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Free-Pass Model to Manage Quality Relationships With Suppliers: An Italian Case Study

Federica Murmura, Laura Bravi
University of Urbino, Urbino, Italy

In order to be competitive in today's challenging business environment, manufacturing companies must have the ability to effectively integrate internal functions within a company and effectively link them to the external operations of suppliers and supply chain members. This could be done thanks to the implementation of an effective Supply Chain Management System. The aim of the research is to contribute to the literature panorama on Lean Supply Chain Management through the analysis of a case study of Alpha, Italian company in the arm industry, which has developed a new model called "Free-Pass", and to give a useful, realistic tool, expendable by companies that want to open up to Lean Supply Chain. A qualitative approach has been chosen, based on a longitudinal, single case study; a semi-structured interview has been carried out per year, with the company's Quality Manager from 2009, the year in which the "Free-Pass" model has been implemented, until 2016. Relevant secondary data were also used such as company reports, web site, and performance quantitative data. The implementation of the Free-Pass model across the company leads to a great change, both in terms of the transformation of the production process in a process flow "pulled", both at the organizational level, with the reduction of hierarchical levels, the process orientation, cross-functional teams, the streamlining of functions, and above all, the involvement of suppliers. This implied a radical change in thinking from management and from all the staff and a true "cultural revolution" for the company itself and for its suppliers, but it bought to both financial and organizational benefits. In conclusion the research has shown the importance of implementing quality relationships with suppliers based on trust and cooperation in order to achieve mutual benefits. The value of the research is given by the definition of a new model of Lean Supply Chain as an important tool of operation management which is expendable by companies.

Keywords: Lean Supply Chain, Lean Thinking, Lean Production, Free-Pass, quality management, suppliers' management

Introduction

To successfully compete in today's challenging business environment, manufacturing companies ought to be able to effectively integrate internal functions within a company and effectively link them to the external operations of suppliers and supply chain members (Agus & Hajinoor, 2012).

The core of Supply Chain Management (SCM) is Lean Production, which is defined as a set of tools and methodologies that aims for the continuous elimination of all waste in the production process. Main benefits are

Federica Murmura, professor, Department of Economics, Society, Politics, University of Urbino, Urbino, Italy.
Laura Bravi, Ph.D. student, Department of Economics, Society, Politics, University of Urbino, Urbino, Italy.
Correspondence concerning this article should be addressed to Federica Murmura, Department of Economics, Society, Politics, University of Urbino, Carlo Bo, Via A. Saffi 42, Urbino 61029, Italy.

lower production costs, increased output, and shorter production lead times (Agus & Hajinoor, 2012; Fuentes, Sacrista´n-Dı´az, & Martı´nez-Jurado, 2012; Wahaba, Mukhtara, & Sulaiman, 2013). Lean Production focuses on continuously improving the processes, a philosophy of eliminating all non-value adding activities and reducing waste within an organization (Alabama Technology Network, 1998; Inman, 1999; Davis & Heineke, 2005; C. Hofer, Eroglu, & A. R. Hofer, 2012).

The first attempts at reducing waste in production were introduced by Toyota under the names “Toyota Production System” (TPS) or “Just-In-Time” (JIT) manufacturing in the 1960s (Bruun & Mefford, 2004; Reichhart & Holweg, 2007; Taj, 2008). JIT manufacturing aims to eliminate waste and to improve their productions by using a continuous improvement approach, including, maintaining the only required inventory and reducing setup times to decrease lead times, queue lengths, and lot sizes to reach minimum cost. This process, defined as Lean Production (LP), enables the integration of various tools in the production system and supply chain and focuses on waste elimination to reduce costs, improve quality, and decrease lead time, inventory, and equipment downtime. Numerous enterprises have applied LP to improve their productivity and competitiveness over the past decades (Chen, Cheng, & Huang, 2013).

Shah and Ward (2007) defined LP as an integrated socio-technical system, in which the main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer, and internal variability. However according to Holweg (2007), it is not enough to focus on manufacturing operations to achieve these objectives; LP must be extended to product development and aspects of distribution and SCM. Companies that want to move forward in adopting LP must, therefore, manage variable supply, processing times and demand (Hopp & Spearman, 2004; de Treville & Antonakis, 2006), and also manage relationships in the value chain (Shah & Ward, 2007; Fuentes et al., 2012).

The progressive increase of relationships between companies and within supply chains has led to the development of the concept of Lean Supply Chain (LSC): it is no longer possible to think that a company is lean only in terms of production, but it must also be lean across its supply chain, starting from the organization of logistics, understood as a flow of materials and information.

LSC is defined as a system that enables costs to be reduced, flexibility to be increased, and substantial improvements in products to be made (Vonderembse, Uppal, Huang, & Dismukes, 2006). Moreover, the declination of Lean principles within the complex relationships of a network is of particular importance, especially since the adoption of models oriented to the value stream in this area is not generated, as in a single organization by an act of will of the internal decision-makers, but it needs to find a point of convergence in the analysis of convenience of all elements of the network involved from time to time.

However, there is still little empirical research on the subject. While Jayaram, Vickery, and Droge (2008) find that a lean strategy should be preceded by the forging of relationships with the main supply chain partners, Simpson and Power (2005) state that the results obtained with LP depend on the extent to which knowledge is shared in supplier-customer relationships. For this reason, the aim of this research is to widen the literature panorama on Lean Supply Chain considering a case study of an Italian firm called Alpha, a company that works in the arms industry in Italy, which has implemented an LSC system called Free-Pass with its network of supplier, in order to evaluate the strengths and weaknesses of this method.

After the introduction section the paper was structured as follows: firstly a literature review paragraph has been provided; this was followed by the presentation of the research methods and of the results of the case study. Subsequently the results have been analyzed and the conclusions have been drawn.

Literature Review

As competition in the 1990s intensified and markets became global, so did the challenges associated with getting a product and service to the right place at the right time, at the lowest cost. Organizations began to realize that it is not enough to improve efficiencies within an organization, but their whole supply chain has to be made competitive. It has been pointed out that understanding and practicing SCM has become an essential prerequisite to stay in the competitive global race and to grow profitably (Power, Sohal, & Rahman, 2001; Moberg, Cutler, Gross, & Speh, 2002). SCM has been defined to explicitly recognize the strategic nature of coordination between trading partners and to explain its dual purpose: to improve the performance of an individual organization, and to improve the performance of the entire supply chain. The goal of SCM is to create sourcing, making, and delivery processes, and logistics functions seamlessly across the supply chain as an effective competitive weapon (Li, Rao, T. S. Ragu-Nathan, & B. Ragu-Nathan, 2005).

The emphasis of SCM has changed in the past two decades: approaches to SCM are much more systematic, focusing on relationships involved; market competition is no longer based on a company versus company model, but instead is a supply chain versus supply chain, and in order to see success, companies need to achieve integration that is external to the company, with customers and suppliers (Stuart, 1997; Dossenbach, 1999; O'Marah, 2001; Frohlich & Westbrook; 2001; Bruce, Daly, & Towers, 2004; Agus & Hajinoor, 2012). A key feature of present day business is the idea that it is supply chains that compete, not companies, and the success or failure of supply chains is ultimately determined in the marketplace by the end consumer. Getting the right product, at the right time to the consumer is not only the linchpin to competitive success, but also the key to survival (Agarwal, Shankara, & Tiwari, 2006).

Building partnerships with suppliers is considered to be a means by which to achieve the best performance within the supply chain and that co-operation and collaboration in the SC are crucial to the success of the company (Wong, 1999; Bruce et al., 2004; de Treville & Antonakis, 2006; Shah & Ward, 2007; Agus & Hajinoor, 2012).

Womack and Jones (1996) developed the idea of a *lean enterprise* concept as a group of individuals, functions and legally separate but operationally synchronized companies.

Variours authors studying lean have sought a common understanding of the term (de Treville & Antonakis, 2006; Hines, Holweg, & Rich, 2004; Hopp & Spearman, 2004; Paez, Dewees, Genaidy, Tuncel, Karwowski, & Zurada, 2004; Shah & Ward, 2003; 2007; Hasle, Bojesen, Jensen, & Bramming, 2012). It is often suggested that lean should be understood on two levels: the strategic level of how to understand value; and the operational level (tools) of how to eliminate waste (Hines et al., 2004).

This is in accordance with the discussion of lean as a philosophy and a set of operational tools (Shah & Ward, 2007). Shah and Ward (2007) reviewed the literature on lean definitions and concluded their review with a simple definition that summarizes some of the most important characteristics of work systems that can be described as lean. As told before they define lean as: "an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer, and internal variability" (Shah & Ward, 2007, p. 791). The two authors follow up the theoretical definition with a survey of lean practices applied in manufacturing industry, and they end up identifying 10 key practices: supplier feedback, JIT delivery, developing suppliers, involved customers, pull, flow, set-up time, controlled processes, and involved employees. However, as pointed out in the lean literature, treating lean primarily as the reduction

or elimination of waste is but one side of the coin. The other side is that lean is also a framework for enhancing efficiency and thus maximizing improvements.

Therefore, the focus of lean supply management is the elimination of all waste, including time, to enable a level schedule that is established (Agarwal et al., 2006), since it is a tool to compete successfully in today's challenging business environment, integrating internal functions within a company and effectively linking them to the external operations of suppliers and supply chain members. Synergies with suppliers in the production flow management and product design, and development can allow the company to significantly improve its time, cost, and quality performance, since the percentage of purchases on the product cost has reached very significant values.

However, often, the implementation of lean principles within their own production company also brings out and highlights the shortcomings and weaknesses in the supply chain, and the performance of its suppliers, with the consequent difficulties in achieving the quality improvement objectives, service levels, costs, and thus reducing competitiveness of the market and the end customer demand. This research's aim is to enrich the literature panorama on LSC through the analysis of a case study and the subsequent description of "Free-Pass", an LSC model adopted by the Italian company Alpha. The study wanted to continue and develop the research lines started in the last decade by Bonavia and Marin (2006), Agus and Hajinoor (2012), and Hofer et al., (2012), explaining the negative and positive effects that the model has brought to the company organizational system and giving a useful, realistic tool expendable by companies which want to open up to Lean Supply Chain.

Therefore the research questions are:

RQ1: does an LSC management system permit to save time and internal and external costs in the management of relationships with suppliers?

RQ2: is the adoption of an LSC management system effective in order to improve the quality of the relationships with its suppliers?

RQ3: does the company need to change its culture in order to implement an LSC system?

Research Methods

As the research was exploratory in that it addressed a sector, the arms industry, where little research into SCM had been undertaken previously, a qualitative approach was chosen, based on a longitudinal single case study, which allows for examining in depth changes in company behaviour, internal processes, and relevant actors and variables (Halinen & Törnroos, 2005; Medlin, 2004), to map out a particular supply chain and to gain insight into the pattern of SCM that was in evidence. To construct the case, a semi-structured interview per year has been carried out with the company's Quality Manager, from 2009, the year in which the "Free-Pass" model has been implemented, until 2016. These interviews have allowed analysis of the evolution and changes in SCM of Alpha over the years, identifying the points of strength and weakness of the Free-Pass method implemented.

Relevant secondary data were also used, such as company reports, web site, and quantitative data obtained during the performance analysis carried out by the company during the years in order to evaluate the performance of the "Free-Pass" implemented model. The secondary data provided background and context to the primary research data gathered from the interviews.

Results

Supply Chain Management: Alpha Case Study

Company profile. Alpha was founded as a joint stock company, in 1967 in Italy, owing to the initiative of two brothers, owners of another famous company, Beta, which produced motorcycles. In a few years Alpha has evolved from a small company into one of the most important industrial centers of Italy, with currently 300 employees, winning the leadership in Europe and worldwide.

Since 1983, Alpha is part of Gamma Holding, which produces firearms, and is specialized in the production of semiautomatic shotguns for sport use and defence. The entrepreneurial efforts focused mainly on strengthening of the research, design, and testing, equipping Alpha with new resources, means, and facilities for the productive sector and innovative software systems for production, management, and control.

Alpha makes huge investments in design and provides innovative products where technology, prestige, and design blend to suit every need. The diversification of its offer has represented the tool to consolidate and expand its position in the market: in fact, Alpha operates not only in Italy but in 78 countries, with 32 locations in Europe, two in North America, nine in South America, 20 in Asia, seven in Africa, and three in Oceania, with more than two million shotguns produced in 40 years, and the possesses of 20% of the global market share in the sector of semiautomatic shotguns.

The company exports its brand and its products all over the world thanks to an efficient and targeted choice of expanding its distribution and organizational network and setting out, and additionally, great attention to the creation of a highly qualified staff, able to work with professionalism, prepared to meet the needs of customers and to allow a development of products and services in order to place the company to a high level in the sports arms and defence market.

The manufacturing facility is equipped with the most advanced machinery to ensure maximum mechanical precision with almost total automation; the creation of each product is developed by technical area engineers using sophisticated technology such as Computer Aided Design (CAD), Computer Aided Engineering (CAE) and other advanced software which precisely determine the structural calculations and simulate any mechanical process with absolute reliability.

The company also pays attention to the communications channels through the website, for direct and interactive contact between consumer and enterprise but also between company and supplier, cycles of workshops, sporting events, meetings with students, and collaboration with universities. Another key strength for Alpha that completes the important business strategy, is represented by the suppliers of modular parts, which over the years has grown around the company.

The company mission is represented by the design and production of mainly semiautomatic shotguns, which distinguish themselves on the market from the other competitors for their advanced technology, exquisite style, and unparalleled reliability. In a perspective of Total Quality Management and continuous improvement, Alpha involves its human resources every day in training courses that not only sharpen the purely technical skills of operators but also improve internal and external relational systems.

The Production Department operates and plans all the processing steps, through activities carried out with the help of advanced machinery, which ensure tight tolerances in complete automation. All processes are carried out under the careful vision of the Quality Assurance function, which operates so that the functions and

activities correspond to the company's quality system according to ISO 9001 and NATO AQAP 2110, that is a management system for suppliers to the arms industry.

A further recognition of the company's organizational and operational capacities is confirmed by the possession of the Environmental Management Standard ISO 14001 and the Management of Health and Safety Standard OHSAS 18001, which further strengthen the quality of Alpha products.

The quality of products made in Italy represents for the company, a key value to search; Alpha in fact can claim the fact of entirely producing its products in Italy, thanks to a 99.99% Italian chain that is certified with his "product traceability". Figure 1 shows the origin of Alpha suppliers.

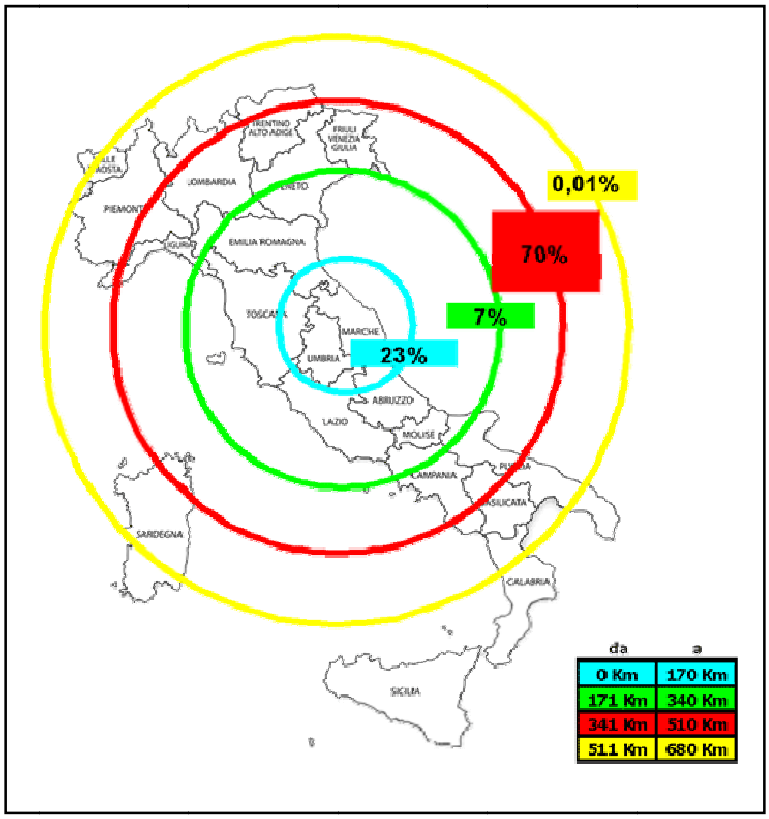


Figure 1. Alpha and made in Italy.

Alpha relationships with suppliers. The contribution of suppliers, both in terms of operations, innovation, and business support, requires the management of complex structures, designed and coordinated by the procurement function, and represents an important critical success factor for the company.

The cost of making a product mostly depends on the components that are provided by external actors; for this reason, Alpha computerized the relationships with suppliers with the aim to create a real synergetic network, enabling them to enhance the exchange of information resources and to optimize the integration of the various links in the supply chain.

Alpha implemented tools to improve the integrated relation between customer and supplier to increase the logistics and accuracy of information in order to reduce costs.

In companies, the focus is on the processes and, therefore, excellence in business can only go through the government of excellent processes. In this sense, the role of the supply chain, specific of the

purchasing department, becomes increasingly important in order to ensure the level of service, the flexibility and reliability required by the market and the efficiency and the continuous improvement necessary for the development.

To remain competitive and to adapt the organization to the growing production volumes, in 2007 Alpha has revised its organizational model, which is now outdated, and instead, adopted an approach that aims to consolidate an LSC, based on the strategic role of production, logistics, and purchasing.

Possible competitive factors for improvement at time of the intervention were the integration capabilities of suppliers in order to anticipate customer needs and the speed development of the products. The problem of the choice of supplier is of primary importance within the company because it affects the total costs, the level of service, as well as the quality of the product itself. To this end, Alpha makes use of a very strict supplier selection process based on audit in accordance with the relevant ISO standards.

The most interesting solutions that can meet the demand for innovation and competitiveness should not be sought only within the organization but, should be sought outside of it, above all, by creating a network of synergistic and capable actors. The goal, then, of this renewal to support the corporate strategy is the implementation of an improvement program to transform Alpha in a lean organization and, in particular, to integrate into the value chain Alpha suppliers in an LSC model. The resource procurement strategy, aims at developing long-term partnerships with suppliers that are beneficial to both parties and are able to offer the best answer to the company's activities in terms of cost, quality, and services.

The projects are based on the same common denominator: the confidence in the supplier's ability to dominate in autonomy, the level of service, and quality of its supplies, thanks to a structured way of working with Alpha.

Suppliers represent a natural extension of the internal activities and it is important to obtain a transparent and efficient collaboration with them, such as to bring competitive advantages to all stakeholders: customers, investors, and suppliers themselves are an aspect not to be overlooked.

In order to establish an open communication process with its suppliers, Alpha has created an online portal; the portal aims to improve and intensify the collaboration with business partners and provide them with all the information needed to be Alpha supplier. This portal also represents a point of contact between Alpha and its suppliers, a place where you can listen to and compare ideas, developing new proposals, promoting innovative solutions, and increasing customer success and competitiveness in the long term.

In particular, every year, the purchasing department of Alpha organizes meetings with its suppliers giving ample space to the growth and integration of the entire network.

In the site, there are also various initiatives, that are always new and interesting, such as the Suppliers Recruitment, a 2012 project aimed at looking for new partnership opportunities, new suppliers, and the consolidation of existing supply relationships.

Lean supply chain management: the Free-Pass model. In 2007 in order to remain competitive and adapt the organization to the growing production volumes, Alpha started to implement the lean supply approach. This was developed with its suppliers, from 2007 to 2010, defining five projects, that is, Purchase orders, Self service, Prebolla, Traceability, and Free pass.

The opening towards their suppliers with integrated activation of these five projects, was born from the desire to strive for excellence by leveraging the ability of suppliers to dominate in absolute autonomy the level of service and quality of its supplies, due to a structured way of working with Alpha.

This important link which Alpha has established with suppliers is also possibly due to the direct access to the supplier's portal in Alpha's web site.

The proper implementation of the various activities is fundamental for Alpha and it is at the base of the retention of the status of "Supplier of Excellence".

Thanks to Purchase orders, suppliers have full visibility of their order backlog. With the Self Service function, always through the web portal, suppliers have continuous visibility of Alpha's needs and can then create the order, in full autonomy, with a consequent drastic reduction of the waiting time between the rising demand and the arrival of the information suppliers. This feature allows an effective involvement between customer and supplier, highlighting the importance of communication between the parties.

With Prebolla, the supplier can instead communicate with advance delivery note content to Alpha, while Traceability creates a link between the internal traceability system of suppliers and Alpha system; all made possible due to the trust in the partner and to integrating projects.

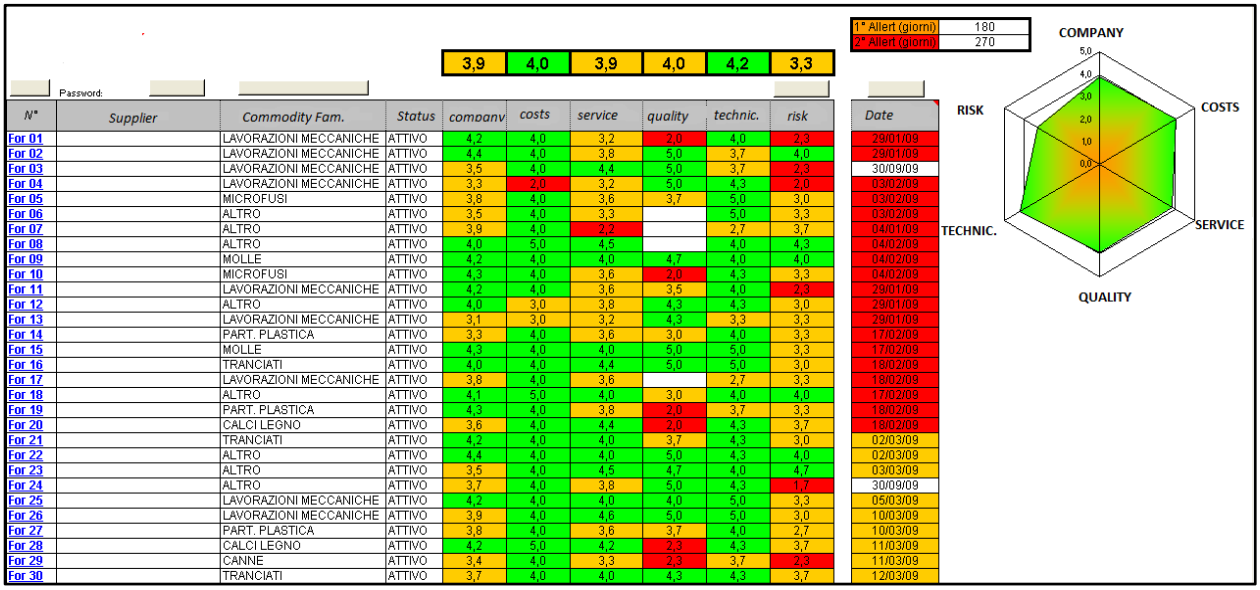
Finally, the Free-Pass model was born in 2009 from the desire to create a trust client-provider relationship by eliminating the controls in acceptance.

There are different types of quality checks in the supply relationships, largely attributable to two main categories: traditional controls in acceptance (i.e. on delivery), and quality assurance. A supplier is certified when its Quality Management System, and its products are considered to meet the buyer's requirements, so that it does not require any type of routine inspection and acceptance (Free-Pass). With the self-certification, supplier unilaterally declares the conformity of the product in accordance with for example the sample product initially approved by the purchaser or a quality certification body. The value of self-certification depends, obviously, on the credibility of the quality promise made by the provider, and then, ultimately, by its reputation. Schematically, one can identify three main levels of supplier involvement in quality control activities. At the first level supplier, it is only liable for compliance with technical specifications laid down by contract and verified through entry checks at the buyer's attention. At the second level, there is a responsibility of the supplier for the quality levels of the product, which comes in Free-Pass to the buyer, that is without checks in acceptance; the supplier is also involved in continuous improvement programs. For the third and final level, the supplier, in addition to involvement in continuous improvement objectives, assumes the burden of the co-design of quality specifications and co-responsibility on the end-customer satisfaction. Supplier personally ensures the quality of production output from the production system, reaching even to systematically monitor the efficiency of its processes. According to Roveda (2006) the Free-Pass model is therefore the acceptance of the product without controls and with possible corrective actions directly made to the buyer's production line for synergistic partnership to customer satisfaction.

The main strategic levers behind a Free-Pass project are the following: the reduction in total cost of purchase, that is, reduction of non-quality costs and of the costs of the supply conditions; reliability and reduction in lead times and thus a reduction of the average stock level with greater production flexibility and responsiveness of the client company; performance improvement of suppliers and process innovation, due to greater collaboration between the client company and the supplier in sharing timed needs of materials (direct supervision of Audit) and greater accountability of the supplier on stocks. In detail, the objectives that led Alpha to implement the free-pass were as follows: a robust method of work that allows it to commit no errors in relation to customer as for quality and service; increased competitiveness on the market for Alpha and its

suppliers; the maintenance of high quality standards claimed by the customer, combined with the reduction of costs due to waste reduction.

The Free-Pass allows direct access to the materials' production lines without quality controls at the entrance. It represents a significant recognition from Alpha of the quality of the products produced by its suppliers. For each supplier, the monitored parameters are the company itself, costs, quality, service, specifications, and risk. Figure 2 shows how these parameters are monitored.



				3,9	4,0	3,9	4,0	4,2	3,3		1° Allert (giorni)	180
	Password:										2° Allert (giorni)	270
N°	Supplier	Commodity Fam.	Status	company	costs	service	quality	technic.	risk	Date		
For 01		LAVORAZIONI MECCANICHE	ATTIVO	4,2	4,0	3,2	2,0	4,0	2,3	29/01/09		
For 02		LAVORAZIONI MECCANICHE	ATTIVO	4,4	4,0	3,8	5,0	3,7	4,0	29/01/09		
For 03		LAVORAZIONI MECCANICHE	ATTIVO	3,5	4,0	4,4	5,0	3,7	2,3	30/09/09		
For 04		LAVORAZIONI MECCANICHE	ATTIVO	3,3	2,0	3,2	5,0	4,3	2,0	03/02/09		
For 05		MICROFUSI	ATTIVO	3,8	4,0	3,6	3,7	5,0	3,0	03/02/09		
For 06		ALTRO	ATTIVO	3,5	4,0	3,3		5,0	3,3	03/02/09		
For 07		ALTRO	ATTIVO	3,9	4,0	2,2		2,7	3,7	04/01/09		
For 08		ALTRO	ATTIVO	4,0	5,0	4,5		4,0	4,3	04/02/09		
For 09		MOLLE	ATTIVO	4,2	4,0	4,0	4,7	4,0	4,0	04/02/09		
For 10		MICROFUSI	ATTIVO	4,3	4,0	3,6	2,0	4,3	3,3	04/02/09		
For 11		LAVORAZIONI MECCANICHE	ATTIVO	4,2	4,0	3,6	3,5	4,0	2,3	29/01/09		
For 12		ALTRO	ATTIVO	4,0	3,0	3,8	4,3	4,3	3,0	29/01/09		
For 13		LAVORAZIONI MECCANICHE	ATTIVO	3,1	3,0	3,2	4,3	3,3	3,3	29/01/09		
For 14		PART. PLASTICA	ATTIVO	3,3	4,0	3,6	3,0	4,0	3,3	17/02/09		
For 15		MOLLE	ATTIVO	4,3	4,0	4,0	5,0	5,0	3,3	17/02/09		
For 16		TRANCIATI	ATTIVO	4,0	4,0	4,4	5,0	5,0	3,0	18/02/09		
For 17		LAVORAZIONI MECCANICHE	ATTIVO	3,8	4,0	3,6		2,7	3,3	18/02/09		
For 18		ALTRO	ATTIVO	4,1	5,0	4,0	3,0	4,0	4,0	17/02/09		
For 19		PART. PLASTICA	ATTIVO	4,3	4,0	3,8	2,0	3,7	3,3	18/02/09		
For 20		CALCI LEGNO	ATTIVO	3,6	4,0	4,4	2,0	4,3	3,7	18/02/09		
For 21		TRANCIATI	ATTIVO	4,2	4,0	4,0	3,7	4,3	3,0	02/03/09		
For 22		ALTRO	ATTIVO	4,4	4,0	4,0	5,0	4,3	4,0	02/03/09		
For 23		ALTRO	ATTIVO	3,5	4,0	4,5	4,7	4,0	4,7	03/03/09		
For 24		ALTRO	ATTIVO	3,7	4,0	3,8	5,0	4,3	1,7	30/09/09		
For 25		LAVORAZIONI MECCANICHE	ATTIVO	4,2	4,0	4,0	4,0	5,0	3,3	05/03/09		
For 26		LAVORAZIONI MECCANICHE	ATTIVO	3,9	4,0	4,6	5,0	5,0	3,0	10/03/09		
For 27		PART. PLASTICA	ATTIVO	3,8	4,0	3,6	3,7	4,0	2,7	10/03/09		
For 28		CALCI LEGNO	ATTIVO	4,2	5,0	4,2	2,3	4,3	3,7	11/03/09		
For 29		CANNE	ATTIVO	3,4	4,0	3,3	2,3	3,7	2,3	11/03/09		
For 30		TRANCIATI	ATTIVO	3,7	4,0	4,0	4,3	4,3	3,7	12/03/09		

Figure 2. Dashboard for the control of Alpha suppliers.

The Free-Pass is awarded for each single article after a joint evaluation of the Purchasing and Quality Area; the procedure for the release of the Free Pass-qualification is not automatically linked to generic statistical factors, but to a more detailed analysis on the organizational/structural characteristics of the supplier, the historical waste trend, the intrinsic features of the product, and its problems with the end user.

In detail, for a positive Free-Pass assessment, six key points had to be respected:

1. Supply Quality Index (SQI) lower than 0.6% for two consecutive years;
2. The 80% of codes provided in the year without Non-Compliance Reports (NCR);
3. The compilation of the Production Part Approval Process (PPAP) file for each product code;
4. Audit by the Alpha quality department;
5. The sending of the "Control Plan" for every delivery;
6. Two consecutive months against verified supplies by Alpha.

The SQI index can be calculated with the formula:

$$SQI = 1 - a \times \frac{\text{n. of non-conforming lots}}{\text{n. of checked lots}} + b \times \frac{\text{n. of non-conforming products}}{\text{n. of checked products}}$$

where a and b are coefficients whose sum is equal to one.

Over time these ratios should vary since, initially, if the supplier's evaluation is based on the results of the two questionnaires completed, after a certain period of acceptance, inspections that recorded the SQI factor should become predominant. The SQI index can be calculated on the basis of a defined reference period (one month, three months, six months...) and subsequently updated.

Furthermore the operational working tool to use and share with Alpha is Production Part Approval Process (PPAP) file; that is a process by which suppliers are obtaining from the customer, in this case Alpha, the approval of the supplied components and of their production processes. The PPAP file, adopted by Alpha, was developed initially in the automotive industry production chain to ensure the approval of the components and their production processes and suppliers, setting the goal of determining if all customer engineering design record and specification requirements are properly understood by the organization and that the process has the potential to produce product consistently, meeting these requirements during an actual production run at the quoted production rate. This process has been created and adopted by the three largest American automotive industries: Chrysler, Ford, and General Motors. The first version of this process was published in February 1993; it is within the context of the QS 9000 standard. QS 9000 is a quality standard developed by a joint effort of these three major car manufacturers, introduced in industry in 1994. On December 14th, 2006, all QS 9000 standards have been declared obsolete. The QS 9000 is not more valid, but is considered to overcome from ISO/TS 16949. This PPAP file was divided in 19 sections and the output of this activity is given by a set of documents, with a form certifying the whole, called Part Submission Warrant (PSW), that the supplier must deliver to the customer's plant together with the sampling of the product (UNI ISO 2859-10:2007).

Starting from this point, the purpose of the PPAP file developed in Alpha is to determine if all the design and product requirements are observed and if the production process of the supplier is able to maintain these requirements in a series production in terms of:

- aesthetic acceptability criteria;
- process capability (Cp, Cpk);
- methods and control tools.

The suppliers have to share with Alpha all the information necessary to ensure the quality of products.

In the PPAP file, which consists of 10 sections, the compilation is performed by the supplier and is submitted to the Alpha quality department in the following cases:

(1) new products;

(2) series of products (80% for Free-Pass);

(3) significant changes in the product or process (design changes, new production technologies).

The Free-Pass and the relative PPAP files compilation is undoubtedly an important tool for Alpha and its suppliers as it allows:

- the mapping of processes;
- the adaptation of projects to the production reality;
- the minimization of non-compliance.

The Free-Pass is notified to the supplier via a written notice made jointly the purchasing and quality departments, and the supplier must provide to put on all packages the "Free-Pass supply tag".

These requirements that were previously regarded as explicit only for excellence suppliers, and today that the Free-Pass project finished, are implicit for all Alpha suppliers. Since 10 September 2012, the lack of information and incompleteness of requested information is considered as non-compliance, with the acceptance in derogation of the provision, and therefore, with influence on the calculation of the SQI. This is also valid for samples of new products.

Analysis of the Results

Introducing lean thinking in the company is a courageous choice that requires the change of culture and attitudes; the customer will see the result of lean principles only if the culture of lean thinking will cross the entire supply chain, creating a Lean Supply Chain.

The five projects implemented jointly by Alpha and its suppliers have produced and continued to produce significant results hitting the targets expected in terms of:

- reduction of lead-time delivery thanks to the reduction of items checked, the waiting time for Alpha check acceptance, and the returns to the supplier (which doubled the lead-time);
- reduction of non-quality costs incurred by providers, eliminating internal repairs and production line stops in the company or from suppliers;
- cultural growth of the companies involved; doing training in statistical process control techniques, and sharing with the supplier of the quality standards expected by Alpha (PPAP).

As seen in Table 1 and Figure 3, in the first three years when the five projects have been set up, the number of defective parts delivered to Alpha from its suppliers has decreased significantly from 9% in 2007 to 90% in 2010 with a drastic reduction in costs of 85% and with percentages of defects reaching values less than 0.6%.

Table 1

Alpha Reduction of Costs and Defects of Materials (Period 2006-2010)

Year	Defective parts (N)	Defective parts (%)	Reduction of defective parts (%)	Non-quality costs	Quality costs	Total quality/non quality costs	Reduction of costs (%)
2006	488,198	2.83	0	€280,836	€240,000	€520,836	0
2007	534,329	2.36	-9	€137,006	€200,000	€337,006	-35
2008	346,378	1.50	-35	€64,089	€160,000	€224,089	-67
2009	131,148	0.90	-75	€83,671	€120,000	€203,671	-75
2010	58,678	0.42	-90	€42,534	€80,000	€122,534	-85

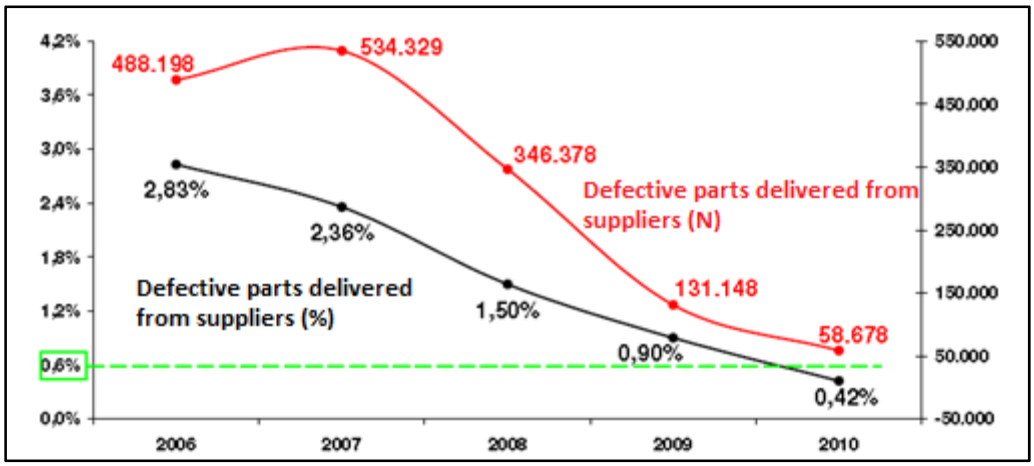


Figure 3. Alpha reduction of costs and defects of materials (period 2006-2010).

In addition, the Free-Pass model turns out to be dynamic and evolves over time with the introduction of new products or the exclusion of codes found to be non-compliant. For this reason, in order to maintain the status of “Supplier of Excellence” the suppliers have to prove that it has at least 80% of the codes with PPAP

file approved. From 2009 to 2016 there has been a radical conversion of Alpha supplies; in detail, it has gone from 24% of total supplies in Free-Pass, to 83% of them (Figure 4) and only in the years 2009-2010, 761 PPAP files were approved.

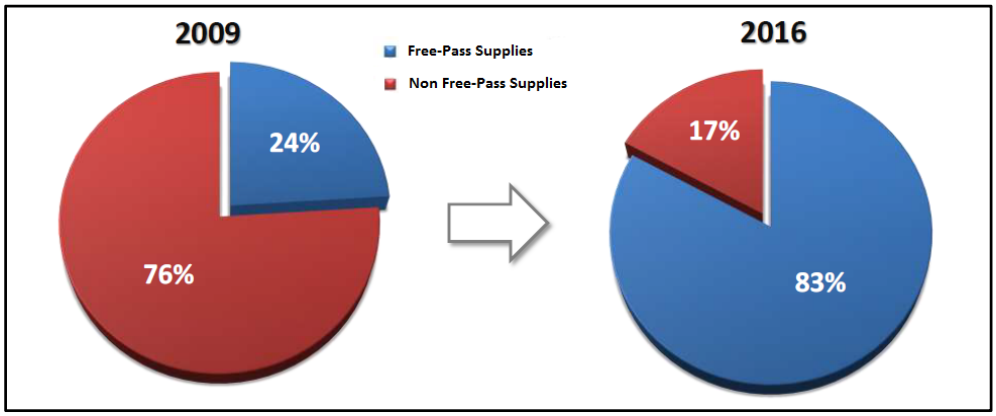


Figure 4. Changes in Alpha supplies (period 2009-2016).

The development of the Free-Pass model has led over the last seven years (2009-2016) to the reduction of 84% of number of not complying pieces, a reduction of 88% in non-quality costs and now the 75% of the turnover is gained in Free-Pass.

From the analysis of SQI in the decade 2006-2016, comparing the Free-Pass suppliers from no-Free-Pass one, it can be seen the huge performance gap has been created in the early years between the two different subjects, but this gap has reduced with time, showing that the adoption of the Free-Pass model resulted in significant improvements in all the Supply Chain Management even for those suppliers that are still not qualified purely as Free-Pass suppliers (Figure 5). The defect level of 0.6% is set as the Acceptable Quality Level of all Alpha Quality Acceptance Plans. The introduction of the Free-Pass model resulted in savings three operators on six employees (-50%) in the control Quality Acceptance.

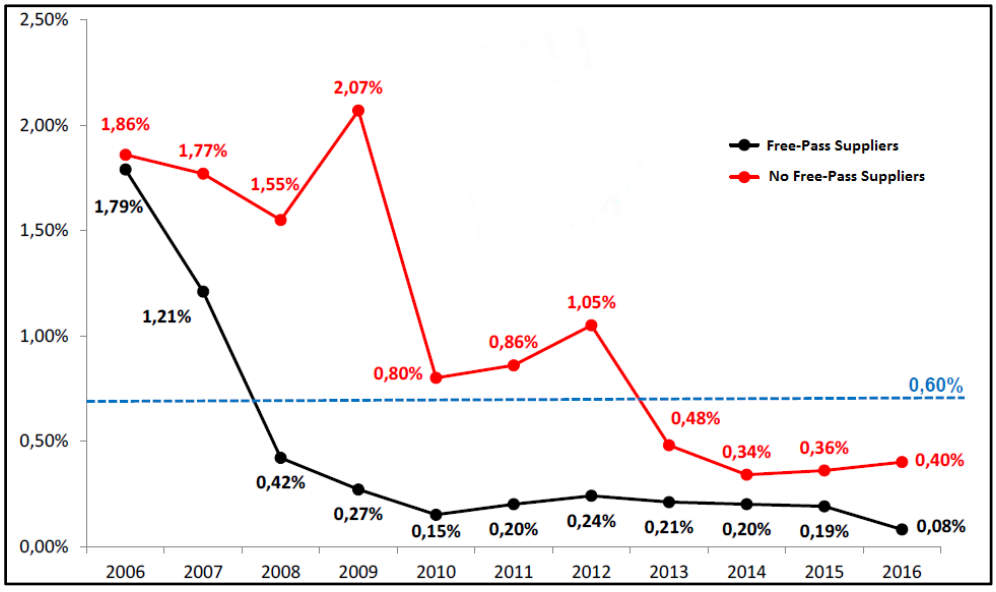


Figure 5. Alpha results obtained from the analysis of SQI (period 2006-2016).

Conclusions

Profitability, cost reduction, competitiveness, and innovation: these, now more than ever, become imperative for managers and entrepreneurs find viable business models that can cope with the rapid changes in the market and the difficult economic situation. If on one side the current global crisis was perceived as an obstacle, it must be addressed on the other side as a great opportunity to invest, to gain competitiveness, to improve the quality standards, and to perceive and manage change. Alpha has developed the lean thinking philosophy exactly with the aim of gaining an innovative and concrete response to this need of businesses and to have a "total transformation vehicle".

The lean implementation across the company leads to a great change both in terms of the transformation of the production process in a process flow "pulled" both at the organizational level with the reduction of hierarchical levels, the process orientation, cross-functional teams, the streamlining of functions, and above all, the involvement of suppliers; this implies a radical change in thinking from management and from all the staff and a true "cultural revolution".

The approach to the problems, and the business, and industrial simplification, can take place successfully if guided by a company thought and mindset that can provide a rational and fair approach, identifying what is valuable and what is not.

However, although in the practical application stage there will be resistance and difficulties, as in any real change, a strict application leads to significant and lasting results; the drastic reduction of design time, the lead time shortening along the production and procurement process, the improvement of quality both in terms of timely delivery and in terms of product quality are obtainable results, precisely, through a rigorous application of lean thinking in the supply chain.

The organization's ability to provide rapid and flexible response to customer requests through activities such as the development of new products, development of suppliers, order fulfillment, and customer management can provide a powerful competitive advantage. It follows that for companies, this advantage comes more and more from excellence in the management of the complex network of relationships and flows that characterize the supply chain where suppliers become an added value and an integral part of the company, allowing the reduction of delivery times and the relative costs and improving the response to the market. Alpha to remain competitive and to adapt the organization to the growing production volumes in 2007, has revised its organizational model, given importance to the relationship with suppliers, and has implemented a supply strategy based on five innovative projects—Purchase Orders, Self Service, Prebolla, Traceability, Free-Pass—to transform the company into an LSC company.

An examination of these projects, and in particular an examination of the Free-Pass model, which permits to delegate the quality control of products directly to the supplier after verification of reliability and compliance with the quality parameters of the company, has shown the importance of implementing quality relationships with suppliers based on trust and cooperation in order to achieve mutual benefits.

References

Agarwal, A., Shankara, R., & Tiwari, M. K. (2006). Modelling the metrics of lean, agile and leagile supply chain: An ANP-based approach. *European Journal of Operational Research, 173,* 211-225.

Agus, A., & Hajinoor, M. S. (2012). Lean production supply chain management as driver towards enhancing product quality and business performance: Case study of manufacturing companies in Malaysia. *International Journal of Quality & Reliability Management, 29*(1), 92-121.

Alabama Technology Network. (1998). *Lean manufacturing handbook*. Huntsville, AL: University of Alabama.

Bonavia, T., & Marin, J. A. (2006). An empirical study of lean production in the ceramic tile industry in Spain. *International Journal of Operations & Production Management, 26*(5), 505-531.

Bruce, M., Daly, L., & Towers, N. (2004). Lean or agile: A solution for supply chain management in the textiles and clothing industry? *International Journal of Operations & Production Management*, *24*(2), 151-170.

Bruun, P., & Mefford, R. N. (2004). Lean production and the internet. *International Journal of Production Economics*, *89*, 247-260.

Chen, J. C., Cheng, C. H., & Huang, P. T. B. (2013). Supply chain management with lean production and RFID application: A case study. *Expert Systems With Applications*, *40*, 3389-3397.

Davis, M., & Heineke, J. (2005). *Operations management: Integrating manufacturing and services* (5th ed.). New York, NY: McGraw-Hill.

De Treville, S., & Antonakis, J. (2006). Could lean production job design be intrinsically motivating? Contextual, configurational and levels-of-analysis issues. *Journal of Operations Management*, *24*(2), 99-123.

Dossenbach, T. (1999). Basic supply chain management = greater profits. *Wood and Wood Products*, *104*(10), 105-107.

Frohlich, M., & Westbrook, R. K. (2001). Arcs of integration: An international study of supply chain strategies. *Journal of Operations Management*, *19*, 185-200.

Fuentes, J. M., Sacrista´n-Dı´az, M., & Martı´nez-Jurado, P. J. (2012). Cooperation in the supply chain and lean production adoption. *International Journal of Operations & Production Management*, *32*(9), 1075-1096.

Halinen, A., & Törnroos, J. A. (2005). Using case methods in the study of contemporary business networks. *Journal of Business Research*, *58*(9), 1285-1297.

Hasle, P., Bojesen, A., Jensen, P. L., & Bramming, P. (2012). Lean and the working environment: A review of the literature. *International Journal of Operations & Production Management, 32*(7), 829-849.

Hines, P., Holweg, M., & Rich, N. (2004). Learning to evolve: A review of contemporary lean thinking. *International Journal of Operations & Production Management*, *24*(10), 994-1011.

Hofer, C., Eroglu, C., & Hofer, A. R. (2012). The effect of lean production on financial performance: The mediating role of inventory leanness. *International Journal of Production Economics*, *138*, 242-253.

Holweg, M. (2007). The genealogy of lean production. *Journal of Operations Management*, *25*(2), 420-437.

Hopp, W. J., & Spearman, M. L. (2004). To pull or not to pull: What is the question? *Manufacturing and Service Operations Management*, *6*(2), 133-148.

Inman, R. R. (1999). Are you implementing a pull system by putting the cart before the horse? *Production & Inventory Management Journal*, *40*(2), 67-71.

Jayaram, J., Vickery, S., & Droge, C. (2008). Relationship building, lean strategy and firm performance: An exploratory study in the automotive supplier industry. *International Journal of Production Research*, *46*(20), 5633-5649.

Li, S., Rao, S. S., Ragu-Nathan, T. S., & Ragu-Nathan, B. (2005). Development and validation of a measurement instrument for studying supply chain management practices. *Journal of Operations Management, 23*, 618-641.

Medlin, C. (2004). Interaction in business relationships: A time perspective. *Industrial Marketing Management*, *33*(3), 185-193.

Moberg, C. R., Cutler, B. D., Gross, A., & Speh, T. W. (2002.). Identifying antecedents of information exchange within supply chains. *International Journal of Physical Distribution & Logistics Management*, *32*(9), 755-770.

O'Marah, K. (2001). A reality check on the collaboration dreams. *Supply Chain Management Review*, May/June, 23-26.

Paez, O., Dewees, J., Genaidy, A., Tuncel, S., Karwowski, W., & Zurada, J. (2004). The lean manufacturing enterprise: An emerging sociotechnological system integration. *Human Factors and Ergonomics in Manufacturing*, *14*(3), 285-306.

Power, D. J., Sohal, A., & Rahman, S. U. (2001). Critical success factors in agile supply chain management: An empirical study. *International Journal of Physical Distribution and Logistics Management*, *31*(4), 247-265.

Reichhart, A., & Holweg, M. (2007). Lean distribution: Concepts, contributions, conflicts. *International Journal of Production Research*, *45*, 3699-3722.

Roveda, I. (2006). *Partnership: Strumento per l'innovazione. Istruzioni operative per aziende* [Partnership: tool for innovation. Operating Instructions for companies]. Milano: Franco Angeli.

Shah, R., & Ward, P. T. (2003). Lean manufacturing: Context, practice bundles, and performance. *Journal of Operations Management*, *21*(2), 129-149.

Shah, R., & Ward, P. T. (2007). Defining and developing measures of lean production. *Journal of Operations Management*, *25*(4), 785-805.

Simpson, D. F., & Power, D. J. (2005). Use the supply relationship to develop lean and green suppliers. *Supply Chain Management*, *10*(1), 60-68.

Stuart, I. (1997). Supply-chain strategy: Organisational influence through supplier alliances. *British Journal of Management*, *8*, 223-235.

Taj, S. (2008). Lean manufacturing performance in China: Assessment of 65 manufacturing plants. *Journal of Manufacturing Technology Management*, *19*, 217-234.

UNI ISO 2859-10:2007. Sampling procedures for inspection by attributes—Part 10: Introduction to the ISO 2859 series of standards for sampling inspection by attributes.

Vonderembse, M. A., Uppal, M., Huang, S. H., & Dismukes, J. P. (2006). Designing supply chains: Towards theory development. *International Journal of Production Economics*, *100*(2), 223-238.

Wahaba, A. N. A., Mukhtara, M., & Sulaiman, R. (2013). A conceptual model of lean manufacturing dimensions. *Procedia Technology*, *11*, 1292-1298.

Womack, L., & Jones, D. (1996). *Lean thinking*. New York, NY: Simon and Schuster.

Wong, A. (1999). Partnering through co-operative goals in supply chain relationships. *Total Quality Managemen*t, *10*(4/5), 786-792.