, 2008; Lucey, Bateman and Hines, 2005; Emiliani, 2003 and 2008). Besides, consistently complementing the empirical and valuable evidence of the latter, Bartlett and Ghoshal theorized, from 1994 to 1997, a managerial model, whose vivid purpose consists of assessing the rate of dependence of superior firm performances by structured and coherent managerial decisions taken on the following fields: process, people and purpose.

These three distinct areas, if joint together, are about to build up the entire causal and logical infrastructure of management functionality, by framing the role of company decision-taker as the figure in charge of coordinating and guiding human resources and internal processes toward the ultimate corporate goal, the satisfaction of customers' needs (Womack, 2005 and 2011; Jones, 2005). Farther, as claimed by Shook (2008) and Ohno (1988), the central focus actually shifts from an unconditional top-down attitude to command, up to assuming the following different features: a pull-based authority exercised on processes; the reliance on scientific methodologies for corporate problem solving (Bowen and Spear, 1990; Deming, 1986); the perceived importance of coaching and training rather than imposing or directing (Argyris, 1957), the deep awareness about the need of taking more advantage of all the

expertise, knowledge, people skills, insights and talents, that are, most of the time, loosely dispersed and unreasonably wasted throughout the whole company (Rother, 2009; Takeuchi and Nonaka, 1995). Moving forward, the model developed by Bartlett and Ghoshal can then be applied to continuous improvement procedures that daily involve the company, up to the point of framing the threefold circle “purpose-process-people” (Womack, 2005, 2011; Jones, 2005) as a useful vehicle to then analyze in depth the lean manufacturing proceeding. Moreover, as Anand (2010) states, continuous improvement practices stand for a company’s fundamental capability and, for this reason, they need to be both fed by the suitable set of managerial actions and supported by consistent corporate dynamics which would facilitate and speed the pace of change into the organizational environment.

The strong breakthrough brought by lean thinking has also been emphasized by Fujimoto’s research contribution (1999), who depicts it as a structured ensemble of disrupting and evolving patterns, which, coming to evidence through defined organizational routines, trigger and enable firm’s adaptation and tendency to innovation. Moving forward on this path, according to Ahmed and Wang (2007), lean system also has to be assessed through a twofold analytical investigation, owing to its underlying components, behavioral and operational. In fact, these are the two levers that people frequently resort inside the firm in order to shape the corporate strategic goals and value proposition through remarkable attributes of adaptability and higher flexibility. As a matter of fact, *Kata*, a notion conceptualized by Rother (2009), does not meet more than this significant need of building up specific patterns and behavioral practices, so as to achieve timing, balance and harmony. Hence, after having established such competencies and schemes, the lean functioning turns out to be easier, more effective and agile (Sakakibara, 1997). Therefore, taking as reference the academic contributions provided by Spear and Bowen’s Toyota analysis and Fujimoto’s notion of routine, managerial behaviors were classified, according to Rother (2009), into two different typologies:

- *Improvement Kata*, that stands for all routines implemented and developed, in such a way as to establish the adequate mechanisms that are functional to improve processes, conform them to the specific context and purpose, and, lastly, enrich them with constant innovation.

- *Coaching Kata*, which represents the array of methodologies followed by managers to transfer principles to employees, explain to them how to develop routines to ensure that continuous improvement occurs regularly in the workplace.

An alternative to the classification conceptualized by Rother (2009) is offered by Shook (2008), who provided the A3 thinking approach, mostly used by managers to assess problem-solving circumstances and significantly learn through company improvement. In other words, any theoretical pattern explained up to now, represents one of the possible routes to both firstly determine the direct linkage between company's daily routines and solutions for process improvement inside the company, and well qualify the figure of the manager. In fact, he represents the lead actor, able to coordinate and guide people in fitting the surrounding operational context and, in the mean time, succeeding in achieving the desired market purposes. In particular, his intimate role consists of laying the basis for a direct connection between processes and employees, in order to suit daily routines to the ultimate goal, as much as intervene on behaviors and individual competencies, according to an approach of standardization and continuous learning. Following these dimensions above, capabilities can then get to be considered as the work conduct carried out by the individual employee by following set behavioral schemes (Shippman, 2000). These crucial skills, that should be owned and regularly put into practice by managers, embody a large set of typologies and fields of expression: from social to cognitive, from rational to emotional (Sternberg, 1996; Goleman, 1998, 2006; Gardner, 1983; Boyatzis, 1982; Kolb, 1984).

Another dimension which would deserve to be taken into consideration is represented by the conceptualized comparison provided by Womack (2011) between lean management approach and the modern managerial one. More in deep, the former concentrates on the horizontal value-adding flow crossing from raw material procurement to downstream end customers. Hence, this entails manager's tendency to both communicative integration across distinct functional branches and frequent reliance on problem solving activities. Instead, the modern management approach, rather characterized by the adoption of a top-down based authoritarian attitude and the exercise of an accurate control, tends to assume a vertical perspective throughout the entire organizational hierarchy and its different constituent functions. Furthermore, modern management is based on MBO (Management by Objectives) methodology, according to which the functionality and effectiveness of processes depend on the evaluation of the corporate financial performance (Rother, 2009). On the contrary, the

lean manager, according to Liker (2004), is supposed to identify a unique foundation for the correctness of his job, such that exists only one best way to properly fulfill the execution of a specific task, and thus achieve the desired results (i.e. a natural result of a “Management by Process” methodology). In addition, lean management provides for the introduction of a new paradigm in the distribution of responsibility along the hierarchical ladder. Specifically, this leads to the implementation of differentiated problem solving techniques, in accordance to the organizational level, which houses the problem and has sufficient experience and knowledge tools to solve it.

Another aspect of remarkable attention lies in the analytical reasoning followed by managers in figuring out problems, identifying criticalities and bottlenecks, taking effective decisions and achieving smart solutions: according to lean perspective, choices and insights stem from facts and concrete information (Sutton and Pfeffer, 2006), while modern managers rather opt for the observation and investigation on data, which are definitely far from the root causes and the actual nature of a certain issue to fix. By assuming such attitude to problem resolution, the lean manager tries to guide people’s reasoning and their countermeasures design very slowly, by submitting them questions and doubtful elements. Hence, the decision-making process is collectively performed at companywide level, and is geared to select the most suitable solution among a list of possible alternatives. The opposite direction is, instead, chosen by the modern managerial approach, according to which the very foundational cause underlying the problem is disregarded and the solution is identified very quickly. However, in this way, the implementation stage will take much more time than provided by lean, since the choice is made by managerial roles without the involvement of the other relevant actors.

The main reason for such discrepancy existing between the two managerial attitudes may be explained by the different level of confidence towards the achievement of final results. In fact, according to lean standpoint, plans are continuously subjected to revision by relying on PDCA (Plan Do Check Act) cycle, whereas, in modern management systems, well structured plans automatically lead to expected results without any kind of revisal of the underlying principles of planning. Besides, a further point of differentiation between the two management styles is represented by the opposite conception of process standardization and its conventional source of determination. In particular, similarly to the collective and participatory nature of their decision-making process, lean managers’ point of view claims the endogenous trait of the established standards and developed best practices. As a matter of

fact, the latter stem from a joint compromise and decisional agreement among the various company's actors, regardless of hierarchical level: from managers to employees, from machine operators to staff workers, from external experts to staff specialists. On the other side, instead, modern management-based companies loosely derive their own standards, rules patterns from the outside and, through managers, apply within the entire organizational infrastructure. Thus, in so doing, not having played an active role in the definition of the latter, employees rather opt for a stand-alone attitude, mainly aimed to get what they want by not following and complying with established stakes.

Finally, to complete this in-depth comparison between lean and modern management models, it would be appropriate to emphasize that the former demonstrates a lower sense of strict adherence to hierarchy, such that each employee, at any position or degree of responsibility, put himself at disposal of subordinates, guiding them, transferring them valuable expertise, and helping them developing a natural self confidence and awareness of the value added to the firm through daily work and commitment.

2.16 Lean manufacturing: The good of being more efficient and smoother

In this section, the attention is concentrated on the analytical investigation of the main success factors and positive effects brought to firm by the implementation of lean manufacturing principles. In particular, among the studies that have been conducted in this field, Crute (2003) undoubtedly provided a valuable contribution by identifying five significant hints on how to build up a vivid lean culture inside the company and sustain it over time. Such set of essential drivers is represented in Figure 3.

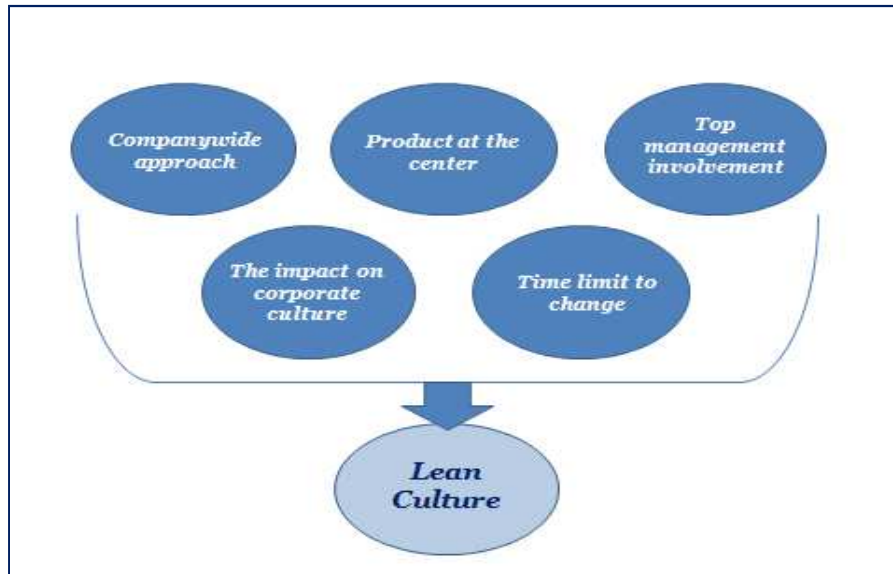


Figure 3 – Five Drivers to build Lean Culture (Crute, 2003)

Source: Elaborated by the author

- Company-wide approach in running a targeted change initiative

To ensure optimal results, lean thinking needs to be conceived and adopted, in its underlying philosophy as well as practical application, by the company as a whole, rather than in a fragmented way. In fact, this latter wrong behavior is basically due to two types of reason: the mechanical execution of techniques and practices which have not been really understood by managers; the usual resistance to change from the firm's workforce. Thus, the importance of intensive training programs geared to employees lies exactly in enabling workers to look clearly at the potential future gains of such innovative thrust, mainly expressed in the form of waste removal and continuous process flow.

- Product is the real protagonist

The analytical emphasis comes to focus on the ultimate and core outcome of company's daily activity: the product delivered to final customer. Such last step of the assembly line naturally represents a function of both accurate resources management and effective check-and-control procedures on a regular basis. Hence, the production cycle definitely reveals to be the most sensitive dimension to inspect as much as the main epicenter for the enterprise's improvement.

- Top management involved into change

As largely stated in the section on knowledge roll-out procedures, high level managers' engagement, either located in the headquarter or in command of the subsidiaries, proves to strongly support execution, facilitate modernization and make change happen. However, on the other hand, it would be important not to impose an excessive control over employees' (to be considered as actual executors of change), but provide them the appropriate degree of freedom in running the daily plans for improvement.

- The impact on corporate culture

The impetus for change represents a real breakthrough into company's ordinary life and, similarly, impacts employees' mindset and encourage them to start thinking in a different way than the previous schemes or usual framework. In so doing, workers end up acquiring increasing motivation over time and, through greater flexibility, higher autonomy and less bureaucratic dynamics, they can lay the foundations for a structured and orderly growth.

- Imposing a time limit to change

As a matter of fact, the quality of the result of a change process should be necessarily evaluated, in addition to its intrinsic value of effectiveness and reliability, also and especially for the time horizon spent for its ultimate implementation. To set a deadline for each of company's projects definitely means to both critically analyze each corporate performance and primarily break any barriers raised by firm's resistance to what is new, uncertain and difficult to predict.

Going further on the same path, Pius Achanga (2006) also provided valuable contributions by conducting on-field interviews into Small and Medium manufacturing enterprises (SME's) and detecting four important factors to comply with, so to pursue satisfactory results in terms of lean implementation processes. Indeed, although the Thesis focus is centered on large multinational firms, all favorable factors listed below are absolutely worthwhile for ensuring a successful transition to lean and stimulating new insights, regardless of company size. Hence, the four fields of intervention are described as follows:

- *Leadership*, whose existence definitely demonstrates to be essential for the structuring of an efficient communication system throughout the whole enterprise. In fact, relying on an integrated platform of information exchange between hierarchical levels, it is therefore possible to remove large time waste, speed up problems resolution through the action of cross-functional teams, and finally make process flow more flexible and smooth.
- *Expertise and capabilities*, which together build up the set of strategic tools that allow the firm to both stay long in the market and work out its incremental innovation. In fact, to hold a sustained competitive advantage over time depends on company's ability to grasp its human and technological potential as much as possible, so to keep staying differentiated within market environment and reducing the probability of being easily imitated.
- *Corporate culture*, which has to necessarily embody strong values and concrete ambitions of continuous improvement on a daily basis. Thus, this is the primary condition for outstanding performances and optimal future trends.
- *Availability of financial resources*. In order the company to correctly establish a lean system and make it work properly over time, it would be important to rely on a certain amount of resources, in such a way as to bring employees closer to this new perspective and train them regularly, sometimes rather agreeing to stop the production cycle in favor of such better system adoption. Likewise, in taking strategic decisions, managers should willingly accept only investment projects that match an immediate and legitimate outlay of resources, for a short-term gain.

Besides the fact that any company's initiative is supposed to arise and be inspired by a vision originally stated at the head quarter level, any process or scheme successfully applied into company's structure has also to deploy and well manage the following weapons (Kettinger and Grover, 1995; Motwani, 2003):

- Willingness to learn

Since the priority and functional purpose of learning is about positively shocking a given company by driving improvement, more suitable adaptation to market conditions and truthful change, it would be convenient, for the firm, to foster such a deep orientation to new valuable knowledge, that can be acquired both through countermeasures taken within the competitive battlefield and the careful observation of competitors' best practices. Therefore, for an enterprise eager to achieve satisfactory results, it ought to be essential conceiving incremental adaptation and frequent learning opportunities as crucial tools for its overall performance.

- Cultural integration for learning

As is known, the corporate culture naturally represents the solid and stable foundation for sharing future expectations as much as current paths. Assumed that, the most sensitive aspect lies in company's chance to try to create conditions so that individual expertise can effectively collimate in a unitary and shared vision of growth, fluid communication flow and time-effective decision making.

- Managerial push to change

High level managers definitely represent the very first drivers of change, since they are supposed to set up the improvement design, practically decline it in actions on field and, thirdly, transfer it to lower level employees to be finally implemented and adapted according to local needs and core features. Thus, it is critical that top managers give a serious boost to firm, by both showing up new future horizons and acting as a model of motivated attitude towards an uncertain but fruitful change.

- Enhanced network relations and social ties

An outstanding performance in a process implementation within the firm can be positively supported and influenced by prominent organizational dimensions such as the existence of cooperative environments, countless opportunities for team-work and valuable circumstances for lively social interaction among company's employees. Besides, the use of patterns for open and transparent communication strongly impacts on better interactivity inside the workplace, more willingness to sharing knowledge as well as insights, more widespread creativity within the whole enterprise.

Moreover, it would be convenient to point out that enterprise's transformations are most likely to occur when a sense of real dissatisfaction is perceived with the current state of things, into the organizational structure. Thus, the impetus for change not only comes from a shared orientation towards company's improvement, but also from the unique opportunity to identify areas for future growth, just where problems, bottlenecks and technical constraints are currently detected. In so doing, each challenging struggle can easily end up being a suitable and enviable ground for learning. (Motwani, 2003)

2.17 A preliminary step in the route towards Lean: Total Productive Maintenance

First of all, TPM consists of a structured set of team-based activities performed throughout the company and geared to ensure high results in equipment maintenance, quality of products and assets' effectiveness (Nakajima, 1989). As a matter of fact, due to the innovative trends lately observed in world class manufacturing, the nature of the production process, in the past considered a key driver for delivering high quality to end customer, has achieved a relevant level of automation and standardization such as to be no longer considered a differential feature in the actual competitive environment. On the contrary, a critical role has been recently acquired by equipment, depicted as the very crucial source for pursuing satisfactory results in most of the company's performance indicators such as productivity, safety, efficiency, needed amount of inventory, and quality (Nakajima, 1989).

Indeed, while operations has gone through procedures of increasing and sophisticated automation, production facilities testify their absolute reliance on human contribution, to the extent of requiring more specialized staff, highly skilled workers, expert supervisors. Thus, running on a companywide level, TPM definitely involves and requires the participation of the whole corporate community, regardless the position of belonging in the organizational hierarchy, so to encourage a shared commitment toward effective management of facilities and efficient production system, by minimizing operational problems, defects, risk of accidents' occurrence and irregularities potentially detectable inside the factory.

In particular, the value added to firm by such overwhelming attitude to equipment maintenance is twofold: ensuring *zero defects within realized products* and *zero equipment breakdowns*. Hence, if properly achieved, those two dimensions can positively impact cost

reduction, incidence of inventories on firm's overall cost, workforce productivity and operation rates of equipment (Nakajima, 1989). Nevertheless, considering the heavy reflection of such improvement initiative on the entire company's turnover, the two targets described above do not ensue from ready-made patterns, but normally take a certain period of time, in order to both coping with the outlay of financial resources needed for equipment replacement, and synchronize the workforce on a more demanding and advanced set of skills required.

Walking back in the years, TPM is generally considered to be a tailor-made version of the American productive maintenance, then adopted by Japanese manufacturing companies to fit the different conditions of their industrial landscape, until then to definitely be part of Total Quality Management program in 90's (Nakajima, 1989). Hence, TPM is best known nowadays as the result of a combination between preventive maintenance, of American matrix, Total Employees Involvement and Total Quality Control, so as to shape a cultural framework inside the firm such that every employee, as relevant component of the whole system, develops a sense of property and responsibility of his equipment and strongly cooperates with managerial and engineering departments in order to allow enterprise's facilities to work effectively and regularly during their everyday working life.

Therefore, as stated by Nakajima (1989), the proper implementation of TPM policies is due to the compliance with the following principles and distinctive aspects:

- Maximization of the *Overall Equipment Effectiveness* (OEE), so to improve facilities utilization rate. In fact, OEE represents a measure of the company's overall equipment performance or, according to Williamson (2006), can be interpreted as the degree to which the equipment is doing exactly what it is supposed to do. More in detail, such indicator ensues from a threefold investigation, carried out on performance, availability and quality yield. Indeed, aimed at increasing equipment productivity by leveraging on input minimization and volume optimization, the objective to increase OEE significantly, lies in having a positive impact on several firm's prospects: from higher quality to lower production cost, from shorter delivery time to more healthy conditions, from higher people motivation to safer standards into the workplace. Lastly, if properly calculated, OEE can lead to detect hidden productive capacity and, by doing so, foster a more balanced process flow. (Bulent et al, 2000)

- Improve current programs of *planned maintenance* and develop an accurate system of *preventive maintenance* which should both persist effectively throughout the entire equipment useful life, and ought to be structured in such a way as to prevent frequent and wasteful breakdowns
- *Great reliance on the operator.* In fact, dealing with a specific machine and having gathered considerable experience over time, he is the person who is more likely to monitor its proper operation, establish and assure best work conditions, detect potential problems and aspects of inefficiency, before they turn uncomfortably into higher production costs and longer downtime.
- Put prominent emphasis on *training* employees, by enhancing and upgrading their maintenance competencies, technical knowledge and operational skills
- *Involving the entire organizational hierarchy* (from top management to shop floor level), increasing morale inside the workplace, and relying on cross-functional teams for the implementation of such improvement initiatives. In particular, such teams are loosely made up of skilled and trained operators, one of which with strong technical expertise.

According to the academic research developed over time in this field (Nakajima, 1989; Bulent, 2000; Hartmann, 1992; Japan Institute of Plant Maintenance, 1996) TPM can be splitted up into eight pillars, for what concerns its resources deployment, distinct areas of implementation and directing of the various initiatives undertaken in accordance with this new methodology of maintenance (Nakajima, 1989). Those several dimensions are described as follows:

- Allow the structuring of an *integrated design*, by providing cutting-edge systems in order to both lower cycle time for facilities and products, and promote advance solutions for better succeed in reducing set-up time intervals, enhancing equipment reliability and, finally enabling operator to work properly and keep its machine clean and efficient.
- Build up *First-Line Maintenance*, by laying the groundwork for a massive effort in improving employees' commitment, morale, sense of duty and responsibility towards factory equipment. In this sense, it is critical to fill the knowledge shortage, facilitate

team working and individual empowerment, and ensure the prior assessment of potential irregularities within the system.

- Providing *Planned Maintenance* programs, in such a way as to trigger programs for Predictive as well as Preventative analysis, in terms of company's facilities as much as operational tools and capabilities.
- Undertaking in-field interventions geared to allow significant *improvements in firm's processes and equipment*, with the ultimate purpose of achieving optimized results in efficiency, by removing the sources of waste and loss.
- Developing *Process Quality Management* programs, which consist of a series of actions mainly carried out to monitor and keep under stable control the current state of equipment underlying parts, which significantly affect the quality of products delivered to final customer. As a matter of fact, such company's performance indicator definitely proves to be a function of several dimensions, such as equipment conditions, process patterns and production methodologies.

The remaining three pillars respectively relate to the implementation of TPM practices for a careful information streamline into company's administrative and staff branches, tireless orientation to training and improvement in technical capabilities as much as soft skills, and, lastly, a serious activity of supervision on safety and prevention from the occurrence of harmful and unpleasant environmental effects.

2.18 The TPM practical implementation within the firm

In order to properly work out, Total Productive Maintenance needs the assistance of an effective leadership for the very first steps of the implementation procedure. In fact, without the essential support of actors who skillfully connect TPM evidence to business and enable employees to become by far more responsible and protagonists for performing highly specialized work practices, the overall performance attained by plant equipment will be inexorably destined to decline (McBride, 2010). Moreover, one further issue is represented by the importance of rethinking to the notion and functionality of maintenance, no more as a functional dimension exclusively devoted to settling problems, but as strategic and value-

adding source, available to the firm, so to improve the performance and avoid the potential occurrence of unpleasant events. In addition to this, most of the companies are generally used to cut the financial resources for maintenance, thus negatively impacting higher costs due to the reduction of the equipment effectiveness.

Furthermore, according to what stated by McBride (2010), the companies which have reported satisfactory results, in terms of zero breakdowns and zero defects, followed a twelve-step TPM implementation process, thus structured as follows:

- **TPM Announcement:** The launch of TPM programs has to be supported by the Top management of the company, so avoid possible reactions of resistance and skepticism by employees.
- **Training session:** A training program is organized, in the attempt to educate all actors involved about the main TPM features and positive externalities achievable through the contribution of any single employee.
- **Creating a structure for support:** The reason for this solutions lies in the chance to build up a business group which could actively contribute to the correct installation of TPM standards, through the reliance on team based tasks and widespread at any hierarchical level of the firm. The integrated communication, joint with increased workers' involvement along the plant, represent two essential conditions for the ultimate success of the project.
- **Defining policies and tangible goals to achieve through TPM:** Elaborating concrete targets of performance which should be realistic, feasible to be achieved, measurable and bound to time.
- **Establishing a master plan:** This document highlights the amount and time schedule for the set of resources, which are necessary to be deployed for various company's purposes: from maintenance management to cutting edge technologies, from improvement solutions to training programs.
- **The start of TPM:** The implementation stage begins.
- **Acting on the improvement of each equipment component:** Each underlying component deserves an accurate analysis.
- **Developing a system for ensuring autonomous solutions for maintenance, that would be available to operators:** This would help significantly the everyday life on the shop floor, especially in terms of cleaning and detection of irregularities.

- **Building up a program for preventive or planned maintenance**
- **Organizing training so to trigger employees' empowerment and skill improvement:** The maintenance branch turns to be in charge of such task.
- **Setting up program to manage the equipment:** Contribute to the improvement of the equipment by following maintenance principles.
- **Putting the basis for continuous improvement:** Deploying significant efforts towards the establishment of a lean-based mindset.

3. BE LEAN: HOW TO MAKE IT HAPPEN AT PIRELLI TYRE BRAZIL: TPM AND PMS

3.1 A brief introduction

In this section, the Thesis paper aims to firstly address more closely the issues related to TPM (Total Productive Maintenance) and its main features, then to have a direct feedback on their application and functioning within Pirelli Tyre industrial complex. Then, the second part will mainly assess the reasons for the transition process, experienced by the Italian multinational firm, from TPM to the introduction of a truly integrated production system, the Pirelli Manufacturing System. The shift to such a renewed attitude towards organizational and production operations, testifies and highlights the Pirelli's vivid desire to innovate in a lean sense, as well as strongly reach steadily increasing results in terms of their efficiency and sustainability.

3.2 Total Productive Maintenance: The Experience of Santo André plant

Established in 1940, Santo André plant represents the very first step taken by Pirelli Tyre in its Latin-American history. Covering an area of 202.198 m², the factory receives the daily contribution of about 2.200 employees and is devoted to the production of Agro tyres, Truck tyres, inner tubes and flaps. Indeed, Santo André is localized in the State of Sao Paulo, notoriously known to be a strategic crossroads for automotive industry in the entire American market.

The industrial plant, as the focal point for the administration of the whole Pirelli Tyre Latin American industrial complex, is currently composed of distinct production departments, structured by cycle stages and differentiated by product typology. More in detail, Santo André is made up of the following production areas, each of them with some specialties and peculiarities to be noticed into the product cycle:

- UPMS: Representing the crucial internal supplier of productive resources for the final product realization, this area is devoted to the processing of rubber and semi-finished materials, so to then transfer them to the subsequent phases inside the flow chain.
- UPGR: This area is geared to the production of the Radial Giant, namely as the tyre typology for trucks.
- UPOC: In this department, it takes place the production of tyres for Agricultural vehicles (best known as Agro segment in the automotive industry).

In 1994, Pirelli Tyre introduced TPM policies in its Latin American plants. Such disrupting and overwhelming attitude to equipment maintenance stems from four peculiar concepts of interest, such as the creation of inter-functional teams, management by objectives, measures of global efficiency, and reliance on a process-based vision. Furthermore, it ought to point out that TPM stands for a set of operative routines and technical tools which can only work out when strongly supported by rigor, rigid discipline and faithful compliance with all sequential steps of their implementation methodology. All in all, if rightly structured within all its constituent components, TPM can enable the firm to concretely lay the basis for reporting steady and convincing performance in efficiency, as well as make excellent result in manufacturing operations finally a realistic goal.

Going into detail, the configuration of the eight underlying pillars took on a customized tone to both the characteristics of the Italian Multinational and the distinctive features of the market industry. More specifically, the first version, launched in 1994, provides for the existence of eight different entities, isolated, self-referential and not mutually integrated. Such pillars, each of them with specific conditions and performance indicators to fulfill, are listed as follows:

- *Individual improvements.* It regards the intervention, by the single employee, in four different fields or analytical dimensions: Equipment (set-up, over usage, breakdowns and waste reduction), Work productivity, Materials (Kanban systems), Quality (Poka-Yoke, capacity improvements).
- *Autonomous Maintenance.* Its achievement is ensured through a seven-step preparatory process: initial cleaning, countermeasures adoption, compliance with lubrication standards and preservation over time, general inspection, autonomous inspection, organization and cleaning.
- *Learning and Training.* Several programs and initiatives were performed on the issues of production and maintenance. Training and knowledge transfer to employees has been a crucial preparatory step for the ultimate adoption of cutting-edge operational standards.
- *Planned Maintenance.* The efforts put in this direction mainly regarded the establishment of five analytical procedures: breakdowns analysis, replacement parts management, preventive maintenance, maintenance at base conditions, efficient information system on equipment life and performance.
- *Quality Maintenance.* Preservation and eventual adjustment of quality standards and conditions, constant activities of monitoring and checking of the conditions maintenance, overall control exercised on process.
- *Safety and Environment.* The boosted initiatives in this field were actually geared to assess a twofold goal: on one hand, the quality of the workplace, in terms of a proper treatment of the issues related to light, noise, heat and cold; on the other hand, safety, in the sense of ensuring employees to operate on safe machines.
- *Early Equipment Maintenance.* This TPM pillar actually aims to carefully assess the clinical picture of the factory equipment, through both the collection and analysis of the informative sources necessary for carrying out preventive actions, and the accurate revision of the operational specifications for any single machine.

- *TPM in the Office*. Such activity is not performed inside the factory, but within the company's administrative branch, the offices. In such a context, it ought to be convenient to act on two fronts: providing for a careful and efficient system of information storage; laying the foundations for the frequent occurrence of several opportunities for improvement.

However, two years later, in 1996, Pirelli Tyre went through remarkable changes in the structural framework surrounding the TPM pillars, up to present some significant improvements and differential traits. In fact, compared to the previous version, the latest one presents a modified layout, especially for what concerns the correlation linkages between the pillars. In particular, Individual improvements, Learning and Training, and Autonomous Maintenance turn out to be transversal to the others, thus testifying the firm's stronger interest in enriching the five remaining pillars with the valuable resource and tools embodied by the former three.

In conclusion, in 1996 Pirelli Tyre won the award for TPM excellence, as a prize issued by the Japanese Institute of Plant Maintenance, on the basis of the significant achievements pursued by the Italian Multinational on three distinct dimensions:

- Outstanding improvements in applied technologies and practices
- Cutting-edge modernization techniques
- Remarkable results in productivity, cost reduction, product quality and cultural change

3.3 Pirelli Manufacturing System: The Experience of Santo André plant

In 2008, Pirelli launched in all its factories worldwide its innovative and integrated production system, the Pirelli Manufacturing System (PMS). The main reason for such breakthrough in operations mainly lies in company's strong desire to establish a disrupting strategic paradigm, which would be such as to better bear with steadily growing competition and constantly create significant value for customers through continuous innovation in products and services. Besides, as defined at the headquarter level, Pirelli Tyre mission consists of providing distinctive and creative solutions to customers and, simultaneously, contributing to have a positive impact on corporate image, quality, safety and outstanding performance of its products portfolio.

Thus, drawing from an ambitious plan of future goals and reasonable expectations, PMS proves to act as a new management attitude to production, which aims to both make a big leap towards the future adoption of a lean identity and lay the foundation for all the Group factories to become by far more effective and efficient through the proper control of the following crucial levers: quality excellence in products, focus on customer (internal and external), motivated people and committed workforce, in-workplace organization and cleaning, creative and innovative environment, machines and equipment in good conditions, autonomous and cost-effective management.

Therefore, beyond representing a substantial improvement in company's way of conceiving manufacturing as well as the attitude to manage production operations during factories' lifecycle, the ultimate configuration of Pirelli Manufacturing System (Figure 4) entails a deep change within the entire organizational framework and indexes its vivid effectiveness and consistency to a detailed assessment of three underlying dimensions:



Figure 4 – PMS structure

Source: Pirelli Tyre Brazil

- Standardization and methodology

It is absolutely essential, for Pirelli Tyre, moving straight to the definition and subsequent implementation of norms and practices that would promote the full compliance with set

standards and settled procedures. In addition, it would also contribute to radically root out several sources of waste existing within the firm's context, produce considerable gains in quality and efficiency, and, finally, ensure a clearer and more effective communication flow throughout the company. In fact, as core driver to quality excellence, standardized and methodological practices have to be gradually mastered and deeply embodied within each worker's daily conduct, in such a way as to automatically take part the production pace.

More specifically, the Italian multinational has opted for a vast set of solutions for standardization as well as processes regulation, among which the main ones are represented by safety instructions, quality specifications, work and task specifications, 5S programs, detailed sequence of each job position's characterizing activities. Joint together, all these undertaken initiatives aim to build up a regulatory code, tailored to enterprise, and, if fully complied with over time, gradually able to be an integral part of its corporate culture.

- Discipline

All the efforts made by the company in order to both promote a better resources management and, especially, direct all its business practices to a standard reference model, may turn worthless and insignificant if not definitely associated to a disciplined and respectful employees' conduct within the firm. In fact, to place discipline and perseverance at the base of corporate vision basically means to push the company to grow and evolve as a learning organization, in which the absolute priority definitely stems from valuable problem solving abilities in combination with constant orientation to improvement and removal of non-value added activities. All in all, if properly carried on and practiced during its life route, disciplined mindset enters every employee's routine, to the point of strongly shaping the corporate culture as one of its founding pillars.

- Autonomous management

This dimension can be depicted, according to PMS format, as the result of a sequential and progressive process of operational empowerment. In effect, through the deep integration of the operator at the center of production flow, he becomes the one who ensures the satisfactory achievement of the final result and takes significant responsibilities for managing the entire

cycle. By doing so, the single employee is therefore allowed to take the following actions and decisions, within the factory supply chain:

- If noticing defects or irregularities, he is authorized to stop the production line and thus avoid and prevent the occurrence of anomalies and unpleasant consequences
- Direct involvement in the resolution of problems through the design and construction of Poka Yoke, small devices that enable the single operator to carefully verify the correctness of the operation performed, or the one that has just ended.
- He is constantly motivated to apply the 5Ws methodology, which is aimed to discover and detect the root cause of a problem and remove it permanently.

Therefore, the compliance with those aspects described above, can contribute over time to achieve the ultimate goal theorized as Jidoka by Toyota approach, namely as the release of the inflexible operator-machine relation and then the transition from a concept of automation to one of better and complete autonomy at plant level. The impact of such increased autonomy, then declinable into six different dimensions of interest (equipment, people, production line, anomalies, faults, and defects), requires time, patience and great dedication, so to produce remarkable results on the enterprise shop floor.

More in deep, at Pirelli Tyre, autonomous management has been taking on the traits of a five-step system, whose inner purpose consists of evolving from the mere respect of 5S conditions to the establishment of advanced initiatives for autonomous inspection. Specifically, 5S implantation represents the very starting and crucial device in order to set up the more suitable surface for making the expected change actually happen at Pirelli Tyre. Likewise, equal importance has to be devoted to those phases positioned between the two just described, such as:

- Countermeasures implementation and preparatory steps for inspection. At this stage, the company finds it crucial, beyond checking the compliance with 5S, to control basic conditions of safety inside the workplace, monitor factory's performance indicators (OEE above all), root out all potential sources of contamination.

- Creating and maintaining specific standards for cleaning and lubrication. In this case, it would be convenient, to the firm, to both make sure that the basic conditions are met, through the careful consultation of a check-list, and keep on monitoring the regularity and adequacy of 5S.
- At this stage, it is essential to make sure that basic and ideal conditions for machine operation have been maintained, encourage the implementation of inspection standards for equipment components and underlying systems, conduct intensive training sessions geared to operators about the notions of equipment efficiency and the set of requirements for machine regular functionality.

As stated above, the terminal part of this operational procedure is represented by the achievement of advanced solutions for autonomous inspection, made possible through the simultaneous intervention on the various fronts of visual management, the improvement programs oriented to ensure zero breakdowns, accidents and defects, and, lastly, the optimization of inspection controls, by triggering reciprocal rationalization and integration among all the defined dimensions to be inspected and constantly monitored.

Moreover, once largely defined the three foundational principles of Pirelli Manufacturing System, it would be worth pointing out that the overall effectiveness of such disrupting production approach also depends on the significant effort put in the direction of an accurate supervision of three further critical aspects:

- *Production*, functionally defined and structured according to the firm's primary duty of effectively meeting customers' needs, preferences and expectations, at the right time, in the right moment and in the proper way. Such renewed attitude to operations has to be naturally complemented, as previously described, by a full compliance with 5S rules.
- *Safety*. It stays as an absolute priority during the daily life of company factories. In fact, the policy set so far by Pirelli Tyre, is based on three main considerations: working safely is the necessary condition for individual employability; each operator is personally responsible for his own safety and that of his colleagues; the importance of finding out potential sources of danger and bear professional risks, through the reliance on suitable methodologies and effective technical solutions.

Therefore, it is possible, for each employee within the corporate context, to work under safe conditions, by generally following some comprehensive guidelines: the respect of procedures and safety instructions; employee's high concentration during the execution of his task; the utilization of personal protective equipment; completing check-list when needed; carrying out all the activities in accordance with 5S standards; developing and implementing structured solutions rather than lacking or temporary ones; following OPA method (Observe, Plan and Act) in approaching problematic circumstances.

- *Quality*, to be effectively ensured by making products that should strongly suit customers' preferences and ultimate market acceptance. Thus, in order to pursue such ambitious goal, Pirelli Tyre Latam (Latin America Division), putting into practice what was established by the Italian Head Quarter, has set the following targets in its industrial complex:
 - Continuous improvement and development on all fronts where the company is currently included and committed.
 - Pursuit of excellence in customer satisfaction through the creation and delivery of high performing products.
 - The ongoing collaboration and mutual support with upstream suppliers, so to share innovative aspirations, plans for future improvement and growth targets.
 - Acting with qualified and skillful human resources and maintain the workplace as a high motivating context, so to succeed, through both factors, in providing the maximum utilization of human potential inside the enterprise.
 - The importance of enhancing people integrity and well being, as much as preserving the firm surrounding environment.

Hence, after having defined all of the following dynamics that are mainly relevant for the proper and balanced livelihood of the whole Pirelli Manufacturing System, it would be also important to identify the concrete benefits that would result from the adoption of this new

approach to factory management. In particular, the positive effects of such a breakthrough in manufacturing can be more easily observed along the following analytical dimensions and value drivers:

- People

The PMS implementation would lead to significant achievements in terms of personal learning, individual empowerment, new knowledge and skills acquisition, higher qualified employees, effective team working, participatory and high-motivating workplace, strengthened value for safety, and, lastly, deeper morale and stronger sense of belonging to the company. To involve employees in an appropriate manner and make them feel at the centre of company's decisions and business initiatives, is undoubtedly essential to ensure that the entire Pirelli Manufacturing System can bear fruit and evolve continuously along trajectories of sustainable growth.

- The customer at the center

The ultimate firm goal consists of making safe and high-quality products, always maintaining intact characteristics and equal features for the entire duration of the firm's production cycle. Moreover, to rely on a standardized production system represents a primary condition for both fulfill customers' preferences and timely reacting to demand fluctuations as much as innovative trends within the market.

- Considerable improvements in work environment

The fields of intervention concern a safer workplace, the removal of both possible interferences and risk of potential irregularities, and, lastly, the valuable chance to work on tidy, clean and restored equipment. Farther, it ought to be important to proceed with the introduction and, especially, the faithful adherence to the Toyota-based standards of efficiency, cleaning and discipline throughout any plant, in such a way as to approach gradually lean best practices and make further progress on the path of continuous improvement.

A further important factor, which definitely contributes to think at PMS in its authentic and most evolved version, is represented by the traditional nature, inner identity and functional role of its underlying pillars. In fact, according to Pirelli Tyre perspective, a pillar can be considered as a group of employees, whose common goal basically consists of supporting and cooperating, up to the extent of helping the firm pursuing its goals and continuously improving its daily operations. Therefore, both objectives can be successfully achieved by concurrently acting on three notable levers:

- Developing methods and strategies for ensuring tireless improvement on the shop floor as well as on the plant managerial systems.
- Removing a set of losses detected throughout the whole factory environment.
- Undertaking proper solutions in accordance to what scheduled by the Master Plan, namely as a corporate document redacted before the beginning of the ordinary activities into the plant. In particular, the main dimensions highlighted in this relation, act as guidelines and, in the same time, reference stakes to the autonomy of the factory operations.

Moving forward on this issue, it would be worth concentrating some emphasis on the valid contributions each PMS pillar can consistently provide as a center of knowledge development within the company. As a matter of fact, it demonstrates to assist the organization on three distinct hierarchical levels, aiming to reach a different and key objective for each of them:

- At Plant Executive level, sustaining the managerial board, through the serious accomplishment of the following activities:
 - Defining the vision of the pillar and ensuring the coherence with the integrated vision of the plant, involving the totality of the pillars. Indeed, keeping on maintaining stable relations and mutual informative connection among pillars, so to fit plant goals.
 - Assisting the group of plant directors in both the assessment of potential gaps and the selection of the improvement teams, finally making sure that the targeted KPIs results for each pillar, will be attained.

- Developing the root cause analysis of the substantial losses realized into a specific plant.
- Ensuring that all visual management devices (pillars based ones included), located along the plant will be kept updated.
- Supporting the improvement teams, by acting on the following fields:
 - Ensuring the adequate training to employees, so to both trigger their professional advancement and carry out educational initiatives that would fit the vision of each PMS pillar inside the plant.
 - Checking and monitoring the progress of training programs undertaken throughout the plant and aimed to entail knowhow, analytical skills and empowerment.
 - Coordinating all the support activities addressed to project leaders at each single step of the process, by constantly coaching, instructing and auditing.
 - Making sure not only the availability of valuable and necessary methodologies, but also the training of employees and each pillar specialists as actual owners of a satisfactory range of abilities and expertise.
- At machine level, assisting supervisors, coordinators and first level operators in the proper achievement of significant results, in terms of sustainability and preservation of gains. Hence, those objectives can be reached through a strong effort put in the control and prevention of losses, which can be further boosted by the development of suitable operational systems, such as preventive maintenance or planning methodologies.

4. METHODOLOGY

4.1 Theoretical background

According to Silverman (2007), different research methodologies actually exist and their selection, among a pool of possible alternatives of investigation, is actually a function of several components, such as case study selection and strategies of data collection and subsequent analysis. In this case, the paper relies on a qualitative type research, thus achieving a balanced compromise between the field used for data collection, typically characterized by small samples, and the useful chance to infer reasonable and stable considerations from empirical evidence. Therefore, differently from quantitative methodology, the qualitative one appears to be more systematic, because of its considerable degree of conformation to standard schemes set by research community, and closer to the experiential sphere. (Shank, 2002)

In addition, regarding what argued by Zikmund (2000), owing to the restricted area of action, a further precious contribution on the notable value added by qualitative investigation is due to the deeper intention to achieve a more comprehensive and explanatory understanding of the single analyzed phenomenon, rather opting for a more accurate consultation of actors' feelings and personal experiences, as much as carrying out a detailed case study framework by devoting the proper attention to all its causal and contextual variables.

4.2 Data collection

As carefully prescribed by academic literature, the nature of data which are eligible for collection and the subsequent proceeding of analytical interpretation and inference, can be distinguished into two typologies: primary data and secondary data. In fact, the former stands as the set of information that are attained through the conduction of an ad hoc research initiative and direct observation. Instead, secondary data represent the result of the reliance on the consultation, analysis and selection of existing documents or informative sources, such as archival records, web sites, corporate documents, i.e.

If applied to the specific purpose, the provision of information available for the complete and structured development of the explanatory investigation, has been thus characterized by the appropriate deployment of research efforts on the two following channels for data collection:

- The primary data, stemming from direct intervention on the shop floor, were mainly attained through personal interviews with area supervisors and coordinators, and in-depth interviews with EGR project analysts and production staff members.
- The secondary data were basically obtained from the constant in field activity, the active participation and regular attendance to the EGR implementation steps, the interaction with the employees involved, and, lastly, the consultation and analysis of firm documents and corporate informative material.

4.3 Methodological approach

The paper is based on the analytical investigation conducted on a single case study, in accordance to what has been theoretically claimed by Yin (2009). Indeed, the qualitative research, applied to EGR implementation at Pirelli Tyre Brazil, has been carried out with the ultimate purpose of explaining the results of the project impact and gather valuable contributions and empirical evidence which would support the completion of the entire work.

In particular, with regard to the main research question, geared to assess the actual feasibility of EGR as consistent and effective solution to be implemented in manufacturing, the paper has been divided into four different sub-propositions, respectively referring to the SWOT. SWOT stands for “Strengths, Weaknesses, Opportunities and Threats” (Humphrey, 2005). SWOT analysis is a structured planning method that can be applied to individuals, organizations or specific projects. Its key principles are an awareness of an organization’s current situation and direction. In developing this awareness, it is important to keep in mind political and social developments affecting marketing, competitors and technology (Humphrey, 2005). The SWOT model is pragmatic in nature, and is often used to diagnose an organization’s potential, as well as certain weaknesses that may threaten it. SWOT analysis involves a methodology that separates information derived from environmental analysis into internal and external factors (Humphrey, 2005).

In order to carry out SWOT analysis, one must first identify both internal and external factors that may help or hinder an organization’s overall goals, and then establish an objective consisting of metrics that are both achievable and relevant to the organization’s goals. If

applied to the analysis of a single case study, the reason behind the reliance on SWOT matrix lies in the chance to take a picture of the current results, quantitative and qualitative as well as positive or negative, that EGR Project achieved so far. In this sense, threats and weaknesses tend to be the most critical area, thus requiring a considerable attention in shaping future countermeasures and undertaking upcoming initiatives.

Besides, more specifically about this issue, the thesis research is mainly directed to grasp the main traits of change brought by EGR project both on Pirelli Tyre traditional attitude to operations and on employees' daily routine and mutual interaction on the shop floor. Therefore, in this sense, it would be very interesting to check the actual correspondence between, on one hand, Toyota practices and lean foundational principles, and, on the other hand, the empirical evidence of EGR introduction in Santo André plant.

In structuring the research project and collecting all relevant findings, the paper relies on a vast set of methodological sources:

- **Corporate documentation and internal informative material**

As previously stated, a clearly relevant role to the consistent development of the research project, has been played by the comprehensive and valuable set of administrative and operational information provided by Pirelli Tyre Brazil, and especially by the Industrial Engineering Department of Latin American Division and the Continuous Improvement Staff, both located in Santo André plant. Of course, the access and use of those documents has been exclusively permitted for the redaction of this paper, thus complying with the strict confidentiality and privacy policy adopted by the firm.

- **Direct involvement into EGR implementation process**

The direct involvement and proactive participation to the several stages of EGR implementation, turn out to be undoubtedly essential to the quality of the whole research structuring. In fact, given the full-time internship activity performed in the Industrial Division of Pirelli Tyre from April 2012, a countless series of visits have been taken in the two areas of the plant where EGR has been firstly launched, namely as UPMS and UPGR. Along with the intensive activity on the shop floor, a further value adding dimension has been represented by

the precious chance of directly interacting with all actors involved in the project, and classifiable as both first line protagonists and real beneficiaries of the fruitful change brought by EGR.

As a matter of fact, having the unique opportunity to discuss with company employees, follow by near their daily routine inside the factory, listen to their opinions and personal considerations, definitely complement the research findings with sustained empirical evidence, otherwise difficult to obtain. Indeed, it would be worth remembering that this series of fundamental contributions, acting as a valid reference for research articulation and this paper redaction, should be also added to the collection of both documents to the seven step project construction in each single area, and all available artifacts and information tools that were particularly useful and core for the ultimate EGR adaptation within Pirelli Tyre industrial complex.

- **Interview sessions**

Depending on the hierarchical position and key area of responsibility of each interviewee within the Santo André plant, two distinct types of interviews have been conducted:

- The *individual focused interviews* have been conducted with area managers, supervisors and coordinators, currently working at Santo André plant. In particular, the six actors involved in this stage of the investigation were listed as it follows:
 - UPGR Area manager
 - UPGR Area supervisor
 - UPGR Area coordinator
 - UPMS Area manager
 - UPMS Area supervisor
 - UPMS Area coordinator

The main reason behind this methodological choice of interview, lies in the primary purpose of collecting authentic, reliable and genuine considerations and opinions from the true protagonists of the project, thus preserving the uniqueness of each individual contribution, and avoiding incurring the risk of results distortion as well as that of potential homogeneity of the participants' beliefs. Each interview had a duration of about thirty minutes.

In particular, the interview protocol responds to a semi structured layout with open ended questions that are mainly aimed to grasp each recipient's attitude towards some significant issues:

- his personal experience as leading actor involved into EGR project;
- his subjective view about the nature of impact produced in his traditional routine by the disrupting entrance of EGR;
- the existence of particular problems or obstacles encountered during the EGR adoption within the plant area;
- a personal estimate regarding the extent of the improvement brought by such lean based project in Pirelli Tyre everyday operations;

Indeed, the group of respondents is made up of employees with an age between 40 and 55 years, thus denoting both a considerable professional experience in the sector, and providing a meaningful, constructive and objective assessment of the marked potential of change embodied by the EGR project.

- The *in-depth one-to-one interviews* have been conducted with two members of the Continuous Improvement Staff, who are responsible for the entire process of EGR implementation in Santo André plant.

The two interviewees have been chosen among a set of potential respondents, for their peculiar specialty and significant knowhow in the coordination of several operational projects and improvement programs all along the factory. Furthermore, a further interesting aspect is given by the degree of discrete exclusivity existing between the different factory areas, that is due to the different stage of the production cycle. Thus, although belonging to the same factory, each area shows up some differential and stand alone features that can both inevitably lead, over time, to the ideal creation of internal sub-factories and impact the way employees interact with each other. For this reason, picking up a figure of general supervision and coordination of the whole factory, helps to provide a reliable opinion and less influenced by the local peculiarities of each area of the plant.

If compared to individual interview approach, in-depth interviews end up embodying a different underlying format and ultimate inner purpose. Each of these interviews had a

duration of about sixty minutes. In fact, differently from the previous interview conditions, the profile and observation perspective of the respondent tends to take on distinctive traits from the ones of the area directors, supervisors and coordinators. Hence, daily operating away from the shop floor, the former is supposed to hold a broader and apolitical standpoint about EGR project itself and its implementation process within Santo André plant, thus providing a constructive set of considerations that would go beyond the mere EGR impact on machine level, up to the point of framing an inclusive feedback about the overall transformation caused by the project along the whole organizational hierarchy of the plant.

5. RESULTS

5.1 Introduction

This section aims to go through the description of EGR project, in order to better outline its underlying theoretical foundations, the technical tools regularly deployed, the sequential steps for its gradual implementation, the expected overwhelming benefits and remarkable gains deriving from its proper and orderly functioning.

Moreover, beyond assessing its inner value proposition, the paper is committed to take deeply into account the vivid impact produced by this project on company's workforce, in terms of involvement into decisional processes, commitment to work, degree of clarity and efficiency in communication flow, level of cooperation between different hierarchical levels.

The Italian multinational company has lately begun to take the first steps towards lean approach in its Latin America industrial complex and definitely hopes to achieve a waste-free identity in the upcoming future. In particular, going further on this ambitious path, Pirelli paved the way for EGR Project with the ambitious purpose of definitely adapting the actual PMS (Pirelli Manufacturing System) to the ideal lean firm profile, by paying attention to several aspect: from the setting of standardization metrics to an higher quality of communication between hierarchical levels, from enhanced people involvement to motivated commitment to production efficiency and quality excellence.

Furthermore, the research will be focused on Santo André plant, where EGR has been firstly launched, with the aim to grasp the relevant changes brought to the Italian company, by both running field surveys as well as gathering evidence from the personal experience and observations of the actors involved.

5.2 Core features and purposes of the project

First launched in April 2011, as pilot, in the UPGR area, EGR project represents a strategic and operational tool which can be wisely used by Pirelli Tyre to achieve satisfactory and significant results in the daily routine management of its factory complex. This project, which has been currently taking part the Pirelli Manufacturing System and is geared to plant supervisors and coordinators, mainly consists of developing the corporate ability to correctly evaluate the potential gap existing between expected and current results, so to both figure out possible deviations and underlying causes, and continuously boost and encourage improvement in company performance through two main levers: process standardization and waste reduction. These two goals can be pursued by acting on the following means:

- Significant improvement of technical skills, problem solving effectiveness and training on behavioral leadership, which are both undoubtedly needful to support each project team.
- Enhanced effectiveness in managing the operational performance of any single Group factory and across its distinct constituent units, in accordance with KPIs (Key Performance Indicators), set at the Head Quarter level.

Moreover, the EGR program strongly enters the organizational hierarchy, so to then concentrate its attention on the second rung of the corporate pyramid, occupied by supervisors and coordinators of any single factory area. Hence, such project takes on a specific perspective in conducting the analysis throughout the entire firm's industrial complex: in this case, the emphasis of the investigation is focused on the factory area, rather than assuming other different standpoints, such as the single machine, the mini-plant or the plant as a whole. As a matter of fact, the typology of exploring point of view chosen so far definitely tends to be a function of result expectations and purposes that were previously defined by the company before launching and implementing the project.

Moreover, each hierarchical level within a given company's plant is directly associated to a determined methodology built up to ensure the proper and regular functioning of PMS. In effect, each level of the pyramid is in charge of ensuring the compliance with a set operational standard. (Autonomous management and 5S at machine level; Process Kaizen Engineers at mini-plant level; Black Belt programs throughout the entire plant unit). As a proof of what has been stated above, EGR thus aims to primarily act on the area level, training and shaping skillful and effective performance control leaders and, lastly, introducing the use of a certain methodology, the PDCA cycle, up to gradually make it a dominant design, permanently followed on the shop floor.

Therefore, it would be convenient to outline that, according to the basic architecture of decision-making process undertaken within the firm, the reliance on PDCA method should be depicted as the second station of a more comprehensive and sequential decisional path, faithfully employed within problems resolution proceedings and orchestrated as follows: the first preparatory and indispensable stage is characterized by the establishment and subsequent preservation of basic equipment conditions; then, it is the turn of PDCA to trigger a standardized and functional mechanism of time-effective and efficient fixing of irregularities across the whole factory.

Indeed, going more deeply into the definition of PDCA cycle, it can be better depicted as the process, within which one specific problem is understood, analyzed, assessed, and then appropriate countermeasures are established so that the problem would no longer occur. Put differently, the PDCA cycle (Plan, Do, Control, Act) stands for a structured methodology of problem solving which tends to assess any single irregularity in an accurate and comprehensive way, and up to the extent of removing root causes and thus drastically cut out any possibility of its recurrence. Farther, responding to specific and sequential stages for its correct implementation, such analytical procedure requires the compliance with two essential conditions:

- The progressive standardization of corrective solutions, in order to strengthen them and thus make them irreversible for specific typologies of problems to be fixed.

- Provide training sessions to all employees in a way that could supply them with the sufficient familiarity in the application of the methodology as much as in the use of technical tools.

Besides, following the trail, the next step naturally stems from the generation of strengthened and tested routines for consistent loss reduction.

Lastly, the culmination of this process of incremental approach to a consistent discipline and well-structured attitude toward the final result of quality excellence and operational efficiency, is represented by the development of Six sigma program. In particular, such set of tools for process improvement, performs as an empirical methodology of measurement which is mainly oriented to figure out and deeply understand how production process has been carrying out. Hence, being both data-driven and based on the constant assessment of various measures of standard deviation from the mean value, such analytical approach attempts to provide reliable tools and technical solutions in order to improve equipment capability and reasonably cut down the rate of defects incidence. The benefits of Six Sigma adoption, can thus result in different fields of the firm's economic performance: from notable improvements in product quality and profit margin, to drastic reductions in production cost, customers' satisfaction and stock levels.

Indeed, looking at what formerly stated under lean spotlights, a significant synergistic relationship can be found out. As a matter of fact, such mutual tie would be declined according to the following proposition: the higher speed induced by lean manufacturing increases quality as well as the higher quality promoted by Six Sigma programs triggers greater rapidity in processes execution.

EGR can be then portrayed as an overwhelming tool made available to the firm in order to take into serious consideration the difference between the results currently achieved and those set as targets, with the ultimate intent of identifying deviations, investigating their root-causes, and generating actions and countermeasures to both fill any existing gap and keep firm's performance under control. In this sense, a core aspect is represented by the company's relevant need to improve by far the quality of managerial practices, by leveraging on two dimensions: a clearer level of information and an effective optimization of supervisors and coordinators' ordinary tasks within the different factory areas. Therefore, it ought to be outlined not only that the EGR is meant to be a strong and fruitful breakthrough into Pirelli's

ordinary life, but also that it can definitely work out by constantly keeping in mind the objectives at the base of its reasonable introduction and positive revolution: mutual respect, overcoming of traditional paradigms, propensity to change, standardization and, lastly, serious adherence to discipline.

Going further in the description of the main aims and benefits brought by EGR, it would be convenient to state that such operational program is oriented to provide full and notable benefits to Pirelli, by properly balancing and deploying its efforts on three areas of intervention as well as analytical perspectives:

- Behavioral perspective

From this standpoint, beyond entailing more transparency and clarity in the communication at shop floor level as much as in the information management, EGR turns out to be a useful driver for triggering growth and higher empowerment of all the employees involved, in terms of leadership, teamwork and abilities to conduct quick, effective and successful meetings. When actually implanted into the firm, such devices would contribute significantly to improve employees' morale, self-reliability, mutual cooperation and commitment to firm's goals.

- Functional perspective

The EGR implementation undoubtedly plays a decisive role in putting the firm in the position to develop functional solutions for companywide standardization. By doing so, daily routines, work practices and regulations, production procedures, and safety specifications can thus be involved into a generalized improvement program, aimed at not only streamlining coordinators and supervisors' schedules tasks but also encouraging their mutual support and facilitating interaction in the workplace. In these terms, directing the entire operational structure toward a target of uniformity, detectable in its underlying components as much as in the game rules, means to make some relevant steps on the route to lean.

- Technical perspective

With regard to the most peculiar advantages gradually brought by EGR, it ought to include some worthwhile contributions and perks concerning an agile problems prioritization and

subsequent resolution. In fact, the latter stage is by far facilitated through the adoption of an organizational paradigm which consists of consulting higher hierarchical positions, to fix irregularities and anomalies, according to their degree of severity.

All in all, directing the entire operational structure toward a target of uniformity, detectable in its underlying components as much as in its regular functioning, means to enable Pirelli Tyre making some relevant steps on the route to lean and continuous improvement.

5.3 The project implementation: A seven-step process

Within its internal skeleton, EGR embodies seven sequential stages, whose appropriate execution is undoubtedly compulsory, in order to accomplish effectively project goals and expectations. More in detail, each listed step is associated to a set of practical initiatives and concrete actions to be carried out and properly checked in progress. Indeed, during the entire duration of the program, EGR can rely on the full availability and serious collaboration of a cross-functional team, suitably built up for such specific purpose and loosely characterized by the intervention of key figures, so to ensure the fruitful interaction of contrasting standpoints and the proper functioning of the project in each area of prominent interest within the plant. More in deep, picking out the case of Santo André factory, the team thus constructed for EGR implementation in UPGR area, entailed the actual involvement and participation of the following organizational actors:

- UPGR Area manager
- Productive Efficiency specialist
- Continuous Improvement analyst
- Process Efficiency analyst
- UPGR Area supervisors
- UPGR Area coordinators
- Quality analyst
- Human Resources Development analyst
- Health, Safety and Environment analyst

Farther, the careful assortment and structured composition of EGR team, represents, by itself, a significant starting point and indispensable ingredient on the path towards greater efficiency, effective daily routine management and constant improvement.

Therefore, such subsequent process stations are described as it follows:

5.3.1 Identification and verification of the current system for controlling company performance

At this first stage, the main purpose consists of analyzing the current state of the daily routine management within all its underlying features and activities which every organizational actor, more specifically supervisors and coordinators, is in charge of. Going into detail, for each mini area of the factory, this primary task can be achieved by fulfill two crucial and sequential activities. Firstly, it would be important to both accompany supervisors and coordinators during a typical day of work and conduct in-depth interviews about their own work conduct. By doing so, relevant workplace dynamics, potential anomalies and hidden irregularities during the daily life on the shop floor, can arise and then be detected. Secondly, it is necessary to closely observe each activity undertaken by both hierarchical positions and identify two types of gap: red colored (severe gap), which represents a specific activity that has to be removed since it is not a value-adding one; yellow colored (moderate gap), instead, shows a certain task which has to be maintained in supervisors and coordinators' work protocol but it should be improved in terms of higher time effectiveness and cost efficiency. In the same way, all those activities which do not show any irregularity or chance for improvement, will be labeled with green color and remain unchanged and regularly fulfilled during the factory daily routine.

More in deep, some examples of the activities which may be subject to improvement and/or elimination, as characterized by a high NVA rate (Not Value Added), can be provided by the following circumstances, highlighted as a result of field investigations carried out on the shop floor:

- Lack of organization and discipline during work shifts inside the plant
- Excessively high level of administrative activities carried out

- Absent or poor focus on the important relation between OPI and KPI indicators
- Limited reliance on visual management systems in the factory routine
- High level of inefficiency in the information management and communication flow within the plant, detected within the same hierarchical level as much as between different ones.

After having underlined all those relevant criticalities about the current state of the plant, a further leap forward is represented by the redaction of the Brown Paper, an integrated factory road-map which both carefully analyzes the stream of work actually performed by each organizational actor in the following decreasing order of hierarchical importance: Plant managers, Efficiency and Production Department analysts, plant area supervisors, plant area coordinators, machine operators, and other functional branches that support the daily company operations (Quality; Human Resources; Equipment maintenance; Health, Safety and Environment).

Indeed, in order to contribute to a better detailing of the current flow of work into the plant, each activity can thus be categorized by following two criteria: the hierarchical level that is responsible for its execution towards supervisors and coordinators; its frequency of occurrence (yearly, monthly, weekly, daily, or once per work shift). Hence, such mapping initiative is strongly geared to grasp, critically scan and portray all those tasks which testify the existence of correlation between the supervisory and coordination level (namely as the EGR target) and the rest of workforce acting in the factory.

Furthermore, it would be convenient to point out a further significant source of value brought by the construction of the Brown Paper: the precious chance of overthrowing a traditionally wrong paradigm: now more than ever, in the manufacturing sector, it should be taken very clear that all company's functions have to mutually cooperate and jointly ensure the regular functioning of production, which is the very strategic and most sensitive pillar for both company value proposition and lasting stay in the market. Instead, in the past, each functional entity was supposed to be stand-alone, self referential and autonomous respect to the others in delivering value to customers. Therefore, the Brown Paper thus built up, succeeds in reversing

this past thinking and lays stable basis for a production-centric approach to operations inside the company’s industrial complex.

In conclusion, the last stage of Brown Paper analysis consists of accurately assessing the set of gaps, moderate and severe, detected along the in-field investigation and developing an Action Plan, made up of concrete actions and practical programs for their respectively improvement (yellow gaps) or elimination (red gaps).

5.3.2 Development of the tree structure for performance indicators

This second step, differently from the analytical focus adopted in the previous one and geared to deeply monitor firm’s activities according to a value-adding perspective, ends up establishing a tree-shaped structure of the factory’s performance indicators, which go through a preliminary phase before coming to their ultimate determination. First of all, it is crucial to define clearly the underlying linkages existing between the different classes of indicators within a specific plant. In fact, as visible below (Figure 5), each plant performance can be evaluated according to three distinct level of indicators:

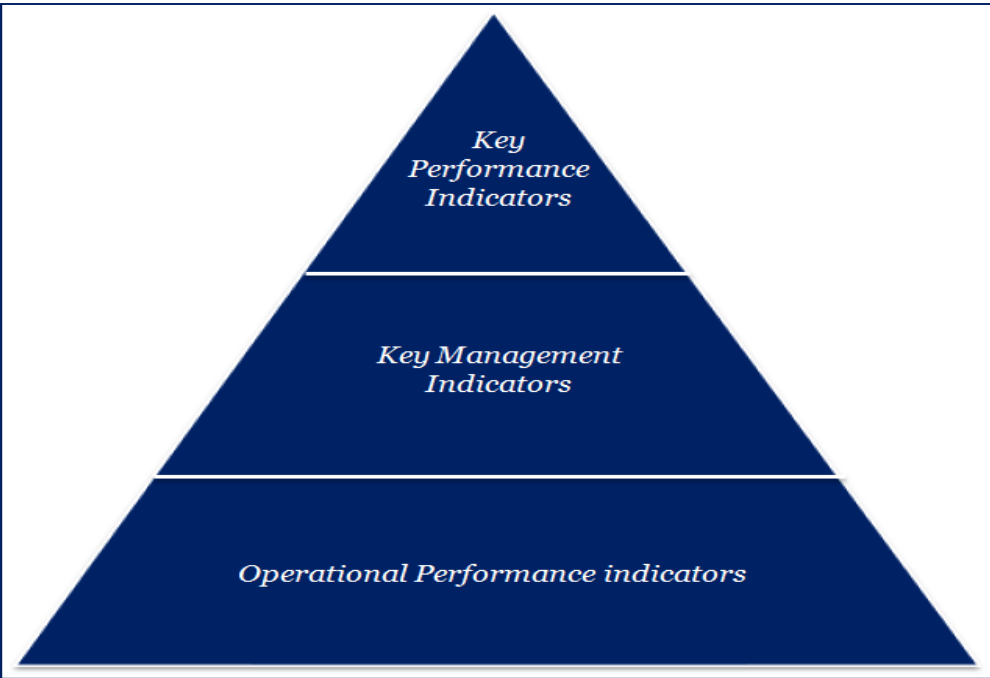


Figure 5 – The three levels of performance indicators

Source: Elaborated by the author

- *Key Performance Indicators (KPIs)*, which are valid at the managerial level of the plant and require corporate strategic alignment with all worldwide Pirelli Tyre factories. More specifically, the establishment of those indicators and the reason for their widespread application lies in the fact of being set, on a centralized basis, by the Italian Head Quarter, taking as reference five prominent dimensions and strategic levers of the firm business operations: People; Delivery; Quality; Cost; Safety. Such five pillars of the company performance, although mostly homogeneously spread throughout the vast Pirelli Tyre industrial landscape, are affected by reasonable variations related to the product line specifically made in each factory. In the peculiar case of Santo André, the set of developed indicators would be most suitable to truck and agro tyres.
- *Key Management Indicators (KMIs)*, which are applied to each single production area of the factory and respond to a plant supervision level.
- *Operational Performance Indicators (OPIs)*, whose validity acts at the plant coordination level and, in particular, on a specific group of machines devoted to a single specified phase of production flow.

According to EGR value proposition and operational mission, KMIs and OPIs, framing respectively the first and second rung of the company's indicators pyramid, converge in a uniquely coded alignment, oriented to sharpen the key drivers for the overall and comprehensive evaluation of plant performance.

Hence, at this stage it is therefore crucial to both identify the actual level of correlation of KPIs to KMIs (or OPIs, according to EGR) and, at the same time, facilitate the interpretation of corporate results, through a fortified and clearer linkage between the centralized managerial sphere and the strictly operational one. To effectively meet this objective, an precious contribution is provided by the use of 9-3-1 Matrix. Such tool allows to assess the degree of correlation of Head Quarter based KPIs to the specific Plant OPIs (or KMIs), by deriving it from a subjective evaluation of EGR team members which is based on the following criteria:

- Assign the score of 9, when the correlation is assumed to be high
- Assign the score of 3, when the correlation is assumed to be medium
- Assign the score of 1, when the correlation is assumed to be low

The opinion expressed and the score assigned by group members, thus lead to the overall outcome of 9-3-1 Matrix, which is represented by the sum of all correlation scores per single OPI (or KMI). That sum, calculated for each single operational indicator, shows its degree of frequency required in the control of such variable. Hence, depending on the total score reported, the higher it is, the more frequently it will be controlled, in the light of a more reliable total factory performance. In so doing, basing on each indicator's subtotal, the company monitoring system will be then structured and planned by taking as reference the level of priority assumed in controlling any single OPI: the higher focus the firm concentrates on a specific indicator, the more likely it will be checked with higher frequency. Therefore, the rate of control adopted by the firm will be scanned daily, weekly, monthly or annually, in accordance with the level of emphasis given to each factory's OPI.

By doing so, a more explanatory and direct relationship has been developed between the corporate strategic KPIs and every specific set of Plant based operational indicators. Farther, that stage then holds great importance primarily for having ensured all the basic and necessary requirements for the establishment of a renewed and more agile methodology for scanning and controlling company's performance from time to time in its ongoing activity on the shop floor.

5.3.3 Definition and setting of the new system for controlling company performance

In this phase of the project, the main purpose consists of developing and providing the firm with a streamlined device for effectively scanning and assessing company's performance through the remarkable reliance on visual management system. The latter practice, if jointly combined with a deeper accuracy in addressing the information flow very clearly, can thus lead the firm to significant results in terms of both higher level of disciplined integration among employees inside the organizational infrastructure and enhanced effectiveness of its operational activities.

Farther, it would be also convenient to outline the main changes brought by the company for the better and more effective visual management utilization in operations. In fact, before the EGR arrival, the state of use of visual tools inside the factory could be summarized as follows:

- Several boards located all over the different plant areas, some of which monothematic (reporting only the results of Quality, or Safety, i.e.)
- Low level of integration and coherence between company's performance dimensions
- Detected existence of some boards just to inform, rather than some others kept unused or outdated
- Absence of board panels for the reporting of both the Action Plan and the set of initiatives undertaken to solve the observed problems

On the contrary, the principles and practices introduced by EGR project are such as to allow a more consistent and efficient management of information resources throughout the factory, according to the considerations listed below:

- High integration and combination of the various dimensions of corporate result, in order to achieve common and shared objectives
- The reporting of the data related to the overall factory performance, to be assessed in the several functional fields of analysis
- The structuring of boards and tables, whose content should be quick, clear and easy to understand, in addition to be constantly kept updated to factory daily life
- In this case, the emphasis is focused on the actual and constructive management of the information, and not on their mere informative purpose

Turning to the detail, according to EGR code, visual management functionalities and features definitely result and can be practically framed as the result of the crucial utilization of two board typologies, to be used evermore at the shop floor level:

- One internal board for the management of the working day and each work shift. Such board rises to the goal to carry out a rapid (or immediate) information cycle, which is oriented to preserve current positive results as much as resolve irregularities or problems already occurred. In this case, the analytical standpoint acts on a short-term horizon.
- One external board for the management of the weekly and monthly status of plant performance. Indeed, more specifically, this second type of board helps company to think on a medium to long-term perspective, enabling employees to grasp and improve company's growth potential as well as prevent the occurrence of unpleasant events and the achievement of negative results.

Those two graphical tools described above are clearly interrelated, since the first contributes to the construction of the second one, while the latter, operating on a wider future outlook, demonstrates to be useful in entailing the incremental improvement of plant's standards and underlying components. Besides, if investigating retroactive business dynamics concerning the plant, the nature of the external board strictly depends on the internal one, in such a way as the reported data can be causally led to a daily detailed analysis.

A further relevant activity, which characterizes this third step of EGR implementation process, is represented by the effort, put by the cross-functional team, in order to understand the causal, organizational, hierarchical and functional linkages between the Pirelli Tyre PMS pillars. Those corporate entities, with some reasonable variations due to the diversity detected across Pirelli plants, are geared to support the ordinary activities of each plant's industrial team so to ensure the achievement of effective, satisfactory and lasting results in terms of product quality excellence, equipment maintenance and constant improvement solutions.

Applying what stated above to the Santo André plant, the PMS pillars (Figure 6), actually operating as a crucial support to production branch, are the ones listed below:

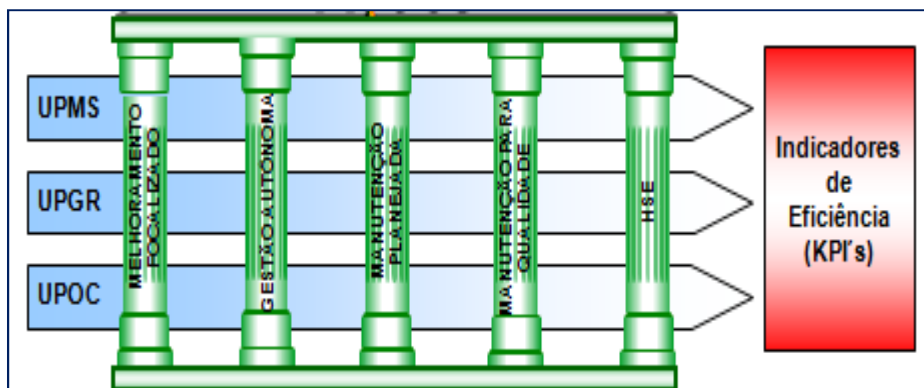


Figure 6 – PMS Pillars in Santo André plant

Source: Pirelli Tyre Brazil

- **Planned maintenance**

This pillar aims to ensure the reliability and availability of equipment, machines and industrial facilities, in such a way as to preserve them and thus pursue remarkable levels of excellence

productivity, productive capacity, safety, and consistency with the surrounding environment. More in detail, the PM pillar can allow the firm succeeding in the improvement of plant performance and reduce the cost of maintenance, by both relying on the elimination of unplanned downtime and technical losses, and developing a system for planned maintenance which tends to be cost effective and integrally carried on by the production staff all along the plant.

- **Maintenance for Quality**

It contributes to promote training and employees' professional empowerment, through the application of continuous improvement methodologies, the structured integration between pillars and the strengthening of systematic vision for the attainment of both efficient processes and best quality products.

- **Health, Safety and Environment**

This pillar aims to direct and support the creation of safe workplace and health environment inside Pirelli Tyre, thus based on the rigid compliance with the prominent principles of sustainable environment and mutual respect among individuals.

- **Autonomous Management Staff**

The most relevant purpose assumed by this pillar is represented by a twofold dimension:

- the opportunity to enable machine operators to regularly work with greater autonomy, sense of duty and responsibility towards the equipment.
- promote teamwork among employees from different professional backgrounds (production, maintenance, quality, process efficiency, safety and human resources) in the pursuit of steadily improving results.

- **Education and Training** (as a relevant duty of Human Resources Department)

This pillar is mainly oriented to ensure a constant corporate support to its employees, in order to trigger an enhanced involvement in the ongoing projects of the plant (EGR above all) as much as to produce a positive impact on individual motivation, higher morale in the workplace and more cooperative attitude with colleagues.

Therefore, after having described the remarkable role played by such corporate forces, the next step will be directed to assess the degree of intensity, interrelation and functional dependence subsisting between them. This result can be achieved through the construction of DE-PARA Matrix, which synthetically portrays the nature of the linkages across the several plant pillars, up to the point of establishing structural and formalized ties within the same factory engine.

5.3.4 Development and installation of the new set of indicators for the firm performance assessment

This phase of the process aims to fruitfully combine the evidence grasped by both the second step, through 9-3-1 Matrix, and third step, mainly characterized by the renewal of visual management practices and the valuable structuring of DE-PARA matrix. In this circumstance, it would be essential, to Pirelli Tyre, to redefine and properly implant the new system for the comprehensive evaluation of company performance. More specifically, at this stage, it is time, for EGR project, to lay the foundations for the serious accomplishment of two important missions:

- The structuring of the new system for indicators control, embodying a more direct, vivid and causal relationship between Head Quarter KPIs and plant OPIs.
- The introduction of a greater contribution to discipline within the organization and among its members, whose observance and respect is essential to achieve prominent targets of effectiveness, efficiency, growth and innovation in operations.

Hence, inside each plant area and for each OPI, related to a certain KPI, entailing a specific frequency of control and pertaining to one of the five dimensions of corporate performance (quality, cost, safety, people and delivery), it is crucial to build up the RACI Matrix. This explanatory chart, taking as reference all the dynamics described up to now, succeeds in

enriching the firm with a formalized design for the appropriate deployment of the information responsibility across the entire plant hierarchical structure. In fact, thanks to such a renewed attitude to information management, within each plant area and in accordance to the type of indicator under observation, it would be thus feasible to spread the responsibility for its assessment among a defined set of employees and differentiated hierarchical positions. Indeed, by complying with reasonable criteria of clarity and objectivity, each employee turns out to take part the operation of the new control system, within which everyone contributes to a small but vital portion of monitoring and improvement activities of the firm business results.

Having clarified all those crucial aspects and assumptions, the RACI Matrix can then be constructed by taking into consideration the actual meaning of its underlying components, each of which demonstrates to have a certain degree of importance and exclusivity. As a matter of fact, each of the composing letters identifies one specific position, who is responsible for that single task in managing the information flow throughout the firm. Hence, the RACI matrix is made up of the following components:

- R: It identifies the person who is the first responsible for taking a given information.
- A: It points at the position that is in charge of the complete utilization of the received information.
- C: It signals the person who cooperates with the information owner (A) in order to undertake an improvement initiative on the firm's result.
- I: It indicates who received the information and makes use of it. This label is basically assigned to the managerial positions of the plant.

Once theorized the main features that characterize RACI matrix and the allocation of responsibility within the plant infrastructure, it would be worthwhile to accurately describe the new disrupting dynamics, introduced by EGR, in terms of the inner organization and foundational principles of routine meetings. If applied to the specific case, with regard to the daily management of the plant, the internal board will exhibit results of each of the three work shifts per day, thus displayed according to production, overall losses, administrative activities and decisions taken. In the same way as the work shift, those defined results will be then resumed in the daily section of the specific plant area of interest, beyond to be included both in the work shift book and into the Action Plan. Therefore, expanding this analytical perspective on a longer timescale, it works similarly for the plant management on a weekly, monthly and yearly basis.

Moreover, another aspect which deserves a prominent importance is referred to the various problem solving strategies to be applied along the operational life cycle of the plant. Going into detail, lean thinking provides a set of valuable tools to be implemented in order to solve problems and fix the anomalies detected across the factory. More specifically, positively depending on both the actual significance of the action (retention, immediate or definitive action) underlying the resolution of a given problem and the degree of severity of the latter (from the involvement into the single work shift up to the whole month duration), it is possible to identify a wide range of instruments and resolution strategies, which are listed as follows:

- Preservation, on work shift basis, of plant basic conditions, through the compliance with Autonomous Management and 5S programs.
- Undertaking immediate initiatives on daily basis, as agreed in the Action Plan.
- Implementation of a definitive action on the specific problem, by carrying on an Analysis of the Anomalies inside the factory. Such intervention tends to be performed on weekly basis.
- Conducting definitive actions through the support of methodological techniques such as A3, Basic PKE, Advanced PKE programs. Those three technical equipments are used on monthly basis and respectively correspond to an increasing level of pervasiveness of the remedial action.

Furthermore, for what concerns the revised cycle of meetings as a fundamental support to daily routine management, one further side of change regards the new approach followed in the selection of the participants. In particular, the first two goals of EGR project consist of triggering higher empowerment and increased autonomy of first level employees, area supervisors and coordinators. As a consequence, plant director and managers seem to take on a lesser role in work shift meetings, thus encouraging the decision-making authority by those employees who are closer to the source of potential problems and familiar to those peculiar criticalities and local dynamics that characterize each part of the plant.

In so doing, both the timetable of routine meetings and their streamlined composition tend to be framed in the following way:

- On work shift basis: one coordinators meeting (20 minutes long) and one supervisors meeting (with planning purpose) per single work shift. There would be also the chance of arranging a meeting (30 minutes long) about the issues of Safety, Quality or Maintenance. Such format will require the attendance of area supervisors and analyst of the PMS pillar.
- On daily basis: one daily meeting (30 minutes long), during which area supervisors and area managers are the ones who actually participate. In this case, coordinators are not about to take part.
- On weekly basis: one weekly meeting (one hour long) attended by the manager, representative of the specific plant area, and the analyst of each of the PMS pillars that are actually involved into the debate.
- On monthly basis: one monthly meeting (one hour long) which predicts the participation of the primary representative of PMS pillar as well as plant area managers. Indeed, differently from the other meetings format, it does not require the attendance of supervisors, while contemplates the presence of the plant director.

All in all, the general impact of such disrupting intervention on the current state of routine meetings can be easily summarized in one logical equation:

Standardization + Higher Quality meetings – Less Time losses = More effective results

5.3.5 Framing and building up plans, reports and more efficient formats of routine meetings, in accordance with the new operational model to be introduced

In this section of the project, the main purpose lies in the essential chance to structure concretely the new control system by following the theoretical premises and operational guidelines outlined up to this stage of the implementation process.

First of all, an issue of great importance is given by the establishment of a contract that should regulate functioning, disciplinary norms, location, time constraints and internal articulation of each routine meeting inside the several productive areas of the plant. Hence, depending on both the type of meeting (on work shift basis, daily, weekly, monthly or yearly) and the specific area of the plant where it would take place, various dimensions are thus set: the meeting agenda, the list of participants, the KPIs trends to check out, i.e.

Furthermore, independently from the differential aspects that could compose the routine meetings to be performed, some features tend to be exactly the same, no matter the productive area of particular interest or the frequency of occurrence. In this regard, those invariable components of the contract are represented by the following elements:

- Start and end time of the meeting, differentiated only by frequency but equal to any single area of the plant.
- Ultimate purposes of the meeting, changing only according to frequency but equal to all productive areas of the plant. Indeed, the topics for each meeting may, of course, vary in dependence on the peculiar dynamics at the base of each working day. In any case, it is possible to think of the following proposition: the less the frequency of meeting occurrence, the more likely meetings will respond to a standard format and formalized protocol.
- Documentation outputs, which varies only in agreement to the frequency of meeting occurrence. Those are generally constituted by both a summary report on the meeting just ended and the updated Action Plan, which incorporates the agreed set of corrective actions to be undertaken on the shop floor.
- Documentation inputs, to be analyzed and taken into consideration at the beginning of the meeting. Such informative equipment still only varies in dependence on the frequency of the specific routine meeting.
- Basic rules and key behavioral norms that all participants have to comply with. Those are generally set by cross-functional team and apply to any kind of routine meeting occurring throughout the entire plant. Suitable examples of correct conduct can regard: punctuality; respect of set timetables; preparation in advance on the issues that will be discussed during

the meeting; attendance at all meetings in which the single employee is required to participate; notify in advance when someone is unable to attend the scheduled meeting; ban on the use of mobile phones or other electronic devices; mutual respect and education of all participants, both at the meeting as well as throughout the whole factory environment.

5.3.6 Implementation of the new system for monitoring and controlling company's performance

After having largely described the main dimensions of benefit, thus being reflected into company improvement in cost saving, operational efficiency, standardization and waste removal, that would be brought to Pirelli Tyre by EGR project, the emphasis will now be centered on people. In fact, the companywide transformation boosted by EGR can only work out, fulfill result expectations and entail effective gains, if properly supported and strongly fostered by employees, who are the very first hand users and crucial drivers of such change.

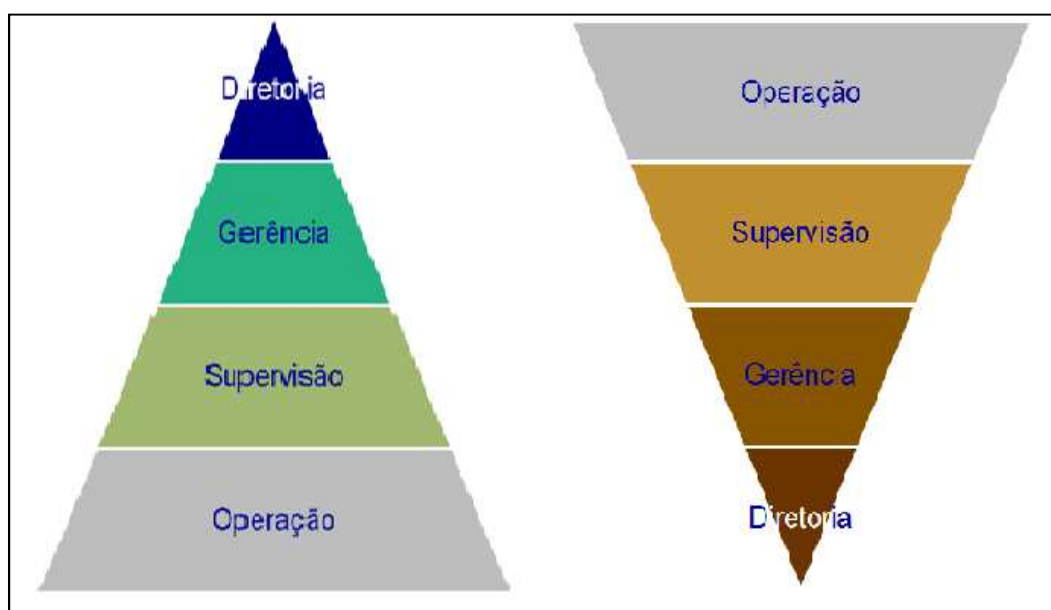


Figure – The Customer Market pyramid

Source: Pirelli Tyre Brazil

In fact, as visible in the Customer Market Pyramid figure, operators demonstrate to be crucial and fundamental actors for the effective achievement of results by the firm.

Furthermore, within the corporate infrastructure, not the totality of its underlying levels will be directly involved and automatically responsible for the overall success of the entire project.

As a matter of fact, since the target of EGR is represented by the position of supervisor and coordinator along the several areas of the plant, those two hierarchical levels would end up being by far the protagonists of such operational and organizational revolution. Therefore, in such a way as to enable those actors not only achieving the scheduled ambitious goals but also acting as facilitators of change, it would be essential to educate and properly train them on this new conception of daily operational routine, adopted by Pirelli Tyre in its Latin American industrial complex.

Farther, in so doing, it is important to schedule, for each Group plant, a four-day training session, in order to start to practically transfer supervisors and coordinators the necessary knowhow and innovative skills that such disrupting attitude to manufacturing operations would undoubtedly deserve, so to regularly work out. In particular, this training program, both in its internal articulation and in the series of covered contents, takes inspiration from a distinct notion of “doing management”. More in detail, relying on lean thinking as the vivid theoretical background of its ordinary functioning, EGR project fits the managerial dimension as a function of the balanced, causal and objective relation between data, facts and decisions.

In effect, lean thinking outlines a managerial attitude and a decision-making process that are both based on the faithful adherence to concrete data. Hence, the latter highlight and signal the occurrence of specific events, and subsequently lay the foundations for the adoption of suitable countermeasures and proper actions by workers, within the factory. The so described dynamics thus contribute to delineate the traits of a managerial approach which is basically centered in the cause-effect mechanism, through the valuable support of empirical evidence and intimate feasibility of the solutions taken as remedial to problems and irregularities found out on the shop floor.

Besides, the training program, conducted by a specialized consultancy, is thus geared to plant supervisors and coordinators and is characterized by the ultimate goal to enrich and enhance the quality of their skill set, with significant contributions oriented to strengthen crucial concepts such as: the calculation of percentages, simple and weighted average; the techniques of charts construction for the display of results; OEE notion and practical utilization; i.e.

5.3.7 Checking the effectiveness and regular functioning of the system, through frequent follows up and feedbacks

At this final stage of the project implementation, the company is thus in charge of constantly monitoring and verifying the correctness and effectiveness of EGR dynamics and practices in their ordinary functioning across the factory. With reference to this, a series of accurate inspection activities and follow-up sessions has been conducted in UPGR and UPMS areas on a monthly basis, in order to thus detect potential problems and anomalies across the factory as well as collect valuable feedbacks and gather precious advices from employees about the corrective measures to be taken, so to allow a progressive tuning and overall adjustment of the project.

Therefore, in so doing, it is possible to ensure the practical consolidation of EGR project inside the two areas of its current actuation (UPGR and UPMS) and, in the mean time, trigger the execution of significant incremental interventions which are mainly aimed to increase, from time to time, the quality of the company adaptation to the new factory management model, and drastically reduce the likelihood of future unpleasant events, actually diverging from the growth trajectory.

5.4 Research results

After having largely described the sequential steps of EGR implementation in Santo André plant, in this section the main purpose consists of showing the actual impact of the project on both the company economic performance and on the employees' ordinary routine within the plant. Therefore, given those two prominent areas for the overall interpretation of the project outcome, at this stage, it would be convenient to actually divide the range of results between the two core spheres of the research.

5.4.1 The project impact on economic results

At this juncture of the investigation, the central goal is represented by the chance to frame the effect of EGR entrance on some synthetic indicators of firm performance that can grasp as much as possible the company reaction to such transformation on the route to lean. In fact, given the complex articulation of the production cycle in manufacturing industry and

assuming the existence of various factors (both controllable and independent on the actual company conduct), which profoundly influence the final result, the performance dimensions that are taken into consideration mostly concern the observation of the progressive trend of some operational indicators. In so doing, the latter can thus effectively contribute to best reflect the distinctive characteristics of each plant area analyzed and concurrently isolate the specific benefits brought by the EGR project.

Besides, the chosen indicators are more likely to depict the considerable gains attained by the Italian firm in terms of cost saving and improved efficiency. Farther, owing to the objective of performing a more accurate assessment of corporate data, the paper is focused on the results reported by EGR in the UPGR (pilot area), thus confirming the reasonable intention to run the investigation on a wider time horizon and then avoid risks of distortion and production seasonality. Therefore, the impact of EGR project on UPGR area, in Santo André plant, can be then summarized by the following set of performance indicators, which portrays the historical evolution of Pirelli Tyre, before and after EGR implementation:

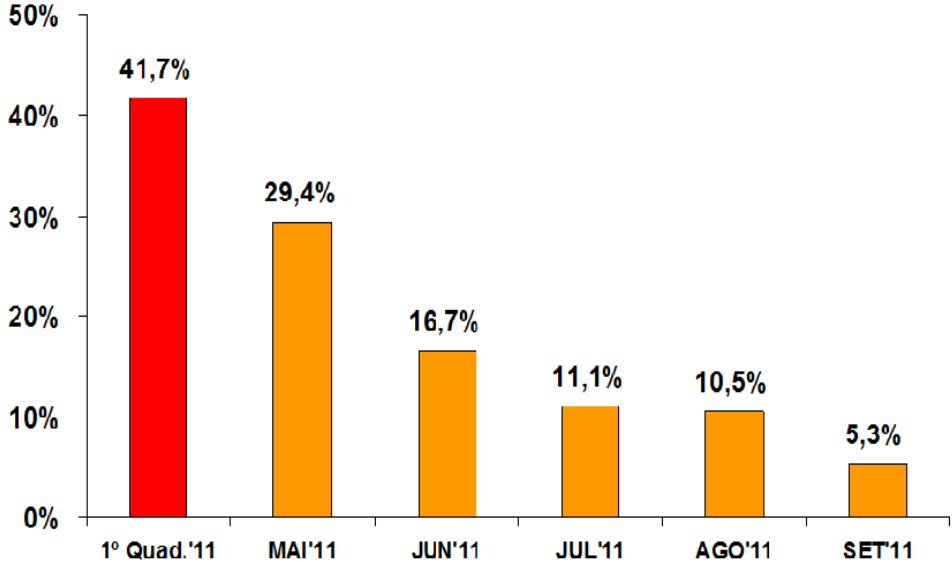


Figure – Percentage of UPGR operational indicators outside the tolerance band

Source: Continuous Improvement Staff, Pirelli Tyre Brazil

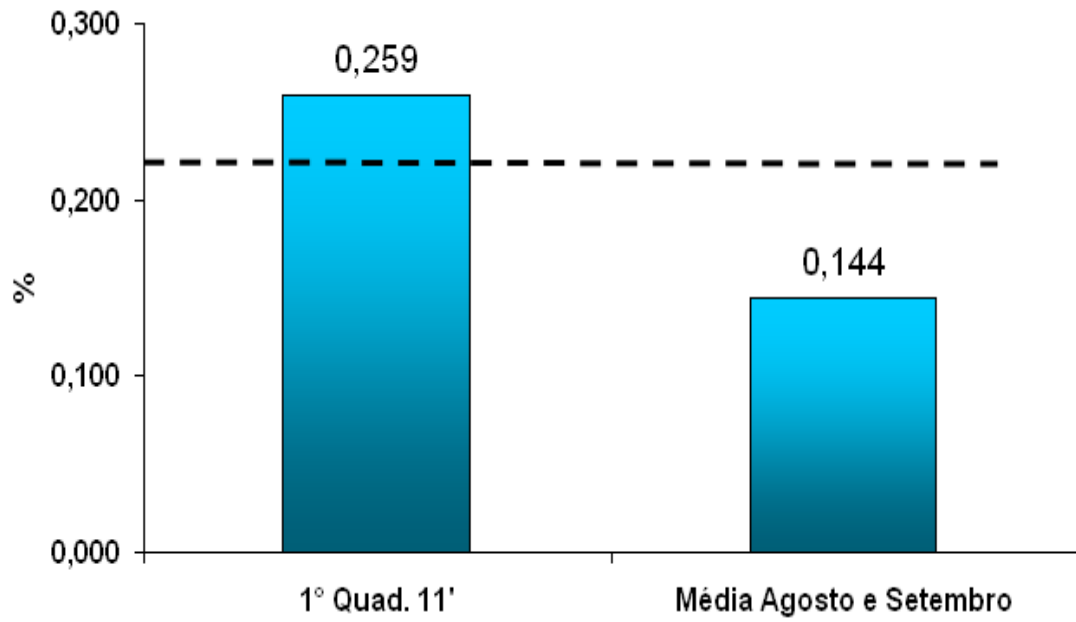


Figure - Variation in scrap rate of tyre carcass in UPGR area, before and after EGR implementation

Source: Continuous Improvement Staff, Pirelli Tyre Brazil

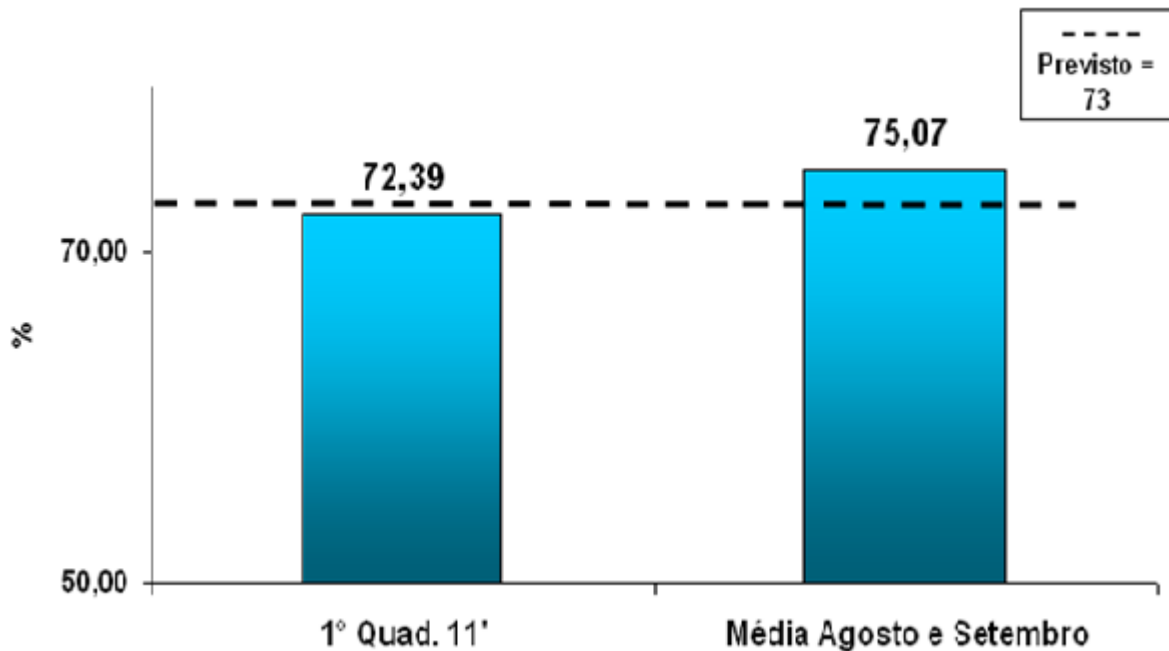


Figure - Variation in OEE rate, in UPGR area, before and after EGR implementation

Source: Continuous Improvement Staff, Pirelli Tyre Brazil

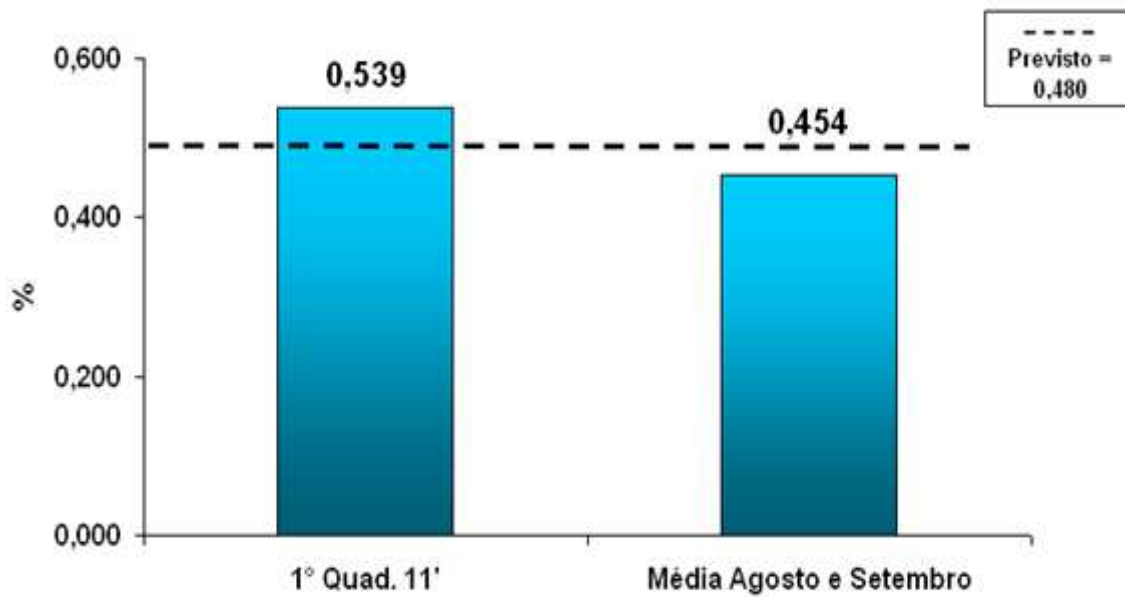


Figure - Variation in scrap rate of finished products in UPGR area, before and after EGR implementation

Source: Continuous Improvement Staff, Pirelli Tyre Brazil

5.4.2 The project impact on employees' daily routine

In contrast to the pure quantitative size that underlies the analysis of the operational results brought by EGR implementation on Pirelli Tyre shop floor, a further major aspect in the overwhelming shift induced by this lean based program, is assumed by the strong resonance produced on each employee's traditional daily routine within the plant. Indeed, this section is precisely oriented to outline the most peculiar dimensions of change in the everyday work schedule of plant area managers, supervisors and coordinators. Differently from the previous section, the productive areas now taken into account are UPGR and UPMS, in chronological order of kick-off.

5.4.3 The project impact on plant area managers, supervisors and coordinators

All the interviewed area managers, supervisors and coordinators provided valuable contributions and positive considerations about EGR, from several distinct perspectives, such as theoretical foundational principles, internal articulation, tools and drivers for its

implementation, disrupting attitude to routine transformation, and considerable benefits in operational efficiency as well as in the organizational environment. In particular, they perceived a remarkable progress in the way ordinary activities on the shop floor were drastically modified for the better, and boosted by a more effective, transparent and clearer communication flow across plant hierarchical levels.

Indeed, most of respondents claimed that the initial and normal reaction, by most of Pirelli Tyre employees, towards the introduction of such a new approach to daily routine management, initially consisted of a bit of skepticism and confusion, reasonably due to a still little understanding of the new project methodology (*"The first impression I had of EGR was that this project would have increased my workload. Of course, I was wrong"*, Coordinator, UPMS). At the same time, they also emphasized that such apparently defensive attitude of company workforce, derived from the natural individual response to the novelty, which implies, by definition, something more uncertain and less comfortable than the current situation (*"Each individual, towards the new, tends to have one foot forward and one foot back"*, Plant manager, UPGR). Once more, this employees' behavior, as repeatedly stressed by both interviewees, has not been a reason for obstruction or resistance to the EGR introduction, but has been represented the preliminary path for the gradual adaptation to the renewed factory routine.

Moreover, another element, that has certainly facilitated and accelerated the process of change led by EGR, has been provided by the joint participation of the whole work team (made up of area manager, supervisors and coordinators per each area of the plant) to the EGR training sessions. Such circumstance has meant, for lots of employees, one more precious chance to further develop a sense of belonging to a team, to be strongly reiterated in the daily mutual support as much as in the struggle to achieve common goals. (*"The participation of the entire group in the training program has ensured that all of us we began to speak the same language throughout the plant"*, Supervisor, UPGR).

Therefore, after having understood a further detailed explanation about the internal structure of the project, the strategies of action and the expected benefits, all UPGR and UPMS employees started cooperating, in a proactive and participatory way, for the success of the whole EGR project. (*"No one of us opposed EGR, but all we have overcome the initial concerns with patience and desire to learn"*, Plant Manager, UPMS). Indeed, in order to

better complement what argued up to now, one interviewed area coordinator stated that EGR soon appeared to be the kind of innovation that the Italian Multinational actually needed in such a way as to streamline the information flow in a most efficient manner. All in all, the great achievement of EGR is due to the significant value added to the quality of daily routine from a better and efficient time management. (*“It was love at first sight. From the first moment I realized that EGR would have helped considerably our day by day throughout the plant”*, Supervisor, UPMS).

Farther, with regard to the difficulties encountered during the preliminary approach to the EGR principles, the most relevant one was undoubtedly characterized by the setting of the new schemes at the base of routine meetings. As a matter of fact, before EGR introduction, meetings took place in any area of the plant, lasted a notable amount of time and were mostly unproductive. However, with the complete insertion of EGR paradigm inside Santo André plant, the various types of meetings, obviously differentiated by frequency of occurrence (per work shift, daily, weekly, monthly), were fully conformed to a structured and standard format, in terms of time duration, selection of participants, and choice of the prioritized topics to be assessed and discussed.

Moreover, as observed for the attendance at routine meetings, initial difficulties were initially detected in both adhering to the whole operational protocol and complying with the new norms set on the shop floor, by the vast majority of employees. In this sense, so as to achieve a better level of adaptation to the refurbished factory dynamics, it was essential the reliance on a vivid sense of belonging to a corporate community, whose regular functioning is thus bound to the respect of such foundational principles. (*“Feeling the all of us on the same path towards a common goal has been the key to overcoming any obstacle”*, Coordinator, UPGR).

In addition, according to the interview findings with a plant area supervisor, another powerful dimension of novelty brought by the EGR project, is given by the sincere awareness that this new system of routine management effectively requires the equal and undifferentiated contribution of each employee to the committed achievement of common corporate goals. In this context, each worker equally participates, without any kind of distinction or recognition of higher merits and abilities. (*“EGR is a democracy. We all contribute in the same way and there is no need of champions”*, Supervisor, UPGR).

Furthermore, as strongly emphasized by both area managers, it would be worth reminding that all those innovative changes and drastic adjustments carried out to Pirelli Tyre traditional operations, require a certain period of time to be truly assimilated and mastered by employees, and thus be fully integrated into the renewed factory daily routine. Hence, it is also essential to point out the importance, for a company in continuous evolution as Pirelli Tyre, to ensure a high level of persistency in making change effectively happen. In fact, it is possible to establish a new attitude only through a great employees' motivation and commitment: any lack of these necessary factors inevitably leads to the failure of innovation and the preservation of the traditional scenario.

Turning to the main benefits and advantages experienced by the respondents in the application of EGR inside the plant, the following ones have been considered as the most important:

- Daily routine organized, logically structured and referring to standardized metrics;
- Creation of the discipline in the workplace, through the clear definition of task, duties and responsibilities;
- Better, easier and more agile use and availability of information inside the factory. Thanks to the development of visual management systems and the detailed description of results per single machine and work shift, information now flow more effectively and straightforward;
- More and better involvement among employees, thus aiming to the pursuit of the same corporate goal.

Besides, as stated by a plant area supervisor, another important leap forward made by Pirelli Tyre through the EGR implementation, can be associated with a deeper dimension of individual empowerment, professional development and enhanced autonomy demonstrated in carrying out his ordinary tasks. Hence, this statement is all the more valid as the focus goes down the plant hierarchy. Similarly, the chance to delegate increases as the emphasis moves from the bottom to the top of the organizational pyramid. (*"In the past, the amount of activities was far greater than the time at my disposal. Today, through the EGR, I delegate*

more to my subordinates and I have much time to fully perform all the activities that are referred to my position”, Supervisor, UPMS)

All those aspects listed above, definitely contribute to outline the features of a notable turning point in Pirelli Manufacturing System. This has been made possible thanks to a revitalized atmosphere inside the factory, where employees feel part of a team, mutually support each other and, much more than before, are determined to achieve a common goal. (*“Thanks to EGR, now, certainly more than ever, we are a team. Every day we work together for the same goal”, Supervisor, UPGR).*

A further interesting point, come out during the conversation with one area manager, was related to the great potential, owned and expressed by EGR, for the analysis of operational problems and the investigation of root causes. As a matter of fact, a more efficient information management and higher decision-making power deployed along the hierarchy, allow the firm to trigger a virtuous cycle, which can be mainly geared to ensure, in the long run, the development of more consistent and structured solutions than temporary and sub optimal ones previously performed, for the same entity of problem.

Therefore, a great benefit of EGR is achieved with the construction of a process for the accurate analysis and incremental improvement of the state of the factory, both made possible through the drastic removal of underlying causes and the development of innovative initiatives aimed at anticipating even the occurrence of unpleasant events. (*“Now, our decision-making process is more structured and the analytical techniques are carefully defined. In other words, we solve many more problems and save much more time”, Plant manager, UPMS).*

Shifting the attention to the social dimension of each employee’s routine throughout the entire factory, the interviews conducted have showed up, as a result of the EGR implementation, a considerable saving of time during the working day, so that it can be otherwise devoted to valuable opportunities to interact with colleagues, regardless the hierarchical level. Those activities, if properly carried on, deeply contribute to improve both the overall quality of the workplace and also the nature of personal ties between employees within each area of the plant.

In addition, as stressed by one interviewed supervisor, it is worth mentioning the intrinsic relevance now associated with the chance to stay in touch with colleagues, constantly support each other, understand their personality traits and behaviors, and intensely cooperate for the same objective. (*“When, thanks to EGR project, I started to have more time available in my day, I realized how my employees were in need of proximity and human contact”*, Supervisor, UPGR). Indeed, assuming supervisor’s perspective, a further important ingredient to allow the preservation of a fruitful and satisfactory relationship, is represented by the possibility of providing workers with a frequent feedback on their performance. In the past, this activity of discussion on job performance was carried out only in case of negative results, and never if results were satisfactory, thus incurring in the natural reduction of individual motivation at work.

During the interviews, the respondents have been asked to ideally deploy a given amount of time, equivalent to a single working day, into the following different typologies of tasks performed in the workplace:

- In field activities and intervention for problems on plant equipment
- Attendance to meetings
- Administrative and bureaucratic task
- Personal direct contact with colleagues

Therefore, as a demonstration of the growing importance assumed by the frequent chances of contact and interrelation with colleagues, the internal composition of the daily timetable for supervisors and coordinators, shows a significant increase in the amount of time dedicated to those activities, as a further consequence of taking part to more concise, timely and effective routine meetings. Indeed, the impact of such relevant time saving is more visible for supervisors and coordinators, while area directors, even demonstrating an higher commitment to personal sphere and direct interaction with colleagues, seem to maintain a very similar trend to the one prior to EGR implementation.

5.4.4 The project impact on Continuous Improvement Staff

As described in the methodology section, the in-depth interviews have been conducted with two members of Continuous Improvement Staff, who have closely followed and coordinated all the sequential stages of EGR implementation in Santo André.

Both conversations were aimed at understanding and depicting the respondents' position on three different dimensions of the analytical investigation:

- The real value of EGR project, in terms of main benefits and advantages stemming from its introduction in Santo André plant
- Problems, objections, irregularities, and difficulties caused by the adoption of this lean based approach and detected on the shop floor
- Dynamics and mechanisms of the project functioning, which did not seize the desired results

Therefore, the respondents stressed the emphasis of EGR experience on three ambitious goals achieved by the project. Firstly, the enhanced commitment and deeper involvement demonstrated by employees into the daily routine. As a matter of fact, after an initial period of difficulty and progressive adaptation to the renewed operational paradigms, employees started acting in accordance with EGR artifacts and principles, thus pursuing high levels of individual empowerment and vivid sense of belonging to the corporate community. In second place, such boosted attitude to effective collaboration among employees, laid the foundations for the creation of a virtuous cycle, based on the genuine sharing of experiences and the true exchange of expertise and knowhow. At the same time, in contrast to the stand-alone proposition typically observed in the traditional factory model, thanks to EGR, the set of countermeasures undertaken to fix a specific problem do not stem anymore from an individual decision, but each employee provides his personal contribution to a shared solution that comes from a collective decision-making process.

Thirdly, as widely noted out during the preceding paragraphs on the results of investigation, EGR managed to allow the firm to rely on a smoother, clearer and efficient information flow, which had a significant impact on the quality and ultimate effectiveness of routine meetings. Hence, given the availability of a wider range of information resources, the crucial stage of

decisional process, namely the routine meeting, definitely offers an opportunity for a constructive and open discussion between skillful employees and concerning on the most relevant agenda items.

Complementing what explained so far, the enhanced clarity and effectiveness in information management entails a higher level of accountability for workers. In fact, each of them ends up being the owner of a small portion of the communication channel, and then depends on the other employees' contribution, in order to achieve a consistent and suitable resolution to a specific problem. (*"Within each area of the factory, most of the workers began to feel part of a group and began acting as playmates"*, Project coordinator).

According to respondents, a further critical paradigm that has presented some initial difficulties to be overcome, was characterized by the abandonment of the traditional pattern of routine meetings. In this sense, it was essential to clarify, during the training session of Pirelli Tyre workforce on EGR contents, the absolute and indisputable equality of decision-making authority among the participants at the meeting. In contrast to that, according to the traditional model, the decision-making process was focused on the highest hierarchical figure taking part the meeting (namely a plant manager), and the dynamics of interaction tended to converge uniquely to that position. (*"Thanks to EGR, we became aware of the fact that the meeting is not manager centered, but all together, in the same way, we contribute to the final result"*, Project coordinator).

Moving forward, as stated by both interviewees, the analytical approach and revolutionary attitude brought by EGR project were so advanced and disrupting to not allow, at present, to identify possible failures in its underlying methodology and ordinary functioning on the shop floor. Without any doubt, having addressed in depth the operational mechanisms of the company and having transferred to employees a new work philosophy, make EGR Project a very strategic tool, through which Pirelli Tyre has made further progress on the route to lean. (*"Without the increased efficiency and drastic reduction of waste, both induced by EGR, we would not have been able to compete successfully in the current market situation"*, Project coordinator).

6. CONCLUSIONS AND FINAL CONSIDERATIONS

Walking back to the research question, it would be worth pointing out that the consultation of corporate documents as much as the conduction of field interviews have undoubtedly contributed to provide comprehensive answers to the questioned issues. In particular, the research project addressed the three sub-dimensions of the investigation purpose:

- **Operational efficiency:** It is proved by economic data (OEE increase)
- **Waste removal:** It is visible through company’s performance (Reduction in scrap rate)
- **Enhanced employees’ involvement:** This aspect can be analyzed through the evidence gathered in field interviews

After that, a SWOT based analysis will be carried out, in order to mainly assess the strengths and weaknesses, and then focus on the accurate observation of the possible threats and the most valuable opportunities for future improvement.

6. 1 The SWOT Analysis applied to EGR Project

In this section, the paper goes through the synthetic investigation of the most relevant dimensions that marked the EGR experience in Santo André plant. In particular, a special emphasis is devoted to the description of both the peculiar weaknesses detected during the project implementation and the opportunities for improvement and future paths of innovation. Once accurately analyzed, the real project weaknesses are broken down into their causal factors as well as the critical dimensions of improvement can be then related to feasible solutions to be applied by Pirelli Tyre on the short-medium run.

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> - Standardization and uniformity in daily routine - Enhanced involvement of employees on the shop floor - Visual management and information 	<ul style="list-style-type: none"> - Exclusion of operators from EGR - Possible interference of corporate entities which are external to EGR

streamlining	
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> - Cellular manufacturing - Inclusion of operators into EGR 	<ul style="list-style-type: none"> - No periodic review of factory areas already mapped and renewed - EGR actions not undertaken and effectively finalized by the firm

6.1.1 Strengths

With regard to the main strengths pursued and brought to Pirelli Tyre by EGR implementation in Santo André, all the great advantages and prominent benefits that have been described and

Table 1- SWOT Analysis on EGR Project

Source: elaborated by the author

section. In fact, routine standardization, visual revisors and coordinators' accountability, l by EGR on Pirelli Tyre shop floor. Indeed, the full commitment to those partners, the constant seek for informative efficiency, and the vivid tension to effectiveness in decision-making, are the very key factors in order to make EGR project sustainable and fruitful in the upcoming future. Hence, those points of strength can be summarized as follows:

- **Standardization and uniformity in daily routine**, through the introduction of structures and patterns which are capable of ensuring the proper and sustained

operation, on daily basis, of the new operational system. Indeed, according to a future perspective, it would be further important to strengthen the faithful and strict adherence to renewed factory paradigms and behavioral norms on the shop floor. All in all, the maintenance and over time preservation of the satisfactory results achieved so far, is a function of the company ability to remain anchored to such cardinal points of everyday life throughout the factory.

- **Enhanced involvement of employees on the shop floor.** Likewise, this second advantage, driven by EGR, tends to be equally strategic for the suitable functioning of the new operational engine, but requires great persistency in pursuing desired targets and strong tension towards the continuous improvement of both the process and output quality. The feeling of true belonging to the working team, the construction and favorable competition logics between different teams to achieve always a common goal, the mutual collaboration and support in hard times, represent all ambitious dimensions, to be attained only through constant commitment and high levels of motivation.

If those two conditions are properly fulfilled, such growing integration of the single employee within the corporate inner dynamics and his deeper identification with a familiar, rather than a mere employer, can both prove to be prominent success factors of the new Pirelli Tyre value proposition in operations.

- **Visual management and information streamlining.** The latter demonstrate to be crucial drivers for the stability and genuine conservation of the overall value created by EGR on the shop floor. The chance of straight relying on a agile and fluid information flow, undertaking agreed problem solutions through timely and effective meetings, is fundamental, together with enhanced levels of efficiency and waste removal, in order to both pursue satisfactory operational results and lay the basis for incremental and continuous improvement throughout the firm.

6.1.2 Weaknesses and threats

With regard to the weaknesses and threats detected into the EGR project implemented in Santo André plant, the infield research shows four aspects that, albeit with different intensity and variable degree of severity, could entail, if not properly assessed and managed, the potential failing of the described model. As a matter of fact, the reason behind the joint collocation and assessment of those two analytical variables lies in the fact that the critical issues, that will be explained later on, do not markedly belong to one of the two categories of weakness or threat, but concurrently embody both the natures. Therefore, the investigation has highlighted the following four dimensions, located in descending level of relevance:

- **Exclusion of operators from EGR.**

As widely pointed out in the section devoted to the description of the project, the hierarchical targets of EGR are represented by plant area managers, area supervisors and area coordinators. Operators, located at the first level of organizational pyramid, are thus outside the scope of the program and assist, at a distance, to a program of operational transformation that should actually involve them completely.

In fact, complementing the theoretical inference and remarkable findings stemming from the notion of Customer Market pyramid, the operator is meant to be the actual protagonist and most decisive actor for the daily proper functioning of the company. Indeed, contrary to what might be thought, the sustained success of a firm depends not only on the quality of the strategies developed, but especially on the correctness and intimate effectiveness of their execution. Hence, in such a way as to ensure a serious and tangible improvement in economic results as well as factory environment, it would be highly recommended, for Pirelli Tyre, to fully involve operators in the EGR forefront. At present, they are actually detached from such innovative atmosphere brought by EGR program, and they manage to neither completely grasp the authentic potential of value created, nor make a real contribution to its full achievement.

- **Lack of revision and control over the factory areas that have already experienced EGR.**

Another important aspect, further confirmed by academic literature, relates to the need, by the company, to monitor, on a regular basis, the progress of ongoing projects.

Nevertheless, as it happens in most cases, it might be believed that, once launched and properly implemented, the single project may not be longer susceptible to error, efficiency or fallacy.

Therefore, it may be essential, for Pirelli Tyre, carrying out those activities, in order to prevent the occurrence of unpleasant and unpredicted events. More specifically, if applied to EGR case, within a plant area already characterized by the touch of the project, it may happen that some low value added activities, without a clear causal matrix, begin to automatically enter the new routine factory, thus resulting in the creation of a new and dangerous inefficiency. Therefore, in the absence of an effective and updated control system, the quality of the operating standards of the factory would be at strong risk.

Moreover, in order to avoid such negative consequences, a practical solution for improvement may consist of carrying out again, after some time, both the mapping of activities relating to the specific area of the plant and the preparation of Brown Paper, so as to highlight any differences and variations eventually occurred.

- **EGR actions not undertaken and effectively finalized by the firm**

Within the general transformation experienced by Pirelli Tyre along the introduction and subsequent implementation of EGR project on the shop floor, it would be worthy of pointing out that the quality of the improvements made by the project passes, also and above all, through an organizational engine that has to be respondent and effective in reacting promptly and quickly, so as to implement and carry out the set of actions required to make the project benefits absolutely real and not merely ideal or potential. Sometimes, in effect, the lack of coordination and timeliness by some staff departments that are external to the specific area actually involved in the project, bring to the activity of implementation a much slower pace than the one required, thus negatively impacting the overall quality of the project outcome.

- **Possible interference of corporate entities which are external to EGR**

This issue is directly connected to the one explained above. As widely stated so far, it is crucial for the firm to support EGR progress at companywide level, by shaping a renewed organizational infrastructure and a functional framework which should jointly ensure the proper accomplishment of all targets of the project.

6.1.3 Opportunities

According to the rest of SWOT analysis conducted up to this section, the paper now concentrates a considerable emphasis on the two following paths that could be taken by Pirelli Tyre on its route towards a lean based manufacturing model.

Cellular manufacturing and inclusion of operators into EGR

At the beginning of this section, it would be important and convenient to claim that the very profound premise to the suggested solutions for EGR improvement, can be identified in the purpose of making the operator more participative and involved in the business dynamics than he is now. Such clear objective thus portrays a valuable opportunity to be exploited, in order to capture all the great value created by the project. At present, all this potential is only partially grasped by the firm, due to the absence of a very important component of factory structure.

Taking as reference the deep theorization of one piece flow and other lean patterns, provided by the significant contributions of Womack and Jones (1996) and Liker (2004), the production cell represents a significant spotlight of Toyota way, thus shaping the perimeter and layout of the factory in such a way as to adapt production flow to customer needs and measures mostly based efficiency maximization and waste removal. In so doing, the cell solution definitely stems from the vivid company orientation to build up a productive chain which would be able to both fulfill final customer expectations and rely on the prominent expertise and skill set owned by each employee. Besides, as further evidenced by the historical series of corporate results, Toyota proves to be an employee centered company (Liker, 2004). Farther, such remarkable performance is surely due, amongst other strategic drivers of this success, to the brilliant reliance on work cells. Of course, owing to the spatial concentration of equipment so as to build up an entire production cycle, each work cell would

cover a smaller perimeter than the dimension of a current factory area, such as UPGR. Hence, there would be the chance to arrange several work cell within a single area of the factory.

Therefore, applying what has been previously stated to Pirelli Tyre case study, it ought to be argued that EGR project, jointly combined with the reassuring results attained in the past through TPM and PMS application, undoubtedly testifies the serious intention of the Italian multinational company to move forward with conviction on this path. Thus, the next step of Pirelli Tyre operational evolution could be certainly represented by the gradual construction, within the factory, of work cells in accordance with both the volume of production and the internal composition of production mix

Besides, ideally simulating the introduction of cellular manufacturing within Santo André plant, it could strongly draw considerable benefits on the following perspectives:

- Much higher involvement and commitment of each worker, in the pursuit of common plant results.
- Enhanced empowerment and higher accountability of each employee across the plant.
- Removal of coordinators, in favor of team leaders, one per work cell.
- Further strengthening of information management, before differentiated by phase of the production cycle, while now focused on the entire process.
- Wider span of control for area supervisors within the factory hierarchy, but considerable benefit in terms of higher specialization on information and process, inside the work cell.
- More direct and agile contact between operator and supervisor within the work cell, thanks to the presence of only one intermediary, the team leader.

All in all, given the positive externalities and considerable benefits that Pirelli Tyre can draw from the implementation of cellular manufacturing throughout its industrial complex, the company could start laying the foundations for applying EGR at work cell level. The achievement of such a target may obviously require a natural period of trial, however, through

precious expertise and the great operational experience so far accumulated, the future path of the company should not be particularly difficult and tortuous.

A further interesting point is represented by the introduction of a new actor on the shop floor: the team leader. Hence, replacing the coordinator, he enters the plant hierarchy and directly reports to supervisor, thus facilitating the communication flow across the two levels and increase the effectiveness of the whole production process. In this way, removing a rung of the ladder, before represented by coordinators, the team leader stays at the same level of operators and acquire a technical level of control, while supervisors tend to maintain a hierarchical level of control over them. Indeed, it would be convenient to briefly describe tasks of the two actors inside the plant:

The supervisor is the head of operators, exercises leadership and is responsible for people management. He also carries out follows-up and supports improvement projects together with the assistance of team leaders. On the other hand, the team leader stays at the same level of operators, cover absences, alternates if necessary, enables the mutual cooperation along the production chain, and is responsible for the training in operations.

6.2 Theoretical implications

The paper, in its first section, was oriented to assess the main characteristics, features and patterns that characterized the lean manufacturing approach followed by Toyota, and then focused on the analytical investigation about a specific case study, EGR project, implemented by Pirelli Tyre in Santo André plant. The central purpose thus consisted of deeply evaluating the underlying steps of EGR introduction within the Brazilian plant and tested its actual effectiveness both on the results reported by operational indicators and employees' involvement and interaction inside the workplace. In the final section, the paper went through the description of investigation results, underlined weaknesses and portrayed potential paths for future improvements. All the theoretical background proved to be very useful and crucial for the research structuring and the final evaluation of the collected results.

Therefore, it would be convenient to assess, more in detail, the constructive comparison between the theoretical framework described in the literature review section and the actual

impact of the lean-based EGR Project at Pirelli Tyre Brazil. At the same time, the thesis aims to verify whether the Italian multinational firm actually complies with Toyota operational practices and tools that have been largely described, so to point out prescriptive recommendations in case of potential gaps existing between the initial theorization and the practical implementation.

With regard to standardization, visual management and waste reduction, accurately analyzed by Liker (2004), Womack (1996) and Jones (2006), significant results have been attained in Santo André plant thanks to EGR implementation. Before the EGR launch, each area of the plant had a standalone, or sometimes inexistent, set of norms in terms of tool boards, careful articulation of performance indicators and organization of routine meetings. In addition, it would be essential to remind that EGR project has been recently launched inside Pirelli Tyre industrial complex, thus it would need a wider time horizon so to put in evidence the vivid benefits brought to the plants. At the moment, EGR has been applied on a daily basis only in Santo André plant, whereas it may be gradually introduced into Campinas, Sumaré and other Brazilian factories only in 2013.

For the same reason, it would be still premature to consider further issues such as the quality of knowledge transfer process carried out with EGR, as much as the behavioral patterns adopted by managers during the project implementation (Camuffo, Paolino, Secchi, 2012) and the roll-out procedures between distinct factories of the same firm.

All in all, the strategic and fundamental value of people (Liker, 2004) for the ultimate success of EGR project appears to be clearly tangible, especially through the considerable explanatory evidence gathered by conducting field interviews. In fact, without committed, motivated and skillful employees, lean is less likely to be the key driver for lasting success and steadily growing results in the industry (Liker, 2004; Womack, 1996).

6.3 Managerial implications

The paper was oriented to describe the core elements of Toyota Lean Way, and then examined its success factors as well as underlying components. After that, the analysis was centered on EGR Project, with the intimate attempt to detect the strengths, the weaknesses and the threats of its implementation experience in the Brazilian plant of Santo André.

Therefore, relying on specific investigation techniques and useful technical tools, a further analysis was conducted to test the actual effectiveness of lean manufacturing and its impact on the operational performance and employees' attitude of Pirelli Tyre.

6.4 Limitations

Concerning the limitations of the paper, it is worth stating that, although the research provided satisfactory results, valuable feedbacks and constructive recommendations, the gathered evidence was formulated on the basis of a single case study, namely the implementation of EGR Project by Pirelli Tyre Brazil in the plant of Santo André, and thus depicts a specific business experience based on a single analytical perspective, whose findings may be confirmed or confuted by broader range investigations.

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APPENDIX I : Interview protocol for individual focused interviews with area managers, supervisors and coordinators

Vincenzo Prudentino

11th November 2012

Interview Protocol

Managers, supervisors and coordinators (UPMS & UPGR, Santo André plant)

1. What were your first impressions when EGR was launched in your area?
2. When you started taking part EGR, what were your perceptions/expectations on the possible results of the project? Positive or negative?
3. Did some initial problems arise during the project implementation?

4. What were the main benefits of EGR? (In the personal sphere, at the workplace, in the relationship with colleagues, superiors and subordinates) Please choose one in particular and give me an explanation underlying such choice.
5. Has EGR changed your everyday approach to work? If so, in what way?
6. Did EGR help you identifying problems and inefficiencies of which you did not have previous perception? Did EGR fix them?
7. Assumed your daily working time to be 100, how did you organize it, Before and After EGR, in the following activities:
 - Attendance to meetings
 - Resolution of unexpected problems on plant equipment
 - Administrative and bureaucratic tasks
 - Personal contact with colleagues
8. In your opinion, what did EGR make it wrong?
9. What could be improved in the upcoming future ?
10. In one sentence, what is EGR for you?

Thanks a lot for your help

APPENDIX II: Pictures from EGR Project in Santo André plant

The Meeting Room



APPENDIX III: Pictures from EGR Project in Santo André plant

Cross functional team members during various steps of project implementation

