Leanness and Agility in a Distribution Company : A Romanian Case Study

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List of Abbreviations

ABREVIATION	EXPLANATION
ADI	Advanced Demand Information
B2B	Business to business
B2C	Business to customer
BSSP	British Steel Strip Products
CM	Manufacturer/Distributor lead-time
CMR	Waybill
CSCMP	Council of Supply Chain Management Professionals
CT	Customer's demand lead-time
DC	Distribution Centre
EDI	Electronic Data Interchange
EOQ	Economic order quantity
EPAL	Euro pallet
EPLF	European producers of Laminate Floorings
ERP	Enterprise Resource Planning
Gov2B	Government to business
HVLD	High Volume Low Demand
IMPV	International Motor Vehicle Programme
JIT	Just-in-Time
LEAP	The Lean Processing programme
LERC	Lean Enterprise Research Centre
LTL	Less than Truck Load
MTO	Make to order
MTS	Make to stock
MRI	Minimum Reasonable Inventory
NHS	National Health Service
NMUK	Nissan Motor Manufacturing UK

NUMMI…….....……..New United Motor Manufacturing Inc.

OWS…….....……...Order Web System

PAM…….....…….…Process Activity Mapping

RC…….....…….……...Regional Centre

RIE…….....……Rapid Improvement Events

SCM…….....….....Supply Chain Management

SEJ…….....……Seven Eleven Japan

SKU…….....……Stock keeping unit

TBL…….....……Triple Bottom Line

TPS…….....……Toyota Production System

TQP…….....…….Toyota Quality Process

TU…….....……Transport Unit

VSM…….....……Value Stream Mapping

WMS…….....……Warehouse Management System

WO…….....……Warehouse Officer

Abstract

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The customer's demands are constantly changing both in terms of variety and price range. Consequently, with the increasing number of customers, the complexity of the value perceptions is increasing as well. Nonetheless, it is generally agreed that for those who take a supply chain view, two dimensions of value often arise, namely cost savings and service enhancements. In their attempt to be both responsive and cost effective, companies adopted throughout the supply chain lean as a tactic of cost efficiency and agility as a tactic of responsiveness. There are currently known three different viewpoints regarding lean and agility adoption by enterprises: lean, agility and leagility, the proposed term when the two paradigms are allied.

Lean and agile principles and practices have been widely adopted in manufacturing over the last three decades. However, their use in the warehouses, distribution centres or distribution schemes has been slower to catch on. The majority of the existent academic approaches are delimiting only theoretically the two paradigms while others are emphasizing their cohabitation, separated by a decoupling point but in parallel supply chains. Few of them address the leanness and agility cohabitation in warehousing and distribution. Moreover, to the best of the author's knowledge, no study yet researched the two paradigms beyond the decoupling point. Nonetheless, further research has to be conducted on the companies acting like intermediaries or distributors, as these enterprises are subject of lean pressures from the manufacturers and agile pressures from the retailers, resellers or final customers.

Using a case-study approach this study will focus on the leanness and agility of a Romanian home improvement goods distributor of its logistic processes. In addition, the study will research the trade-off between lean and agility in the logistics activities of the company with a specific emphasis on the decoupling point, known also as the point that delimits these two conflicting supply-chain paradigms.

Key terms: Lean, Agility, Leagility, Distributor, Romania

Declaration

I declare that no portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Copyright Statement

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Chapter 1 - Introduction

1.1. Introduction

At the beginning of the century, the manufacturers tried to gain, preserve and enhance their competitiveness by adopting different manufacturing techniques. In the upstream part of the supply chain, where the manufacturers are traditionally positioned, the fight for production processes enhancement was between lean and agility. By adopting these paradigms, the enterprises managed to achieve both economies of scale and economies of scope. After the enterprises adopted the paradigms they competed, cooperated or engaged in co-opetitive business relationships. To state the obvious this perpetual change of strategies was influenced by an unpredictable factor yet possible to forecast: the customer demand.

The customer demands are changing constantly both in terms of variety and price range. Consequently, with the increasing number of customers, the complexity of the value perceptions is increasing as well. It is generally agreed that when the value of a supply chain is assessed two dimensions of value often arise, namely cost savings and service enhancements (Mangan et al. 2012). In their attempt to be both responsive and cost effective, companies adopted throughout the supply chain lean as a tactic of cost efficiency and agility as a tactic of responsiveness. There are known three different viewpoints regarding the forms of lean and agility adoption by enterprises: lean, agility and leagility, the proposed term when the two paradigms are allied. According to Naylor et al. (1999) lean can be defined as "executing more with less resources as long as the customer satisfaction is maintained" and agility can be defined as " is a comprehensive response to the business challenges of profiting from rapidly changing, continually fragmenting, global markets for high-quality, high-performance, customer-configured goods and services".(Goldman et al., 1995). The definition of Leagility is "the state of being customer responsive with the least possible cost" (Naylor et al., 1999).

The research of lean and agility in the downstream part of the supply chain has not received the attention it deserves, and it is still in its initial stages of development. Nonetheless, the eventual conflicts between lean distribution and agile distribution were discussed by Christopher and Towill (2002). Some of them are delimiting only theoretically the two paradigms while others are emphasizing their cohabitation,

separated by a decoupling point but in parallel supply chains. Few of them address the leanness and agility cohabitation in warehousing and distribution. Moreover, to the best of the author's knowledge, no study yet researched beyond the decoupling point.

In theory, the supply chain is traditionally divided into two ‘streams’: the upstream and the downstream. Traditionally the manufacturers and their suppliers are in the upstream part and in the downstream part are the distributors, resellers, retailers and end-customers. While in the 21st century the manufacturers are adding less value to the product, the value shifts down the supply chain and the role of the distributors in the final price of the product increases; Gattorna (1996) emphasis the continuous increasing role of the intermediaries due to the firms' reversion to their core competencies. Nonetheless, further research has to be conducted on the companies acting like distributors or intermediaries, as these enterprises are subject of lean pressures from the manufacturers and agile pressures from the retailers, resellers or final customers. It is important to consider which paradigm is best for a particular industry in terms of its supply chain characteristics. Using a case-study approach this study will focus on the leanness and agility of a Romanian home improvement goods distributor. The research will make two main contributions. The first contribution of the study consists in the research of the trade-off between lean and agility in the logistics activities of a company a topic that has not been researched extensively in the operations literature. The study will have a specific emphasis on the decoupling point, known as the point that separates the part of the organization oriented towards customer orders from the part of the organization based on planning (Naylor et al., 1999). The second contribution consists of a development of a theoretical framework that will conceptualize the trade-offs between the two paradigms and will construct the paradigms cohabitation in a supply chain segment.

1.2. Statement of the problem

The majority of the researchers agree that both leanness and agility are likely to create competitiveness. Some researchers nonetheless say that leanness is not likely to create an advantage anymore due to its ample implementation amongst companies. Therefore they propose agility as the feature that is expected to enhance competitiveness. In theory there were many attempts to link the two paradigms. The

state encompassing the two paradigms, called ‘leagility’ came as a finding. In practice, manufacturers sought performance enhancement and efficiency through implementing lean principles. They also perfected their customer responsiveness adopting agile tools. ‘Leagilty’ has been tested in manufacturing and the decoupling point was discovered, debated and applied. There were attempts to implement the concepts either separately, or allied in the supply chain and in some industries as isolated case studies. However, to the best of the authors knowledge no study yet stressed specifically how leanness and agility cohabit in a supply chain, where has to be the decoupling point in order to diminish the waste from the processes and enhance the responsiveness, or to be lean and agile with the lowest possible cost and the smallest waste quantity.

There is a profound gap between ‘leagile’ research tools and practical methodologies that are likely to improve processes and simultaneously increase responsiveness in a supply chain. The focus of the researchers and academics on the upstream part of the supply chain may explain the lack of research conducted in the downstream part. The literature addressing lean and agile strategies in warehousing and distribution companies is scarce. Nonetheless, there are several articles researching case studies on distributors from different industries. Unfortunately, they do not practically debate the limit between leanness and agility. These are some of the most important issues that remain under researched.

In the light of this statement, a case study is required to test the reliability and the validity of the cohabitation of the two paradigms in a company playing a distributor role.

1.3. Research questions

The present literature that researches the cohabitation of leanness and agility in the downstream part of the supply chain is extremely scarce. Therefore, it fails to address the following issues:

a) Do lean and agility cohabit in the downstream part of the supply chain, specifically in an enterprise playing a distributor role?

b) If they cohabit how lean implementation and continuous improvement can influence agility?

c) Where is the decoupling point positioned on the map of this specific supply chain pipeline?

1.4. Aims and objectives of the Study

The aim of the thesis is to investigate how leanness and agility are cohabiting in a home improvement goods distribution company, specifically in a warehouse environment and to position the decoupling point also known as the point that delimits the two paradigms. In addition, aims to investigate if the leanness can influence the company's agility.

The objectives are defined through measurable outcomes. Through these objectives the aim will be researched.

Firstly, the data will be collected from a case-study company after some lean tools and procedures will be implemented in the company's distribution centre. Through primary and secondary data collection the waste from the logistic processes will be assessed in a case-study company.

Secondly, the data will be collected from a customer of the case-study company. The collected data will reflect the customer's perception on the agility of the logistic processes of the case study's company.

The data from both sets will be synthesized to establish if exists any relationship between lean and agility.

1.5. Structure of the thesis

The focus of this research is in the warehouse processes. The perspective in which the processes are evaluated is the lean perspective. The improvements are part of a series of process improvements conducted in the case study company. There are 3 subjects to be researched in the warehouse processes: inbound and outbound processes, quality issues and inventory control plus the distribution processes. All these processes are analysed in connection with a customer of the case study company. Firstly lean tools and techniques will be implemented in the warehouse processes. Then the eventual link between these newly implemented techniques and the agility of the new processes will be evaluated.

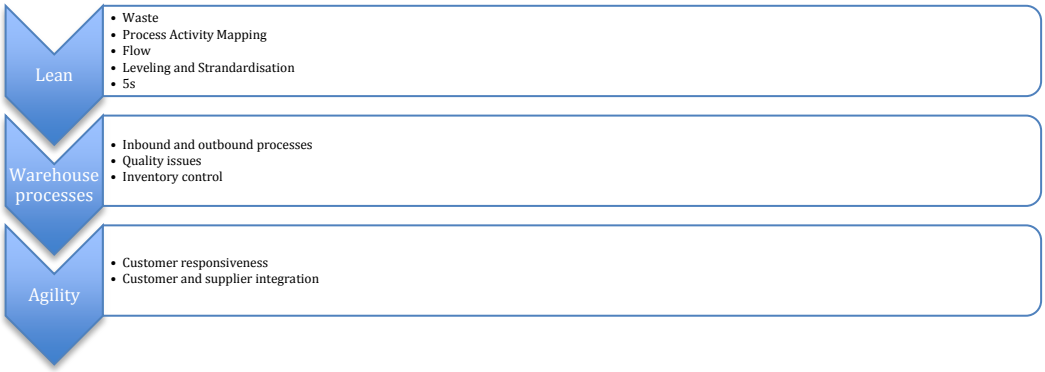


Fig.1.1. Lean implementation framework (Author)

The thesis has the following structure: The literature that critically debates the two paradigms, the theoretical background and the history of the paradigms are reviewed in Chapter 2. The literature review of the paradigms is followed in Chapter 3 by the methodology presentation and justification. In Chapter 4 is presented the case study company together with the findings. In Chapter 5 the conclusions, the answers to the research questions are discussed together with the presentation of the framework. Finally, Chapter 6 debates aspects of further research directions and the limitations of the research.

Chapter 2 - Literature Review

2.1. Introduction

The following section will critically review the literature debating the lean and the agile paradigms in the automotive, manufacturing, services, retail and supply chain following the adoption timeline. It will also present the development of lean thinking ideas from its initial implementation in automotive manufacturing to its implementation to lean warehousing. The agility from different perspectives will be analysed as well, with a specific focus on agile processes in warehousing and distribution.

The first part of the chapter exposes and analyses the approach of lean thinking from the automotive industry to lean in other sectors. It has been chosen this approach in order to expose the drivers and the development of the waste removal process and how the lean tools were adopted in different sectors of the industry. The first part of the report is particularly focused on the impact of lean on the inventory turnover and the impact of lean on companies in general, in particular on the build to stock policy, an approach in which the goods production or stock is planned based on historical demand or forecast.

The second part of the chapter explains the agile paradigm and its critics. It begins with the definition of the paradigm, followed by a discussion of the adoption of the paradigm in the supply chain function. The history of the agile paradigm is not debated because is a relatively new paradigm. Moreover, it reviews the adoption of the agile paradigm allied with the lean paradigm in different sectors like manufacturing, services with an emphasis on logistics and warehousing.

2.2. Lean – introduction

In the following chapter the lean concepts are briefly reiterated for a better understanding of the concepts that underpin the paradigm.

Lean is most of the time associated with waste and process efficiency (Womack et al. 1990). Both waste and efficiency were initially debated in relation with one another in 1911 in Taylor's management principles which separated planning from execution. Taylor analysed during the manufacturing process how tasks are executed in order to

identify the most efficient ones. Taylor argued that if the task was precisely executed, then the system in which the task is executed was about to achieve the maximum level of productivity and produce products with superior quality. Moreover, fewer steps were needed for a process to be executed. After Taylor, Henri Ford had a huge contribution to the development of the manufacturing processes in general. In particular, he introduced in the production process the interchangeability of parts concept together with the mass manufacturing principles. In mass manufacturing the processes were undertaken by focused skilled workers. These workers were executing tasks exclusively related to their job. If one part of the manufacturing chain failed to function than the whole factory activity halted until the small part that failed was repaired. Contrasting to Ford, Ohno (1998) had a different view. During his observation of the manufacturing processes he concluded that the key of the productivity success stays in multi-skilled teams rather than in simple executioners. In addition, he introduced the concept of KAIZEN, a concept that ensured the continuous perfection of the manufacturing processes through periodic evaluation.

2.2.1 Lean in the Japanese automotive industry

The lean concepts were born in the automotive industry from Japan in the early 40s. The concepts and the system were contrasting radically with Henri Ford's Mass production rules that were rigid and not responsive. The latter failed to incorporate the ‘pull by the customer’ production, in other words it failed to produce when needed, in the quantity needed, but more important flawless and high quality products. After four decades, Ohno will comprehensively gather all the lean concepts in his book Toyota Production System (TPS) all his concepts underpinning the lean rules and principles. Hence, each and every book or research paper about Lean thinking is considering Ohno's book as a fundament for lean concepts.

Lean thinking, apart from being only a philosophy, involves a collection of tools as well. These tools once applied in a business or in a process are likely to reduce the waste and improve efficiency in a company's activities (Womack et al., 1990).

Ohno (1988) argued that the lean implementation in the automotive sector creates notable advantages in productivity versus mass production tools and techniques. These advantages are usually seen regarding the customer demand in general, and in productivity increase and waste removal, in particular. Two years after Ohno's book was published, Womack et al. (1990) further developed his idea in the book The

Machine that Changed the World. The book was written based on the studies developed at Massachusetts Institute of Technology. The studies are known to be the first which benchmarked the world's automobile industry. One of the most important findings of their study reveals the efficiency increase in productivity in the Japanese automotive plants. The credits of the success were mainly given to the lean implementation policies existent in the Japanese factories. Womack et al. (1990) surveyed the assembly plant's characteristics in 1989 and concluded that the productivity index calculated in hours per vehicle assembly is twice in Japan compared to America or Europe. Moreover, Womack et al.'s (1990) study reveals the existence of far better indicators of waste removal in the Japanese automotive industry compared to the similar US or European industry. Waste (Muda) is a key term in lean and represents an activity, which does not create value for the customer but is still consuming resources (Liker, 2004). In their study, Womack et al. (1990) consider as waste the defects per vehicle or the space used by the worker per manufactured car and the inventory of parts. The defects per vehicle are found to be triple in the United States' car manufacturing factories, the space per car is doubled, while the inventory parts present in the production facility have an astonishing proportion of 1 to 168.

Based on Womack et al.'s (1990) benchmarking three basic lean principles were found and developed: the identification of value-adding processes, the identification of waste processes and the generation of flow in activities.

After Womack et al.'s book was published academics tried to research and explain the superiority of the Japanese manufacturing concept based on Ohno's Toyota Production System. The systems' principles were functioning based on both time and activity waste-removal. Ideally after implementation all the activities used for executing a task have to be value added. According to Ohno (1988) the seven wastes in production are considered to be the defects, the overproduction, the inventories, the over-processing, the unnecessary motion of employees, the transport and the handling and waiting.

However, some researchers suggest that Toyota Production System is superior than other production methods only if is transferable from Japan to other cultures (Hines, 1998). Nevertheless, in 1984 NUMMI was opened in the USA. NUMMI was a joint venture between Toyota, which promoted lean-production and General Motor, the artisan of mass-production. The goal of the joint venture was to increase the efficiency of the former GM factory and to produce automobile at a competitive rate.

2.2.2 Lean in the North-American Automotive industry

After NUMMI began its activity several more Japanese car manufacturers entered the American market. This was a normal reaction to the Voluntary Automobile Import Agreement with Japan, which imposed an eight percentage reduction to the Japanese automobile import in USA (Luttrell, 1981). Render (1992) in his field studies from 1985 identifies three joint ventures between the American and three Japanese big automobile producers: General Motors with Toyota, Chrysler with Mitsubishi and Ford with Mazda. Furthermore, Toyota after its key role in revitalization of NUMMI principally due to the lean techniques applied decided to export the lessons of Fermont factory in Canada (Render, 1992).

After only one year of activity the productivity results as well as the waste removal processes at NUMMI remarkably improved. The reported results in defect rates determined the researchers to survey and validate the results in the Japanese joint ventures. Womack et al. (1990) display in their studies that the joint venture factory managed to achieve the same results as the Japanese factories in domains like productivity/car and waste removal. After the successful implementation at NUMMI, many researchers tried to find how a Japanese technique was successfully implemented in a different culture like the American one. Holweg (2007) for instance referred to the lean implementation in the United States as a transplant, comparing the Japanese concept implementations in the USA with body organ transplants in a foreign body. Relative to this point, he researched the effects of these transplants on lean production in automotive manufacturing in the United States.

However, not all the researchers agreed that lean implementation was beneficial. The efficiency of the lean as a successful technique in the US automotive market was widely criticized by other researchers. In their research paper Pil and MacDuffie (2000) agreed in a certain extend that the Japanese transplant practice was a success. Nevertheless, they observe that the lean transfer level of success varies by practice, same as the quality levels achieved throughout this lean transfer. Moreover, Bergenwal et al. (2012) emphasize new insights of the Toyota Production system implementation on the TBL (Triple Bottom Line) in order to achieve sustainability in the manufacturing process. The triple bottom line is a process designed on the economic dimension (profit), social dimension (workforce management) and environmental dimension (planet) (Bergenwal et al. 2012). Render (1992) identified gaps in the lean implementation processes after the ‘transplants’ from Japanese

companies were made. The gaps identified are related mainly with the organizational control system. Render (1992) gave certain examples of work stress issues and safety issues discovered in a case study at one of the Japanese-American joint ventures.

Despite the lean critics there are several concepts outlined in the Japanese automotive environment that became popular in other industries: precisely specify value for specific products, identify the value stream for each product, make value flow without interruptions, let customer pull value from the supplier and pursue perfection. Taylor and Brunt (2001) insisted that the most striking benchmark examples in Womack et al.'s (1990) study where the Greenfield plants started by Japanese in the West in the late '80s. These transplants blew some claims so prevalent in those years. The claims stated that lean in order to work smoothly depended on Japanese environment, education and cultural institutions.

All in all, the certainty of the results broadcasted by Womack et al. (1990) determined in the last instance the European car manufacturers to adopt lean techniques in order to regain their market share.

2.2.3. Lean in the European Automotive Industry

After the American manufacturing industry adopted parts of Toyota Production System, their processes gained a certain level of efficiency (Womack et al. 1990). The knowledge transfer of these techniques called transplants as well in Europe was thoroughly researched by Farooq et al. (1997). They studied how the buyer, in this case Jaguar, a UK car manufacturer adopted Lean techniques from Nippondenso, a Japanese spare part supplier, emphasizing the buyer-supplier integration as part of lean functioning Furthermore, Thompson (1995) show in their research article how Nissan, a Japanese car manufacturer conducted the knowledge transfer in the UK, by establishing NMUK (Nissan Motor Manufacturing UK). The study concludes that the Japanese transplants successfully function in the United Kingdom.

There were attempts to research the causes of successful implementation of the Japanese techniques in the European automotive industry. McDermott (1996) suggested that the rebirth of the United Kingdom automotive industry is based on the range of six initiatives. These initiatives are as follows: the level of investment, the labour relations, the technology transfer, the supplier relationship, the recruitment,

gaining and skills and the gains from a UK presence. Nonetheless, the Japanese practices together with the UK workforce made the 'UK automobile manufacturers to be a world class again' (McDermott, 1996). They suggest that the success of the British Companies is based on an original mix of some native manufacturing procedures with the Japanese ones. The study has very strong arguments and it reinforces the idea that the efficiency tools came 'transplanted' from Japan. During this study McDermott (1996), expose an interesting point of view, showing that in contrast with the Japanese investors, the US car producers had a different legacy in the UK. At the end of the eighth decade, Ford tried to 'Japanize' the practices of the Ford factory from UK. The results were disappointing: the whole European network halted by a strike in the UK. The company admitted the defeat, and soon after, Ford cancelled further investments in the United Kingdom.

One of the most important achievements in the Lean manufacturing research in the United Kingdom was called LEAP, in other words The Lean Processing Programme. It commenced in April 1997. The LEAP project was funded by the United Kingdom's Government jointly with nine private-owned participating companies and it was one of the first comprehensive studies that benchmarked the British automotive industry. The objective of the programme was to create a lean Supply Chain from the raw material supplier (BSSP) British Steel Strip Products, through two steel service centres to six 1st tier component suppliers in the automotive industry. These suppliers provided component parts for the major car manufacturers in the United Kingdom. The project cost two million pounds and lasted for 3 years. The justification and the background were quite obvious. Three years before, in 1994, professor Hines of LERC (Lean Enterprise Research Centre) from Cardiff carried out a research called The Dantotsu Benchmarking Project. This project compared the performance of the supplier systems used by Toyota in Japan with the supplier system used by Toyota in the United Kingdom. The results showed that the performance of typical automotive component suppliers in the UK was well behind that of the best in Japan.

Besides the widely debated conceptual sucess, the productivity of the newly implemented lean tools was measured. Taylor and Brunt (2001) benchmarked some automotive companies in the United Kingdom and compared the findings from the Japanese automotive companies within four product category areas. The results were as follows : 100:1 quality gaps, 2:1 productivity gaps and nearly 7:1 inventory gaps. He suggested that the Japanese companies results are likely to be better because of the use of the Toyota Production System. In the paper that compared the two

systems, the British and the Japanese one, Taylor and Brunt (2001) observed mechanisms in Japan that are clearly differentiated from the UK counterpart. Through observation, Taylor and Brunt (2001) noticed four key elements that have been brought together in Japan that were absent or at least only partially realised in the UK. Firstly, it is the policy deployment which involves step by step planning, implementation and review processes for managing change. Secondly, it is the Cross Functional Management which involves Quality, Cost and Delivery as the key cross-functional processes. Thirdly, the TPS which is a method developed by Toyota in which they deliver the products to the customer in a timely manner, more timely than the traditional way. By traditional way, the author suggests the delivery time specific to the mass production. Lastly, it is the supplier integration, which integrates each tier one above and below.

However, the success of the Japanese techniques in the automotive industry was not so sound in all European Countries. In Sweden for example, a country with an old tradition in car manufacturing, Volvo, a car manufacturer, had its own production system considered by Render (1992) to be more humanistic than the Japanese lean system. In his study Render (1992) points the limitation of human costs in the Japanese lean system compared to the Volvo system, suggesting that Womack et al. (1990) were inconsistent in analysing the human capital costs when they analysed the European car manufacturers. Render (1992) argues that the Volvo manufacturing system compared to the Japanese lean is no less than "an innovative quantum jump". Nevertheless, lean expanded further as a practice enhancing the productivity on one side, and removing the waste on the other side. After 1989, in Eastern Europe new ex-communist states began to align step by step to the capitalist line. Among them, Romania and the Czech Republic had quite developed automotive industries (Harwit, 1993). Harwit details in his study how Western European companies or joint ventures captured the growing markets implementing Japanese techniques in the Eastern European factories. Companies like Volkswagen and GM/OPEL, which were already considered as transplanted by the Japanese car manufacturers bought the former communist plants introducing the lean techniques in the Eastern European factories' assembly lines.

Johansson et al. (1993) stress that from the oil crisis (1973) onwards, many Western European manufacturers implemented Japanese manufacturing techniques. Many of them still use these Japanese processes in a tactical sense mainly for process improvements. However, the author observed that in their early stages of

development at the beginning of 90s, few of them improved their external processes using these processes. In other words they did not use the lean tools beyond the factory's four walls.

The success of lean implementation in the automotive manufacturing was sound in the mid 90s. Its biggest achievements were considered to be the process automation, the smoothness of the production line by removing the bottlenecks, the decrease of inventory level and the ease of activity planning. Therefore, its principles were widely embraced by other manufacturing industries.

2.2.4 Lean in manufacturing

Researchers like Trent (2008) consider lean as a concept that can be applied to every enterprise, profit or not profit, industrial or not industrial, service or manufacturing. Moreover, Melton (2005) stresses that are well documented examples of the application of 'lean thinking' to business processes such as project management, healthcare or retailing.

The following paragraphs focus on lean application in manufacturing. According to Taylor and Brunt (2001) lean manufacturing can be defined in contrast with the mass production, pointing that the mass production used simple and flexible tools ran by unskilled workers. Jacobs et al. (2009) define lean manufacturing as an integrated set of activities designed to achieve production using minimal inventories of raw materials, work-in-process and finished goods. By contrast, lean manufacturing employs teams of multi-skilled workers at all level who ran automated machines. After the sound success of lean implementation in the automotive industry, many enterprises, from various industries aimed for achieving efficient processes with bigger quality delivery. Therefore, lean thinking was adopted in other sectors using the same concepts that made this concept popular in the automotive industry: process automation, bottlenecks removal, the decrease of inventory level and activity planning.

But before continuing with the lean paradigm proliferation in other industry sectors, the term quality requires clarification. According to Ernst and Young Quality Improvement Consulting Group definition of quality can be summarized in two statements. The first statement proposes that quality is conformance in specifications, where quality is defined as the relative absence of defects. The second statement

proposes that quality meets the customer requirements, where quality is measured by the degree of customer satisfaction in respect with the products characteristics and features. However, a fair proposal would be to mix both concepts in order to define quality completely. If nobody wants a product, even if it's flawless, then what is the use of quality? But these concepts will be further explained later in the thesis.

After its implementation in the manufacturing sector, the lean paradigm was widely researched by academics. Shah and Ward (2007) called for rationalising the lean paradigm hence their approach consisted in modelling the paradigm. They conducted an extensive literature research to explain the confusion of the term between the lean paradigm and the lean tools or components. Without a conceptual framework the paradigm risked to end as an empty slogan. In their paper Shah and Ward (2007) state that lean as a term was for the first time conceptualised by Ohno (1988) in his well-known book Toyota Production System while Davies et al., (1998) argue that the lean as a model emerged from Womack et al.'s (1990) book "The Machine that Changed the World". Hines et al. (2004) suggests that the origin of lean thinking is on the shop floors of the Japanese manufacturers, in particular innovated by Shingo (1981). However, Ohno (1998) was the pioneer that empirically defined the basic key concepts of the Lean manufacturing: The seven wastes that threat the efficiency of a corporation. He also defines constructs and creates the conceptual word of lean. In other words he theorized the concept by creating the concept's pillars.

Relative to the adoption timeline in the western cultures of the lean principles, Hines et al. (2004) observed that the western manufacturing interest in Ohno's ideas was limited until the study of Womack et al. appeared in 1990. From that moment onwards the lean concepts proliferated all over the world causing that the mass production, at least in the automotive industry, to become obsolete. In a study on lean implementation in manufacturing in Western Europe, Benders and van Bijsterved (2000) note that lean production's reception was nowhere as enthusiastic as in Germany. They consider that lean diffused in Germany so rapidly due to the needs of reorganizational measures for that time. Furthermore, Womack et al. (2005) dedicate the whole ninth chapter of their book "Lean Thinking: Banish Waste and Create Wealth in Your Corporation" to Porsche, a German car manufacturer which in 1994 adopted lean as a production system. Womack et al. (2005) emphasized the superiority of the lean system against the German 'Technik'.

Relative to the lean production measuring tools Shah and Ward (2007) emphasize in their study that there are only two research papers specifically related to lean manufacturing measurement. In addition, they propose a more holistic concept by capturing both internal and external lean practices for a better alignment of the concept with its origins. Their study validates the empirical research and leaves further research for lean adoption in production and manufacturing. Moreover, from the upstream part of the supply chain the lean paradigm implementation shifted to the downstream part. In other words it became at the end of the last century increasingly adopted by the big retail chains.

2.2.5 Lean in retail

The retailers began to increasingly adopt lean practices, insisting for the manufacturers to replenish their stores on an ongoing basis. Therefore, the retailers began to shift the inventory responsibility to their suppliers aiming to reduce their inventory to the shelf inventory (Abernathy et al., 2000).

In the late 90s Cox (1997) revealed that the lean thinking approach became somehow the dominant paradigm in the supply chains. Relative to this point he proposes eight defining characteristics of the lean approach. The first characteristic is to strive for perfection in delivery value to the customer. The second characteristic is to only produce what is pulled from the customer. The third one is to focus on the value adding activities in the operations. Additionally, the lean enterprise has to recognize that all the participants in the supply chain are stakeholders directly interested to add value to the business. The fifth characteristic refers to the development of close, collaborative, reciprocal and trusting relationships, rather than adversarial partnerships with the suppliers. Moreover, in order to create a demand-driven supply chain pipeline close work with the suppliers has to exist. The seventh characteristic is to reduce the number of suppliers in order to assure the smoothness in the supply chain pipeline. Finally, the eighth characteristic refers at the creation of a network of suppliers that works all together for waste removal and operational efficiency in delivering the existing products or services. Surprisingly, Cox's attributes are somehow focused on the supply chain itself rather than on the internal operation flows of a logistic system. Therefore, he stresses the waste removal needs only in the supply chain as a whole but not in detail on each supply chain component separately.

On the other hand researchers like Lukic (2012) focuses on conceptual wastes in operations from the retail sector rather than lean on the whole supply chain. Relative

to this point Lukic (2012) insists more on operational concepts such as KAIZEN and on terms that define waste removal concepts rather than on technical lean tools appropriate for waste removal. However, he recalls some of the tools used by Naruo and Toma (2007) in their case study on SEJ (Seven Eleven Japan). Researching beyond the conceptual tools Naruo and Toma's (2007) findings indicate some common grounds between Toyota Production System and Lean Retail Strategies. For example he proposes Kanban, a tool that schedules production, initially used by Ohno in his lean manufacturing system, as a store initiative ordering procedure. Kanban is traditionally known a lean technique used in production. It represents a signalizing procedure that announces the replenishment need on a shelf in retail's case. Nonetheless, these tools once applied in case studies did not constitute a robust organisation worthy to be called lean in retail.

Abernathy et al. (2000) researched the behaviour of the retailers during their development as lean enterprises in a supply chain. He argued that the retailers began to control better the cost of the inventory by transferring the stock responsibility to the manufacturer. They achieved that by placing weekly orders based on the last week sales or ordering directly from the stock held by its supplier. They electronically signalized the need for the shelf replenishment with the desired product, in the desired quantity and in the desired time. This issue prevalent at the beginning of the 21st century generated by the lean retailers began to affect the manufacturing costs of the suppliers indirectly. The manufacturers had to forecast the weekly variability in demand and to keep a safety stock of finished goods. Moreover, due to the fact that lead-time in most of the cases exceed one week, the majority of the manufacturers were not in the position anymore to adopt a more agile paradigm such as Made to Order. In addition, the manufacturing prices slightly grew mainly because of the safety stock that the manufacturer was obliged to manage (Abernathy et al., 2000). Undoubtedly, the adoption of lean techniques in the retail had a very strong impact on the rethinking of the product categories. Therefore, companies experienced for the first time the differentiation of products through supply chains. Most of the manufacturers were in the position to outsource at low cost or close to market at a higher cost to be able to meet the demands of the retailers and to control cost of the inventory (Abernathy et al., 2000).

Abernathy et al. (2000) conclude by considering lean in retail as a concept that vertically integrates suppliers and customers through Just in Time (JIT) policy. In its ideal form, JIT integrates the entire supply chain's marketing, distribution, customer

service, purchasing, and production functions into one controlled process (Claycomb et al. 1999). Abernathy et al. (2000) stress that the lean tools are instruments for achieving order fulfilment in a global retail supply chain. Therefore, they focus more on developing a smooth supply chain externally throughout information exchange with suppliers. The study conducted by Abernathy et al. (2000), empowered by a survey among the US retailers, shows that the average profit margin grows with the level of lean tools adoption.

Evans and Harigan (2005) follow Abernathy's hypothesis about the enablers of the lean retailing such as supplier integration. Moreover, they propose bar codes for keeping daily track of the sales by the retailer and EDI (Electronic Data Interchange) for rapidly data exchange between the retailer and the supplier. In addition, they stress the need for modern distribution centres placed near the retailer that can rapidly deliver the goods. However, Stratton and Warburton (2003) argue that the offshore supply can offer immediate cost benefits but usually is carrying a higher level of inventory for supporting a slower response capability. Nonetheless, the higher is the degree of responsiveness, the higher are the inventory costs and in the end the higher the retail product cost.

There were researchers that saw the shortcomings of the lean adoption through integration as well. Cox and Chicksand (2005) consider the lean integration profitable for some of the participants in the Supply Chain with some limitations invoking the concept called buyer domination. The buyer domination situation is likely to occur due to seven key power levers. In this case the most important level seems to be: Few buyers, but many potential suppliers (Cox and Chicksand, 2005). According to the authors, the buyer will have a high level of profitability, while the supplier level of profitability will decline. Besides some of the shortcomings, researchers point several reasons that make difficult the implementation process of lean procedures in the retail sector. Jaca et al. (2012) stress that lean methods are very difficult to implement in companies that are playing a distributor role due to the volatility of the customer demands while Huq (2005) suggests that the lean adoption process in companies from the distribution sector requires a different approach because of the higher degree of human participation in the automated job.

The popularity of lean in operations was unquestionable. Lean production not only remained popular in manufacturing, but has evolved from the operational level to strategic level (Hines and Rich, 1997), and to empirical domains beyond automotive manufacturing such as shoe manufacturing (Gati-Wechsler and Torres, 2008), supply

chain for personal computers (Naylor et al., 1999), supply chain for food (Cox and Chicksand, 2005) or Healthcare (Waring and Bishop, 2010). More and more companies were adopting the paradigm. Arguably, lean transformed itself much more in a management strategy. Therefore, it was embraced in other sectors mainly in the service sectors. Some researchers stress that lean became "a paradigm for operations and its influence can be found in a wide range of manufacturing and services strategies" (Lewis, 2000, p. 959). Moreover, beyond the car industry Womack and Jones (2005) focused on the consumption end of the supply chain citing retailers like Wall Mart or Tesco as examples of successful lean model implementation. These models were known to generate both cost reduction and process efficiency.

2.2.6 Lean in Healthcare

Service businesses are in many ways very similar to manufacturing business (Jacobs et al., 2009). Services can be however different when the high degree of personalization is considered. These notable differences did not stop the Lean concepts together with its tools to be widely adopted by service providers for internal process improvements. Jacobs et al. (2009) identified ten of the more successful applications of these tools: organizing problem-solving groups, upgrade quality, clarify process flows, revise equipment and process technology, level the facility load, eliminate unnecessary activities, reorganize physical configuration, introduce demand-pull scheduling and develop the suppliers networks.

In the end of the 20th century the service sector in general and the public service sector in particular was widely criticized for the poor level of service it provided. Amongst these service sectors it was the public service sector of healthcare. In an attempt to acquire operational efficiency, the health service sector has adopted various tactics for improving operational flow. Amongst all the improvement tactics, lean seemed to be appropriate for the waste removal existing in the bureaucratic procedures of these sectors. One of the first public systems that embraced the lean tools was the healthcare system.

According to www.leanromania.org lean in healthcare is seen as a system aiming for value add services and elimination of waste from the client's point of view (in this case the patient) not from the state, government, insurance system or doctors' perspective.

Radnor et al. (2012) observe that the level of interest in lean implementation in the public sector increased from 2001 onwards even though most of the lean tools were applied preeminently in the private sector. According to Radnor et al. (2012) lean can improve the operational efficiency of the healthcare system by enhancing the task flows. Jacobs et al. (2009) argued that the tools of flow diagrams and the capacity analysis are similar in services with those from manufacturing. Moreover, they also identify the first attempts to implement lean in the public system in general, specifically in the healthcare service system. The first attempts to implement lean in healthcare were in 2001 in the United Kingdom and in 2002 in the United States (Radnor et al. 2012). Furthermore in their study, Radnor et al. (2012) identify significant contextual differences between production and health system, and try to analyse in what degree lean is implemented in healthcare. Lee et al. (2011) express an interesting opinion about the healthcare operational system. They state that the healthcare system itself is complex system because on one side it treats and prevents diseases, on the other side manages a complicated supply chain from medical exercise equipment to wheelchairs and general materials. On the other hand, Hook (2009) considers that one of the biggest challenges of lean in healthcare is to manage material costs while meeting the customer demands.

Studying the lean implementation above the operational boundaries Waring and Bishop (2010) conclude in their study that lean implementation in healthcare can potentially contribute to the reconfiguration of occupational boundaries and to new forms of clinical leadership.

Nonetheless, lean in healthcare is quite widespread nowadays. De Souza (2009) points in a study that most lean projects in healthcare are in the USA, with 57 %, in the UK with 29 % followed by Australia with only 5 %.

Conceptually, in healthcare the customer value has been defined. In the 2004 yearly report, the NHS Modernization Agency points the unnecessary procedures that have to be removed through lean implementation such as recording patient in multiple places or excessive waiting for staff. Therefore, value for the patient is seen as minimizing the waiting time and the enhancement in quality of the medical act, for the system is low cost and inexistent bureaucracy. Besides the operational procedures enhancement the lean implementation in healthcare brings significant excess stock reductions of unused materials in the storerooms (Radnor et al. 2012). There are at least two tangible benefits after lean implementation in different sectors such as services and manufacturing. The first common benefit is the quality enhancement of

the service associated with the manufacturing, distribution or sales process. The other common outcome of lean implementation in such a variety of domains is undoubtedly the inventory reduction (Womack et al., 1990, Nauro, 2007, Jacca et al. 2012). Therefore, the concept of inventory and how the inventory can be influenced by lean implementation policies will be further debated into the next chapter.

2.2.7. The lean practices impact on the inventory turnover

Inventory is the stock of any item of resource held in an organization (Jacobs et al., 2009). The inventory in general has costs associated to tied-up capital, warehouse operations and deteriorations (Waters, 1992). However, there are logic reasons why organizations keep inventories. One of the main reasons is to allow a buffer between supply and demand. If stock is absent then some of the operations are not able to function smoothly. Therefore bottlenecks are likely to appear in processes and the lean techniques once applied are not to ensuring effectiveness.

The term leanness is often used in connection with lean manufacturing to imply a "zero inventories" just-in-time approach (Christopher, 2000). It is rather usual for companies to try to enhance the effectiveness of the operations by using tools and techniques to improve the inventory turnover. However, before considering any improvement process a strong analysis of total costs is recommended. Grant et al. (2006) suggests a better consideration of the inventory turnover impact on the overall logistic costs. He considers the inventory a large and costly investment and stresses the idea that a better management of the stocks is likely to enhance the cash flow and the return of investment. Nowadays, one of the biggest issues that all companies are facing no matter if they are retailers or wholesalers is the stock out. Besides stock-outs, due to demand uncertainty companies sometimes face inventory obsolescence. Relative to this point academics like Goldsby and Griffiths (2006) propose an efficient buffer inventory to cope with the demand uncertainty, but under 'lean regulation'. They see the lean thinking somehow borrowing some principles from MTS production, with the difference that lean relies on a much shorter forecast period. MTS, or made-to-stock production is the strategy used to reduce production runs and through the stocks to ensure a quick response time to customers (Shao and Dong, 2011). Analysing the lean organization, as part of a lean distribution system, Karlsson and Ahlstrom (2009) propose a minimum level of stock called Lean Buffers. They also suggest the use of methods of inventory stock reductions in production due to the customer volatile demand.

Demeter and Matyusz (2011) consider the inventory level as a key indicator of the success in companies that decide to implement lean practices. Moreover, Karlsson and Ahlstrom (2009) acknowledge that inventory is probably one of the most important sources of waste. In their study, Huson and Nanda (1995) demonstrate how inventory downturn affects the profit margin.

In a study that is evaluating the wholesale industry in the United States, Chen et al. (2005) find that Stock Reduction increases performance while it decreases the cost and the level of customer service. Although the question remains: How big these stocks have to be?

Contrary to Huson and Nanda (1995), Eroglu and Hofer (2011) emphasize that there exists limited evidence that inventory leanness generates improvement in a company's performance. Therefore, they propose an industry-by-industry analysis to survey the effect of leanness inventory on the firm performance. The study implies that there is an optimal degree of inventory leanness beyond which the marginal effect of leanness on financial performance becomes negative. This 'ideal' inventory is called onwards JIT inventory. Zipkin (1991) analyses the ideal inventory level, as well. He identifies two types of JIT inventory, the pragmatic JIT inventory, defined by a certain level of goods in stock, and romantic JIT inventory characterized by zero stock, that is no waste. According to (Waters, 1992), the only possibility to have zero stock is to have suppliers capable of deliveries in a specific time slot. This is likely to happen with short-lead time products whereas for the longer lead-time products an inventory has to exist. In this respect, a player from the supply chain has to carry that inventory regardless its type (raw materials, Work-In-Progress or finished goods). If the inventory is carried in the tiers of the supply chain then the final cost of the product logically will increase as the logistics costs of the enterprise that holds the stock are increasing. His study concludes that the demand issues are more critical than the supply side, and that JIT inventory is managed by a production that responds closely to demand. Zipkin (1998) considers the policy very difficult to implement due to the fact that if there are many products scheduled for production the production response rate is likely to fluctuate widely. To state the obvious, the inventory control is one of the most important pillars that affect the industrial success of the distribution organizations (Gunasekaran, 1999). Its impact on efficiency and responsiveness is very important. The use of the inventory permits production to be spread over a long period of time (Bucklin, 1965). Hence, a much deeper understanding of the lean theories regarding inventory control is needed.

2.2.8 Build to stock policy

Stock or inventory range from raw materials to finished products, as well as inventories held up in transit (Slack et al. 1995). They also point out that the buffer stock considered once a key for fast response in front of the customer uncertainties is now a reason for lead-time increase. Waters (1992) argues that the main reason why organizations keep stock is to allow a buffer between supply and demand. Without stock, the operations are not functioning smoothly therefore bottlenecks are likely to appear. Waters (1992) considers that stocks are important both for unexpected supply and or the unexpected demand. Bucklin (1965) argued that the creation of the inventories with the purpose of holding stocks before the sale is a physical activity that moves both risk and uncertainty in another tier level of the supply chain. To state the obvious, the only possibility not to hold stock is to guarantee deliveries at a specified time, in a time-slot that has to be very tight. This is likely to happen for products with short lead-times. For the long lead-time products a minimum stock is to be held by one of the players in the supply chain pipeline. However, inventory costs are occurring no matter in which tier of the supply chain the stock is held. After all, the 'keeping the stock' costs are present in the supply chain pipeline and will eventually influence the retail price of that product.

Many attempts have been made by researchers to develop stock reduction theories as part of the build-to-stock strategy. Their aim was to link the build-to-stock-policy with an inventory reduction policy. Donselaar et al. (1999) suggested as an inventory reduction tool a protocol called ADI (Advanced Demand Information). The Advanced Demand Information encourages players to share the demand (information) as soon as it has a 'reasonable' certainty. According to Zijm and Dekok (1988), up to 36 percentage of the inventory is possible to be reduced if partial demand information is given in advance to the supplier. However, there is a limitation in the previous exposed research. Firstly, the study was made in the telecommunication industry. Secondly, the authors are proposing a framework that is not likely to be implemented in all industries: if potential demand for large projects is irregular and the probability that proposals turn into actual orders is high (Donselaar et al. 1999). Furthermore, Zipkin (1995) suggests worse response times for customers as a solution to lower the inventory level. Nonetheless, Zipkin's system is likely not to function nowadays due to high demand volatility and strict delivery conditions proposed by the clients, even if they are part of B2B (business-to-

business),B2C (business-to-customer),C2C (customer-to-customer) or even GovtoB (government-to-business).

The inventory level becomes more and more important and critical as customer demands are fluctuating and increasing. And if the inventory level for some reasons is increasing then the final price of the product is also likely to increase due to inventory carrying costs. Hence, a customer can easily become unhappy and choose another supplier. Trent (1998) observes that some companies in order to better control their inventory are using EOQ or Economic Order Quantity. The EOQ allows a calculation of an ordering quantity representing the lowest total cost. When the lowest total cost is calculated, are considered an item's annual demand, ordering cost and inventory carrying charges. Contrastingly, some researchers disagree with the mathematics involvement in order systems. Christopher (1998) suggests that these rules as non-value-adding and cannot cope with uncertainty of the Supply Chain.

The reasons of inventory cost increase preoccupied the academics. Gunasekaran et al. (2001) analyse a wide synthesis of reasons for inventory cost increase. These are considered to be: opportunity cost mainly a storage cost, the cost associated with inventory as incoming stock level, the service cost mainly a cost associated with stock insurance, the cost with the goods in transit, the risk cost, a cost affiliated with the damage, the scrap and rework cost and the shortage of inventory cost associated with the lost sales. For an immediate improvement in inventory management Gunasekaran et al. (2001) propose Pareto Analysis Tool to calculate the stock cost versus the space in square meter allocation. Pareto analysis is a tool that breaks down a problem or a whole showing the relative contribution of its parts. Moreover, Gunasekaran et al. (2001) propose different transportation techniques and a forecasting system based on sales data from the distributor. However, despite the fact that is an interesting proposition, is somehow inconsistent as it is mainly focused on cost. The research treats only the profitability of a certain company with focus on margin rather than a stock policy adoption based on customer demands.

One of the inventory’s characteristics is to ensure that the sale activity is flowing without any bottlenecks. Therefore, it prevents any eventual supply chain disruptions from the availability of the product perspective, ensuring that the supply chain functions smoothly. Yet there are factors affecting the supply chain’s smoothness. According to Shukla et al. (2012) the usual smoothness of a supply chain can be affected by a specific factor in provision of an efficient value to the customers. They claim that the smoothness of the supply chain in this respect is influenced by the

rogue seasonality. The rogue seasonality involves generation of cyclic patterns in order (Shukla et al. 2012). However, in the research literature Jones et al. (2005) proposes a tool called demand amplification mapping, to identify how demand changes along the value stream within varying time buckets or rogue seasonality.

Together with the demand amplification mapping there are other innovative tools useful in the research of the build-to-stock policy. Trent (2008) proposes the use of the principle of postponement as a rule to regulate and reduce the waste in the inventory level. This principle maintains a full-line anticipatory inventory in one or few strategic locations. However, in a postponement strategy, someone has to carry some sort of inventory. The issue of inventory carriage presented above was raised decades ago by Bucklin (1965) who stressed for the first time the idea that the heavy, bulky and expensive products will flow through the supply chain pipeline with more intermediate, speculative inventories then the light, high valued and dense products. Therefore, he suggested that some of the products due to their limitations to be held in stocks in different points of the supply chain. However, this issue was partially solved through the principle of postponement adoption.

Planning the physical distribution with the principle of postponement means that the time of shipment and the location of the final product processing in the distribution of a product is delayed until a customer order is received. The issue of postponement arose due to the increasing number of delivery destinations plus a growing number of units (SKU) that had to be supported by any distribution scheme.

According to Zinn and Bowersox (1988) for serving the actual customer demand, sophisticated forecasts are followed by multiple delivery destinations schemes and anticipatory distribution schemes. In order to be responsive where geographical conditions are not helping (high surface distribution areas), the right stock has to be kept in the right place. The knowledge of order levels and locations can reduce the cost of delivery in specific areas because stocks can be consolidated in a warehouse. Therefore, the transport price is likely to descrease, automatically descreasing the logistic costs of the product. This is also known as the time postponement.

Under specific situations according to Zinn and Bowersox (1988), goods in semi-finished stage can be transported to warehouses. After the customer order is received, the product can be branded, packed or modeled. This form of postponement named form postponement reduces the risk associated with the uncertainty of brand, packing or model. Nontheless the form postponement can be seen somehow as a lean tool.

Firstly, it reduces the waste associated with inventory. In addition, adds value to the product because involves labeling, packinging, assembling. the authors are proposing four types of alternatves to anticipatory distribution : labeling, packiging, assembly and manufacturing. Each type of postponement has different distribution costs, and somehow offer a different customer service level. In addition, each and every type of postponement have a different carrying cost and a different value of transportation. However, all the different postponement methods can create significantly cost reductions as well as agility in a supply chain.

The postponement manufacturing strategy once used has been transformed in time and adapted to some industries as the tool that is simultaneously cost saving and agile. The Japaneese domination on the market in the 90's determined the researchers and practicioners to predict the future state of the principle of postponement: the mass customisation. According to Chase et al. (2006) mass customisation is the state where products are customised to meet the customer's individual demands. It also combines the low cost production. It is considered to be the new frontier of business competition. Its principles rely on the rule of postponement. In the principle of postponement the products are produced in the high volume lean product lines, and when an order penetrtates the pipeline, the product is individualised in the very last stages of production, or even at another tier of the distribution pipeline. Hence, the products are differentiated in the last possible point of the supply chain. However, it is debatable in what extent the mass customisation is suitable for the laminate flooring industries as heavy products with specific manufacturing characteristics and long lead time are involved.

Two decades ago, there were other attempts to develop stock reduction tools like the Just-in-time approach in stocks inventory. According to Waters (1992) JIT implementation in an enterprise ensures the continuous flow of the operations. JIT was initially recommended for a products assembled on a scale process for a large number of identical products in a continuous process. Waters (1992) argues that the JIT stable environment allows costs to be reduced through automation use. The fixed costs resulted from the technology investment will be recovered by the high volume produced. However, due to the volatile and rapid demands of some of the customers Water's JIT proposal might function with difficulties. Bucklin as well (1965) notices that the stocks can be reduced eventually when the delivery time is allowed to increase, situation not necessarily suitable for a rapid and volatile demand environment.

However, in the early 2000s lean began to be implemented in different sectors.
Its implementation rose debates related to stock reduction, waste process reduction or bottlenecks elimination in the automated processes. Hence, its critics appeared and lean began to be criticized conceptual and technical. Its conceptual critics argued that lean is a management tool that excludes innovation and creates unevenness due to its automated processes while its technical critics argued that its tools are excluding any responsiveness of a company in front of its customers.

2.2.9 The Critics of Lean

Lean thinking was criticized in the research literature as a concept and as a set of tools. Other researchers criticized the results of lean concepts adoption rather than the paradigm itself. Cooney (2002) criticized the lean thinking mainly because of its unevenness. He argued that if the full lean sets and concepts are not adopted, lean adoption might generate either hybrid models of adoption or rhetorical adoption. Other researchers like Belzer and Dankbaar (1993) criticized Womack and Jones book arguing that is missing its academic precision. They argued that Womack and Jones book is not scientifically structured and all of the arguments presented in the book are not anchored in scientific data.

Following Cooney's ideas, Abo (1994) further analysis the lean hybrid adoptions in manufacturing. Abo (1994) develops a study based on data gathered in Japanese controlled factories opened outside Japan. The results of his studies suggest that the US joint ventures with Japanese manufacturers are applying some lean techniques unchanged, while they adapt others to the local conditions. These findings follow Turner and Auer's (1996) conclusions according to which lean thinking can meet a barrier in national government rules and regulations. Turner and Auer's study (1996) analysed practices in the automotive industry in Germany, Japan and USA and they observed significant cross national variations and distinct national patterns influenced by government institutions.

Moreover, Doeringer et al. (1998), in their research study present the low adoption rate of Japanese manufacturing practice in the United States' manufacturing enterprises. They observe ambiguous evidence in adoption even in transplants. For their study, Doeringer et al. (1998) choose to make a 'natural experiment' in adoption of the best practices by sampling 28 Japanese plants and American companies from the US, operating between 1978 and 1988. However, he observes that all of the surveyed companies describe themselves as being ‘lean’, but there are major

differences between Japanese transplants and domestic plants in the way they implement the workplace efficiency practices (Doeringer et. al 1998).

On the other hand, Benders (1999) sees a rhetorical adoption of lean. In order to validate his research he used the case study of DAF, a Dutch truck manufacturer. His findings suggest that lean implementation at DAF cannot be considered a substantial adoption. He emphasizes that the lean thinking is built on a quality improvement project called "Sociotechnology". "Sociotechnology" was previously implemented at this plant, but the project was not completely finished because its initiator died unexpectedly and the factory was sold afterwards. (Benders, 1999) agrees that some organization concepts like lean will always leave room for interpretation (has to be applied in various situations) and performance improvement (has to gain the acceptance of different parties involved, preferably all).

All in all, due to its uneven diffusion and adoption in the industries expressed by Abo (1994), Doeringer et al. (1998) and later by Benders (1999) lean had its critics who doubted its coherence as an enhancement of processes in production concept.

On the contrary, Womack et al. (1990) suggest that lean can successfully improve processes. They see lean as a replacement for both craft production and mass production, known for their outcomes in respect with quality issues. Moreover, they consider lean manufacturing as the one and only system that will be used in the 21st century. The authors developed the Just-in-time (JIT) pillar from Ohno's Toyota Production System construction and put it on the foundation of the newly born production paradigm. By doing so they strengthened the idea that lean as a manufacturing technique, trough JIT, removes all the waste in processes by eliminating even the smallest inventory production buffers. Conney (2002) has a more moderate approach. He considers lean as a production method that was developed in addition to other systems rather than overthrowing them. He considers that even though batch or craft production systems adopted lean in order to enhance productivity, this does not necessarily mean that they are 'in transition' to lean. Therefore, multiple types of production system can cohabitate. Conney (2002) he empowered his theory by stating the example of Daimler-Benz that adopted deliberately only some of the lean tools to improve the overall effectiveness of the company.

Lean philosophy is built around waste reduction in processes and enhancement of the value-adding processes. Dobb (1973) criticized Adam Smith's and David Ricardo's

theories of value, emphasizing that the theory cannot readily explain the transformation of values into prices and profits. Nowadays, lean is contested because of its difficulty of transforming the value added concept into measurable return of investment and market success.

Papahristodoulou (1994) suggests that lean thinking concept is not sufficient to explain the Japanese superiority unless favourable macroeconomic and microeconomic conditions prevail. He built his argument by criticizing some inconsistencies in Womack, Jones and Ross study. According to the author, Womack et al's (1990) book has several inconsistencies , some of them present at the beginning of the book. The first inconsistency is the absence of a definition for the main concept of the book : lean. By lean several terms can be understood. Lean can reffer to Just-in-Time, to how a factory is run, to how a car is designed or how a supply chain is coordinated. Furthermore, the author claims that the methodology used by the researchers in the IMPV group (International Motor Vehicle Program) is rather biased against mass production. He suggests that the benchmarking made by Womack and his assistants is not quite relevant. When Womack built his argument, the author compared a Japanese factory named Takaoka with a GM factory from Farmingham in the year. The issue adressed by Papahristodoulou (1994) refers to the fact that Farmingham factory was surveyed in 1986 while in 1989 at the time Womack et al., (1990) wrote the book the factory was already closed because of its poor productivity and high costs. Papahristodoulou (1994) considered that Womack and his assitants in 1986 knew that the factory is going to be closed, so when they refered to it as a bad example of working procedures. His issue was that the working rules and procdures were not respected because the bankruptcy of the company was very clear amongst the employees and the employees were not motivated.

Lean has its critics from the technical point of view. Kochan et al. (1997) expose the limitations of lean concept arguing that employment relations and labour markets influence the lean implementation negatively. Furthermore, Rinehard et al. (1997) open a debate in order to answer some questions regarding workforce happiness in a lean environment. The authors interviewed engineers and workers from transplants in the United States and Canada. They concluded that the first strike that took place in a US transplant in 1992 had its causes in the working conditions. Additionally, many of the working procedures of the staff were associated with lean procedures and rules.

Consequently, most of the technical critics of lean have the same root. They expose similar concerns regarding working conditions in a lean environment, most of them

considered to be demanding and generating stress related disorders. These are likely to appear due to the working conditions and procedures (De James et al. 1997). However, there are studies that are criticizing lean technically, but using a different approach. According to Potter et al. (2007), lean in difficult to be implemented in HVLD (High Volume Low Demand) manufacturing. Their study strenghtened Mason-Jones et al.'s (2000) study whose findings suggested that the HVLD products belong to the Agile paradigm. However, the majority of the Japanese automotive companies achieved relatively high levels of flexibility by producing relatively small lots of models. Unfortunately, reletively was never defined in absolute figures.

The eventual technical inconsitencies were further debated in the literature. Cusumano (1994) analysis the two companies known as market leaders at their time in the Japanese automotive market: Toyota and Honda. Toyota developed this small-lot JIT manufacturing approach through different tools and concepts like milk-run or setting the supplier in the same site with its assembly facility (geographical concentration). Toyota is well known in the industry mainly because of their JIT production, while Honda is well known for its intensilvely product development and innovation. Cusumano focuses on the practical aplicability of the theories that these two companies are using in their manufacturing strategy. Cusomano (1994) notices that Toyota's Just in Time policy is not functioning in highly congested urban areas. Moreover, Cusumano enumerates the limitations of lean in production and product development adoption. The author even proposes solutions for the limitations of lean implementation. For the urban congestion and long geographical distances he proposes less frequent deliveries and more EDI (Electronic Data Interchange) linkage. For the supplier stress issue he proposes more attention to the supplier needs. For the shortage of the blue collar workers, his solution is the outsourcing of the manufacturing process overseas. Nontheless, the factors that influence lean implementaion in Japan seen by Cosumano are specific to the Japanese culture: the scarcity of resources, the geography or the shortage of workers (women at that time were not allowed to work in the factories). Form this pont of view the limitations of the study are somehow evident.

Price (1994) tried to reconcile the criticized pros and cons regarding lean, in his research paper "Lean Production at Suzuki and Toyota: A Historical Perspective". He questioned himself if lean taps the worker's creativity or is a management-by-stress technique. He concludes that at least in the Japanese culture lean improves a business. Furthermore, he considers that lean as a concept diffused in the Japanese

industry, many companies, not necessary in automotive industry adopted it (Price, 1994).

Another interesting critique has been done by Wickens. Wickens (1993) emphasizes that Lean, as a system in equilibrium, is fragile. He built his theory on some of Ohno's (1998) assumptions. Ohno (1998) was the first to introduce in a manufacturing system the idea of KAIZEN, or continuously improvement. Each time the system was in equilibrium, Ohno would remove a man, reduce the material and create a new problem that had to be solved. By doing this Ohno initiates another state of equilibrium that will be eventually tested in the future. If this equilibrium is threatened, the system might collapse (Wickens, 1993). Even the founders of the lean concept Womack et al. (1990) warn that the lean is fragile if it is not properly implemented and continued. Wickens (1993) debated the lean equilibrium from the human resource management point of view. He sees the Trade Unions as the biggest critics of lean. In the early 90s, The Japanese Automobile Workers Union published a material in which the main discussions were focused on three points. Firstly, the workers were exhausted. Secondly, the Lean (m.n.) automobile manufacturers were making very low profits. Thirdly, the Japanese automotive industry in Japan is always bashed from overseas.

Interesting to notice, at the time lean became more and more popular in Western Europe, in Japan there were urgent debates among trade unions about quality of work in lean enterprises and Kariosi (death from overwork) (Berggren, 1995).

2.3 Agility – Introduction

Agility as a concept was introduced in the early 1991 by researchers from Iaccoca Institute. The currently accepted definitions relate agility to the capacity of the enterprises to respond quickly and effectively to unexpected changes in market demand (Sharifi and Zhang, 2001). After it was empirically researched, the scholars stressed that agility can be achieved through integration of three elements: the organization, the highly skilled people and the advanced technologies (Kidd, 1994), (Gunasekaran, 1998).

In general, agility is used in a customer facing sense (e.g in an external context) as the ability to respond and benefit from market changes, for example by suggesting additional inventory buffers, spare capacity, or by postponing the product customization (Ravet, 2011). In particular in this thesis the agility is seen as the

ability of a structure to be responsive with the order processing and expedition in front of the customer's demand as well as the distribution department's ability to deliver quality service to the customer.

2.3.1 The agility paradigm – theoretical approach

In the 90s Ernest and Young in one of their business studies exposed an interesting calculation formula of a company's flexibility and responsiveness. Ernst and Young's specialists proposed a ratio between the customer's demanded lead-time (CT) and the combined supplier, in house and distribution lead-time (CM). Naturally, CT/CM will be below 1, causing a company to manufacture, store and forecast goods. As companies are reducing CM, CT/CM increases so there will be less forecasted inventory needed. Hypothetically, if the ratio CT/CM equals 1, which obviously is the ideal state, all in-house supplier activity can be accomplished to order. While there are industries where the T ratio is higher than M ratio such as furniture, automotive spare parts, or printers (Lowson et al. 1999, Womack and Jones, 1995, Davis, 1993) there are also industries where CT=CM=0 such as food and groceries or even textiles (Fisher et al., 1994, Christopher, 1998). In the industry where the case study company activates has a CT/CM ratio close to 1. This aspect features potential strong variations between customer segments. Even though the companies try to compress the CM, there will be customers not willing to wait for a product. Therefore MTO cannot cope all the time with the customer's demand. Nowadays the customers regardless of the industry in which the demand is placed are demanding the product rapid and cheap.

Christopher, (2000) sees the origins of agility in the Flexible Manufacturing Systems (FMS). According to De Toni, (1998) FMS are systems capable of reacting in front of changes whether these changes are predictable or unpredictable. Christopher (2000) considers that enterprises cannot be agile and lean at the same time. He tests his hypothesis validity in the textile industry through a case study. The conclusions of this study show that the benefits of lean are restricted in the factory. Moreover, waste in material and informational processes can be removed internally, in manufacturing processes or through stock reduction. The author proposes that the benefits of agility can be achieved through external integration in a virtual, informational supply chain. In this respect he uses the example of a global textile manufacturer. The conclusion is as follows: The case study example is lean in-house. The case study example executes all the

value added processes inside the factory such as labelling, cutting or packing. Simultaneously, the case study example is agile because he outsourced most of the non-value adding processes like transportation. Christopher's (2000) study is the most robust one in treating the two paradigms. The study debates the decoupling-point concept both as a specific point in the supply chain that holds a certain stock level and as a concept that separates the two paradigms in a supply chain. Moreover, he suggests that the material decoupling point should be as downstream as possible while the informational decoupling point should be as upstream as possible. Agility through outsourcing is achievable, but is difficult to consider it as a rule for a supply chain on its way to achieve flexibility and responsiveness. Relative to the outsourcing relevant failures were researched by Stratton and Warburton (2003). However, Gunasekaran and Ngai (2005) argued that a company might become agile and responsive when it focuses on its core competencies. They agree that the agility state may be achieved by outsourcing the activities that are not adding value in a company.

While most of the researchers focused on conceptual differences or similarities between lean and agility in supply chain in theory, the transition from the holistic approach to the functionality issues of the agile and lean supply chain management integration is considered only in few papers. One of the few papers debating the functionality of the paradigms is authored by Power (2005). In his study Power analyses the vertical and the horizontal integration of the supply chain, emphasizing the necessity of effective information links with trading partners. Conducting a strong literature review, the author creates a framework for analysing the supply chain integration, the strategy, the planning and the implementation issues of lean practices in supply chain management. Moreover, Power proposes waste removal in the supply chain practices, even though the waste has non-conventional forms. In this respect, in the analysed study, the supply chain integration is seen as removing communication barriers and eliminating redundancies (Power, 2005). In other words the information improving processes by technology adoption which are considered to be agile enablers are able to generate waste removal, which is traditionally a lean enabler. After establishing the two main analysed terms: physical logistics and information flows, Power considers the issues experienced by physical logistics, part of a poor integrated supply chain generated by the customers, such as decreasing levels of standardization of products and demands for customization; customers demanding shorter delivery lead times; increased levels of competition due to globalization

and lowering of tariff barriers; and increasing levels of dynamism (Power, 2005). As a method of vertical integration, or establishing a strong supplier base, to the above exposed issues, partnerships, alliances and co-operations are proposed for better information flow, and quicker flexibility in customers' needs response. Additionally, in respect with the strategic planning, Power uses the examples of Dell Computer and Gateway as companies that have managed to move supply chain management from the realm of operations into a source of competitive advantage.

The academics suggest that besides the uncertainty environment, traditionally seen an agility enabler, there are other enablers that are influencing agility. Johansson et al. (1993) consider the outer integration a necessary condition for a company to be agile. He defines Value as Quality x Service/ Cost x Cycle Time. Furthermore, the authors name for each variable the main proprieties. For Quality there are Meeting the Customer Requirements, Fitness in Use, Process Integrity, Minimum Variances, Elimination of Waste, Continuous Improvement. For Service there are Customer Support, Product Service, Product Support, Flexibility to Meet Customer Demands and Flexibility to meet Market Changes. For Cost the purpose the design and engineering, Conversion, Quality Assurance, Distribution, Administration, Inventory and Materials. Finally for Cycle Time there are the Time to Market (Concept to Delivery, order Entry to Delivery), lead Time (design, engineering, Delivery), Materials and Inventory. Researchers like Hormozi (2001) and Yusuf and Adeleye (2002) consider agility as a world-class quality of a manufacturer, stressing the need of adoption of this manufacturing tool. Furthermore, Bustelo-Vasquez et al. (2007) expose the risk of agility adoption without the adoption of the necessary agile models simultaneously.

Researchers like Swafford et al. (2006,a) argue that flexibility enables a firm to adapt its delivery schedules to unpredictable or rapidly changing customer requirements, thus providing the potential for gaining competitive advantage based on delivery performance. However, unpredictability is likely to generate additional costs. If you have to deliver in 24 hours a smaller quantity than usual, that is pure cost increase. Therefore, sometimes even agile distribution has to be managed in respect with the generated costs.

Bowersox et al. (1999) exemplifies the rule of postponement and MTO integration referring to Compaq, which simplified the structure of its products and reduced the mix of products to enhance the implementation of the MTO strategy. MTO

strategy involves building a product only when an order is placed in the system by an end-customer. An MTO prerequisite involves also "zero inventory for Work in Progress materials" or ending the day with empty tables (Wagner et al. 2003). Long before leanness and agility were empirically defined, Bucklin (1965) had an interesting approach on dealing with the values that form the core of these two concepts. He argues that the principle of postponement combines the two paradigms. Bucklin (1965) sees the system, which uses the principle of postponement responsive because it moves the differentiation of the product nearer to the point of consumption where the demand is more predictable. Therefore, an order can penetrate unmodified the supply chain's pipeline. Simultaneously, the system is considered wasteless and efficient because is capable of savings through process improvement. The savings occur as economies of scale as bigger quantities are sorted and transported through the supply chain pipeline.

A very interesting approach of the agile paradigm in respect with the lean paradigm has been made by Hines. Hines (2005) identified four stages in the lean development: The first stage is called the Awareness Stage . The stage began in the early 80s and lasted until early 90s. The main theme of this stage was the Shop Floor Practice with strong focus in Just in Time techniques and tools. The industry that applied predominantedly the lean tools was the automotive assembly industry. However, there were obvious gaps in this early stage: the waste removal was somehow narrow focused, the applicability of lean was inside the company, but not outside.

The next development stage identified by Hines is the quality stage. This stage begun in the early 90s and lasted until mid 90s. At that time, the best practice benchmarking was developed. The focus was on cost, quality and reengineering. Comparing this stage with the awareness stage, the lean applicability spreaded to the supply partners of the automotive assembly companies. On the other hand, one of the gaps of this era was the lack of holistic perspective, and the absence of the human element in the middle of the processes.

The quality stage develped in the mid 90s. The result was The Lean Enterprise. Its focus was mainly on cost and on processes of quality, cost and delivery. The lean concept spreaded all over the manufacturing scheme. However, the proces lacked the spread in the whole supply chain in order to achieve the best results in lean implementation.

Last decade, Hines (2005) identified the fourth stage of the lean development called the Vaue System. The focus in this stage was on value and cost, with most of the processes integrated. It spreaded throughout the manufacturing and throughout the supply chain. Moreover, it spreaded even in the services sector. Nontheless, gas were identified in this stage as well. The most important gap that is directly linked with this research is: the inability of lean to be implemented in low volume manufacturing or environment. In other words, lean is likely to be unsuccesffull in environments with low volumes of processes, people or products. In this stage they were other gaps identified such as issues of strategic integration or total system capability. According to Hines, the industry is nowadays into the Value system stage, in which value is delivered to the end-consumer. Relative to the advantages that the two paradigms can deliver Mason Jones et al. (2000) developed a matrix in which the market qualifiers and the market winners of the lean and of the agile supply chains are exposed. These are exposed in the following table.

	Market Qualifiers	Market Winners
Agile Supply	1. Quality 2. Cost 3. Lead Time	1. Service Level
Lean Supply	1. Quality 2. Lead Time 3. Service Level	1. Cost

Source: Mason-Jones *et al.*, 2000

Fig. 2.1. Market Winners and Qualifiers (Mason-Jones et al., 2000)

The two paradigms were recently analysed from the purchase viewpoint. Drake et al., (2013) in a study debated lean and agility in purchasing portofolio models. They argued that as far as lean is for standard components and agile for innovative components, then products that have the both characteristics should be approached through leagility. Therefore components that have a high impact on both flexibility and costs have to be approached through leagile purchase strategy.

2.4. Leagility - Combining the two paradigms

Before leanness and agility were properly defined, Ray (1990), in an Ernst and Young study on quality improvement in processes, proposes a mix of agility and

lean characteristics terms into a process called Total Quality. Ray (1990) saw the source of competitiveness as a mix between supplier integration and cost control.

Browaeys and Fisser (2012) argued that it is very difficult to define empirically leanness and agility. Generic hybrids have been usually defined to clarify and potentially satisfy the conflicting requirements of low cost and fast response (Mason-Jones et al., 2000, Christopher and Towill, 2000). Their definition can vary depending on discipline, point of view of the researcher and/or researcher's academic experience. However, Bertelsen and Koskela (2003) define it as a system with the central aim of increasing efficiencies by banishing waste, i.e. anything that does not add value. This elimination of waste would lead to a more cost-efficient use of resources and develop a value stream. Moreover, Naylor et al. (1999) define agility as a system that is using market knowledge to exploit profitable opportunities in a volatile market, which requires the slashing of process lead times and costs throughout the chain.

According to Van Hoek (2006), a specialist in agile logistics, in a turbulent market where the product life shortens, the product variety increases and the customer demand escalate the proper method to face these challenges is to combine agile customization with lean production efficiency within one supply chain.

In order to better understand the eventual similarities or differences between the two paradigms, lean and agile, their empirical definitions will be reiterated. According to Naylor et al. (1999), agility requires the use of market knowledge and a virtual corporation to benefit from rapidly changing market opportunities. Leanness requires elimination of all forms of waste, including time and it requires the implementation of a level schedule. From the initial empirical definitions of the two terms many researchers attempted to critically border the two concepts.

The diffrence between agility and leanness has been debated by Aitken et al. (2002). In the beginning of the study, the authors consider lean as a necesarry pre-existing characteristic for agility. The study is focused on a lighting factory that implemented some lean tools and principles embracing the automated and rigid manufacturing procedures. One of the study’s conclusion was that no single paradigm can provide a matching answer meeting all possible market demands.

Hicks (1999) stressed there are two different approaches for improving supply chain’s flows either by focusing on information technology or focusing on

logistics processes. The first approach considers information as the key to supply chain improvement. Its primary focus is on collaborative planning, sharing information and getting companies synchronized with suppliers and customers (Hicks, 1999). The second improvement is more internally focused and is concerned with quantitative analysis of complex logistical problems. He states that: the future of supply chain strategy lies in the convergence of these two paradigms (Power, 2005). Relative to the implementation, Power proposes one of the two models described above: Agile versus Lean supply chain models. Simultaneously he admits that the difference between the two systems has been a source of considerable debate and academic conjecture. Nevertheless, it is clear that either one of the model's implementation needs to be accompanied by significant vertical and horizontal change. Furthermore, he points that all these changes meant to offer in the end the well-wanted competitive advantage, associate costs, especially in the area of process re-design and in many cases the development of entirely new processes (Power, 2005).

The debates regarding which paradigm is more competitive continued long after the early 90s. Mason-Jones et al. (2000) suggests that agility has been recommended in the beginning of the century as an alternative to the lean manufacturing, developed a decade ago by Womack et al. (1990). However, Bustelo-Vasquez et al. (2007) argues that the literature that clearly demonstrates the Agility's advantage over lean in the organization that implements it is very scarce. In a case study from the Spanish automotive industry they test the agility as a functioning paradigm and the eventual causes that are influencing the implementation success. They also observe that in literature the agility was promoted as a successful paradigm, but without the proper tools for implementing it. The results of the study show that agility can exist in an enterprise only if several conditions are met. The first condition refers to empowered employees trained to work in teams; these teams involve individuals from different departments working for the same targets. The second condition is technological and involves the use of advanced technologies. The third involve the internal integration of operations as well as the integration of these operations with the supplier and with the customer. The majority of the researchers suggest that the internal integration process is one of the most important drivers of the agility. The forth reason is the knowledge management. Moreover, in the end of the study a turbulent environment was found to be the driver for agility. Hence, in his comprehensive study Bustelo-Vasquez et al. (2007) concluded that agility is

appropriate in uncertain environments that are changing because the fluctuant habits of the customer.

In an attempt to delimit the two terms Olhager and Prajogo (2012) stress that lean is mainly suitable for Make-To-Stock strategies while agility is applicable to Make-To-Order systems. Arreola-Risa and DeCroix (1998) or Rajagopalan et al. (2002) had a different approach, more quantitative and tried to model MTS and MTO mathematically. Olhanger and Prajogo (2012) sought the potential difference between these two systems through a survey. Olhager and Prajogo (2012) applied three external variables to the two systems such as limited supplier base (the selection of suppliers on competitive basis), lean practices and supplier integration in order to check the impact of these factors on MTS or MTO paradigms. The findings of their study are somehow predictable. The lean practices that are automated have a bigger impact on MTS system, while the customer integration has a bigger impact to the MTO systems. Olhager and Prajogo's (2012) findings empower Christopher's (2000) findings on lean practices in inventory. Christopher (2000) argues that leanness implementation is likely to be beneficial in the internal processes rather than in external relationships with the business partners. The findings related to the supplier rationalization show that this variable has an impact on both MTS and MTO systems. By applying the supplier rationalization policy, the MTS system removes waste by improving the information flow (less suppliers involves better coordination in the purchase function). Due to the information flow improvement an organization is likely to become more agile after implementing the supplier rationalization scheme.

In a comprehensive study, Narasimhan et al. (2006) attempt to delimit the two terms lean and agile. They analyse the paradigms from the manufacturing and from the performance capabilities perspective. The study delineates how agile and lean differ. In addition, the study aims to figure if agile and lean are competing or they are complementary concepts. They surveyed 130 plants in the United States segmenting them after the study in three clusters: the poor performers (companies that did not adopt any lean or agility practice), the lean performers (companies that adopted lean practices) and the agile performers (companies that adopted agile practices). Unfortunately, the results findings did not delineate the terms. However, the findings were valuable as they suggested that the agile performers

overtook the lean performers in the designed performance indicators, with the possible exception of the cost efficiency.

Other researchers like Aitken et al. (2002) argue that the two paradigms can co-exist in a supply chain. Aitken et al. (2002) developed a framework based on an extensive literature review an tested it in a case study of a lighting manufacturer that made the transition from 'traditional' via 'lean' to 'agile'. They managed to achieve the results by producing both commodities (lean products) and customized (agile products) in the same site. However, the study's conclusions were not stressing firmly the conditions or the limitations based on which leanness and agility can co-exist and they refer to manufacturing.

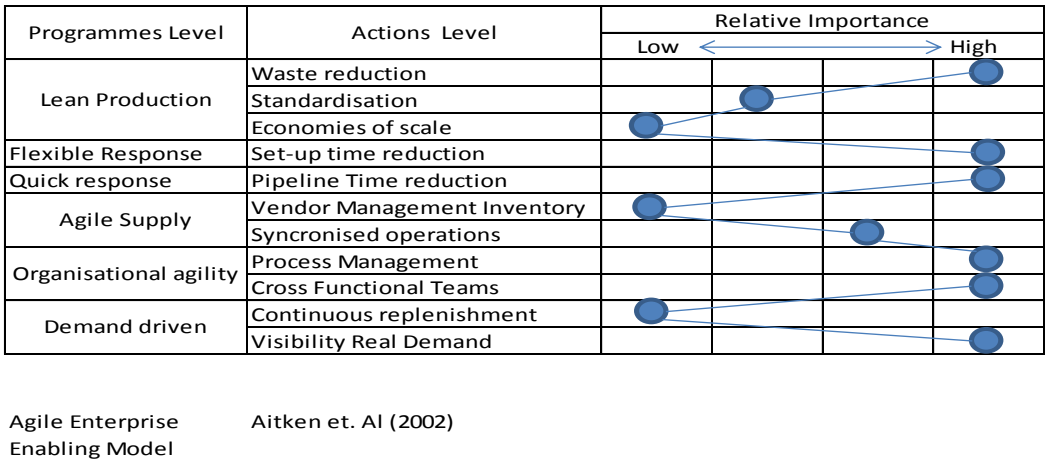


Fig. 2.2. Agile Enterprise Enabling Model (Aitken et al.,2002)

Kisperska-Moron and de Haan (2011) researched the leagile paradigm in another case study on a Polish distributor. They summarized lean as supply 'what, when needed but do this perfectly' whereas agile aims to be 'the first, fast and the best'. They analysed both paradigms in the logistic processes of a polish fast moving consumer goods distributor. Surprisingly, they argued that the distributor actually became lean after it was agile. They stress that five years ago, when the market demanded a less than 24 h distribution time, the distributor had to be agile in order to be able to satisfy both the customer and the supplier. After five years, the market itself matured, and the local shops did not need both frequent and fast delivery. This happened mainly because their turnover time was not that fast. Moreover, stock keeping was possible. Therefore the speed of delivery increased from 24h to 48 h. The increase of the delivery time according to Kisperska-Moron and de Haan (2011) had other causes, too. When the distributor was forced to deliver in 24 h, he was the most rapid and agile, lacking both in quantity and

quality aspects. The agility pressure had negative aspects on the enterprise. The distributor had to balance the push strategy of the Supplier with the pull strategy of the customers. When the market matured, and the consumers knew 'what they needed' the distributor became lean and increased its efficiency in respect with the quality and quantity of the goods provided. However, they increased the delivery time to be able to control the quality of its processes. The agility in the case of the polish distributor became overly expensive and counter-productive, exposing the company to a last minute crisis (Kisperska-Moron and de Haan, 2011).

Stratton and Warburton (2003) consider the combination of lean and agility more like a continuum. They argue that even lean operations have to face variations and the JIT principle, which is one of the fundaments of the lean paradigm, is sometimes under capacity scheduled. Nowadays, there is a significant trend in the laminate flooring industry towards instant delivery, which the present case study will severely illustrate.

All in all, a leagile supply chain can be defined as follows: A leagile supply chain involves simultaneous coordination of the upstream lean processes with the downstream agile processes. Moreover, a leagile supply chain has to decrease lead-time while simultaneously increase variety. However, both paradigms have to be integrated conceptually in the supply chain in general and logistics in particular.

The outcomes of the research analysing the two paradigms show that both lean and agility are delivering quality based on its own market winners and market qualifiers. The results are calling for a closer analysis on these two paradigms and on the possibility for them to co-exist as a functional hybrid system in a supply chain. Moreover, scholars like John Gattorna argues for a dynamic design of the supply chain capable of embracing both of the paradigms because he stresses that different types of demand (stable and volatile) can in fact exist for the same product, even among the same customer depending on when he/she desires to buy the product. Therefore, in the next chapter different positions of the decoupling point will be debated Leanness and Agility will be debated.

2.3.2 The Decoupling point

In the following chapter the theoretical and empirical attempts of separating the leanness and agility as congruent paradigms in a supply chain is reviewed.

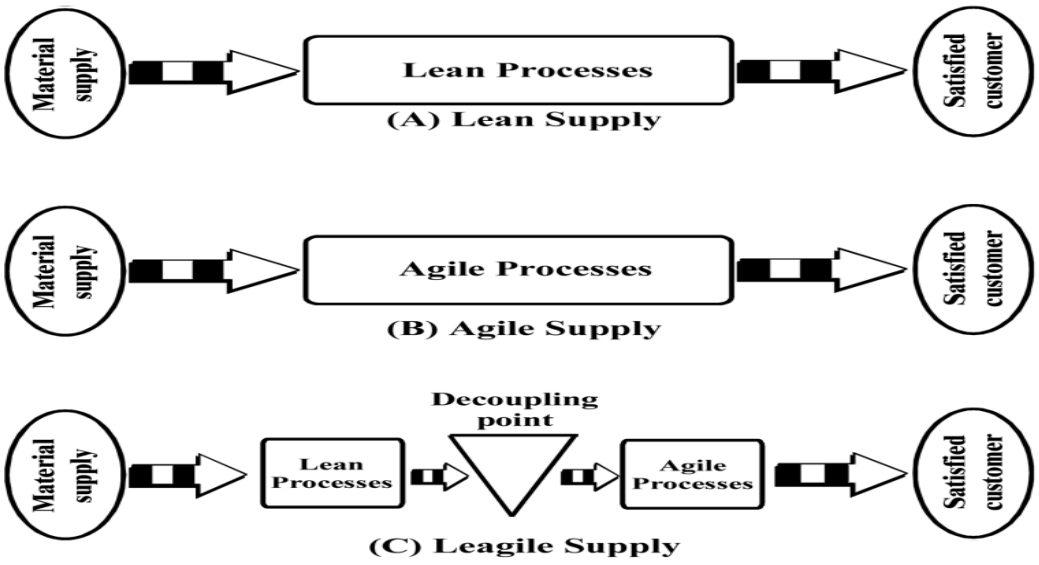
In a plethora of studies researchers tried to combine the lean and the agile paradigms in the supply chains. Interestingly, years before lean and agility were widely researched, Bucklin (1965) argued that the heavy and bulky products are likely to flow through channels with more intermediate and speculative inventories than the products with opposite characteristics. Later on, in a quadrant analysis, Fisher (1997) proposed an interesting reasoning on how to match products with supply chain. Even though he does not use lean or agility as specific terms, he proposes matches between efficient and responsive supply chains with functional and innovative products. Furthermore, he matches efficient supply chain with functional products, whereas mismatches the innovative products with efficient supply chain. For the innovative products he considers the responsive supply chain to be much appropriate. Moreover, he mismatches the functional products with the latter one.

Fisher (1997) advances two types of supply chains for separate categories of products: functional and innovative. Firstly he defines functional products as having a longer life cycle. Secondly, he puts them into the category with low margin 5 up to 20 %. Thirdly, functional products have a lengthy lead-time. Lastly, the average margin of error in the forecast at the time of production is up to 10 %. Fisher on the other hand defines the innovative products as having the following characteristics: short product life cycles, less than a year, higher contribution margin, up to 60 %, high error probability in the forecast, with a minimum of 40 % and shorter leas-times, maximum 2 weeks.

Concluding, for the functional products he proposes a physically efficient supply chain while for the innovative products he suggests the market-responsive supply chain. Furthermore, according to Fisher (1997) in the respect with the inventory strategy the physically efficient SC generates high turns and minimizes the inventory throughout the chain while the market-responsive SC deploys significant buffers of parts or finished goods. Basically, Fisher (1997) proposed a clear separation in time and space of the two paradigms. He initialized a system where the two paradigms can function in parallel but with certain limitations such as different factories and different distribution schemes.

Mason-Jones et al. (2000) follow the use of Fisher's theory trying to define rules of assignment for products to efficient Supply Chains. Similarly with Fisher they stress the concept that the Supply Chain Management uncertainty is induced and amplified by the bullwhip effect. The bullwhip effect is also known as the

'Forrester effect'. It was described for the first time, in an article, in a 1958 Harvard Business Review issue by Forrester. This effect is linked primarily to delays and poor decision-making concerning information and material flow. However, Jones et al. (1997) propose a useful lean analytic tool for managing and reducing the fluctuation of the bullwhip effect called Demand Amplification Mapping. Moreover, Mason-Jones et al. (2000) build a concept that assign rules as market winners or qualifiers for a better match of products with the most efficient supply chain: lean or agile. The researchers try to validate the theory through three case studies: one lean, one agile and one 'leagile'. The latter describes a system where the two paradigms are functioning allied in a hybrid environment.



Source: Mason-Jones *et al*., 2000

Fig. 2.3 Lean/Agile Supply Chain Pipeline (Mason-Jones et al., 2000)

Christopher and Towill (2002) developed Mason Jones et al.'s (2000) leagile matrix. They stressed that the connection between the market winners and market qualifiers as well as the connection between lean and agile are critical in the two paradigms definition. Christopher and Towill (2002) simplified the definition of the two paradigms and concluded that when service and customer value are the prime requirements then agility is the recommended supply chain approach. Relative to the lean definition, Naylor et al. (1999) interpreted the lean paradigm as a value stream development for waste elimination and leveling schedule.

Relative to the advantages delivered by either lean or agility, Cristopher (2000) argues that the competitiveness based on price is a leanness characteristic. However, the leanness sometimes is seen as a threat for the inventory availability performance through obsolete inventory for instance which undoubtely is an

agility atribute. Cristopher (2000) considers that lean concepts are working well where the customer's demand is predictable whilist a much higher degree of flexibility is required where the demand is volatile and the customer demand for variety is higher.

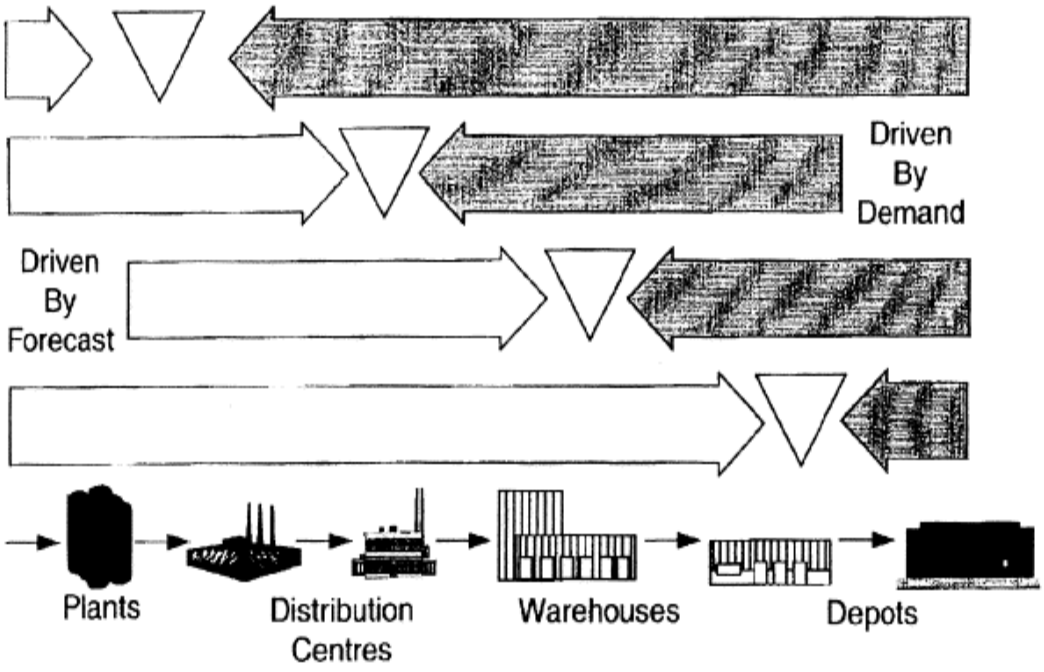


Fig. 2.4 Decoupling point positioning (Christopher et al., 2000)

Moreover, Aitken et al. (2002) considers as a minimum requirement or as an order qualifier for agility the delivery of the right product, at the right place, at the right time to the consumer. This quality seen a decade ago as an order winner can become nowadays just an order qualifier. In this respect, Hill (1993) identifies a cyclical nature of order qualifiers versus the order winners. He considers that this year's competitive advantage or winner becomes next year price of entry or qualifier.

Goldsby and Griffiths (2006) tested the similar concepts that underpin 'leagility' that were used by Christopher. From their research different conclusions can be drawn. They studied a 'leagile' case involving a Toyota dealer where some of the parts were lean manufactured, while the others were available based on a customer's customization. Not surprisingly, the customization parts were manufactured based on a MTO system using the postponement strategy. Goldsby and Griffiths (2006) concluded that the agile paradigm has the origins in the postponement technique. This postponement technique maintains a full-line anticipatory inventory in one or a few strategic locations. In other words, the customization is made possible right before the last selling point. Goldsby and

Griffiths (2006) consider this case as ‘leagile’. However, the ‘leagility’ in this example has its limitations because not all the products can be assembled using this technique. (e.g. building material products).Moreover, more important, the customer's choices were restricted to the customizable products, ready to be made based on a Made-to-Order (Onwards MTO) policy.

Relative to the two paradigms delimitation, Naylor et al. (1999) suggest a decoupling point between leanness and agility. The decoupling point separates the part of the organization oriented towards customer orders from the part of the organization based on planning (Naylor et al. 1999). However, the authors are suggesting that lean manufacturers have to become agile at a specific point due to competitiveness. Therefore, lean and agility cannot be seen in isolation. Moreover, the researchers propose a strategy of becoming agile from lean by keeping a minimum reasonable inventory (MRI). The MRI is partially solving the issue of an inventory, which eventually represents waste based on the lean principle but offers a buffer stock that enables an enterprise to have a certain degree of responsiveness. The MRI must be built based on market knowledge. However, they do not propose an algorithm based on which the level of MRI can be calculated. Nonetheless in this respect Naylor et al., (1999) stress that if a company becomes agile has to be careful with the level of MRI in order to be responsive when the customers are demanding this.

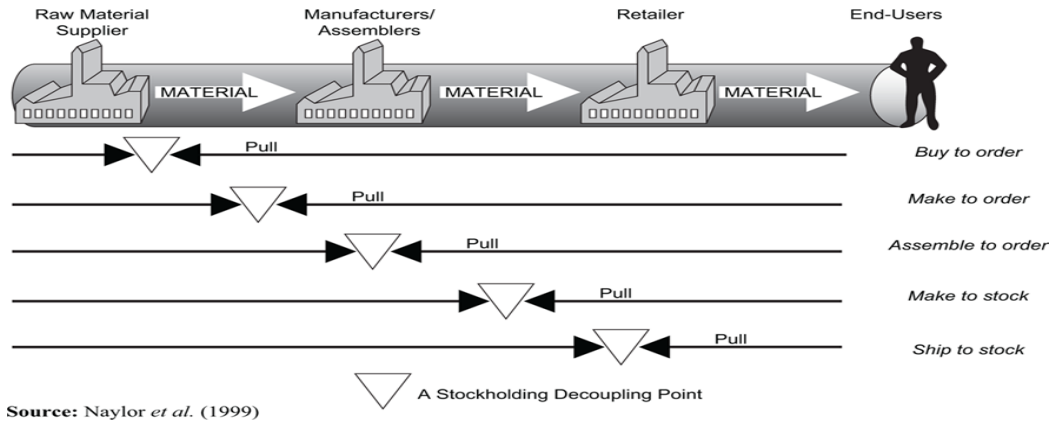


Fig. 2.5. Types of manufacturing strategies (Naylor et al., 1999)

Naylor et al. (1999) attempted to research the lean and the agile paradigm and apply it in a case study from the manufacturing environment. The results generated a theory that accepts the co-habitation of the two paradigms in the same Supply Chain. In addition, they validated the theory in a case study. They cite a case study made by Johansson et al. (1999) about a carpet factory from United

States of America. He stressed how leanness, though waste removal can contribute to the shortening of the lead time and how agility can contribute to a wider offer in matter of assortments for the customer. However, the agility was born in the company due to a technological breakdown. The carpet company had to change the carpet assembly line and bought an innovative carpet paint machine. It is doubtless that this technology breakdown is able to create agility. Nonetheless, probably not even a small percentage of the manufacturers can benefit from a technological breakdown in a year. This argument sustains the presumption that it is not a direct link between agility and technological innovation.

For a better match of the two paradigms, which eventually share some common characteristics, Naylor et al. (1999) rated the importance of the main characteristics in each of the paradigms. Naylor et al. (1999) ranked the importance into three categories: essential, desirable and arbitrary. The findings suggest that leanness and agility share three similar characteristics: the use of market knowledge, the virtual corporation and the lead-time compressor. Through the use of market knowledge, the authors emphasize the idea that all the businesses in a supply chain have a strong focus on the end-user. Womack et al. (1990) consider that a big extent of the companies' success in operating lean is based on the sound knowledge of the consumer market as well as a strong supplier base. Therefore, the lean enterprise will produce the exact quantity demanded to justify the cost, and the agile enterprise will be responsive for the actual demand without any extra stock. Through virtual corporation, the authors stress that companies are working together to meet the demand of the end-user no matter what paradigm is adopted. By lead-time compression the authors understand that a lean company will enhance their lead-time by removing the waste of time. Likewise, the agility itself requires a responsive supply chain. On the other hand, there are similar characteristics of leanness and agility as such waste removal and the smooth demand. While in lean the waste removal is seen as essential, in agility is seen only desirable or optional. While in lean the smooth demand is essential, in agility is arbitrary. One of the pre-condition of a 'leagile' enterprise according to Harrison and van Hoek (2005) is ‘cost of the complexity check’. By cost of the complexity check the authors stress that an enterprise must be sure neither to go for agility at any cost nor for compensating with cost mismanagement. Moreover, Christopher (2000) warns that over-agility means proliferation of products and brands. Needless to say that the process of proliferation of products increases the

inventory costs. In respect with the waste removal Naylor et al. (1999) stresses that in a pure lean supply chain the inventory will be zero. Hence, he proposes a realistic view on inventory in lean called MRI or minimum reasonable inventory. Naylor et al. (1999) consider the MRI to be the point from where an enterprise can respond agile due to the existent minimum buffer stock. In other words, Naylor maps the decoupling point, as he concluded that lean and agility can be separated by the MRI. However, the level of inventory itself is considered to be waste in the lean paradigm. Hence, a from the inventory point of view, a company becoming more agile becomes less lean. Naylor et al. (1999) agrees that additional activities might also be required to provide the ability to be flexible. The MRI theory has been tested on a PC manufacturer. The results were somehow predictable. The PC manufacturer was lean until the MRI, predicting its production, simultaneously keeping a minimum level of inventory in regional hubs. From the MRI downwards, the manufacturer was agile and responsive with standard products produced in advance. These products forecasted to a certain level using the market knowledge formed the MRI (Naylor et al., 1999). Hence, the decoupling point acts like a buffer between the variable demand for a wide variety of products and the level production schedule for a smaller variety of components.

Hines and Rich (2001) delimit the forecast-driven system (push) from the customer demand system (pull). They consider the demarcation point as the point where products stop being made according to the actual demand and instead they are made against forecasts alone. According to the authors this point can be positioned anywhere between a National Distribution Centre and a Supplier. Hines and Rich call this flexible point Decision Point. For a better understanding and eventual further analysis they even propose a tool called Decision Point Analysis. The goal of this tool is to offer the researcher a broader understanding about why and where this point stands. The knowledge of where this point is situaed is found useful in two main aspects. Firstly, the pull and the push principles are properly applied throughout the stream. Secondly, as KAIZEN is happening, useful What if scenarios can be applied. These scenarios are useful to make a better design of future processes when the decoupling point is moved.

All in all, the decoupling point can be defined as follows: the point separates the upstream lean processes with the downstream agile processes. However, both lean and agile paradigms have to be integrated conceptually in the supply chain in general and in warehousing and distribution in particular in order to function

responsive and cost effective. If they function efficiently the transition from lean to agile and vice-versa is smooth enabling the supply chain to be both responsive and cost efficient. In the next chapter the concepts of supply chain and logistics will be debated with a focus on warehousing and distribution. All these terms will be discussed associated with quality delivery both in products and services.

2.5 Service Supply Chain and Logistics

If lean is excluded beyond the factory gates, potential conflicts may result: lean production is based on level scheduling and automation. The automation often conflicts with the volatile demand in the marketplace (Reichhart and Holweg, 2007). Against this volatile demand the lean distribution has to buffer against. The consumer's wishes and tastes are frequently changing in an ever growing rate in every industry. In particular, in the interior home improvement materials market, the consumers call for increasing decors, colours or even thickness of products. Moreover, the distributors are lowering the margins, implementing cost-reduction policies but preserving and even enhancing their responsiveness. For a customer to receive a product in time, at the correct price, in the correct quantity, there is a combined effort of all the members or the echelons participating in the product's delivery to the final customer. These members are part of the Supply Chain and besides the physical delivery of the product to the customer it also delivers services.

The term Supply Chain was introduced for the first time by the business consultants in the early 1980's (Lambert et al., 1998). Only ten years later the academics attempted to give structure to the term and to define it. The Council of Supply Chain Management Professionals (CSCMP) defines the supply chain management as encompassing: the planning and management of all activities involved in sourcing and procurement, conversion and all Logistic Management activities. Importantly, it also includes coordination and collaboration with channels partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, Supply Chain Management integrates supply and demand management within and across companies.

Handfield (2006) gives a simple and straightforward definition to the Supply Chain. The definition is based on the fact that each and every product that reaches

the final customer represents the cumulative effort of multiple organizations. These organizations together with their physical and informational flow form the supply chain of that product.

According to Baumgarten and Thoms (2002) each of the past five decades formed a new milestone in logistics' development. In the 1970s it was the classical logistics era. At that time logistics was concerned on the flow of the goods as well as on material flows. The orders times were long and the logistics was narrowly focused on warehousing processes, transportation, packing and freight forwarding. The logistic management began to develop only in next decade. The logistic was focused on optimizing the sequences of the logistic flows. Simultaneously, logistics' focus was on identifying the bottlenecks in the processes mainly between purchase, warehousing and distribution processes. All these segments were in form of interest at that time. Moreover, warehouses offered some value added services but most of them were focused on the quality control. Baumgarten and Thoms (2002) identified the third stage in the 90s. At this stage the logistic service began to be functionally integrated. At that time the logistics transitioned from a functional perspective to a flow perspective. The logistic focus integrated all the companies in the chain. The focus of interest was in the optimization of the supply chains (functional) and of the value chains (comprehensive integration). In the 2000s the customized end-to-end logistic solutions were born with an emphasis on the integrated supply network management.

An interesting definition with an emphasis on the customer role in the supply chain has been developed by Chopra and Meindl (2001). The authors define the supply chain as consisting from all parties involved, directly or indirectly in fulfilling a customer request. They also enumerate the participants in a supply chain, pointing that not only the manufacturers and the suppliers are part of the chain. They stress the importance of the transporters, warehouses, retailers or the importance of the customers themselves.

According to Davies and Manrodt (1992) customers began in the early 1990s to ask complete involvement of the companies in their non-routine problems. Until then, companies were more determined to reduce their operational costs. Therefore, the firms were more interested to develop their internal processes rather than listening to the demands of the customer. Davies and Manrodt (1992) exposed how external factors like the oil crises and interest rates determined the companies to change their approach. Moreover, Lambert and Stock (1982) show

how companies like Whirpool discovered the possibility of increasing the service level simultaneously with cost decrease policies. After all these changes in the logistic strategy approach of companies a logistic customer service concept was born. Zinszer and LaLonde (1970) empirically defined the customer approach as those activities that occur at the interface between the customer and the corporation, which enhances or facilitates the sales and use of the corporation's products or services. Therefore, customer service is all of the things that a manufacturer does for a customer in moving a product from the end of the production line to the customer.

In those years the competition between companies was focused on price rather than on services. Later on, the customer felt the need of service response after experiencing so many defects per bought products. Womack et al. (1990) stressed the market share drop of the American car manufacturers in front of the Japanese manufacturers mainly because the Japanese cars were superior in terms of 'quality'. Moreover, in the early 90s the people bought mainly Japanese products for the same reason.

The role of the logistic function in quality delivery was debated by Manrodt (1990). He defines three typologies of Logistics Functions. The first one is the Supply Chain Logistics. Its main goal is to physically supply and distribute the goods. The second one is the Service Logistics. In the Service Logistics the product is a necessary component of the service delivery. The third is the Service Response Logistics. This function is defining a responsive organisation that can respond rapidly to the customer requests.

The logistics services are continuously developing (Manrodt and Davis, 1991). Firstly, they developed through the introduction of the Electronic Data Interchange (EDI). According to Lambert et al., (2007) the EDI is an intercompany, computer-to-computer transmission in business information in a standard format. An EDI transmission consists only of business data, not any accompanying verbiage or free-form messages. Moreover, the logistics services are developing because the customer demands are constantly changing. Therefore, Manrodt and Davis (1991) suggest that the service logistics is an area with potential future growth, mainly because the service logistics coordinates the interaction between customers and organizations. Before reaching the service era, a logistic function used to be a part of production, distribution, marketing or quality department. The companies without a stand-alone logistic department

found out sooner or later that the desire for diversity of the customer was greater than their ability to profitably respond. It has to be noticed that Manrodt and Davis (1991) defined the two necessary pillars of a responsive organization. The first pillar is formed by the skilled personnel. These individuals are needed in order to plan and schedule the capacity of the enterprise. In this respect, a company has to invest in the acquisition of logistic capacity (warehouse, other logistic assets), skills and tools. Manrodt and Davis's pillar follows the lean concepts mainly planning and multi-skilled workers. The second pillar is formed by the front-line personnel. These individuals are needed for interacting with the customers to determine what is to be done after this interaction. In other words, how can the consumer demand be translated in logistic language? How quickly a company can respond to this demand? This pillar reminds us of agility concepts, of the capacity of a company to be responsive.

All in all, Manrodt and Davis (1991) point the difference between the traditional logistician who might check of the product is available and the service logistician that will check the availability in delivering the benefits to the customer. However, the service logistician will have budget constraints as well. Relative to this point, Mistry (2005) argues that lean is critical for cost savings while agility is critical in systems where service and customer value enhancement are prime requirements for obtaining and retaining market share. Therefore, for a better understanding of how logistics is designed to support both paradigms quality service in logistics will be debated in the next chapter.

2.5.1 Quality services in Logistics

Until Jones, Hines and Rich researches, all studies on lean or agile were focused on the supply chain as a whole, leaving the operational part of the activity under-researched and under-theorized. Few lean and agile studies in logistics were made, so the end of the review is focused on lean and agile thinking in logistics.

According to Larson and Halldorsson (2004) logistics and supply chain can be seen from four different perspectives: traditionalist, re-labeling, unionist and 'intersectionist'. In the traditionalist approach SCM is a subset of logistics. From the re-labeling perspective logistic is seen as re-labeled by the modern supply chain. In the unionist view logistics is part of supply chain whereas the 'intersectionist' view suggests that the two parts are separate and distinct. In this thesis, the research will adopt the 'intersectionist' view as in the case-study the

SCM and logistics are separated. Moreover, this stands as one of the limitations of this study that the author is aware of.

Logistics is a very important part of the Supply Chain. The Council of Supply Chain Management Professionals (CSCMP) defines logistics management as: the part of the Supply Chain Management that plans, implements and controls the efficient, effective, forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet the customer requirements. Therefore, the study itself focuses on the logistic function of the enterprise rather than on the whole Supply Chain. The aim is to get a better understanding of the lean and agile procedures, divers and enablers in the logistic function of a company.

Jones et al. (1997) draw a research focused on warehouse operations, which has sought to extent Toyota's policies beyond the factory gates. The authors highlight that all the perspectives and business solutions now run their course certainly as a stand-alone solutions of cost and lead-time reductions and waste process removal. After the problem definition and the outline of the logic, the authors highlight the likely reasons why all these methods had a limited impact in companies from fields other than automotive manufacturing. Furthermore, the authors are exposing how the Toyota Product Management can be generally implemented in logistics, specifically in warehouse management. Now, after the limits of the research papers cited above, this one focuses on a segment closer to the end-consumer, directly involved in cost, lead-time and quality assurance. In the beginning of the research paper, Jones et al. (1997) briefly reiterates the production lean tools used in Toyota Quality Process (TQP), insisting on targeting the improvements within the lean enterprise, by adding value rather than costs to the processes. After mapping the activities and the material flows, the authors analyse each TQP process, proposing seven processes out of the total to be used as specific warehouse activity waste-removal tools. These are: The process activity mapping, the Supply Chain response Matrix, the Production Variety Funnel, The Quality Filter Mapping, The Demand Amplification Mapping, the Decision Point analysis and The Physical Structure. For the reader to validate his research for gain a better understanding of the concept, the authors proposed a case study from the industry. After presenting the tool an estimate of the savings that could be reaped as a result of the follow-on work was in excess of £10 million per year, equivalent to a 20 per cent improvement in profitability (Jones et al., 1997). Such work will help

position the company within a truly lean logistics value stream. Concluding the study, even though it was conceptual in nature, it was useful to suggest the gaps in lean logistics implementation. Furthermore, offers basis for future work raising important research questions like: definition of value in new services requires by new customers or defining the right warehouse type for a lean supply chain. Moreover, it leaves open the research of the agile paradigm in the supply chain together with the lean paradigm.

Inman et al. (2003) briefly describes some of the techniques adopted by the manufacturers from lean practices in order to improve the responsiveness in front of the customers' demands, reduce the product's cost, and still remain competitive. Therefore, specific lean terms are analysed like JIT (Just-in-Time) purchase and JIT production, because they are likely to generate responsiveness, in other words agility. In its ideal form, JIT integrates the entire supply chain's marketing, distribution, customer service, purchasing, and production functions into one controlled process (Claycomb et al., 1999). Furthermore, the authors propose an agile approach of the terms. After discussing the lean approach they concluded that due to the fact that many manufacturers adapted lean, the superior responsiveness has become a key to competitive advantage (Inman et al., 2003). As a result, the authors emphasize that agility is the next logical development of lean manufacturing. They call lean an antecedent to agility (Inman et al., 2003), showing results of their study suggesting that leanness is a precursor of the agility.

A first set of hypothesis suggests that a higher level of adoption of JIT purchasing and production strategy leads to a higher level of a firm's manufacturing agility. Moreover, a second set of hypothesis is derived from propositions and suggests that a higher level of manufacturing agility will have a positive impact on a firm's financial, marketing and operational performance. The findings of the research regarding the relationship between leanness and agility demonstrate that only one out of the two JIT elements was found to support agility. Besides, the result is not supporting that the notion of JIT production is a precursor of agility. Testing the second set of hypothesis, results that the development of JIT has a certain impact on the operational, financial and marketing activities of the enterprise in a normal flow between the segments (e.g. bigger sales grow revenues).

All in all, the study demonstrates that leanness and agility are two different strategies, each one of it designed to be applied in different environments: leanness in stable environments and agile in turbulent circumstances. Surprisingly,

the study does not cover the impact of the lean tools in any logistic or supply chain sector.

2.6 Lean and agile warehousing and distribution

Lean principles and practices have been widely adopted in manufacturing over the last three decades. However, their use in the warehouses, distribution centres or distribution schemes has been slower to catch on. Interestingly the warehouse role is seen apparently insignificant but they play a key role in moving the goods from suppliers to the end-consumers.

Bartholomew (2008) is the first who rendered the experience of one of the enterprises, which pioneered the lean introduction in warehouse. His research has been conducted on a site owned by Menlo Worldwide Logistics. In 2007 the company saw an opportunity to overtake its competition. In this respect, the company implemented lean concepts in their outsourced warehouse. To ensure the success of their plan, they named as responsible for the lean procedures implementation the former Head of production from NUMMI. From the first beginning Menlo faced difficulties in the lean implementation process. It took them some time to adapt tools initially used in manufacturing in the warehouse. Nonetheless, the most important outcome of Bartholomew's research on Menlo site is the definition of the wastes in a warehouse, exposed further in Table 1, together with the symptoms of existence of these wastes.

Wastes	**Symptoms**
1. Overproduction	Warehouse Extension
2. Waiting	Large amount of Work In Progress
3. Transports	Moving goods between sites
4. Inventory	Large buffer stocks
5. Overprocessing	Delay in documents
6. Motion	Incorrect data entry
7. Defects	Missed or late orders

Tab.2.1. Waste and symptoms in warehouses (Bartholomew, 2008)

The lean tools used by Menlo were initially used in manufacturing .In manufacturing the tasks are automated whereas in logistics the tasks and activities are somehow fluctuant. Therefore, before these tools are about to be applied, the procedures have to be firmly reviewed and adapted. Not surprisingly, after the adaptation success of the lean tools in warehousing, the companies tried to adapt them in distribution, too.

According to Mulcahy (1994), the distribution is the function that moves the goods from vendors to manufacturers (where the product is manufactured), from the manufacturer to the macro-distributor (where the manufactured goods are stored). From the macro-distributor the good is picked to the customer order requirements, and then is delivered to the point of consumption, or to the customer's facility. The warehousing has a very important role in providing a desired level of customer service at the lowest possible cost. A warehouse is an important link between the consumer and the producer. A warehouse with all its functions is part of the process that delivers a desired level of customer service in a company. Hence, the warehousing activity plays a vital role in the logistic function. It also plays an important role between the supplier and the customer (consumer). Grant et al. (2006) defines the warehouse as the part of the firm's logistic system that stores products between the point of origin and the point of consumption. It also provides the management of status, condition and disposition of the goods sold. However, according to Bowersox and Closs (1996) in some logistic designs the warehouse is playing a switching facility role, rather than a storage facility role.

Because of the rising interest in the paradigms that encouraged the fast moving inventory, like Just-in-Time inventory the role of the warehouse increased. These days, a warehouse has to provide a rapid and efficient feed-back both physical and informational. In this respect, a warehouse has to fulfil all its functionalities at maximum.

From the functionality point of view, according to Mulcahy (1994), a warehouse has nine basic functionalities. However, this paper will insist and will analyse only the first seven of them, as the last two are more related to the sustainability of the supply chain. These two are: the maintenance, sanitation and loss prevention and inbound and outbound truck-yard control. The first function is the loading and the unloading of goods, with other secondary functions like receiving, scanning and checking these goods. The second function is the horizontal and vertical goods

movement in the warehouse to and from the racks, to and from the storage-blocks or to and from the bulk storage. The third function is the storage itself with three sub-functions: deposit, withdrawal and replenishment. The first three functions are part of the inbound processes. These processes executed generate incoming goods flux. The fourth process is the order-pick sorting and checking. The fourth process represents a fair percentage of the overall logistic costs. It is generally accepted that the most expensive part in the overall warehouse costs, as the picking routes may consume as much as 60 % of all labour activities in the warehouse (Oxley, 1988). For a typical warehouse the picking is estimated as 55 % of all the operating expense (Tompkins et al. 2003). The fifith procedure is the packing, sealing, weighting and manifesting. According to Hines et al. (2000) all these three actions are intra-company value adding processes. The sixth procedure is the loading and the shipping and the seventh is the handling returns and off-season products.

Besides its function according to Mulcahy (1994), the warehouse has also an economic value. The value can be summarized in the following statement: ‘your warehouse and distribution product movement-storage-pick operations assures your company that the right good is in the right condition, at the right place, at the right time, in the right quantity, and at the right cost’. By doing so, the warehouse and distribution contributes to the company's profits both by reducing the costs by operting lean and by satisfying the customers by operating agile.

According to Grant et al. (2006) the warehouse decisions may be strategic and operational. The strategic decisions are usually referring to the allocation of resources over an extended period of time.

There are also several characteristics of the warehousing seen by Grant et al. (2006). Some of the characteristics are cost reduction oriented while some of them are responsive oriented. However, in the following table, the characteristics will be described and to each characteristic a paradigm will be assigned. The characteristics are split in two: the cost reduction oriented and the responsiveness oriented. To the cost reduction characteristics lean is proposed to be assigned as matching paradigm, while for the customer responsiveness characteristic, agility is proposed to be assigned as a matching paradigm.

Characteristic	Assigned Paradigm
Achieve transportation economies	Lean
Achieve production economies	Lean
Take advantage of quantity purchase discounts	Agile
Support the firm's customer service conditions	Agile
Meet the changing market conditions	Agile
Overcome the time and space differentials that exist between producer and consumers	Lean
Accomplish least logistic cost commensurate with a desired level of customer service	Leagile
Support JIT programmes of suppliers and customers	Lean
Provide temporary storage of material to be disposed and recycled	Lean

Tab. 2.2. Warehouses characteristics and paradigms assigned (Grant, 2006 - adapted)

The studies researching lean and agile warehouses are few. However, some studies that research the agile design of a distribution centre were made. In one of these studies, Baker (2007) suggests that the minimization of inventory is the key to achieve agility. Interestingly, ten years before Hines and Rich (1997) are discussing that inventory in general in the Supply Chain affects directly a company's responsiveness. They stress that before changing the product, the stocks of the old product needs to be sold. Apart of minimization of stock Baker (2007) proposes the transshipment and the merge in transit as instruments of achieving the desired degree of flexibility. The transshipment involves the shipment of goods or containers to an intermediate destination, then yet to another destination. The merge in transit involves the goods from multiple sources are consolidated in one location, named the agile location. The role of the logistic distribution centres in consolidating the inventory was emphasized by Harrison and van Hoek (2005).

Grant et al. (2006) identifies lots of inefficiencies that can occur in a warehouse. Amongst the most important ones are: the redundant or excessive handling, the

poor utilization of the floor space, the excessive maintenance cost and downtime due to obsolete equipment or dated receiving and shipping dock conditions.

In respect with both process improvement and customer responsiveness the adaptability to customer's standards has to be taken into consideration. If a desired delivery standard is achieved a newer delivery standard is usually required by the customer mainly due to the harsh competition. For instance an old standard of 7-day lead-time can become a new 5-day lead-time standard. A changeover in the warehouse processes is needed to be responsive in front of the customer's demands. The changeovers need to be done both horizontally- in house processes - and vertically- customer related processes. The continuous lean improvement achieved through KAIZEN (continuous improvement) is compulsory after lean thinking implementation. It assures the continuous horizontal improvement. This step involves in-house process improvements, usually referred as horizontal perfection. However, the horizontal perfection achieved through KAIZEN must be simultaneously followed by a vertical perfection needed to achieve agility. The vertical perfection involves customer-related processes many of the related with agility.

If both leanness and agility are implemented in a supply chain then all five operations objectives are likely to be achieved. According to Johnston et al. (2003) there are five basic performance objectives: the quality, the speed, the dependability, the flexibility and the cost. Transforming them into advantages will boost the competitiveness of an enterprise. By implementing lean, two advantages out of five are likely to be achieved: the quality advantage, by ensuring that all the operations are 'in time' with no waste and the cost advantage, by doing things cheaply, giving good value to the customer. By implementing agility, three advantages are easily reachable: the speed advantage, by minimizing the time between the customer asks for goods and the customer receives the goods in full, the dependability advantage, that is, being able to keep the delivery promises that have been made to the customers and the flexibility advantage, by being able to change what is done or to cope with unexpected circumstances.

Christopher (1998) stresses that in order to examine the necessary competencies of a warehouse, the distribution centres must be viewed individually as part of the supply chain that forms the company's competitive framework. In a hierarchical

framework conceptualized by Baker (2008) there are four levels of supply chain integration. The levels are graphically presented in the next figure.

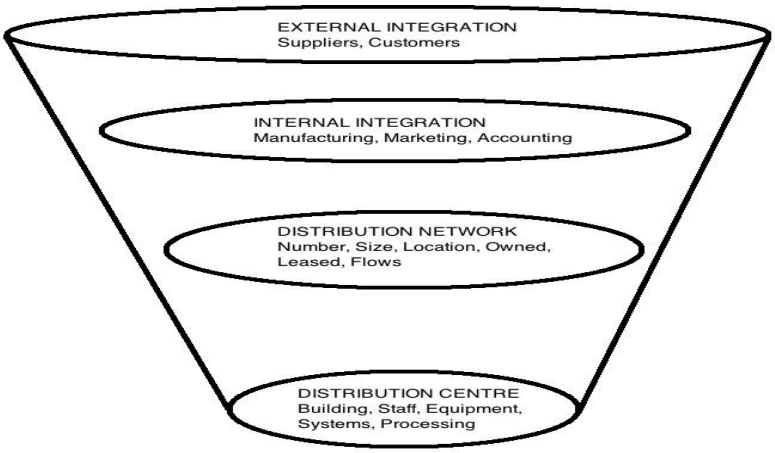


Fig. 2.6. Levels of enterprise integration (Baker, 2008)

The focus of this study is to research the lean and agility in the first two levels of the supply chain: The Distribution Centre and The Distribution Network. The logistic management has the potential to assist the organization in the achievement of both cost and value advantage. The goal of the logistic management should be of creating superior value with less cost (Christopher, 2005). The study focuses on warehousing and distribution because the efficiency of these two parts is important from the responsiveness point of view, as they meet the customer each and every day. Firstly they affect the overall effectiveness of a company and secondly it affects the customer service level that a company is providing. Even though firms or supply chains are considered lean or agile the firm's functions not the firm as a whole are following lean or agile rules and procedures. According to Gunasekaran et al. (1999) the inventory control, the warehousing and the distribution are the underlying processes that primary affect the industrial success of distribution organizations. It is however widely accepted that logistics can be used to generate both cost savings and service enhancement (Mangan, 2012).

2.7 Summary

In the literature review chapter the lean and the agile paradigms were reviewed. To the best of the author's knowledge the paradigms were analysed from all the possible perspectives.

The lean concept and the history of the lean concept implementation were debated at the beginning of the chapter. The history of lean was reiterated for a better

understanding of the concepts of waste removal that underpin the lean management techniques. After a brief history of lean implementation in certain domains like automotive, manufacturing and retail, the implementation of lean in services is debated. The lean implementation in services is important to emphasize the possibility of implementing automated procedures and gaining intangible benefits in other areas than the operation processes. Besides the physical movements of the goods, the distribution and the warehousing is nowadays handled by the 3rd and 4th party logistic suppliers. These suppliers offer distribution, warehousing and even purchasing as services. Therefore, the debate about lean adoption in services is highly recommended.

After the debates regarding lean implementation in the supply chain, the impact of lean practices on the inventory turnover is considered. Inventory in any form is important when the lean concepts are debated mainly because it presence might influence the build-to-stock strategy. Then the different viewpoints of MTO and MTS strategies were compared. The made-to-order paradigm is complementary used with agility.

In the second part of the chapter the agility is considered as a conflicting paradigm with lean. The theories underpinning agility as a manufacturing paradigm are debated. A special emphasis is put on the decoupling point and its multiple concepts: as a strategic point that separates product pull from product push, the point until the orders are penetrating the supply chain pipeline, the point where strategic stock is held to separate the push and the pull paradigms or simply the point that separates the two paradigms.

There are still significant debates about the relative merits of the two paradigms in a supply chain. There is a tendency to suggest that these paradigms are exclusive and conflicting (Harrison, 1996).

In reality agility and lean can complement each other and in many cases there is a requirement for hybrids often called leagility (Christopher, 2002, Naylor et al, 1999, Mason-Jones et al, 2000, Aitken et al, 2000). However, scholars propose the hybrid supply chain design into 2 parallel supply chains one MTO and one MTS separated through time and space (Fisher, 1997, Christopher 2000, Harrison and van Hoek, 2005). This research calls for mapping a dynamic supply chain with a focus on warehousing and distribution functions in which lean and agility are coexisting but not separated by time and space. This specific model encompassing

lean and agility is useful when different types of demands exist for the same product both stable and volatile or when lean and agile activities are present in the same function.

Chapter 3 – Methodology

3.1 Introduction

The literature review identified a fair number of research gaps in the existent academic knowledge. Out of these gaps two are considered of higher importance when lean and agile are researched in the downstream part of the supply chain. These two gaps have eased the development of the following research questions:

a) Do lean and agility cohabit in the downstream part of the supply chain, specifically in an enterprise playing a distributor role?

b) If they cohabit how lean implementation and continuous improvement can influence agility?

c) Where is the decoupling point positioned on the map of this specific supply chain pipeline?

The opportunity to research these gaps in a case study has been identified. However, a research methodology is necessary for delivering reliable results. The next chapters will therefore present in detail the chosen methodology for the overall investigation.

3.2 Epistemological and ontological positioning of the research

In the following section will be detailed the methodology used in this research. In order to understand the reasoning that underpins the research methods, it is useful to know the ontological and the epistemological positioning of the research. According to Mason (2006) the ontology is the philosophical study of the nature of being, existence or reality. The ontological positioning suggests that the people's knowledge, views and understandings are meaningful properties of the social reality, which the research questions are trying to explain. Lean and agility as paradigms are seen as socially constructed in this research. The epistemological positioning allows a legitimate and meaningful way to generate data on the ontological properties by talking to people, asking them questions, listening to their accounts and experiences. In this respect, the interview was chosen as the main method of data collection. The case study is interpretive as it seeks to

address possible explanations of the lean and agile paradigms coexisting in a supply chain. Hence, the case study is explanatory. Leanness and Agility will be assessed and researched in the case study company. Furthermore, the case study will illustrate how lean practices are influencing the agile practices in an enterprise, and where the decoupling point is positioned on the supply chain map of the company. The methods used in this research will be detailed in the following paragraphs.

3.3 Methodology

Lean and Agility are two paradigms that were intense researched by many academics. After these two paradigms were empirically defined and constructed they were mainly debated in the manufacturing environment. Lean and Agility were criticized both separately and allied in a separate concept named Leagility. Researchers like Christopher (1998) argued that a lean company is far from being agile. Other academics like Iman et al. (2003) stressed that lean is a precursor of agility, therefore an enterprise cannot be agile without being lean. In a recent study Christopher and Towill (2002) agree in the end that the two paradigms can co-exist in a manufacturing enterprise but with certain limitations such as space and time separation. In this respect they propose a coping mechanism that allows the two paradigms to co-exist called decoupling point. The decoupling point was widely debated in the upstream part of the supply chain in general, with emphasis in manufacturing. However, the literature debating the two paradigms in the downstream part of the supply chain is very scarce. To the best of the author's knowledge there are few attempts in the literature to research the two paradigms and their existence in a company playing a distributor role. The importance of these studies is major. They will reveal how a company positioned in the downstream part of the supply chain, in this case a distributor, is able to enhance its agility maintaining, developing and perfecting lean processes simultaneously.

3.4 Qualitative research

In the operations management research the survey-based design was predominant until the early 80s. According to Barratt et al. (2011) after the 80s there has been a call for empirical research methods to counterbalance the abundant analytical

operation management. As an alternative to the survey based research, the operations management researchers promoted the use of qualitative research. (Lewis, 1998, Voss et al., 2002).

This study proposes an understanding of lean and agility paradigm, when these co-exist in a supply chain, rather than a quantification of the prerequisites needed for these two paradigms to co-exist. Based on the research questions a qualitative research method was seen as reliable for answering this study research questions. The qualitative research engages the researcher with things that matter, in ways that matter (Mason, 2006). The arguments in the qualitative research are built and constructed on how things work in a particular Hence, the study is designed to provide a better understanding of lean and agility co-existing in an enterprise with distributor role by focusing on the qualitative aspects of processes and programs. Interview questions elicited data on warehouse staff roles, the outcomes of the warehouse processes the impact of the warehouse and distribution processes on company's agility and on client's satisfactions. By identifying characteristics of leanness and agility, the study will strengthen the knowledge base on studies made on the two paradigms interactions in the downstream part of the supply chain. By exploring leanness and agility in a distributor enterprise, the study aims to expose important dynamics that prevail in a distributor-customer relationship.

3.5 The research gap

Narasimhan et al. (2006) proposed complete definitions of lean and agility as concepts. Even though they are related to production, we consider them relevant and adaptable for the logistic processes. Production is lean if it is accomplished with minimal waste due to unneeded operations, inefficient operations, or excessive buffers in operations whereas production is agile if it efficiently changes operating states in response to uncertain and changing demands placed upon it. Therefore, lean involves automation, standardization to ensure the ease of waste removal, while agility requires flexibility and responsiveness. These two paradigms were widely researched in production environment, most of the cases being in the upstream part of the supply chain. Moreover, the majority of the researchers see the two paradigms separated in space and time, basically functioning in two parallel supply chains. The present study addresses a different perspective, studying these two paradigms in a supply chain between lean pressures from the supplier and agile pressures from the customer.

3.6 The research design

According to Yin (2003) a research design is the logic that links the data to be collected and the conclusions to be drawn to the initial questions of the study. It has been used a convenience sampling due to access to data from the site. According to Yin (2003) a case study design should be considered when: (a) the focus of the study is to answer 'how' and 'why' questions; (b) you cannot manipulate the behaviour of those involved in the study; (c) you want to cover contextual conditions because you believe they are relevant to the phenomenon under study; or (d) the boundaries are not clear between the phenomenon and context. In the present study a case study research approach is proposed because the contextual condition of the case study has been considered relevant for the paradigms researched. It is considered relevant the condition of the case study because is researched an enterprise that plays a distributor role. In addition, the company is positioned in the downstream part of the supply chain management.

The case study is explanatory or causal. This type of case study is used if the researcher is seeking to answer a question that sought to explain the presumed causal links in real-life interventions that are too complex for the survey or experimental strategies. In evaluation language, the explanations would link program implementation with program effects (Yin, 2003). In the research the causal eventual relation between leanness and agility is addressed, in a specific environment, the downstream part of the supply chain. Therefore, it can be considered that the situation, due to its particular specificity can be too complex for a survey or experimental approach.

The data collection sources will be the employees of the case study company and the employees of the customer while the units of analysis will be organizations. In this case the units of data collection will be different from the units of analysis. Individuals will be enquired about organizations. Therefore the questions will refer to how and why the organization functions (Yin, 2003).

The chosen technique supports the research objectives. Nonetheless the research has its limitations. The evidence from multiple sources is often considered more compelling, and therefore the study can be considered as being more robust. In this case the conduct of a multiple case study requires extensive resources in time beyond the means of a single research investigator. Moreover, the results will not

be statistically generalized. However, analytical generalization can be achieved, by testing the theory in a multiple case study analysis. There are issues identified in this case study that are likely to exist in other situations or cases. Whereas quantitative generalise from particular to general, through samples, the qualitative research develops a 'logic model'. The logic model basically defines how a researcher expects an intervention, event or process to take place. In the present case study the researcher expects to see how leanness and agility are coexisting in a Supply Chain with its on particularities: in the downstream part of the supply chain specifically in the logistic function and in the laminate flooring industry. However, further quantitative measuring is recommended. Another limitation can be the likehood of selection bias. However, as earlier has been said the case study the company has been chosen due to data access from the site. The case study approach remains however the most suitable technique for achieving the research objectives due to existing constraints.

3.7 The case-study approach

For the research topic a case study approach was used to understand the process of lean and agility co-habitation in an enterprise. The enterprise is a laminate flooring distributor. Yin (1984) defined the case study as an empirical enquiry that investigates a phenomenon in its real life context, where the boundaries between the phenomenon and the context are not clearly evident. According to Bottani (2009) case studies in management disciplines, especially in supply chain management are frequently adopted. According to Yin (1994), case studies can be used as field research where an investigator explores answers to 'what', 'how', and 'why' questions, by focusing on observing contemporary events. Moreover, Eisenhart (1989) proposes the case study as the appropriate tool for researching the Business-to-business environment because they capture the dynamics of the studied phenomenon and provides a multidimensional view of the situation. Case studies have been widely applied in Business-to-business relationships in the Supply Chain environment by Wu and Choi (2005) with remarkable findings. Wu and Choi (2005) through multiple case study research based on the existing dyads between customers and suppliers, conceptually suppliers-suppliers-customers triads. Hence, the case study is the appropriate tool in describing how networks work in different settings and contexts.

A single case study was used for this research. Data was gathered through different data collection methods. The main collection method used is the interviewing. Yin (2003) considers the interviews as the most important sources if case-study information. Focused interview is proposed, because based on the collected information processes are going to be analysed. In this respect, a guided conversation is necessary. Kohn (1997) argues that an interview with many close-ended questions brings it closer to a survey design. It can fail to take advantage of the case study approach to uncover subtle directions and provide richness of understanding. Therefore, at the end of each interview, open ended questions will be addressed in order to capture the holistic view of the lean and agile processes. In order to strengthen the validity of the research observation a process activity mapping has been conducted. Yin (2003) argues that case studies are used in business, where the structure of a specific industry may be investigated by using the case study method. Moreover, the case study allows the researcher to gain a holistic view of a specific phenomenon, in this case study organizational and managerial processes.

3.8 Data collection

The following chapter explains the interview questions for the case-study company (onwards distributor) and the questions for the case-study company's customer (onwards customer). The aim of these questions is to collect data from the distributor's warehouse and shipping processes and the customer's perception and satisfaction on the distributor's responsiveness, respectively. The following table shows the key terms and concepts that are followed during the interview from the distributor and the customer, respectively. The outputs of the distributor are mirrored in the customer’s inputs.

In a comprehensive study Barve (2011) based on researching the available literature review and surveying academics identified ten factors that are affecting agility in a supply chain. Agility is affected mainly by customer sensitivity and responsiveness, by the cost and the quality of the products, by lead-time reduction and by flexibility in the system. These four patterns are highlighted in the table. All the future warehouse and distribution improvements will be eventually related with these four agility drivers. Beside these four drivers there are five more as follows: Organizational integration and willingness for improvement, the commitment of the top management, the outsourcing, the collaborative

relationship with suppliers and the customer satisfaction. These five factors are not considered not because they are not important but because they are related either with the organization (Organizational integration and willingness for improvement and the commitment of the top management) or with an eventual integration with the supplier or customer (the outsourcing, the collaborative relationship with suppliers and the customer satisfaction). However, if any factor that is likely to influence any of these agility drivers that are not assessed it will be mentioned.

CUSTOMER	DISTRIBUTOR
Incoming goods process	Outgoing goods process
Stock outs	Inventory management
Order fill-rate	Order fulfillment
Order frequency	Order process frequency
Backorder frequency	Inventory management
Shipping errors	Warehouse delays Warehouse set-ups
Returns and claims	Warehouse set-ups Shipping set-ups
Customer Cycle time	Distributor cycle time
Change order quantity	Warehouse set-ups, Shipping set-ups

Tab. 3.1. Distributor Input - Customer Output (Author)

The questions for the distributor are designed to gather answers and insights about its warehouse and distribution processes. There were chosen the inbound, outbound and inventory processes as they are known to generate the biggest amount of waste (Bowersox, 1998). The processes are seen as internal such as the warehouse processes where waste exists, and external, distribution processes where agility and competitiveness prevails. According to Harrison and Van Hoek (2005) there are five ways in which a company can compete through logistics: Doing things right (the quality advantage), doing things fast (the speed advantage), doing things on time (the dependability advantage), ability to change what is done (the flexibility advantage) and finally the cost (productivity advantage). The questions are designed to refer to each competitive logistic driver with focus on waste processes of the warehouse. The interview is structured in four parts, the first part will refer to the inbound processes, the second at the

outbound processes the third one refers to inventory, claims, complaints and returns, while the fourth is gathering the general opinion of the distributor about logistic process improvements. From the distributor the following employees will be interviewed: the logistic manager, the purchase manager, the warehouse manager and the distribution coordinator. All the interviewees have extensive experience in logistic and distribution processes. From the customer, the purchase manager will be interviewed. The customer's purchase manager has been in position since 2009 when the company was formed. Therefore he is familiarized with the distributor's logistic system.
The questions for the customer form the basis of a semi-structured interview. The interview will allow a fairly focused and open conversation with the purpose of identifying the level of customer service and responsiveness of the distributor in respect with a customer. The key terms followed through the interview are mainly referring to agile characteristics of the logistic processes: Order frequency, return and claims, customer cycle time, backorder frequency or invoice accuracy.

According to Christopher (1998) there are three components of customer service. The first one is the pre-transaction, the next the transaction and the last is the post transaction. The pre-transaction elements are the customer service policy or the accessibility of the company. However, the pre-transaction elements are not going to be analysed in this paper, as the paper refers to the present degree of agility. Therefore, involves present customers, rather than potential ones.

The next two levels of customer service will be debated based on transaction and post-transaction elements of customer service (Harrison and van Hoek, 2005) and logistic quality services indicators. In addition in the end of the interview general questions about process improvement will be asked. The questions of the interview will be built to assess the customer satisfaction regarding the distributor's responsiveness through the logistic processes.

3.9 Time frame

The time frame for this research is one year. The period of time this research is referring to is between May 2012 and May 2013. This one year period is considered sufficient for an in depth understanding of the logistic processes occurring in the distributor's activity. A longer period of time to be analysed generates a huge amount of data, which can be difficult to be analysed in a short

period of time. Moreover, any additional benefits in analysing a longer period of time are not seen as considerable.

3.10 Data analysis

The data analysis process involves identifying and obtaining patterns of associations between variables plus noting the relationship between the customer's perception on the distributor's agility and the optimisation in the warehouse and distribution processes of the distributor.

During the interviews the probing questions explored both key and emergent themes. The interviews lasted between 25 and 60 minutes and were taped-recorded and transcribed verbatim, with the transcripts subsequently subjected to content and thematic analysis. Content analysis is a systematic technique used to classify qualitative information based on pre-defined categories (Krippendorff, 1980). Themes represent the unit of analysis. The analysis process was inductive and deductive as the research was context-sensitive but informed by previous research. The categories for the coding taxonomy were developed using a deductive approach based on the literature of lean and agility and semi-structured interviews. The distributor’s semi structured-interview questions invited the participants to describe in detail the logistic processes that underpin the customer service delivery in particular the warehouse and the distribution processes. The customer’s semi-structured interviews invited the participant to describe in detail the inbound process from the distributor with an emphasis on the distributor’s responsiveness and the quality of the delivery processes.

As the primary data is acquired from the interviews, the secondary data is acquired from documents with numerical data representing the measurement of the warehouse tasks. The consulted documents are Process Activity Mappings. The Process Activity Mapping involves simple steps: in the first instance a preliminary analysis of the process is undertaken and then all the items required in each process are recorded in detail (Hines and Rich, 1997). Two Process Activity Mappings are drawn one for each process that is considered to generate waste: the inbound process and the outbound process. These processes encompass all the main warehouse tasks executed by the warehouse clerks: picking, warehouse equipment management, dispatching, loading or order processing. The processes were mapped by the warehouse manager after a brief training has been held. He was requested to measure with the stopwatch the steps occurring in the inbound

and outbound activities of the warehouse. The stopwatch was used only to certify certain time allocation for processes identified to be bottlenecks during the interviews.

The aim of the research is to focus on processes rather than on product groups. Therefore the Process Activity Mapping (PAM) was preferred against the Value Stream Mapping (VSM). Firstly VSM is useful in spotting waste removal opportunities through KAIZEN Bursts whereas PAM is mainly used for waste removal processes (Rother and Shook, 1999). Secondly, VSM focuses only one family of products. Hence, multiple VSM have to be drawn to have a holistic picture of the warehouse's processes. The PAM depicts the general flows of the warehouse highlighting the eventual delays or non-senses in a logical flow (Hines et al., 2000). PAM shows the sequences of events that act on the product and shows how a product is handled in a warehouse environment. It is easy to use and requires no training for the staff to make it and measure it.

A study of critical processes in the laminate flooring industry focuses on several level of analysis. In this thesis the focus will be on warehousing and distribution processes occurring in the supply chain. The main point of this thesis is the distributors and secondarily the distributor's customers. Due to the fact that the aim of the qualitative research is to understand the meanings that underpin the existence of the two paradigms in the supply chain, a high level of importance is placed on the construction of discourses.

Once the interviews were recorded they were transcribed. After the transcription the interviews were annotated so the main idea emerged. Then the emerged themes were classified in order to make sense given the objective. The point of the research is to understand how lean and agility cohabit in the downstream part of the supply chain, specifically in an enterprise playing a distributor role and if they cohabit how lean implementation and continuous improvement influences agility. Moreover, the final aim is to map the decoupling point, the point that separates the two paradigms. In the first stage a first-level coding analysis was developed manually. Hence, the meaning was developed from the interview text. Afterwards, themes were grouped in order to develop a causal analysis.

3.11 Data collection limitations

The distributor and the customer were contacted because of the ease of access to the data. However, the case study firm is representative as the company has a moderate supply chain, its customers have variable demands, it is operating as a distributor; in the downstream part of the supply chain and it is improving its processes for waste removal; simultaneously its strategy is to enhance its customers' responsiveness. The interviews were conducted in Romanian so with the translation might emerge some cultural and language issues. The quality of the interview might have been affected by the level of openness of the customer. However, the customer was assured by the interview's confidentiality for more opened responses. The interview responses were quite straightforward and the catch of the insights of the customers' processes was quite difficult. As it has been said earlier, the case study was conducted only on one customer. Further studies on multiple are recommended to test and check the occurrence of the phenomena. However, to strengthen the research a representative customer for the distributor has been chosen. In further studies suppliers can be involved as well. Therefore, studies on leagility can be conducted on the whole supply chain and a holistic view of the paradigms co-existing in a supply chain can be captured.

3.12 Summary

The methodology used in this research is qualitative. A case study approach technique was chosen and a company plus a customer from the laminate flooring industry was chosen to see and test the relationship between lean and agility. Data was collected using the interview technique. Semi-structured interviews were conducted with both employees from the distributor and employees from the customer. Details about the interview scripts can be found in the APPENDIX 1,2 and 3. Moreover the processes activity maps of the distributor's warehouse were used as secondary sources to obtain a better view on the eventual delays, flows and bottlenecks of the processes. In the following chapters the findings regarding these two paradigms will be exposed together with the recommendations for eventual process improvements.

Chapter 4 – Case Study

4.1 Introduction

The present chapter will summarize the findings in the warehouse and distribution process of the distributor as well as the customer's perception on the distributor's agility. The data was collected through interviews to gain an understanding of the lean and agile processes occurring in the warehouse and in the distribution processes. After the interviews were conducted, secondary data was analysed. The documents analysed are Process Activity Mappings that offer to the researcher a quantitative view of the aspects discussed during the interviews: bottlenecks in the inbound and in the outbound process. Therefore this chapter will briefly sketch out these processes highlighting the waste in these processes. The chapter ends with a presentation of the customer's perception on the distributor's responsiveness and agility. These aspects are crucial in building the framework of this research because both leanness and agility are customer-centred activity improvement strategies.

4.2 The global laminate flooring industry

The lean distribution was widely debated in literature for some products. For cars and computers MTO strategies were proposed (Holweg and Pil, 2001, Hertz et al, 2001). Researchers suggest that other products like sport equipment or automotive spare parts in order to cope with the uncertain environment may require BTS strategies (Fisher, 1997, Christopher, 2000). The lean and agile paradigms in distribution were debated in the house building products industry, too. However, to the best of the author's knowledge no study debated yet lean and agile distribution in the house improvement goods industry.

According to EPLF (European Producers of Laminate Flooring) the total quantity in m2 of laminate flooring sold in the world in 2012 was 459,000,000 m2, out of which European customers bought 396,000,000 m2 or 86,21 %. Customers from Eastern Europe bought 98,000,000 m2 or 24, 75% out of the total European sales. The Romanian customers bought 9,600,000 m2 or 9,8 % out of the Eastern European sales. The distributor sold in 2012 3,000,000 m2 or 31,25% out of the Romanian laminate sales.

In the next two chapters, the distributor's company and warehouse facilities are described for a better understanding of the infrastructure that underpins the logistic processes. These processes will be detailed in the findings of this research. Consequently, the customer's company is briefly described together with a short presentation of the goods and informational flows.

4.3 Case study introduction – The distributor

The case study company, named onwards a distributor is the largest retailer and wholesaler of floor covering products and interior decorations in Romania. The company has 30 stores and 5 logistic centres in Romania. The company operates in five countries (Hungary, Croatia, Moldova, Romania and Slovakia). It supplies over 1500 small and medium resellers and also all the big five DIY Chains using its own logistic network centres and some own transport capabilities. The company's turnover in 2011 was around 40 million euro. It has around 400 employees. The warehousing facilities are as follows: a Central Warehouse and three other regional centres. The regional warehouses are used only for cross-docking purposes and serve few customers hence the processes occurring in these warehouses are simple and do not require immediate adjustments. The central warehouse operations are executed both through manual picking and warehouse equipment. The goods stacked in blocks are moved by forklift trucks. The goods stored on racks are moved with reach trucks because the racks are positioned using the narrow-isle principle for space purposes. The warehouse deals with both predictable tasks (milk-run distribution) and unpredictable tasks (uncertainty of some customer's demand).

In the logistic department there are 78 employees from which: 2 are overhead staff, 55 are employees of the DC and 21 are employees of the regional warehouses. This study will refer to improvements in the central warehouse, therefore the processes executed by 57 employees or 73 pct. will be directly affected. Out of the 55 employees of the central warehouse 37 are warehouse staff, 6 distribution staff and 12 are drivers.

The department has four hierarchical tiers. The department is led by the logistic manager. The warehouse manager is subordinated to the logistic manager. The warehouse officers are subordinated to the warehouse manager, and the forklift drivers and the warehouse clerks are subordinated to the warehouse officers.

The distribution flows are coordinated by 6 Distribution Coordinators. The Distribution Coordinators are supervised by the logistic manager. They coordinate a fleet of 23 trucks through which the distribution from the DC to the RC and from DC/RC to customers is planned and executed. The fleet is tracked using a Global Positioning System. The inbound transportations from the suppliers to the DC/RC are outsourced to different 3PL companies.

The transport frequency is as follows: there is a minimum of 5 inbound transports daily, and a minimum of 10 outbound transports for five months a year (December to April) and a minimum of 10 outbound transports and 20 outbound transports seven months a year (May to November).

The goods are stored in the warehouse based on their weight and on eventual stackable restrictions. A limited amount of goods are efficiently stacked on metallic-racks. These are usually the laminate accessories and the plumbing products. The percentage of how much of the total surface of the warehouse is occupied by different storage goods is: the 5 level racks are occupying approximately 25 % of the warehouse surface, the six level blocks are occupying 30 % of the warehouse and the 3 level blocks are occupying 45 % of the warehouse.

All of the stored goods are hone improvement goods like: laminate flooring, doors, carpets, rugs, radiators, fittings. The products based on their dimensions (width and height) are stored on EPALS (europallets). According to the European Pallet Association a euro-pallet's dimensions are 800mm x 1200mm. Based on their Width, they occupy the surface from 1 EPAL to 3 EPAL. The approximate percentage of goods based on their occupancy is as follows: EPAL goods – 15 %, 1.2EPAL goods or EUR3 – 25%, 1.5EPAL goods – 20 %, 2EPAL goods – 25 % and 3 EPAL goods 15%.

The warehouse is divided into five areas. Each area is holding separate types of goods based on their specificity. When the orders are received the system splits them on the five areas so each area receives the orders containing specific products. The areas are named as follows: Laminate Flooring Area, Laminate accessories area, Plumbing area products, Doors products and Rugs and Carpets area. Each area has its own staff formed from warehouse officers, forklift drivers and clerks. Consequently, each area has its own warehouse equipment assigned. In the next chapter the customer company is briefly described for a better

understanding of how the goods and information is flowing between the two companies.

The staff was divided into 5 areas mainly because of the number of active SKU's: 10,000. So each team handled roughly 2,000 products at least once a week. The logic behind this divison was simple: the company considered that is simpler to deal with a limited number of products on a daily basis, it is easier to spot problems associated with these products and the teams are likely to find solutions more rapidly to everyday problems. The forklifts were split on the 5 areas based on their type as different products have to be handled with different forklifts. However, 90% of the products can be handled with one type of forklift truck. In total there is a number of 8 fork lifts.

The warehouse has 11 loading gates, out of which the first 4 are used by the laminate area, the next 2 by the doors and plumbing area, the next three by the accessories area and the last two by the rugs and carpets area.

4.4 Case study introduction – The customer

The customer of the case study company named onwards customer is a regional retailer with seven stores and one distribution centre. The distributor is the customer's main supplier for all the main categories of products. The customer orders products from the distributor following a specific process. The process is as follows: The Customer places the orders to the Distributor through an order form via e-mail or by completing an excel file attached to the e-mail. The orders are placed each evening by the store managers after the stock-taking is made. Besides the stock-taking the store managers place the orders taking into consideration the sales-forecast or eventual promotions or future discounts. Then the customer's purchase manager approves the order and places it to the Distributor. The details about how the distributor responds will be described in the findings. After the order is processed by the distributor is dispatched and delivered to the customer. The delivery of the products ordered by the customer is in the distributor's duty. There is a contractual delivery time, which is 72 hours after the order is placed by the customer. After the goods are dispatched, the distributor gives a delivery time and a time slot for the goods to arrive in the customer's warehouse. When the lorry arrives the goods are unloaded with the customer's warehouse equipment. During or after the unloading, the goods are inspected quantitatively and

qualitatively. The eventual complaints are transmitted to the distributor. The details about the complaints will be further described in the findings.

4.5 Findings in the distributor's activity the inbound and outbound processes

In the following chapter the inbound and the outbound processes of goods are described together with quality, responsiveness and eventual issues occurring in the day-to-day activity in the warehouse. The findings are the results of a series of semi-structured interviews with the managers involved in the logistic process. Simultaneously, during data collection, the inbound and the outbound activities of the distributor were mapped by the warehouse manager using the Process Activity Mapping. The conclusions of this chapter are describing the inbound and the outbound processes and the eventual set-ups during the inbound and the outbound processes. The key terms followed through the interview are mainly referring to lean characteristics of the logistic processes: waste processes occurring in the warehouse, bottlenecks in the warehouse processes and warehouse information flows and delays. Moreover, the inbound process of the goods and the outbound process of the goods are mapped. Therefore the quality, responsiveness and eventual issues occurring in the day-to-day activity in the warehouse are easily identified in the daily processes. Afterwards, these processes are described together with their logical flow. Moreover, the eventual bottlenecks are described in detail and are timed. After the processes are mapped the warehouse manager is interviewed about his perception on the value added and on the non-value added processes that occur in the inbound warehouse flow of goods.

4.5.1 The inbound process

The inbound process is the process of receiving goods from the distributor's suppliers. The inbound process consists of 29 steps executed by the warehouse staff, mainly by the pickers, the forklift drivers and the warehouse officers. The first step is when the orders are invoiced by the supplier. The first step in the inbound process consists of the invoice by the supplier. The supplier usually invoices the goods the next day after the goods are shipped from the supplier's warehouse. The goods on their way to the distributor's warehouse are traveling with delivery note. The transports are not accompanies by invoices due to security reasons. Due to the fact that the inbound goods are transported with lots of 3PL's

there is a chance for the acquisition prices to be seen by the competitors. Hence, the invoices are sent directly to the distributor's office via e-mail or fax. The second step involves the introduction of the order in the orders web system. From this order web system (OWS onwards) the incoming goods order is replicating in the Warehouse Management System (WMS onwards). Through this process the quantities from the invoice are manually introduced by a purchase clerk in a Web Application, and the list with these goods are received by the warehouse staff as an incoming goods order. If necessary the orders are mixed by the purchase clerk. Orders are usually mixed when on a lorry are present Less than a Truck Loads (LTL onwards) orders from different suppliers. The mix is necessary for the orders to be separately seen in the WMS. After the order is mixed, the order replicates from the OWS to the WMS. After the order is replicated the warehouse clerks are able to process any introduced inbound order. In the fifth step the lorry is arriving. After the lorry arrives, the lorry driver handles the delivery note and the waybill (CMR onwards) to the warehouse staff. After the delivery note is handled, the warehouse clerk announces the WMS administrator and awaits from the WMS administrator a gate allocation. Through the gate allocation the lorry is matched in the WMS with a loading gate. Therefore after matching, the order instructions can be seen on the bar code scanner display. After the gate has been allocated the lorry awaits instructions to enter a specific gate. After receiving the instruction, the lorry parks in the gate. The eleventh step consists from the log-on order procedure executed by the forklift driver who searches for the order associated with the gate in the barcode scanner. After logging on, the goods are unloaded in the transit areas ready for the goods to be inspected or eventually sorted. The sorting step occurs if the goods are mixed on the same pallet (e.g. different decors of laminates are on the same pallet due to space constraints in the lorry). When the inspection is made transport unit stickers (TU) are labelled on each pallet. The TU match the bar code of the product with the WMS's location. Then in 2 consecutive steps the warehouse clerks are scanning the TU of the pallet together with the product barcode. Visually the warehouse clerks are checking if the quantities are correct which roughly is equivalent with a visual inspection of the goods whether the goods are pallets, boxes or cartons. After the goods are unloaded, labelled and inspected the goods are waiting for an available forklift truck to move them into the WMS recommended location. When each pallet is moved into the location, the pallets are scanned so the TU of the pallet is matched with the TU of the pallets already in location (the first pallet in the location is

matched with the location). After all the goods are moved from the transit location, the warehouse staff notifies the WMS administrator that the physical inbound process is finished. The WMS administrator checks if all the goods initially present on the order placed by the purchase clerk were scanned. His duty is also to check and announce if any of the received products have any qualitative problems. If there are no issues occurring with the inbound goods during the physical inbound process he notifies the purchase department that the physical inbound goods process is clear. Afterwards, the purchase department is checking if the prices from the invoice are correct. After the purchase department agrees this issue, the goods are received in the Enterprise Resource Planning Software (onwards called ERP). After the reception of the goods takes place, the WMS administrator unblocks the goods from the WMS. Through unblocking the goods are now ready to be ordered. The last two steps in the inbound goods process are the printing of the reception papers, which is a legal requirement and as a proof that the goods from the lorry are identical with the invoice and are in marketable condition the reception of the goods paper is signed by the warehouse member who was responsible of the unloading.

4.5.1.1 Set-ups in the inbound process

During the interviews with the warehouse manager about the inbound process of the goods, he was questioned about the bottlenecks that might occur during the inbound process of the goods. The set-up, which occurs more often is the absence of the invoice from the supplier. The invoice is important as the Romanian law forbids any income goods operations based only on the delivery note. Therefore without an invoice the inbound order cannot be introduced in the OWS.

Due to the web-order interface restrictions the orders from different suppliers present on the same lorry have to be mixed otherwise the order cannot be executed. This is an operation that occurs in 10 percentage of the cases, and causes slight delays in the inbound goods process. However, much bigger delays are occurring in these 10 percentage of the cases because some of the five areas of the warehouse, because of particular products specificity, execute the tasks quicker than the others. Therefore the whole incoming order has to wait until all the warehouse areas are ready with the goods receptions.

The sorting process is another warehouse task that is considered to be a set-up by the warehouse manager. Thirty five percentage of the goods, mainly high-margin laminate flooring together with skirting boards are loaded all together on pallets,

even though the products are different geometrically, due to space allocation issues in the lorry. That involves a sorting process and re-arrangements of the goods based on their categories: laminate floorings with laminate flooring and skirting boards with skirting boards. Moreover, to avoid future mistakes the sorted products have to be same décor and thickness (e.g. 6mm oak together with 6mm oak not with 7mm oak which is a different product). Another set-up observed by the warehouse manager occurs in the unloading of the goods in transit area rather that the direct unloading in the warehouse location. The goods are unloaded in the transit area because they have to be labelled or sorted. The products have to be relabelled because the supplier's bar codes are not compatible with the distributor's barcodes. In 80 percentage from the cases the products are not repacked, foiled or labelled. However, in 20 percentage the products are labelled with bar codes, as the codes from the supplier are not correct. Usually this occurs because alternative products or products are offered from different production batches initially manufactured for another customer.

The inbound processes task can be handled by 25 warehouse employees. The number of people that can be involved in these tasks were pointed in the Process Activity Mapping by the Warehouse Manager.

There are certain rules and regulations about how the flows and the procedures can be handled. There is an explicit process description about the inbound goods procedures. It is uploaded on the company's intranet so everyone is able to consult it. Moreover, a hard copy in printed in the warehouse for the persons that do not have access to the intranet resources to be able to consult it whenever is needed. All the employees are informed where to find it. However the logistic manager reckons that few of the warehouse staff is consulting periodically the procedures. He argues that these rules and procedures are transmitted to the new staff through the word of mouth.

The size of batches of the incoming goods may vary considerably. In the majority of cases pallets are moved as batches, roughly representing 65 percentage of the material batches. This is why in the 75 percentage of warehouse are stored only full-pallets. The minimum order quantity placed at the supplier for the goods in pallet batches is the pallet. In the rest of the cases, in 25 percentage of the situation are various boxes that are placed on the pallet. In 10 percentage of the cases each TU is transported manually because of its volume.

In the last five months, since January 2013 the suppliers became more flexible and are accepting orders below 9 pallets per decor. Now orders can be placed for 1

pallet per decor. However, in general there are not possible orders below one pallet for 80 percentage of the laminates sold. For the rest of the 20 percentage that have a much higher margin orders below one pallet are possible. There are certain products like laminate flooring skirting boards that have a minimum order quantity despite the initial customer order. Relative to this point the logistic manager thinks that this is a cause of the inventory increase.

In the APPENDIX 4 the process activity mapping for the inbound process is presented. In the process activity mapping each task occurring in the inbound process has separately assigned a letter which points what type of task is executed from the Process Activity Mapping possibilities. The possible actions are as follows: Operation, marked with O, Transport, marked with T, Inspection, marked with I, Storage, marked with S and Delay, marked with D. Based on the mapping the warehouse manager was interviewed about the possible variances of the processes. He was questioned about the variances because of the diversity of the products and because same tasks can be executed differently if different products are involved. All the products are received in stock following the 29 steps described in the Process Activity Mapping. The main processes that can vary considerably are the 12th, 13th, 14th and 19th. The following processes can slightly vary: the 14th, 15th and 16th. The 12th process can vary between 30 and 90 minutes, the 13th between 60 and 150 minutes, the 14th between 5 and 15 minutes and the 19th process can vary between 30 and 200 minutes. All the 15th, 16th and 17th processes summed up do not exceed 8 minutes all together in the worst case and 0.7 minutes in best case. The incoming orders are split on the 5 areas of the warehouse, so each area receives its goods separately.

In the interview the warehouse manager was questioned about the shortest and the longest cycle time for an inbound order to be processed. He pointed that the shortest reception of goods has the length of 50 minutes, and the longest reception of goods has the length of 700 minutes. The shortest cycle time is for high demand laminate flooring and the longest is for carpets. The inbound orders based on their complexity are as follows: 45 percentage of the inbound orders are simple orders (up to 70 minutes of time per inbound order), 25 percentage of them are medium complex orders (up to 300 minutes of time), and 30 percentage of the orders are complex (up to 700 minutes per time).

After the tasks were reviewed, the warehouse manager was asked to state his opinion about the value added and the non-value added tasks occurring in an inbound process. The warehouse manager reckons that the following steps are

adding value to the product: The gate allocation (without this the lorry cannot be unloaded), the order log-on, the codes scanning, the ERP receive process, the reception document printing. Moreover, there exists non-value adding but necessary steps all of them except the delays. All of these value added tasks sum up 5.62 percentage out of the total inbound process. Moreover, there are tasks that are not perceived as value adding tasks. These tasks mainly involve delays such as: lorry waits for information of the gate allocation, unloading the goods in the transit area and the waiting for an available forklift. However, the longest delay is considered to be the waiting time for the other areas to finish the reception. As it was said before, due to product specificity the reception time between the five areas may vary. In the next chapter the information needs for execute the physical tasks described earlier are going to be reviewed.

4.5.1.2 Information needs and quality issues in the inbound process

The flow of goods described in the previous chapters is ensured by a correct flow of information between the purchase department and the logistic department of the case study company. The findings are based on interviewing the logistic manager as well as consulting the process activity mapping described in APPENDIX 4.

The tasks in the inbound process that require immediate and correct information to avoid bottlenecks are the 2nd, the 3rd and the 26th. In all the other steps the information flows smoothly without any bottlenecks.

In the 2nd and the 3rd step of the distribution process the information is acquired from the purchase department via telephone or mail. In the 26th step the information is mainly acquired verbally or via the mobile phone. In general, for the inbound process the information output step in complete in 90 percentage of the times. This means the orders are correctly introduced in the WMS by the purchase department. However, in 10 percentage of the cases the orders are incorrectly introduced, therefore the warehouse clerk is either unable to execute the inbound order or it executes it wrong. The mistake is likely to appear during the 22nd task is executed when the goods are quantitatively and qualitatively checked by the WMS administrator. After the WMS admin identifies the error a rework has to be executed. By rework process the logistic manager stresses that all the goods from the warehouse location, where the product with the wrong quantities are present, has to be emptied and all the products re-scanned to discover the differences.

There are no stringent quality issues with the majority of the distributor's suppliers. However, there are quality issues with the products from China. Every container contains damaged goods or issues of quality. Unfortunately, over 20 % of the goods in a transport are damaged. Usually the company receives a credit note for these damaged goods. These unfortunate issues occur despite the fact that the company has a paid representative in Shenzhen that supervises the loading of the products from the suppliers.

There are no meters to evaluate the supplier performance. The distributor's suppliers are only segmented based on the yearly turnover. Usually the case study company has three suppliers on each range of products. If one of the suppliers fails to meet the quantity requirements, the second supplier is chosen. The third supplier is the "reserve" supplier.

In general, the goods from the distributor arrive in time. In the last year the shipments arrived in time from the supplier. The only transportation issues faced by the case study company were related to the time slots some of the trucks arrived. For example, the lorries were announced to come in the morning but arrived in the afternoon. This generated a 24 hours delay in the customer lead-time of the product.

In the last year there were three shipments of returned goods to the suppliers. In all of the three cases the goods were not selling for a long period of time. However it is not a rule of thumb for the goods to be returned because they are not sold in a specific period of time despite inventories bought years ago that were not sold from different causes.

4.5.2 The outbound process

The outbound process is the process through which the goods are delivered to the distributor's customers. The outbound process consists of 31 steps. These steps are divided into two sections: the distribution section, which contains 7 steps and the warehousing section, which contains the other 24 steps.

The distribution section deals with the orders from the customers. The flow begins when the order is received by the distribution coordinator. After the order is received in the OWS, the order is opened and checked. The order is checked to avoid ordering by mistake products that are not sold anymore by the company. After the order is checked, the order is confirmed. If any of the products are not in

stock then alternative products are offered by the distribution coordinator. When an alternative product is offered, the distribution coordinator has to check a Microsoft Excel Sheet with the products. After the product is suggested, if the customer does not agree with the product, the distribution coordinator inquires for a lead-time for the out-of-stock product or checks the stocks and availability in the other warehouses. In either case, the order is afterwards saved and printed.

The warehouse section contains 24 steps. After the order is saved by the distribution coordinator, all the orders have to be reserved. This is an important step as ensures that all the products placed on an order will be displayed on the warehouse pickers' barcode-scanner. Afterwards, the order replicates in the WMS from the OWS. Consequently the distribution coordinators are printing the orders in duplicate by giving one copy to the invoicing staff and one copy to the warehouse staff. This is to ensure that any eventual mistake occurring during picking (products missing, non-marketable products) is tracked on paper and it is supposed to prevent invoicing mistakes. In order for the orders to be displayed on the scanners the distribution coordinator has to allocate the orders at a loading gate. After the gate is allocated an hour is assigned for the order. In this moment technically the order is ready to be loaded. Normally at the designated hour the lorry arrives and awaits instructions regarding the gate assigned. After receiving the information about the loading gate, the lorry enters the loading gate. The warehouse clerks log-on the outbound order in the barcode scanner. After logging, the forklift drivers are moving to the place the goods are located. The location where the ordered goods are stored can be easily seen on the barcode readers' display. Afterwards, the order is picked from the location by a picker. If the goods are not positioned on the ground floor where the picking is possible without the help of a forklift driver, then the goods have to be taken from the rack. After they are taken the picker picks them manually, scanning the TU of the pallet and checking if the quantity displayed matches the quantity of the goods prepared for expenditure. After the goods are picked, the pallet is put back on the racks by the forklift truck. If there is no available warehouse equipment in the area, the goods are waiting for a forklift truck or a reach truck (depends on the isles). When becomes available, the pallets are transported to the assigned gate for loading with a warehouse equipment. If necessary the pickers are consolidating the goods with stretch foil and are visually checking the order, mainly to see if all the products are prepared. After the goods are checked, the name of the customers is marked on each pallet and the warehouse clerks are inspecting the goods to see if there are

any qualitative issues with the goods that are about to be sent. The name of the customers is marked to ease the driver's mission when he participates in the goods unloading process at the customer. After the goods inspection process is finished the invoice staff is invoicing the goods. They have prepared the products based on the copy provided by the distribution coordinator before the goods are prepared by the warehouse staff. After the goods are invoiced separately on each area, the goods wait for the order from different areas to be completed. Finally the goods are loaded din the truck following the distribution coordinator's specifications and in the end, the warehouse clerk double checks the invoice to make sure that the goods loaded are matching the goods invoiced.

4.5.2.1. Set-ups in the outbound process

During the interviews with the distribution coordinator about the inbound process of the goods, he was questioned about the bottlenecks that might occur during the inbound process of the goods.

The shipping process is different for the 5 main groups of products: laminates, carpets, rugs, laminate accessories and plumbing products. The laminates and the rugs are transported in pallets, the carpets in rolls and the plumbing and accessories in boxes.

In the distribution processes the following set-ups can occur: The products or the quantities in the order are not correct. In this situation the order can be placed in the warehouse without the "all orders reserved status". This affects specific products that are not reserved. Unfortunately if not announced, the picking is executed without scanning and loading these products. Eventually this set-up will be discovered during the step 27.

During the warehouse shipping process the following set-ups are likely to occur: when the goods are picked there is possible for the goods not to exist in the location or the correct quantity not to exist in the location (e.g. 2 pcs of X instead of 3). This involves for the picker to stop the order and wait for further instructions from his supervisor. (Giving him the possibility to "transfer" the information to someone else that can perform a root cause analysis might solve the situation. Moreover it is recommended for the picker to be able to jump over the missing product. If this happens he will not create a domino effect by delaying the other products). The lorry programmed in a time slot might be late or not arrive in a specific day. In 20 up to 25 percentage of the cases this is the main cause why

the order is delayed. When subunits are picked then barcodes have to be applied on each products and correct quantities manually introduced in the scanner. This is because the supplier places bar-codes only on the boxes, not on all the units existent in the boxes. After the goods are transported to the gate, some of the goods have to be repacked or re-labelled to meet the requirements of some specific customer. In parallel each loading list is printed on 2 sheets even though the information exists electronically: one for the warehouse staff and one for the invoice staff. If there are any differences between these two lists bottlenecks are likely to occur. The lengthiest delay is considered to be the following one: the loading of the lorry cannot begin until all the goods from all the areas are ready. As the warehouse manager notices, the vast majority of the orders are delayed because of this issue.

The outbound orders vary considerably therefore the delivered quantities vary. They can vary from one box to several pallets. The orders vary because there is no minimum order quantity for the customers. The customers are ordering exact quantities to deliver them to end-customer for minimum cost per order. The Distribution Coordinator thinks they are not willing to carry inventory.

When analysing the physical goods batches from the outgoing process, in 40 % of the cases the batches are formed from pallets. In 30 % of the cases the outbound batches are below the pallet unit, so laminate boxes are sent. The rest 30 % of the cases are boxes placed on pallets. The informational batches are as follows: 80 % are orders placed via the terminal while in 20 percentage of the cases the information regarding the orders are placed by phone, walkie-talkie or verbal.

There are situations when the distributor does not have on stock the ordered products. The usual stock out rate occurrence in the distributor's orders is 11.9 %. Every time a stock out rate situation occurs, the distribution coordinator is offering an alternative product. Normally in 30 % of the cases the customer accepts the alternative product. In the other 70 % of the cases he cancels the order or asks for partial delivery, even though the distribution coordinator gives the customer a lead-time for the stock-out product. In these situations, the distribution coordinator thinks the customer does not agree with the lead-time of the stock-out product. However, the distribution coordinator is not considering himself a knowledgeable individual when it's about to recommend laminate products. Most of the time, the distribution coordinator is forwarding the information to the product manager. There are situations when the Product Manager is not available so in the end the information with the suggested product does not reach the customer.

There is a process description sent prior to this interview uploaded on the company's intranet. All the employees in the shipping process know where to find it. However, the Distribution coordinator reckons the procedure is rather automated for the individuals that are executing the orders rather than for those that are picking them. Therefore, he considers that the distribution function with the warehouse function must communicate more efficiently.

In the APPENDIX 5 the process activity mapping for the outbound process is presented. In the process activity mapping each task occurring in the outbound process has separately assigned a letter which points what type of task is executed from the Process Activity Mapping possibilities. The possible actions are as follows: Operation, marked with O, Transport, marked with T, Inspection, marked with I, Storage, marked with S and Delay, marked with D. Based on the mapping the distribution coordinator and the warehouse manager were interviewed about the possible variances of the processes.

All the products are sent from the stock following the 30 steps detailed in the process activity mapping. The main processes that can vary considerably are the 10th, the 11th, the 14th, the 15th and the 23rd while other processes like the 12th, the 13th, the 17th and the 19th can vary slightly. The process number 10 varies between 30 and 60 minutes, the process number 11 varies between 30 and 150 minutes, the process number 14 varies between 15 and 45 minutes, the process number 15 varies between 30 and 60 minutes while the process number 23 varies between 30 and 60 minutes. These processes are varying depending on the length of the order. Other processes are varying slightly processes number 12, number 13, number 17 and number 19 summed up vary from 9.5 minutes in the best case to 25 minutes in the worst case. The delays in the process marked with the letter D are highlighted in the Process Activity Mapping but the severe delays are discussed with the Warehouse Manager. They sum up 192 minutes out of the 334 or roughly 57 percentage. The warehouse manager reckons the delay is so lengthy because of the waiting times for the lorry and for the order to be finished by the other areas of the warehouse.

The shortest process of outgoing goods has the length of 70.5 minutes, and the longest of 702 minutes. The shortest cycle is for laminate flooring and the longest is for laminate accessories.

The distribution coordinator suggests that the following processes are adding value to the processes: In the distribution processes the order confirmation is

participating in the process value. Even though there are other steps occurring in the order processing are not adding immediate value they cannot be immediately removed. In the process there are tasks that that determine a severe delay in the processes. Moreover, the coordinator suggests that some of the steps can be removed because they incur double handling (e.g. the goods are not automatically loaded in the lorry after they are picked from their location in the warehouse. In the next chapter the information needs for execute the physical tasks described earlier are going to be reviewed.

4.5.2.2. Information needs and quality issues in the outbound process

The flow of goods described in the previous chapters is ensured by a correct flow of information between the distribution staff and the warehouse staff of the case study company. The findings are based on interviewing the logistic manager, distribution coordinator the warehouse manager as well as consulting the process activity mapping described in APPENDIX 5.

The findings suggest that the steps in the process that require immediate and correct information to avoid bottlenecks are: step 5 of the distribution process and step 7, 21. In all the other steps the information flows smoothly without any bottlenecks. The information is acquired from different sources such as: In the 5th step of the distribution process the information is acquired from the purchase department via telephone or mail. In the 7th step the information is mainly acquired verbally or via the mobile phone. The same rule applies for the 21st step.

The accuracy of the information flow in the outbound process compared with the inbound process varies significantly. For the outbound process the information output step is complete in about 70 % of the cases. This means that the "all orders reserved" command is correctly executed and therefore no bottlenecks are likely to appear in the outbound process. However, in 10 percentage of the cases the goods might not be present in the location. The distribution manager made a root cause analysis and it seems that improper scanning when the order is picked. The warehouse clerks are frequently scanning a particular SKU with identical bar codes more than once instead of scanning each and every product separately. Rework has to be done in both cases. There might be other inaccuracies like the incorrect loading structures done by the distribution coordinator. This generates impossibility of loading because the goods are not fitting in the lorry.

In order to control the above stated issues the delivery reliability is calculated

monthly. The present figure is around 90 %. It usually fluctuates widely between 85 % and 95 %. The delivery reliability represents the percentage of full and on-time deliveries out of the total deliveries in a month. When issues are occurring there is usually a spot intervention but no root case analysis or continuous improvement processes have been executed.

Advanced information technology may help the distributor to use the cross-docking function. The purchase department will publish up to 3 days in advance the loadings from the supplier. The distribution coordinator will therefore be aware about the date in which the goods are incoming to plan de cross docking. The benefits of cross docking are multiple: the physical flows of goods are effectively handled, the FTL shipments are used effectively and proper planning occurs in the inbound and outbound activities (Apta and Wiswanathan, 2000). Moreover, the cross-docking activity decreases warehousing costs, inventory-holding costs, service cycle times and transportation costs (Chen et al. 2006).

During the last 12 months between May 2012 and May 2013, the shipments were delayed in almost 15 % of the cases. Roughly there were 2500 deliveries, out of which 350 were delayed by various reasons. There are three main causes for the delays. Firstly, due to the delays of the warehouse processes, the goods are loaded with delay. Hence the transport can arrive later than promised at the customer with up to 12 hours. Another reason for delays is due to the supplier delays. Hence, the outbound lorry is delayed because of the delay of inbound lorry. The third reason for the delays is due to the transporters employed in high peak seasons. These transporters are not contract-based so quite often are cancelling the contracted transports. Even though the transporters receive a penalty, the goods for the customers are delayed. There are a couple of issues with shipping in general. In particular, the biggest quality issues are found with the non-contracted careers. They tend to deliver bad transportation services. There is not a clear set of procedures approved between departments regarding the customer claims and the damaged goods procedure. However, when goods are delivered with the own fleet the damages during transports are insignificant. In the warehouse there is a situation about the damaged goods in the warehouse, which is updated weekly. The damaged goods reports are not used to control the process. In the following chapters the findings regarding the claims with the customer’s issues are addressed.

4.5.3 Claims and customer issues

In this chapter the complaints procedure between the customer and the distributor is debated. The procedure is executed when quality issues appear during the delivery. The result of such a delivery is a claim placed by the customer.

There are two types of complaints that can be placed by the customer about the delivered products. They can claim any qualitative or quantitative inconsistency regarding the products delivered by the distributor. If there are qualitative or quantitative issues they must complete a form together with the distributor's delegate or to write in the CMR (waybill) the eventual issues found. If there is a delegate, usually the driver, when the unloading takes place and issues are found, then the delegate is handling the form to the distribution coordinator. His duty is to inform the customer or the salesman in 24 hours about the conclusions of the claim. If there is a 3PL service provider the waybill reaches the distributor in maximum 7 days and the coordinator has the same duties as in the other case.

There are bottlenecks that are likely to occur when the distributor faces quality issues with a customer. The warehouse manager reckons that due to the severe delays in the warehouse processes of both the inbound and the outbound flux, highlighted in the process activity mapping, the goods are not properly checked for damages when they are sent. Therefore non marketable goods are delivered to the customer. Moreover, the invoices are not checked after the loading, hence errors occur in the invoicing process and differences appear between the loaded goods and the invoiced goods. After the client places the claim, the distribution coordinator places it in the warehouse. Usually, the distribution coordinator considers that the warehouse clerks are not seeing the claim procedure as a priority. Hence, their response is most of the time delayed.

There is a claim procedure uploaded on the intranet and the employees involved can find it easily. Unfortunately, as the logistic manager observes the lack of training for the new sales staff delays the claim operations as the new staff is not familiarized with the claim procedure. In the next chapter eventual improvements in the logistic process are addressed. The findings are based on an interview held with the logistic manager

4.5.4 General improvements in the logistic processes

In the following chapter the logistic procedures are reiterated from the lean perspective in a discussion with the logistic manager. The purpose of the

discussion is to have a flavour about the possibility of automated tasks in the warehouse and in the distribution of the laminate flooring in general. The first issues addressed is the applicability of the pull principle based on which the order to the supplier is placed when an order from a customer in the supply chain pipeline.

The logistic manager stresses that a full pull product process is not possible in the laminate industry because of the lead-time in production of the products. The lead time vary between 2 weeks and 8 weeks for laminates, one week for accessories and 6 to 17 weeks for carpets and rugs. Very interesting is the case of the very expensive laminate flooring product for which the customer is willing to wait 6 weeks for the product to be delivered. Usually, the orders from the customer are totally unpredictable. He emphasizes the importance of the forecast in order to ensure a buffer stock. Through this buffer stock the fast response process is ensured. He observes that the customers are not so keen to obtain a good price. They rather prefer and ask for fast delivery. This is because in they represent another echelon with fast end-consumer demands. He thinks that the supplier should shorten its lead-time for a faster distribution process to the end-customers. This is why the orders from the customers have to be "filtered" by the distributor before the manufacturing order is placed to the supplier.

The enhancement of the orders process is addressed as well. The logistic manager suggests that a standardization of the orders will benefit the flow and the order cycle is likely to improve. He considers that an eventual standardization will fasten the order process and reduce some of the delays exposed in the process activity mapping, mainly those related to the alternative product offered. He proposes for the orders to be restricted if the prices or the products from the order are not correct. If these rules will be followed than a much improves automation can be obtained in the orders processed by the distribution coordinator. For the inbound processes the logistic manager proposes the following possible improvements: An eventual execution of the order introduction in advance would prevent delays in processing the order immediately when the lorry is into the gate. If the goods are sorted in the suppliers' warehouse then part of the sorting jobs can be avoided. Hence, an increase in the warehouse cycle time is likely to occur.
There are addressed issues of distribution efficiency as well. The distribution process can be standardized if the routing would be respected. Therefore a milk-run transport can be implemented. Due to the orders decrease, the shipments are

not all the time reliable. Therefore the logistic manager stresses that more orders are needed for the milk-run distribution system to be efficient. For the quality issues a certain rule of checking the goods before loading or an eventual regulation about defect handling would be desirable. The logistic manager considers that the outbound process can be improved if the informational batches transmitted as orders to the distribution coordinator can be somehow diminished. For example there can be multiple orders placed by a customer during a day (the result can be easily calculated if the orders versus order launchers are analysed). Relative to the size of the ordered batches the logistic manager reckons that a minimum batch size ordering for all products would have effect on some of the delays of the shipping process. Firstly it will ease an eventual process of automating the loading structures. Moreover, it might offer the possibility for the products to be arranged in a conventional way, on pallets for example.

4.6 Findings in the customer's inbound process from the distributor

In the following chapter are described the issues faced by a customer in relation with the case-study company. These findings reflect the data collected in an interview with the purchase manager of a distributor's customer. In the following findings the inbound process of goods is described together with quality, responsiveness and eventual issues occurring in the day-to-day activity with the distributor. The aim is to assess the purchase processes and set-ups with the distribution company. The key terms followed through the interview are mainly referring to agile characteristics of the logistic processes: Order frequency, return and claims, customer cycle time, backorder frequency or invoice accuracy.

The process of receiving goods from the distributor can be described as follows: The Customer places the orders to the Distributor through an order form, mail or an excel file attached to the e-mail. The orders are sent to the customer's headquarters by the Store Managers after consulting the inventory and the sales forecast. Then the customer's purchase manager approves the order and places it to the Distributor. After the order is sent the distributor confirms or not the availability of the product. It provides the delivery time as well. The usual response time is up to 24 hours.

There are two seasons identified by the Customer: the low season and the high season. During the low season, then the orders are placed once in two weeks. During the high season, the orders are placed weekly, even twice a week. The high season is from April until November and the low season is from December until March. In the low season the orders are placed once in two weeks and in the high season the orders are placed weekly or twice a week.

There are situations when the distributor does not have the ordered products in stock. Relative to this point the percentage of the complete orders from the distributor is around 84 percentage in the last 6 months. From out of 48 orders placed 8 where incomplete. If so, the distributor offers alternative products (by alternative products are understood similar decors with slightly different thickness, for instance). There are few situations when the alternative products are accepted, especially if the customer is demanding a specific decor for instance. When not all the products are in the distributor's stock, there are backorders standing still with a different delivery date. However, the delivery date is few times respected. The usual delays are up to 4 days.

The biggest problems encountered with the distributor in order of their importance are: the delay of the promised delivery term, qualitative issues such as there are other products loaded than the ordered products or the goods are damaged mainly because of the transport. Quantitative issues can occur as well. The quantities are bigger or smaller than the order. The products are generally invoiced correctly. However, there are situations when there are goods invoiced and not present on the lorry. There are no situations when the distributor omits to notify the customer about the availability of the products in an order. When damaged goods are identified, the damaged goods are separated and a special form is filled together with the distributor's representative (driver). The issues occurred are detailed above. After the forms are filled and the damages acknowledged, the customer places an official claim via e-mail. Usually an answer from the distributor regarding the claim is received in 24 hours. However the replacement of the product lasts longer, in some of the situations even two weeks.

After every problem encountered the customer places a claim. Usually there is one claim per month. The answer for the claims is rapid, usually in no more than 24 hours. However, the necessary time for solving the issue is considerably longer. After the claim receives a positive answer from the distributor the return process of the goods is discussed as well. The return transports are made once in a while

for the goods that came damaged on the distributor's transports. A date is agreed together with the Distributor for these goods to be picked up on the distributor's expense. There are cases when a pick-up date is agreed with the distributor but the distributor's lorry is not arriving. Moreover, the distributor is not announcing the delay.

The customer does not perceive the distributor’s delivery service as an on-time service. The delivery term is often exceeded with 1, 2 or 3 days. The usual cycle-time of an order is usually in 80 % of the cases one week. However, in 20 % of the cases the cycle-time is more than a week up to two weeks.

In these findings the information flow with the customer is assessed as well. To avoid misunderstandings, the information exchange with the distributor is made via e-mail. There are several cases when phone calls are placed, especially when the customer is in the store and there is an urgent need for inventory level information for some products. In general, the distributor is providing rapid inventory information in maximum two hours. However, there were situations when the quantities or the products on the original orders placed by the customer were modified by the customer after the order was confirmed by the distributor. However, this did not influence the delivery time.

The customer suggests some improvements in the relationship with the distributor. The first suggestion is a routing schedule for the distributor and possibly a fixed day of the week for delivery. The customer reckons that a routing scheme for the distributor is likely to prevent eventual delays in the delivery time. Moreover, an eventual routing is likely to shorten the cycle time of the orders. One of the main information that the customer would like to share with the distributor is the inventory on the products the customer is selling. The customer is interested in getting information in advance on new products as well.

4.7 Summary

This chapter will focus on the findings in the distributor warehousing and distribution activities. It also reveals the findings of the customer's perception on the distributor's responsiveness.

The chapter begins with a brief presentation of the European and Romanian laminate flooring market. After the introduction the two companies are presented.

Later on, the findings in the distributor's warehouse and logistic activities were presented. The distributor's inbound and outbound logistic processes were described together with the bottlenecks and the set-ups occurring during these processes. Moreover, the customer's inbound process is presented as well in order to have a holistic view on the distributor's responsiveness and eventual agility issues occurring in the distributor's delivery activity. Moreover, some informational needs in the physical movement process are assessed as well.

Besides the necessary tasks needed to execute a whole inbound or outbound process, quality issues are discussed, too. The claims and the customer issues regarding the claim and complaints procedures are addressed. These findings are seen as important because the steps in the distributor's activity are identical with all the customers. In the end of the chapter the possible general improvements proposed by the Logistic Manager are presented.

In the next chapter, the conclusions based on the findings are presented and the improvements in the distributor's activity are proposed.

Chapter 5 - Analysis and Discussion

5.1 Introduction

This chapter will discuss and summarise the results and the outcomes of the work conducted in the case study company during the period of the project. Moreover, the improvements in the warehouse processes will be revealed as well as their eventual influence in increasing or decreasing the distributor's agility will be debated. Throughout the research both the interviews with the key employees were performed and the process activity maps were analysed to gain a holistic view of the lean and agile process occurring in warehouse and distribution.

The key terms of the research can be briefly defined as follows: the agility represents the capacity of an enterprise to react quickly and effectively to changing markets, driven by customised products and services. Leanness can be achieved through a value stream development, which aims to remove all waste including time and ensures a level schedule in activities. Both these two strategies were initially tested and researched in manufacturing environment but nowadays are adopted within to supply chains, too.

The supply chains encompass the planning and the management of all activities involved in sourcing and procurement plus all the logistic management activities.

To state the obvious, in industries nowadays there is a call for responsive supply chain strategies that are customer-oriented but wasteless and cost efficient.

Fisher (1997) attempts to match the efficient and responsive strategies by segmenting products and separating the supply chains in time and space. He assigned different distribution and manufacturing strategies for separate types of products: MTS for commodities and MTO for innovational products. Hence, he suggests an efficient and a responsive supply chain in parallel, separated in space and time. He piorneered Shewchuck's (1998) "one size does not fit all" paradigm.

The two supply chains may meet in the downstream part of the supply chain through the principle of postponement. For example, some parts can be built using lean strategies and assembled using agile strategies. However, there exists a specific point that separates the two strategies conventionally called decoupling point.

The definition of the decoupling point is multifaceted. It is considered by some scholars as the point that separates the "pull" from the "push" activities, as the point until which the orders penetrate the supply chain pipeline or is seen simply as the point that separates the two paradigms. In case of the MTS adoption can be the point where the inventory is held.

There are functional examples in the literature exposing the lean and agility cohabitation in the manufacturing processes such as Dell (computer manufacturing) or Iniditex (garment manufacturing). However, to the best of the author's knowledge none of the existant study researches the lean and agility cohabitation in an organization that is a distributor, which has to cope both with lean pressures from manufacturer and with agile processes from the customers.

Based on the above stated gaps this research calls for an investigation of leannes and agility cohabiting in the same supply chain in a logistic environment in general and in warehousing and distribution environment of a distribution company in particular. The rationale behind the research subject is twofolded: the company is a distributor, hence it sits between the supplier and the customers and the logistic department is the operational lever between the supplier and the customers. Therefore, the need of researching these two paradigms in this specific supply chain segment through a case study arose.

The case study proposes the analysis and answers for three research questions. The first adresses the aspect of leannes and agility cohabitation in a warehouse and distribution environment. The second asks if lean influences or not the agility and the third asks where is the decoupling point on the supply chain pipeline positioned.

In the case study, onwards called the distributor lean was implemented in the warehouse and distribution operations durring a project that lasted several months. Before the lean tools were selected the initial stage of the operation was mapped. For a more robust ovierview of the distributor's agility a customer was interviewd. The customer is seen as a relevant research subject because of its high turnover and its specificity, which resembles with almost 80 % of the distributor's customers. After the lean implementation, the improvements were mapped and specific outcomes were measured. These specific outcomes are seen as agility enablers in the exitent literature. So lean and agility cohabitation was found in this case study. Moreover the lean implementation was inductively corelated with the

agility enablers namely: customer responsiveness, quality enhancement, lead-time reduction, customer sensitivity and flexibility. Hence an eventual influence between lean and agility was discovered, which attempts to answer the second research question. Relative to the decoupling point, as it can be easily deducted from the framework, the findings suggest that it is positioned between the lean and the agile activities. In other words, the lean warehouse tasks are executed based on forecasted short-term activity until the new multi-skilled teams will adjust themselves for agile tasks like unpredictable tasks without direct supervision such as: unpredictable orders, loading issues during the evening or quality issues of the goods delivered just to name a few.

The research is important both for academia and practitioners. It has its degree of generalisability as in companies with similar characteristics the proposed framework is likely to function. So it is fair to say that if lean tools and strategies are adopted in a warehouse and distribution environment of a distributor then agility drivers through leagility are likely to occur.

Nonetheless, the present research is conducted on a distributor because these organizations are subject to lean pressures from the manufacturers and agile pressures from the retailers, resellers or final customers. In the following sub-chapters the lean implementation and its influence on the company's agility will be detailed. In the chapter's end the research framework will be presented together with the decoupling point findings and mapping.

5.2 The delays and quality issue cycle

The delays in the warehouse processes are part of a vicious circle. These delays might generate delays in the process of goods distribution and eventually a lack of customer responsiveness. These findings were noted in the interviews with the distributor. The relationship between delays in the goods distribution processes and lack of customer responsiveness were identified in the interviews with the distributor and with the customer.

The in-depth studies of the process activity mapping are revealing delays that occur both in the inbound and in the outbound activity of the distributor. These delays are affecting the warehouse main flows, generating long response time from the warehouse staff to the distribution staff and in the end to the customer. Moreover, the sending of the non-marketable goods is affecting the quality of the

service provided. When problems occur the management tendency is to have spot discussions and solutions rather than a strong process review. However, the problems mentioned above are persisting and breaking these cycles is a challenging task.

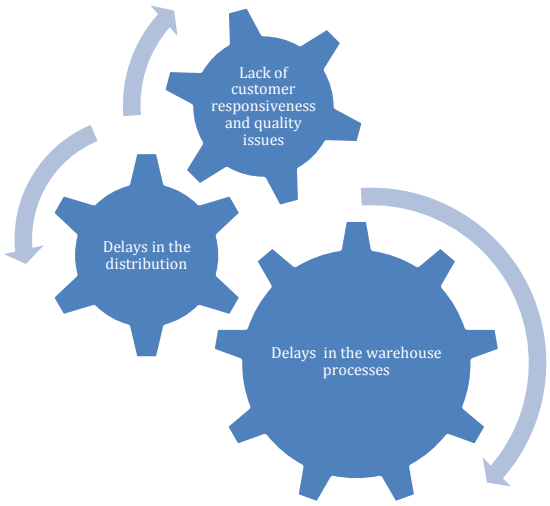


Fig. 5.1. Link between delays and responsiveness (Author)

It seems like the delays in the warehouse are decreasing the distribution capacity and prevents an in-time delivery service and a high quality standards delivery.

In order for the distributor to improve its response time the warehouse processes have to be reviewed. Simultaneously, the quality issues occurring in the delivered goods have to be resolved as well. The review of the warehouse processes is likely to generate both improvements in the rapidity of the distribution process and the enhancement of the quality checks. The following requirements are needed for the processes to be revaluated:

1. In order to shorten the time spent to execute the warehouse processes, the process activity mapping of the inbound and outbound process has to be reviewed and the processes reconsidered. Simultaneously the delays that occur in these processes have to be removed.
2. Quality issues have to be resolved through a tougher quality check to prevent the expenditure of the non-marketable goods to the clients.

5.3 The inbound and outbound process improvements through lean tools

This sub-chapter describes the improvements achieved in the logistic department of the case study company based on implementation of lean tools. Based on the improvements, the results will also intend to answer the first research question of this thesis: Do lean and agility cohabit in the downstream part of the supply chain, specifically in an enterprise playing a distributor role?

Based on the primary data collection (interview findings) and the secondary data collection from the company's documents such as Process Activity Mapping the processes of the company were reviewed and the flows were mapped. According to Rother and Harris (2008) there are three types of flows: the material flow, the informational flow and the operator flow. In this research all the three flows were measured through the Process Activity Mapping. The logic of the informational flow was collected through the interviews with the senior staff and the operator flows (warehouse staff) occur from the Process Activity Mapping. The two main processes were analysed separately: the inbound and the outbound process.

The lean improvement approach used in this research is KAIKAKU not KAIZEN. KAIKAKU consists from improvements via breakthrough events (Hines et al, 2004) while KAIZEN from incremental improvements, step-by-step by continuously re-analysing the flow of processes (Hines et al, 2004). In this specific research KAIKAKU is seen as a feasible solution because the improvements in the processes are implemented in a short period of time and KAIKAKU delivers radical changes. Because it delivers radical improvements, KAIKAKU is sometimes called KAIZEN Blitz, or RIE (Rapid Improvement Events) (Radnor et al., 2012).

After analysing the Process Activity Mapping of the inbound process the delays were highlighted in the first instance. Therefore, the KAIZEN bursts were pointed where the delays occurred, to clarify the problem and point the real situation. The KAIZEN burst is an improvement activity to create more value and remove waste. It is commonly called a breakthrough KAIZEN. The KAIZEN workshops are a common method to kick-off the start of a large step change within an area or value stream. It involves all the warehouse staff to attend the workshop. KAIZEN

workshops would actually start with data collection of the problem and continue to do some data analysis of the problem using the 5s tool, design and even implementation of the improvement (Melton, 2005). During the KAIZEN Burst, the problems occurring were break into small specific ones, using the 5w+h tools. The 5w tools are identifying the multiple causes that underpin a problem. These tools are sometimes called root cause analysis. When using a root cause analysis, the focus of the analysis has to be on the eventual lack of flow and functional behaviour. The root cause analysis addresses six questions such as: Who?, What?, When?, Why?, Where?, How? about the occurrence of an incident. It also develops countermeasures for the causes not to reappear. After the measures are developed, the achievable targets are designed together with their limitations and adoption timeline.

The delays pointed in the map were seen as waste in the logistic and distribution processes. Therefore KAIZEN bursts were organised. In the KAIZEN bursts, the delays were analysed using the root cause analysis. The delays were both discussed in the interviews and mapped by the warehouse manager in the 29 steps of the inbound process. The delay processes at which the root cause analysis referred to were as follows: the delivery note was handled by the driver to the warehouse staff, the warehouse officer informs the WMS admin about the truck arrival for gate allocation, the lorry which awaits for information of the gate allocation, the unloading of the goods in the transit area for checking if the labels are correct, the waiting for an available forklift for moving the goods in the location and the waiting for all the areas to finish the reception.

After careful consideration these six steps were proposed for removal. The six steps represent roughly 38 % of the total time consumed for executing an inbound activity. The process was simulated after the new flow design to check if the new process has any bottlenecks.

In order to develop the decided improvements, the steps of the inbound process were re-evaluated. To avoid the delay generated by 3 processes involving the lorry and the driver (which is delivering the inbound goods) new rules were imposed. The new adopted rules will eliminate the 6^{th} step (delivery note handled by the driver to the warehouse staff) and the driver will have the gate assigned before its arrival. The gate will be assigned based on the information from the purchase department about the day and the hour the lorry is programmed to arrive. The new rule will also eliminate step 7 and 9, both of them related to waiting time (WO

informs the WMS admin about the truck arrival for gate allocation and the lorry waits for information of the gate allocation).

The unloading tasks of the inbound process were redesigned as well. Before the improvement the goods were unloaded in the transit area, sorted and labelled. After the flow was redesigned, the 12th step or the loading in the transit area step was eliminated for a flow improvement in the process. Besides the flow improvement, which first of all delivers a time saving, the elimination of the 12th step also improves the quality check for the non-marketable goods not to enter the warehouse. The warehouse clerk will not label the ballet with a TU if any quality issues with the goods occur. After the goods are labelled, they are directly transported into their storage location. By direct transporting the goods into their location, the 18th step of the initial inbound process is eliminated therefore the waiting time for an available forklift is eliminated as well. The biggest improvement in the inbound process is the elimination of the 25th step. The reasons that underpin the elimination of this step will be detailed in one of the next sections of the thesis. The 24th step, which involves the checking of the invoiced prices by the supplier will be done before the lorry arrives. Therefore the waiting time will be shortened and the flow will have few bottlenecks.

After analysing the Process Activity Mapping of the outbound process the delays were highlighted in the first instance. The identified delays and wasteful processes were: the orders are placed on paper in the warehouse, the lorry awaiting instructions regarding the gate assigned for loading, the waiting for any available lift truck, the goods are waiting for the orders from different areas to be completed and the warehouse clerk double checks the invoice. The KAIZEN bursts were pointed where the delays occurred, to clarify the problem and point the real situation. During the KAIZEN Burst, the problems occurring were break into small specific ones, using the 5w+h tools.

After careful consideration of the reasons that stood behind these activities the 5 steps identified above as delays or wasteful processes were proposed for removal. The six steps represent roughly 30 percentage of the total time consumed for executing an inbound activity. The process was simulated after the new flow design to check if the new process has any bottlenecks. The processes were re-arranged and the outcome was as follows:

The task involving the orders placed in the warehouse was eliminated. This task was executed mainly because of the inventory inaccuracies. The warehouse clerk was using the paper to mark any quantities that were not found at their location during the process. After the order was complete then the warehouse clerk transmitted, if occurred, any inconsistency to the invoicing staff for correction. The company removed this step and developed the WMS. The WMS when any object was picked transmitted the information automatically to the invoice staff and to the distribution during the order processing. The purpose of informing the distribution staff is for the distribution to alert the customer about any quantitative difference that might occur from the initial order.

The 7^{th} step of the outbound process was removed as well. The lorry which initially was waiting for a gate to be assigned for the loading will have a gate assigned beforehand when all orders are reserved based on the information about the day and the hour slot communicated by the person in charge with the transports. The steps 15 and 22 were removed based on a major improvement that will be detailed together with step number 25 from the inbound process later on. Conversely, the distribution process has been slightly enhanced. The timing for offering an alternative product by the distribution coordinator has been improved with 30 minutes. The new process tries to involve less the product manager that suggests an eventual alternative product. Therefore, the distribution coordinator, based on a list provided by the product manager can decide all by himself what alternative product he can offer. In this respect the distribution coordinator becomes multi skilled as well. Relative to the second task from the warehouse process the informatics system was enhanced through a poka-yoke or error-proof implementation. The distribution coordinator is signalised and cannot proceed to the next step if "all the orders are not reserved".

The step number 24 from the outbound process was logically removed because of the WMS improvement that transmits the information in real time about the quantities picked to the invoice staff.

Both the inbound and the outbound process were redesigned in a new logical flow. Relative to this point, the improved processes are detailed in APPENDIX 6 (re-designed inbound flow) and 7 (re-designed outbound flow) were the redesigned processes are mapped. It can be observed the logical flow in the sequence of the areas in the sense that consecutive steps are executed in the same area as much as possible.

5.4 The warehouse process improvement as a whole

The biggest improvement resulted from the KAIZEN burst is the redesign of the central warehouse flows. Before the improvement the warehouse was divided into five areas. The way in which these areas were organized was described earlier in the thesis.

After the delays were removed and the flow re-arranged the new tasks were carefully reconsidered. The tasks were simulated and for a better flow a Spaghetti map has been drawn. The Spaghetti map is a simple lean tool that helps visualize extra movement of people or machines within a process (Millstein, 2010). This specific tool is highly recommended in redesigning processes in a work-area. With a pencil is drawn the movement of a picker from the moment when he begins the pick until the picking order is completed. The orders were divided into three categories based on their difficulty. For relevance, an order that follows the same steps 80 percentage of the time was picked. The initial movements of a picker from each area can be seen in APPENDIX 8. Clearly the Spaghetti Diagram makes the case that this warehouse could be improved; reducing the labour required to pick, pack and ship orders.

After assessing the movements, the possible improvements were discussed. The improvements consisted in eliminating the five areas of the warehouse and make only one area. This means that the whole order placed by the customer reaches a single area in the warehouse. In this single area, a single team handles the order from the beginning until the order in completed. The decision was based on ideas derived from cellular manufacturing with the purpose of delegating the responsibility and authority to the workforce through decentralization (Riezebos et al, 2009). Therefore a functional layout or a process layout was preferred. Relative to this point similar picking processes from different areas were grouped in the re-designed process. Besides other tangible benefits, which will be discussed later, there are intangible benefits known. According to Fogarty et al (1989) as cited in Prince and Kay (2003) the functional layout is flexible and ensures a relatively high utilization of the equipment and offer high employee satisfaction. On the other side, Evans (1983) as cited in Prince and Kay (2003) points some of the disadvantages of the functional layouts like the need of highly skilled workers.

The employees from the past five areas were divided into three categories: warehouse clerks, forklift drivers and pickers each area had its own staff assigned based on their competence in dealing with the products. All the five teams had in total 25 employees.

After the multi skilled teams were created, the total number of the warehouse active employees was 17 divided into 6 teams, in which one team is always a backup team.

The benefits of the multi-skilled teams are multiple. Lloyd (1996) emphasizes that the multi-skilled teams gives everyone the confidence to look on work problems as joint problems to be solved, rather than as responsibilities to be evaded.

For a better understanding of each team's daily mission the duties are assigned each morning by the Warehouse Manager on a Board. This step is part of the Lean Visual System Strategy and it is a tool that constantly reinforces the focus on the process using intuitive colours and/or graphics (Rother and Shook, 1999). This creates a visual impact, and each team is aware about the volume of work for the day. Moreover it creates a competition between the teams because each order is measured with the stopwatch by the Warehouse Manager hence is a useful tool for quantifying the daily activity. A visual board used in the company warehouse can be seen in APPENDIX 10. On the visual board the warehouse tasks can be visualised, as well as the distribution tasks. Each customer has a code assigned. Each code represents an areal e.g. XXYYZZ (XX- city, |YY- part of city, ZZ street, street number).

The multi skilled teams usually benefit both the employer and the employee (Williams, 1998). Their skills are expected to broaden, the control of quality is likely to increase and the team members are likely to work without supervision. (Emery, 1997 as cited in Williams, 1998).

Based on a categorization made by Hackman (1990) there are three types of teams based on the authority accorded by the management: the manager-led teams, the self-managing teams and the self-governing teams. In the case-study teams are invested with significant responsibility in managing their own work. However, others decide about their goals therefore they are considered as self-managing teams.

After the re-arrangement of the processes the orders were picked and a much rapid picking time was registered. Moreover, the distances traveled by the warehouse machines were significantly smaller. The spaghetti map of an order pick in a one-area warehouse can be seen in APPENDIX 9.

The newly formed multi-skilled teams are now able to decide about any loading issue occurring during the evening. Loading issues occurring in this time of the day are unpleasant because some of the goods due to weight or stackable restrictions cannot be loaded into the lorry. In case the goods do not fit into the lorry then can decide based on their new competencies which goods will be sent the next day through a same-day or a next-day delivery service. All in all the goods will reach the customer in time but with different transporters.

Besides the benefits of the multi-skilled teams from the employee motivational point of view there are two major benefits identified by the company management: the warehouse lead-time reduction which resulted in an improvement in the distribution lead-time and enhancement and the quality of the sent goods. The processes were re-arranged and in the new processes a bigger focus on quality was inspired. Probably due to the fact that an order is prepared and loaded by a single team the responsibility about any defects is bigger and the pressure relies on a single team. Moreover, the necessary time due to the waste reduction for quality checks increased and a supplementary step is established.

The majority of studies point that the quality improvement is a profitable activity (HBR, Unconditional Quality, 1991). In the building material industry the eventual quality issues in a product can be identified only visual. Comparing to other electronic devices that can be scanned for defects by sophisticated machines, the building material goods can be only visually inspected therefore human mistakes may occur. The pallet inspection is an operation that requires a fair amount of time before the loading process in the lorry is executed.

The warehouse lead-time reduction is the second improvement a company benefits after the lean tools are implemented in the warehouse. Because of the waste process removal and the warehouse re-arrangement, the warehouse lead-time for preparing an order decreased with 30%. These process enhancements ensure a more flexible and responsive distribution scheme. The lorries are loaded quicker and the goods are reaching the customer more rapidly.

Last but not least, after the cellular re-arrangements the assets were redistributed: the pallet and the forklift trucks. Before the re-arrangements there were forklift trucks in 5 areas. When the warehouse manager measured there effective working time the results were around 4 hours each out of 8 hours normal daily asset working time. The results are displayed in the following graph.

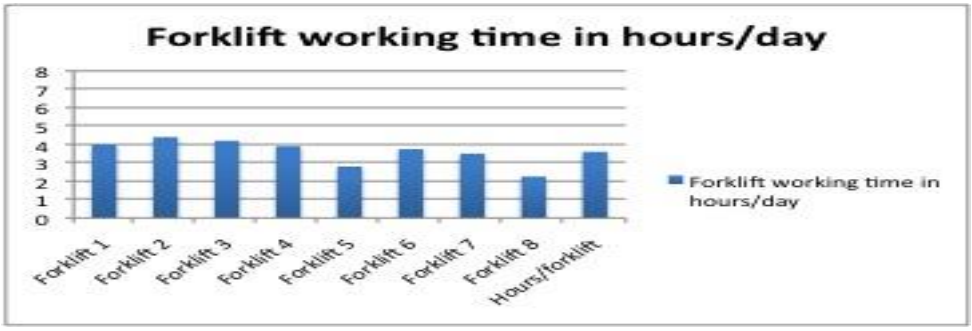


Fig. 5.2. Forklift usage before levelling

After the implementation of the cellular warehouse the management decided to keep only 5 forklift trucks and sell the other 3 that were in excess. After measurement the new figures representing the asset utilization are shown in the next graph.

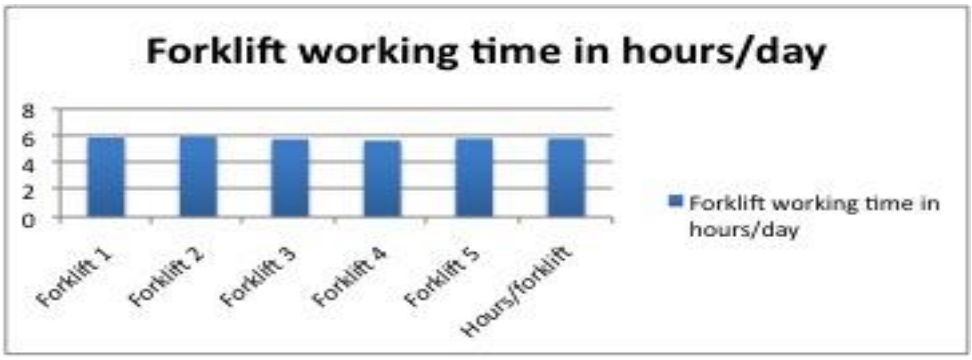


Fig. 5.3. Forklift usage after levelling

After reallocating the forklifts to the multi-skilled team the average working time and efficient utilization increased with 71%.

Besides the cost reduction the efficient asset utilization offers another tangible benefit: the under-utilized assets can be sold for profit.

Another improvement is the inventory decrease.

The literature addressing the lean and the agility cohabitation suggest that lean and agility can co-exist in parallel Supply Chains, lean in the MTS supply chain and agile in the MTO supply chain. (Olhanger and Prajogo, 2012). Christopher (2000)

suggests that leanness is beneficial only for internal improvements in a company and calls for supplier integration to achieve agility. Later on, Christopher and Towill (2002) argued that a Supply Chain has to be lean or agile based on the customer's values. The foundation of their argument is founded on Mason-Jones et al's (2000) leagility matrix. Mason-Jones et al. (2000) recommended the use of a lean supply chain when the customer's order winner is the cost and the use of the agile supply chain when the customer's order winner is the service level. Moreover, the lean supply chain is appropriate when the customer's order qualifiers are quality, lead-time and service level whereas the agile supply chain is appropriate when the customer's order qualifiers are the quality, cost and the lead-time. It is obvious the call of the academics for parallel supply chain both in static and dynamic environments.

The findings of this study suggest the cohabitation of the leanness and agility in the case-study company. The lean implementation generated both tangible and non-tangible benefits detailed earlier in the chapter. Two of the most important tangible benefits are the lead-time reduction and the quality improvement of the delivered product. Moreover, an intangible but very important benefit is the creation of the multi-skilled teams. In the next chapter all the outcomes will be detailed and arranged with the purpose of building a framework. The eventual influence of lean on agility is discussed, too.

5.5 Inventory decrease

Relative to the lean tools and inventory decrease, the following conclusions are presented: there is not a major decrease of inventory through lean adoption due to several reasons. Moreover, this specific supply chain cannot function on a Build-to-Order basis because of the product specificity. Bucklin (1965) suggests that for the long lead-time products a minimum stock is to be held by one of the players in the supply chain pipeline. However, the problem of inventory cost still remains a debatable issue. According to Gunasekaran et al. (2001) the cost associated with the stock are considered to be: opportunity cost mainly a storage cost, the cost associated with inventory as incoming stock level, the service cost mainly a cost associated with stock insurance, the cost with the goods in transit, the risk cost, a cost affiliated with the damage, the scrap and rework cost and the shortage of inventory cost associated with the lost sales. Nonetheless, the costs associated

with the stock are in contradiction with the lean philosophy of waste removal. Hence, in this respect some improvements are proposed.

In the case-study company the inventory is crucial for delivering the goods to the customer in time. This is mainly because the lead-time for the products distributed is very long. The minimum lead-time is 2 weeks, but the average is 6 weeks, therefore forecast is needed. Fisher (1997) considers the products that have a lengthy lead-time as functional products and placed them in his matrix as products that are subject to lean supply chains, not to agile. Moreover in this case study the adoption of the principle of postponement in an attempt to be both lean and agile and to institute a decoupling point is not possible because the product's specificity.

In order to address both the cost and improve the responsiveness issue two tactics will be adopted: cross-docking and direct delivery to the customer. Cross-docking will be possible by perfecting the distribution system based on the customer's request by implementing fixed delivery dates. The cross docking involves the movement of the inbound goods from the receiving dock to the shipping dock with a minimum of dwell time in between. However, if something unexpected comes up express deliveries can be arranged in parallel. This will ensure a slight inventory decrease.

5.6 Leanness influence on agility

This chapter will aim to answer the second research question of this research. In order to properly answer to the second question of the research: "If they cohabit how lean implementation and continuous improvement can influence agility?" a framework design is needed. The purpose of the framework is to reveal a holistic picture of the company processes in respect with its customers and the influence than lean and agility is having on various company processes. The framework is a tool that will help the case study company in their decision making process. It is useful in designing "what if scenario" designs in the company. The "what if scenarios" help companies to tackle differing marketplace uncertainty scenarios (Mason-Jones et al., 2000). The literature suggests ten factors that influence agility (Barve, 2011). These factors are the following:

1. Organizational Integration and Willingness for Improvement
2. Outsourcing

3. Collaborative relationships
4. Lead-Time Reduction
5. Information Sharing and Trust
6. Flexibility in System
7. Customer Sensitivity and Responsiveness
8. Customer Satisfaction
9. Commitment by Top Management
10. Cost and Quality of Service

Out of the 10 factors proposed by Barve, this study suggests that the lean implementation is likely to influence 6 of them. Before a brief analysis of the correlation, the 6 factors are going to be defined. According to Christopher (2000), the lead-time reduction is a factor through which a company can gain a competitive advantage minimizing the time taken from a customer raising a request for a product or service until is delivered. The other terms will be defined using Barve's (2011) perspective on the factors. The information sharing and trust relies in the capacity of the companies to share information for a common goal. The Flexibility is the system's capacity to cope with changes in the nature, volume or timing of their activities. The Customer's satisfaction represents the customer's reaction to his or her perception of the value received as a result of using a particular product or service. The quality and the cost of the service is related with the capacity of a company to deliver customer service quality at a reduced overall cost. After the definitions of the terms the correlations exposed in the table above are detailed.

In the previous chapter the lean improvements in the activity of the warehouse were discussed. The inputs will be presented in the following table together with the outcome in the warehouse processes. After the impact in the major processes is discussed, the correlation with the factors known to influence agility is addressed based on the categorization of Barve (2011). The correlations are shown in the next table.

After the lean tools were implemented in the warehouse, the processes were re-arranged and the warehouse and distribution tasks were re-calculated. The re-arranged processes that initially were seen as bottlenecks, set-ups or delays were correlated with the customer's perception of the service quality from the distributor in order to see if the tasks in relation with the customer are enhanced.

Inputs	Tangible Outcome	Agile output
Spaghetti Diagram	Quicker order execution	Lead-time reduction
Cellular warehousing	Quicker order execution	Lead-time reduction, Customer sensitivity and responsiveness
Remove waste and bottlenecks	Correct order execution	Customer satisfaction, Cost and Quality enhancement
Load levelling	Enhancement of assets utilization	Cost and Quality of Service
Poka-Yoke (Mistake Proof)	Correct order execution	Customer satisfaction, Cost and Quality of Service
Enhanced quality inspection	Correct order execution	Cost and Quality of service
Cross docking	Quicker order execution	Flexibility in the system
Multi skilled workers	Correct order execution	Flexibility in the system
5S	Correct order execution	Flexibility in the system
Visual management	Quicker order execution	Flexibility in the system
Direct delivery from supplier to the customer	Quicker order execution	Information sharing and trust

Table. 5.4. Inputs/Outputs in warehouse

In the lean implementation process that took place in the case-study company 11 lean specific tools or concepts were applied. These concepts generated 3 tangible outcomes: quicker order execution, enhancement of the correctitude of order execution and enhancement of the asset utilization.

The spaghetti diagram revealed the unnecessary motion in the warehouse for order pickings. After the improvements and the re-organization of the warehouse into one single area the warehouse lead-time reduction reduced. The same tangible benefits were obtained by applying the cellular warehousing. Through cellular warehousing the speed in resolving any inquiries or claims placed by the customer will increase significantly. This means that the customer sensitivity and responsiveness will be increased. Therefore, the first two lean tools are

influencing mainly the lead-time reduction. By removing the bottlenecks in the warehouse processes, the quality of the goods sent increases as it will be more time available for the products to be checked for any inconsistencies. Moreover, the customer satisfaction and the customer sensitivity and responsiveness will increase because any eventual claims or inquiries will be promptly resolved and the time to resolve them will decrease significantly. Through the load leveling the asset utilization increases. This will have an immediate impact on the cost and quality of the service. Moreover, through Poka-Yoke or mistake proofing the customer satisfaction and the cost and quality enhancement will increase. By poka-yoke, the distribution coordinator will be obliged to confirm all the positions in the order so all the goods will eventually reach the customers. By enhanced quality inspection there will be less cases of non-marketable goods sent and through 5s and visual management the flexibility in the system will be enhanced.

The last three tools applied in the warehouse are functioning in a lean environment but have agile characteristics. They were applied after the lean tools were implemented and they were the result of the new improvements in the process: the multi skilled teams, the cross-docking and the direct delivery to the customer. The cross-docking is known to increase agility and decrease inventory and handling costs because the goods are unloaded from the inbound transport and loaded directly in the outbound transport (Song and Chen, 2007). The cross-docking decision has been taken after a fixed has been established as the delivery day with the customer. Some of the inbound goods for the customer are programmed to be received an evening before therefore cross-docking has been made possible. Through Information Sharing and Trust some direct transports will be organized to the customer. This is likely to generate an inventory decrease and more flexibility in the distributor's system. Information sharing and trust are crucial because there might be a risk for the customer to eliminate the distributor's echelon and order directly from the supplier. However, it is hard to believe that the supplier will have the necessary logistics (the supplier is 2000 km away) to service the customer.

There is an important recommendation for the success of the activity improvement: the multi-skilled team have to have a major commitment of training within the group it is recommendable for them to meet one a week for a reasonable amount of time to discuss the improvements of their activity.

The 6 outcomes of lean implementation namely lead-time reduction, quality and cost increase, customer responsiveness, customer satisfaction, the flexibility in the system and the information sharing and trust are widely discussed in the existent literature. The lead-time reduction is considered by Mason-Jones et al. (1999) as the essence of an agile supply chain. Christopher and Towill (2000) argue that the lead-time has to be minimised in order to enable agility, as excess time is waste. Relative to the quality and the cost of service both leanness and agility demand high levels of product quality (Christopher and Towill, 2000). Moreover, the efforts to improve agility should be supported by continued effort to improve quality (Vokuska and Fliedner, 1998). Bernardes and Hanna (2008) claim that agility is related the firm's capacity to act on market knowledge to anticipate and rapidly address modifications in customer's expectation. Customer satisfaction is considered to be the route map to agility (Mason-Jones and Towill, 1999). Customer satisfaction is enhanced by flexible logistics (Zhang et al., 2006). According to Baker (1998) agility implies both range and response dimensions, where flexibility is one, the other or both. The concepts are complementary not mutually exclusive. Relative to the information sharing Swafford et al. (2006) considers that agility is enabled through information sharing across functional areas.

The findings suggest that the lean practices are enhancing the agility of the distributor under the 6 most important factors that influence agility: cost and quality, customer responsiveness, customer satisfaction, flexibility in the system and information sharing and trust. Once implemented the lean tools create an enhancement in the warehouse processes, which will eventually increase the agility of the company as it can be seen in the previous table.

After discussing the influences of the lean practices the framework presented in APPENDIX 11 has been designed. The framework design answers the third research question of this thesis: Where is the decoupling point positioned on the map of this specific supply chain pipeline?

Interestingly, the decoupling point has been positioned somewhere between the warehouse and the distribution function of the company. The decoupling point is the point that separates the part of the organization oriented towards customer orders from the part of the organization based on planning (Naylor et al., 1999). Hence, the decoupling point separates the distributor’s activity that functions based on lean rules from the distributor’s activity that can be agile. In the middle

there are the processes called leagile, which can be both lean and agile, and basically qualify the order winners of both paradigms (Mason-Jones et al, 2000): cost for lean and service level for agility. As it can be easily deducted from the framework the decoupling point has been placed between the lean and the agile activities. In other words, the lean tasks are executed based on forecasted short-term activity until the new multi-skilled teams will adjust themselves for agile tasks like unpredictable tasks without direct supervision such as: unpredictable orders, loading issues during the evening, quality issues of the goods delivered.

The findings of the research suggest that the lean function of the company's supply chain is the part oriented to the supplier such as purchase and warehouse where as the part oriented to the customer such as distribution is agile. The input on the warehouse activity generates an agile output in the distribution. In other words the process enhancements in the warehouse generate lead-time reduction, flexibility in the system and offers to the distribution function the possibility to be customer sensitive.

5.7 Summary

The concept of leagility and the decoupling point concept has been widely debated in the literature Aitken et al. (2002), Mason-Jones et al. (2000), Naylor et al.,(1999), Christopher (2000) but it has been rarely research in a company that is a distributor. In this thesis the lean and the agile paradigms together with the mapping of the decoupling point are considered in the context of a distribution company. In this respect a building development products distributor has been selected and it represents the case-study of this thesis.

When manufacturing tactics are considered, the literature proposes three general positions with respect to lean and agility: one position which claims that lean and agility cannot co-exist, one position that believes that these two paradigms are mutually supportive and one which believes that lean is an agility precursor. However it is clear that leagility suits in environments where the customer places both unpredictable orders and it is price sensitive.

The first aim of this thesis was to certify the co-habitation of lean and agility in the same environment. The second aim was to address the eventual influence of lean implementation on agility factors and the third aim was to map the

decoupling point, seen as the point that divides lean processes from the agility processes.

Through a series of semi-structured interviews conducted in the case-study company the current warehouse and distribution processes were assessed. Along with the processes the customer's perception on the distributor's responsiveness, commitment to quality and flexibility was assessed. Besides the interviews, for certifying the results, the staff conducted a measurement of the processes. After the measurement, certain improvements most of them related to waste removal were implemented in the company. One of the most important outcomes is the multi-skilled teams. The multi-skilled teams brought some crucial benefits for the company such as flexibility in order picking, cost reduction through asset improvement and increased the motivation of the teams themselves. The outcomes, the tangible and intangible benefits are detailed in the previous chapter. However, lean and agility in a warehousing and distribution function were discovered as coexisting paradigms. The lean input characteristics such as: lean automation, flow enhancement of the processes, asset efficiency or the inventory decrease through the multi-skilled teams, cross docking or direct delivery to the customer enables lead-time reduction, customer sensitivity, flexibility and quality enhancement. Hence, the second aim of the thesis to research the influence of lean implementation on agility was researched as well.

While the research results suggested that lean and agile are co-existing there is a decoupling point apparent. The map with the positioning of the decoupling point in the case study company is in APPENDIX 8. The decoupling point separates in this research the lean processes with the agile processes and it is the third aim of this research, too. Before the decoupling point the warehouse lean tasks can be executed. These tasks are subject to continuous improvement and are executed in a designated flow detailed in APPENDIX 5 for the inbound flows and in APPENDIX 7 for the outbound flow. After the decoupling point, the tasks are agile. Through tasks like multi-skilled teams, cross-docking or direct deliveries to the customer agile outputs are possible.

In the following chapter, the limitations of the research and recommendation for further studies are going to be discussed.

Chapter 6 - Limitations and Future research

6.1 Summary

This chapter briefly recounts the main idea of the study and moves on to discuss the limitations of the research. However, the previous chapter stated in more detail the gaps and motivation of the work.

Both lean and agility have been widely debated in the extant manufacturing literature. The paradigms have been analysed and discussed extensively in the supply chain processes as well. There are three main theoretical streams that position these paradigms in the supply chain. The first separates the paradigms in space and time, the second considers lean as an agility enabler and the third debates the co-existence of these two paradigms in a supply chain. This study analysis the third theoretical stream but in a different context that to the best of the author's knowledge has not been researched before: a warehouse and distribution environment as part of a supply chain.

In the present harsh economic environment, there is a call for responsive logistic strategies that are customer-oriented but wasteless and cost efficient. Wasteless logistic can be achieved through lean implementation and customer-oriented and responsive logistic is likely to be achieved through agile strategies.

The present study aims to research the co-existence of these two paradigms through a case-study approach. Moreover, it aims to gain an insight on the lean influence on agility. The study suggests the positionig of a decoupling point between the lean and the agile processes and builds a theoretical framework with managerial use.

6.2 Limitations and future research

The future research is derived both from theoretical and empirical findings. Future research is recommended to provide an analytical generalization. The findings are proposed to be future benchmarked in a multiple case-study analysis. Furthermore the present study does not fully cover all the factors proposed by Barve (2011) that are likely to influence agility. Further study on the following factors is recommended: organizational integration and willingness for improvement, outsourcing, collaborative relationship, mainly with the suppliers and the

commitment of the top management. Therefore there is a call for studying the lean influence on all the factors known to influence agility for having a holistic view of the phenomena and fully cover all the factors. The future studies are recommended to test the framework in the same country and in the same industry to see if the research delivers similar findings in other companies. However, the research of the decoupling points' positioning in a more competitive market from Western Europe is proposed.

The author of this research does suggest that future studies should be focused on other parts of the supply chain such as purchasing and manufacturing and on the supply chain as a whole. It is seen as important the mapping of the whole supply chain and to research the eventual lean integration of the supply chain on the supply chain's agility. However, examining leagility in parts of the supply chain, such as one company, which represents a segment, develops a framework that might be of more practical use in to the managers. It is therefore suggested to continue to carry out examinations in limited parts of the supply chain as well, to contribute to the rather extensive amount of existing literature, which considers the whole supply chain pipeline.

In this thesis the findings were built in a framework, which points the separation of leanness and agility in a distributor organization and maps the decoupling point. However, the decoupling point cannot be mapped so firmly. The decoupling point, in this thesis is the point that separates leanness from agility. Hence, it can sometimes slightly move towards lean or towards agility. This shift may occur in the two demand seasons: high season and low season.

Another limitation of the thesis, due to time constraints, is that it leaves an important sector out: the informational decoupling point. The Supply chains are constructed around 2 pipelines: the informational and the material pipelines. Therefore, to make the findings of this research more robust there is a call to research the informational decoupling point for a full use of the decoupling point's functionality.

APPENDIX 1

APPENDIX 1(1/6)

QUESTIONS OF THE INTERVIEW (CODE):

1/DISTR/WAREHOUSEMAN

POSITION OF THE INTERVIEWEE: WAREHOUSE MANAGER

DATE: 22/04/2013

DURATION: 75 minutes

OBJECTIVES AND KEY TERMS DEBATED: The company called Distributor onwards is a big-enterprise retailer and wholesaler. The company distributes building construction materials. The company has 30 stores and 7 warehouses across Romania. The company services around 3,500 clients all of them small and medium wholesalers. In the following answers the inbound process of goods is described together with quality, responsiveness and eventual issues occurring in the day-to-day activity in the warehouse. The aim is to assess the inbound processes and eventual set-ups during the inbound process. The key terms followed through the interview are mainly referring to lean characteristics of the logistic processes: Waste processes occurring in the warehouse, bottlenecks in the warehouse processes and the warehouse information flows

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SECTION 1 - QUESTIONS REGARDING THE INBOUND PROCESS

1. Ordering and receiving process - Interview the Purchase Manager and Logistic Manager - 8 questions

1.1 How would you describe the process of receiving products step by step starting from the moment you receive the incoming goods confirmation until the moment you store the goods in their location in the warehouse. Describe all the possible scenarios if there are several possibilities.
1.2. How would you describe any set-ups occurring the inbound receiving of the goods. *E.g. in a warehouse environment a set-up consists of all actions needed to prepare a team for processing incoming orders. Respectively, in office environment a set-up means preparatory actions that enable processing the order, or supplementary actions have to be taken for the inbound order to be processed properly. Also interruptions of work can be seen as set-ups because the worker might have to take extra actions to continue the work in progress.*
1.3 Are the products received re-packed, foiled or labeled before consolidation? Why? Explain separately for each process how this happens.
1.4 How many people perform each step described in the questions 1.1 and 1.2 and what percentage of their time is used for each step? *E.g. there is one material*

handler who uses 10% of his time checking that ordered goods are correct.

1.5 Do you have an explicit process description, such as a flow chart or a written description, for the receiving process? If so, can this flowchart be sent on a separate e-mail? Do all employees involved in the process know where to find it?

1.6 What size of batches is handled at each step described in the questions 1.2 and 1.3? If there is variation estimate the range of batch sizes. Batches can be made of physical goods or information. *E.g. Batches can be pallets, boxes, cartons or pieces.*

1.7 Is there a standard ordering batch size?

1.8 Do the order batch sizes vary?

APPENDIX 1(2/6)

QUESTIONS OF THE INTERVIEW (CODE):

2/DISTR/WAREHOUSEMAN

POSITION OF THE INTERVIEWEE: WAREHOUSE MANAGER

DATE: 22/04/2013

DURATION: 60 minutes

OBJECTIVES AND KEY TERMS DEBATED: In the following answers the inbound process of the goods is mapped together with quality, responsiveness and eventual issues occurring in the day-to-day activity in the warehouse. The processes are described together with their logical flow. Moreover the eventual bottlenecks are described in detail and are timed. After the processes are mapped the warehouse manager is interviewed about his perception on the value added and on the non-value added processes that occur in the inbound warehouse flow of goods.

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2. Questions regarding the time allocation – if possible you may use stopwatch - Interview the Warehouse Manager - 8 questions

2.1 In reference to the steps described in the questions 1.1 to 1.3, how much time does each step require in minutes? If there is variation, please estimate the shortest and the longest possibilities.
2.2 When and how much are delays in time in the above measured processes? In other words, are there moments when the ordering inbound process is not advancing? What are sizes of these order prepared inventories in hours? *E.g. The inbound orders are not processed immediately when the physical good are entering the warehouse. Orders can wait until the end of a week for different reasons. This means orders wait 0 - 120 hours. Can you briefly describe these reasons?*
2.3 Estimate the set-up times described in the question 1.4.
2.4 How long is the cycle-time for processing an inbound order in total? In other words, how long does it take from the moment the order physically enters the warehouse till the moment your order is stored? If there is variation, estimate the shortest and longest possibilities. If indicated correctly, this should be equal to the sum of total process time, total delay time and set-up times of the questions 2.1, 2.2 and 2.3
2.5 In your opinion, which of the steps described in the questions 1.2 and 1.3 add the process value, in other words, which steps directly contribute to getting the product? *E.g. processing an inbound order adds value while searching for missing information, getting approvals from others or re-entering data do not add value.*
2.6 In your opinion, which steps are non-value adding, in other words, they just make the process longer and more complicated, consume resources and add extra costs? *E.g. excess transportation: placing received products on receiving area*

and later moving them to storage. Why not avoid double handling and place them directly to their right storage location...

2.7 What is the effective daily working time in your company? *E.g. working time is 8 hours minus 45 minutes of breaks.* If individual process steps operate with different effective working time it should be stated, too.

2.8 How many days per year does your company operate?

APPENDIX 1(3/6)

QUESTIONS OF THE INTERVIEW (CODE): 3/DISTR/LOGISTICMAN

POSITION OF THE INTERVIEWEE: LOGISTIC MANAGER

DATE: 22/04/2013

DURATION: 60 minutes

OBJECTIVES AND KEY TERMS DEBATED: In the following answers the inbound informational process of the goods is described together with quality issues occurring in the inbound process. The logistic manager is describing the steps that require immediate and correct information of the smooth flow of the processes to be assured. After the informational flows are discussed, the most important quality problems are debated regarding the distributor's suppliers.
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3. Information needs - Logistic Manager - 2 questions

3.1 What information is needed in each step of the process described in the questions 1.2 and 1.3?

3.2 How is this information acquired and from where? How long does it take to get the required information? *E.g. a sales person sends an order to the logistics coordinator at the DC and a reply arrives within 24 hours.*

4. Quality - Logistic Manager - 9 questions

4.1 For each step described in the questions 1.2 and 1.3, how often is output of pervious step complete and accurate from the perspective of the recipient? Give your answer in percentage (%). Output might be information or physical goods. *E.g. a staff member of the warehouse gets complete and accurate information 90 % of time right away without having to ask for specifications or corrections to make the next step. 10 % of time the person has to do re-work or ask for specifications before processing an order.*

4.2 During the last year (May 2012 - May 2013), how many products were returned back to the supplier? Why? *E.g. because the products didn't sell, they were not the products you ordered or they were faulty.*

4.3 During the last year (May 2012 - May 2013), how many times your order was delayed, in other words, delivery time was longer than promised?

4.4 Have you faced some other problems when ordering and receiving from your suppliers? Describe when and how they occur. What has been done to solve these problems?

4.5 Are any meters / indicators calculated to evaluate the process performance? What are those and how often are they updated? Are they used to control the process? How?

APPENDIX 1(4/6)

QUESTIONS OF THE INTERVIEW (CODE): 4/DISTR/DISTRMAN

POSITION OF THE INTERVIEWEE: DISTRIBUTION MANAGER

DATE: 25/04/2013

DURATION: 55 minutes

OBJECTIVES AND KEY TERMS DEBATED: In the following answers the outbound informational process of the goods is described together with quality issues occurring in the outbound process. The distribution manager is describing the steps that require immediate and correct information of the smooth flow of the processes to be assured. After the informational flows are discussed, the most important quality problems are debated regarding the distributor's customer. The distribution manager is synthesising where these quality issues are likely to occur in the warehousing or distribution processes ----------

3. Information needs - Distribution coordinator

3.1 What information is needed in each step of the process described in the question 1.1?

3.2 How is this information acquired and from where? How long does it take to get the required information?

4. Quality - Distribution Manager - 6 questions

4.1 For each step described in the question 1.1, how often is output of pervious step complete and accurate from the perspective of the recipient? Give your answer in percentage (%). Output might be information or physical goods. *E.g. a staff member of the warehouse gets complete and accurate information 90 % of time right away without having to ask for specifications or corrections to make the next step. 10 % of time the person has to do re-work or ask for specifications before processing an order.*

4.2 Has your delivery reliability been calculated? What has been done to improve it? How often is this figure updated?

4.3 During the last year (May 2012 - May 2013), how many times your shipment to your customers was delayed, in other words, delivery time was longer than promised? Why?

4.4 How often do you experience a stock-out, in other words, you do not have a required product in stock?

4.5 Have you faced some other problems when shipping? Describe when and how they occur. What has been done to solve these problems?

4.6 Are any meters / indicators calculated to evaluate the process performance? What are those and how often are they updated? Are they used to control the process? How?

APPENDIX 1(5/6)

QUESTIONS OF THE INTERVIEW (CODE): 5/DISTR/DISTRMAN

POSITION OF THE INTERVIEWEE: DISTRIBUTION MANAGER

DATE: 26/04/2013

DURATION: 90 minutes

OBJECTIVES AND KEY TERMS DEBATED: In the following answers the outbound process of goods is described together with quality, responsiveness and other issues occurring in the day-to-day activity in the warehouse. The aim is to assess the inbound processes and eventual set-ups during the outbound process. The key terms followed through the interview are mainly referring to lean characteristics of the distribution and warehousing logistic processes: Waste processes occurring in the distribution and warehouse, bottlenecks in the warehouse processes and the warehouse information flows in the process of goods expenditure. ----------

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SECTION 2 - QUESTIONS REGARDING THE OUTBOUND PROCESS

1. Order processing and shipping to end customers - Distribution Coordinator - 10 questions

1.1 Describe the complete process of receiving orders and shipping products to your customers step by step starting from the moment you receive a customer's order till the moment you send an invoice and other final documents.

1.2 Is the shipping process the same for all products?

1.3 Describe any set-ups occurring in the outbound shipping process. *E.g. in a warehouse environment a set-up consists of all actions needed to prepare a new order. Respectively, in office environment a set-up means preparatory actions that enable processing a new order or a batch of orders, for example opening the transactions needed in the information system and finding related customer base data. Also interruptions of work can cause set-ups because the worker might have to take extra actions to discontinue and continue the work in progress.*

1.4 How many people perform each step described in the question 1.1 and what percentage of their time is used for each step? *E.g. there is one material handler who uses 40% of his time picking parts.*

1.5 What size of batches is handled at each step described in the question 1.1? If there is variation estimate the range of batch sizes. Batches can be made of physical goods or information. *E.g. Batches can be pallets, boxes, cartons or pieces.*

1.6 Is there a standard shipping batch size?

1.7 If shipping batch sizes vary, why is there such variation?

1.8 How many customers did you have during the last 12 months? Which portion (%) of them order three times a week? Which portion (%) of them order two times

a week? How about once a week? Are there customers, which are placing orders once in two weeks, or once a month?

1.9 What is your approach when you are in stock-out at a customers' order? Do you offer him an alternative product?

1.10 Do you have an explicit process description, such as a flow chart or a written description, for the shipping process? Do all employees involved in the shipping process know where to find it? You can attach it to your reply e-mail.

APPENDIX 1(6/6)

QUESTIONS OF THE INTERVIEW (CODE): 6/DISTR/WAREHOUSEMAN

POSITION OF THE INTERVIEWEE: WAREHOUSE MANAGER

DATE: 26/04/2013

DURATION: 90 minutes

OBJECTIVES AND KEY TERMS DEBATED: In the following answers the inventory issues are debated and the way inventory is held in the warehouse. The aim is to assess the type of inventory management, the safety stock and the capacity of the company to be responsive based on this stock. Moreover, issues about complaints and customer returns are addressed with the aim of identifying any issues occurring in the relationship with the customers.

SECTION 1 - Questions about inventory

1.1 How do you control your physical inventory? How do you know how much of each item you have in stock? Do you know the exact location of each product?
1.2 Are you using ABC - categorization for the items kept in stock? Describe how you control different categories of items.
1.3 Do you know the inventory turnover for the products you hold in stock? Is it calculated separately for each product, each group of products or aggregate inventory? How often is this information updated?
1.4 Is inventory turnover used as a control parameter for inventory management?
1.5 How do you pick products for customers' orders? Are the usual products placed at the first level so they can be manually processed?
1.6 How much is your safety stock worth in days? In other words, for how long could you satisfy your customers' demand with the safety stock? Define your answer separately for laminates, rugs, carpets and vinyl, laminate accessories and plumbing products.
1.7 How much is your average stock worth in days? In other words, for how long could you satisfy your customers' demand with your average inventory? Define your answer separately for laminates, rugs, carpets and vinyl, laminate accessories and plumbing products.
1.8 Are items kept in one location all the time after they arrive from suppliers till they are shipped to final customers? Explain why items have to be moved. *E.g. newer items are moved closer to a shipping area as older items are shipped because there is not enough room next to a shipping area for all products, items are put in different part of the warehouse for pallet splitting.*
1.9 Do you think it would be possible to reduce your inventory? Why / why not? How much do you think it could be realistic to reduce your inventory?

SECTION 2 - Questions about claims, complaints and returns
2.1 Can you describe how are you dealing the claim procedures with the clients?

2.2 Are there any set-ups occurring during the claims procedures? If there are any set-ups can you briefly describe them? Would you say that the response to inquiry time is the biggest issue in this process?

2.3 Do you have an explicit process description, such as a flow chart or a written description, for the shipping and return process? Do all employees involved in the shipping process know where to find it? You can attach it to your reply e-mail

APPENDIX 2

QUESTIONS OF THE INTERVIEW (CODE): 7/DISTR/LOGISTICMAN

POSITION OF THE INTERVIEWEE: LOGISTIC MANAGER

DATE: 22/04/2013

DURATION: 30 minutes

OBJECTIVES AND KEY TERMS DEBATED: In the following answers the eventual improvements in the distribution system are discussed together with the logistic manager to see if he proposes any eventual improvement in the system based on lean principles

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SECTION 4 - QUESTIONS REGARDING THE LOGISTIC PROCESS IMPROVEMENTS

1. Your opinions - Logistic Manager

1.1 What do you think it would require to your purchase order system in order for you to be able to order based on your customers confirmed demand, not based on forecasted demand? *This means you would **pull** products from the supplier at the same speed as your customers **pull** products from you. If you are already operating in specific cases based on customer demand please explain how it is working.*

1.2 Could order processing be simplified and standardized? How?

1.3 How could incomplete and inaccurate outputs of ordering and receiving process identified in the process activity mapping be improved?

1.4 Could the shipping process be simplified and standardized? How?

1.5 How could incomplete and inaccurate outputs of shipping process identified in the process activity mapping be improved?

APPENDIX 3

QUESTIONS OF THE INTERVIEW (CODE): 1/CUST/PURCHASEMAN

POSITION OF THE INTERVIEWEE: PURCHASE MANAGER

DATE: 08/04/2013

DURATION: 45 minutes

OBJECTIVES AND KEY TERMS DEBATED: The company called Customer onwards is a medium-enterprise wholesaler, which distributes building construction materials. The company has 7 stores across Romania. The case-study company is the customer's main Distributor. In the following answers the inbound process of goods is described together with quality, responsiveness and eventual issues occurring in the day-to-day activity with the distributor. The aim is to assess the purchase processes and set-ups with the distribution company. The key terms followed through the interview are mainly referring to agile characteristics of the logistic processes: Order frequency, return and claims, customer cycle time, backorder frequency or invoice accuracy.

1.1 How would you describe the process of receiving products from the distributor step by step starting from the moment you place the order until the goods arrive physically to your warehouse?
1.2 Do you order on a daily basis, weekly or monthly basis?
1.3 When placing an order are there situations when the distributor invokes stock-outs? If it invokes, does it offer you an alternative product?
1.4 Can you say the approximate percentage of the fill rate of your orders? By fill rate we understand the percentage of your orders satisfied from distributor's stock.
1.5 Referring to question 1.3, are there backorders usually taken after the initial order is not fulfilled?
1.6 What are the usual shipping-errors in the distributor's delivery system? By shipping errors we understand that the wrong product came on the order without your prior consent. Please name them in their order of importance.
1.7 Do you generally consider the distributor offers an on-time service? In particular are there situations when the deliveries are overdue? By on-time we understand that it arrives in the time slot you requested the goods.
1.8 What is the average cycle time of an order? If there is variation, please estimate the shortest and the longest possibilities. Would you like a shorter cycle time? Can you give an absolute value?
1.9 Can you briefly describe the claims process? How would you describe any set-ups occurring during the complaints process? Are there many credit claims placed by you to the distributor during a month?

2.1. You described earlier the claims process. How would you describe the returns process? Are there any set-ups in the return processes?

2.2 How would you describe the activity that occurs when there are quality problems with the incoming goods from the distributor? Are there many damaged products in the distributor's shipments?

2.3 Do you find the invoice difficult to read? Are the products usually correctly invoiced? Are there in particular cases when the products are not correctly invoiced? How do you deal with these situations?

2.4 How would to describe the information availability to the distributor's range of products and product availability information?

3.1 What recommendations for process enhancements do you have for your distributor?

3.2 Have you ever considered sharing stock information with the distributor?

APPENDIX 4

#	Step	Flow	Area	Dist (M)	Time (Min	People	goods	Operation	Transport	Inspect	Store	Delay	Comments
1	Order invoiced by the supplier	O	Office 2		1	1		O	T	I	S	D	
2	Order introduced in the WMS	I	Computer		60	1		O	T	I	S	D	The order is wrongly introduced in the WMS by the purchase department.
3	Order mix if necessary	I	Computer		30	1		O	T	I	S	D	10% of the orders require mix - Mix means the goods are arriving from different suppliers on the same lorry
4	Order replication from ERP to WMS	D	Server		8			O	T	I	S	D	
5	Lorry arriving	T	Yard			1		O	T	I	S	D	
6	Delivery note handeled by the driver to the wareh	T	Yard/Warehouse	50	10	1		O	T	I	S	D	
7	WO informs the WMS admin about the truck arriva	I	Warehouse		5	1		O	T	I	S	D	
8	Gate allocation	O	Office		1	1		O	T	I	S	D	
9	Lorry waits for information of the gate allocation	D	Yard		15			O	T	I	S	D	
10	Lorry parks in the gate	T	Yard/Warehouse		10			O	T	I	S	D	
11	The order log-on in the terminal	O	Warehouse		2	1		O	T	I	S	D	
12	Unloading the goods in the transit area	D	Unloading bay	800	30	1	25 pal	O	T	I	S	D	
13	Sorting the goods where necessary	I	Transit area	300	60	3		O	T	I	S	D	35 % of unloadings require sorting
14	Warehouse staff applies TU on the boxes from the	D	Transit area		5	1		O	T	I	S	D	
15	Warehouse staff scans TU and the goods	O	Transit area		0.1	1		O	T	I	S	D	
16	Warehouse staff scand the article code	O	Transit area		0.1	1		O	T	I	S	D	
17	Warehouse staff checks if the quantities are corred	I	Transit area		0.5	1		O	T	I	S	D	
18	Waiting for an available forklift	D	Transit area		10	1		O	T	I	S	D	
19	Goods are moved into location	T	Warehouse	400	30	1		O	T	I	S	D	
20	Goods scanned into location	S	Storage area					O	T	I	S	D	
21	Warehouse staff notifies the WMS admin that the	T	Warehouse	50	1	1		O	T	I	S	D	
22	WMS admin verifies quantitatively and qualitative	I	Office		10	1		O	T	I	S	D	
23	WMS admin notifies the purchase department that	T	Office 1/Office 2		5	1		O	T	I	S	D	
24	Invoice prices are checked by the purchase departr	I	Office 2		30	1		O	T	I	S	D	
25	Waiting for all the areas to finish the reception	D	Warehouse		100			O	T	I	S	D	
26	The goods are received in the ERP	O	Office 2/Office 1		5	1		O	T	I	S	D	
27	WMS admin unblocks the goods	T	Office		3	1		O	T	I	S	D	
28	The reception papers are printed	O	Office		2	1		O	T	I	S	D	
29	The reception is signed by the warehouse clerk	O	Warehouse/Office	200	15	1		O	T	I	S	D	This is an ocassionaly executed step
	TOTAL		29 STEPS	1800	448.7	26		8	7	7	1	6	
	OPERATORS				25.2	8							
	% VALUE ADDING				5.62%	30.77%							

APPENDIX 5

#	Step	Flow	Area	Dist (M)	Time (Min	People	goods	Operation	Transport	Inspect	Store	Delay	Comments
1	Order invoiced by the supplier	O	Office 2		1	1		O	T	I	S	D	
2	Order introduced in the WMS	I	Computer		30	1		O	T	I	S	D	The order is wrongly introduced in the WMS by the purchase department.
3	Order mix if necessary	I	Computer		15	1		O	T	I	S	D	10 % of the orders require mix
4	Order replication from ERP to WMS	D	Server		8			O	T	I	S	D	
5	Lorry arriving	T	Yard			1		O	T	I	S	D	
6	Gate allocation	O	Office		1	1		O	T	I	S	D	
7	Lorry parks in the gate	T	Yard/Warehouse		10			O	T	I	S	D	
8	The order log-on in the terminal	O	Warehouse		2	1		O	T	I	S	D	
9	Sorting the goods where necessary	I	Truck/Unloading bay	300	60	3		O	T	I	S	D	35 % of unloadings require sorting
10	Unloading and Warehouse staff applies TU on the boxes from the pallet	D	Truck/Unloading bay		5	1		O	T	I	S	D	
11	Warehouse staff scans TU and the goods	O	Truck/Unloading bay		0.1	1		O	T	I	S	D	
12	Warehouse staff scan the article code	O	Truck/Unloading bay		0.1	1		O	T	I	S	D	
13	Warehouse staff checks if the quantities are correct	I	Truck/Unloading bay		0.5	1		O	T	I	S	D	
14	Inspecting goods	I	Truck/Unloading bay		5	1		O	T	I	S	D	
15	Goods are moved into location	T	Storage area	400	30	1		O	T	I	S	D	
16	Goods scanned into location	S	Storage area					O	T	I	S	D	
17	Warehouse staff notifies the WMS admin that the inbound process is finished	T	Warehouse	50	1	1		O	T	I	S	D	
18	WMS admin verifies quantitatively and qualitatively the goods	I	Office		10	1		O	T	I	S	D	
19	WMS admin notifies the purchase department that the goods are OK	T	Office 1/Office 2		5	1		O	T	I	S	D	
20	Invoice prices are checked by the purchase department	I	Office 2		30	1		O	T	I	S	D	
21	The goods are received in the ERP	O	Office 2/Office 1		5	1		O	T	I	S	D	
22	WMS admin unblocks the goods	T	Office 1		3	1		O	T	I	S	D	
23	The reception papers are printed	O	Office		2	1		O	T	I	S	D	
24	The reception is signed by the warehouse clerk	O	Warehouse/Office	200	15	1		O	T	I	S	D	This is an ocassionaly executed step
	TOTAL		29 STEPS	950	238.7	23		8	6	7	1	2	
	OPERATORS				25.2	8							
	% VALUE ADDING				10.56%	34.78%							

APPENDIX 6

ORDERS PROCESS

#	Step	Flow	Area	Dist (M)	Time (Min	People	Operation	Transport	Inspect	Store	Delay	Comments
1	Order recieved	O	Server		0.5	2	O	T	I	S	D	Mistakes in the order place consisiting in quantities or inexistent products
2	Order opened	O	Computer		0.5	1	O	T	I	S	D	
3	Order checked	O	Computer		1	1	O	T	I	S	D	
4	Order confirmed	O	Computer		2	1	O	T	I	S	D	
5	Alternative product offered	D	Office		60	2	O	T	I	S	D	in 11,99 percent of the cases backorders are ocurring
6	Order saved	O	Computer		1	1	O	T	I	S	D	
7	Order printed	O	Office		2	1	O	T	I	S	D	
	TOTAL				67	9	6	0	0	0	1	
	OPERATIONS				7							
	VALUE ADDED ACTIVITIES				10.45%							

WAREHOUSE PROCESS

#	Step	Flow	Area	Dist (M)	Time (Min	People	Operation	Transport	Inspect	Store	Delay	Comments
1	Order replicated into the WMS from the WEB order interface	D	Server		6		O	T	I	S	D	
2	All orders reserved	D	Server		3	1	O	T	I	S	D	There are situations when the commands are not executed using this procedure around 10 perc
3	Orders placed on paper in the warehouse	T	Office/Warehou	200	10	2	O	T	I	S	D	
4	Orders allocated to gates	O	Office		3	1	O	T	I	S	D	
5	Hours allocation to gate for the lorry	O	Office		2	1	O	T	I	S	D	
6	Lorry arrives	T	Yard				O	T	I	S	D	The lorry is late
7	Lorry awaits instruction	D	Yard		60		O	T	I	S	D	
8	Lorry enters gate	T	Yard/Warehouse		10		O	T	I	S	D	
9	The order log-on in the terminal	D	Warehouse		3	1	O	T	I	S	D	
10	transport to location	T	Storage area	400	8	1	O	T	I	S	D	
11	picking the goods	O	Storage area		30	1	O	T	I	S	D	The goods might not be present in the location
12	TU scan	O	Storage area		3	1	O	T	I	S	D	
13	Correct quantity checked	I	Storage area		1	1	O	T	I	S	D	If there are subunits picked
14	Goods taken from the racks	T	Storage area		15	1	O	T	I	S	D	
15	Waiting for a fork lift truck	D	Storage area		5	1	O	T	I	S	D	
16	Transport to gate	D	warehouse	450	30	1	O	T	I	S	D	If goods are not packed they are repacked.
17	Consolidate the good with stretch foil	O	loading bay		5	2	O	T	I	S	D	
18	Checking the final order	I	loading bay		5	1	O	T	I	S	D	
19	Marking the customer on each pallet	O	loading bay		0.5	1	O	T	I	S	D	
20	Warehouse cleck inspects the goods	I	loading bay		10	1	O	T	I	S	D	
21	The invoice staff invoices	O	office		5	1	O	T	I	S	D	If there are loading mistakes the customer is informed
22	Goods wait for the orders from different areas to be completed	D	loading bay		90		O	T	I	S	D	The goods prepared from one area waits for the goods from other areas to be consolidated
23	The goods are loaded	O	loading bay		30	2	O	T	I	S	D	
24	The warehouse clerk double checks the invoice	I	office/outside		5	1	O	T	I	S	D	Ocassionally
	TOTAL			1050	339.5	22	8	5	4	0	7	
	OPERATION				48.5	10						
	VALUE ADDED ACTIVITIES				14.29%	45.45%						

APPENDIX 7

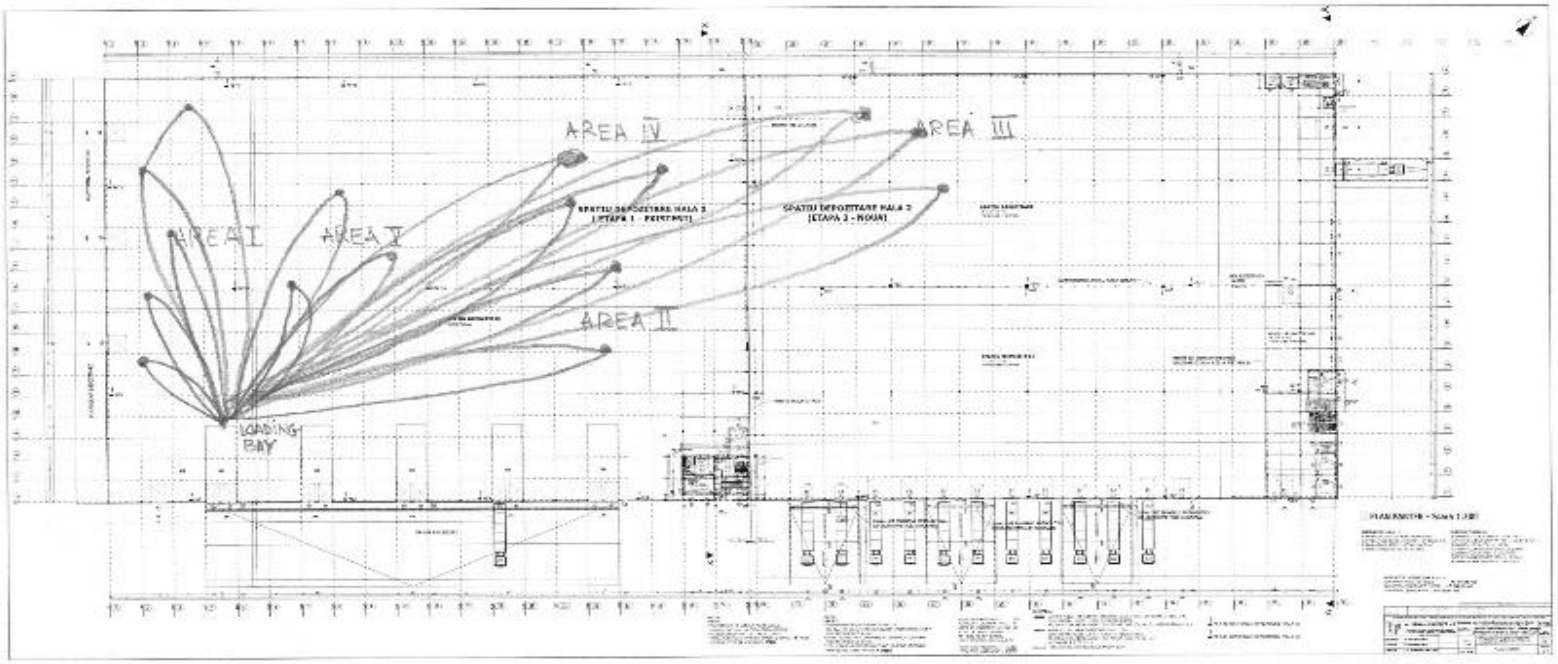
ORDERS PROCESS

#	Step	Flow	Area	Dist (M)	Time (Min	People	Operation	Transport	Inspect	Store	Delay	Comments
1	Order recieved	O	Server		0.5	2	O	T	I	S	D	
2	Order opened	O	Computer		0.5	1	O	T	I	S	D	
3	Order checked	O	Computer		1	1	O	T	I	S	D	
4	Order confirmed	O	Computer		2	1	O	T	I	S	D	
5	Alternative product offered	D	Office		30	2	O	T	I	S	D	
6	Order saved	O	Computer		1	1	O	T	I	S	D	
7	Order printed	O	Office		2	1	O	T	I	S	D	
	TOTAL				37	9	6	0	0	0	1	
	OPERATIONS				7							
	VALUE ADDED ACTIVITIES				18.92%							

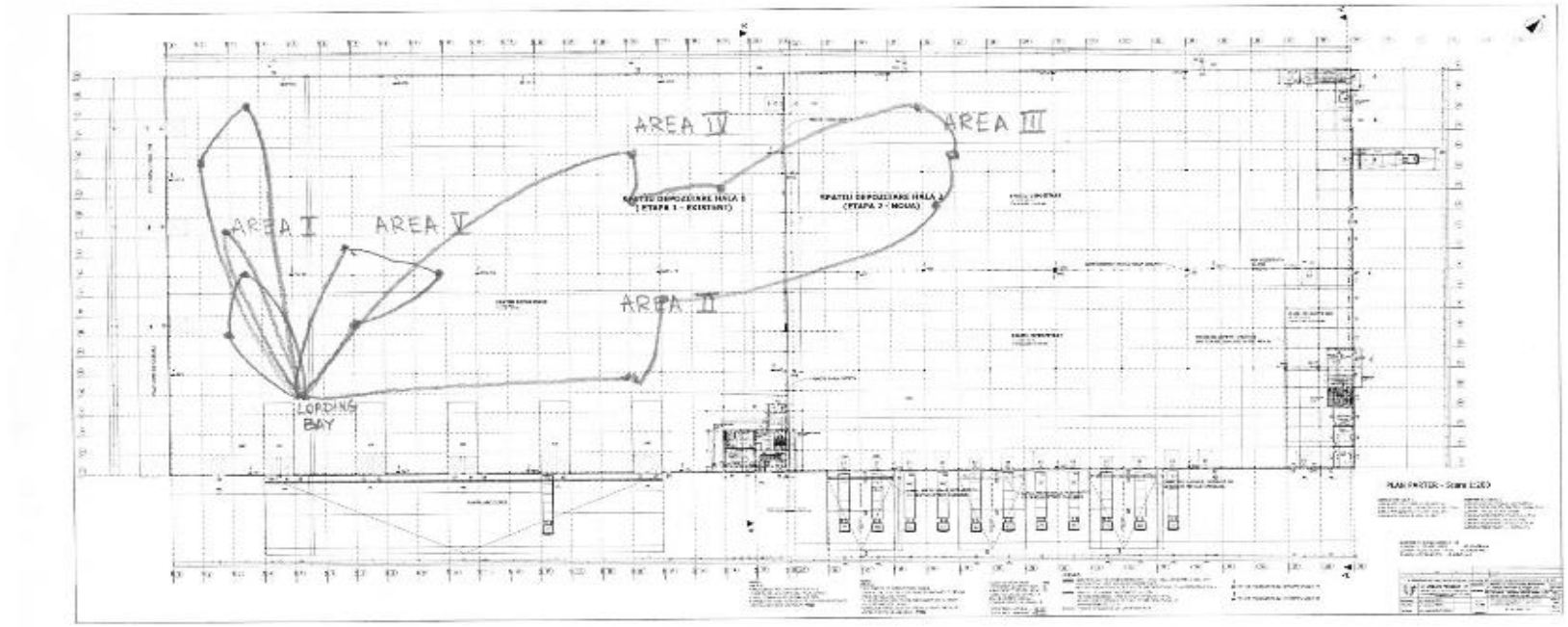
WAREHOUSE PROCESS

#	Step	Flow	Area	Dist (M)	Time (Min	People	Operation	Transport	Inspect	Store	Delay	Comments
1	Order replicated into the WMS from the WEB order interface	D	Server		6		O	T	I	S	D	
2	All orders reserved	D	Server		3	1	O	T	I	S	D	Poka Yoke
3	Orders allocated to gates	O	Office		3	1	O	T	I	S	D	
4	Hours allocation to gate for the lorry	O	Office		2	1	O	T	I	S	D	
5	Lorry arrives	T	Yard				O	T	I	S	D	
6	Lorry enters gate	T	Yard/Warehouse		10		O	T	I	S	D	
7	The order log-on in the terminal	D	Warehouse		3	1	O	T	I	S	D	
8	transport to location	T	Storage area	400	8	1	O	T	I	S	D	
9	picking the goods	O	Storage area		60	1	O	T	I	S	D	The goods might not be present in the location
10	TU scan	O	Storage area		3	1	O	T	I	S	D	
11	Correct quantity checked	I	Storage area		1	1	O	T	I	S	D	If there are subunits picked
12	Goods taken from the racks	T	Storage area		15	1	O	T	I	S	D	
13	Transport to gate	D	Storage area	450	60	1	O	T	I	S	D	If goods are not packed they are repacked.
14	Consolidate the good with stretch foil	O	loading bay		5	2	O	T	I	S	D	
15	Checking the final order	I	loading bay		5	1	O	T	I	S	D	
16	Marking the customer on each pallet	O	loading bay		0.5	1	O	T	I	S	D	
17	Warehouse cleck inspects the goods	I	loading bay		20	1	O	T	I	S	D	
18	The invoice staff invoices	O	office		5	1	O	T	I	S	D	If there are loading mistakes the customer is informed
19	The goods are loaded	O	loading bay		30	2	O	T	I	S	D	
	TOTAL			850	239.5	18	8	4	3	0	4	
	OPERATION				48.5	10						
	VALUE ADDED ACTIVITIES				20.25%	55.56%						

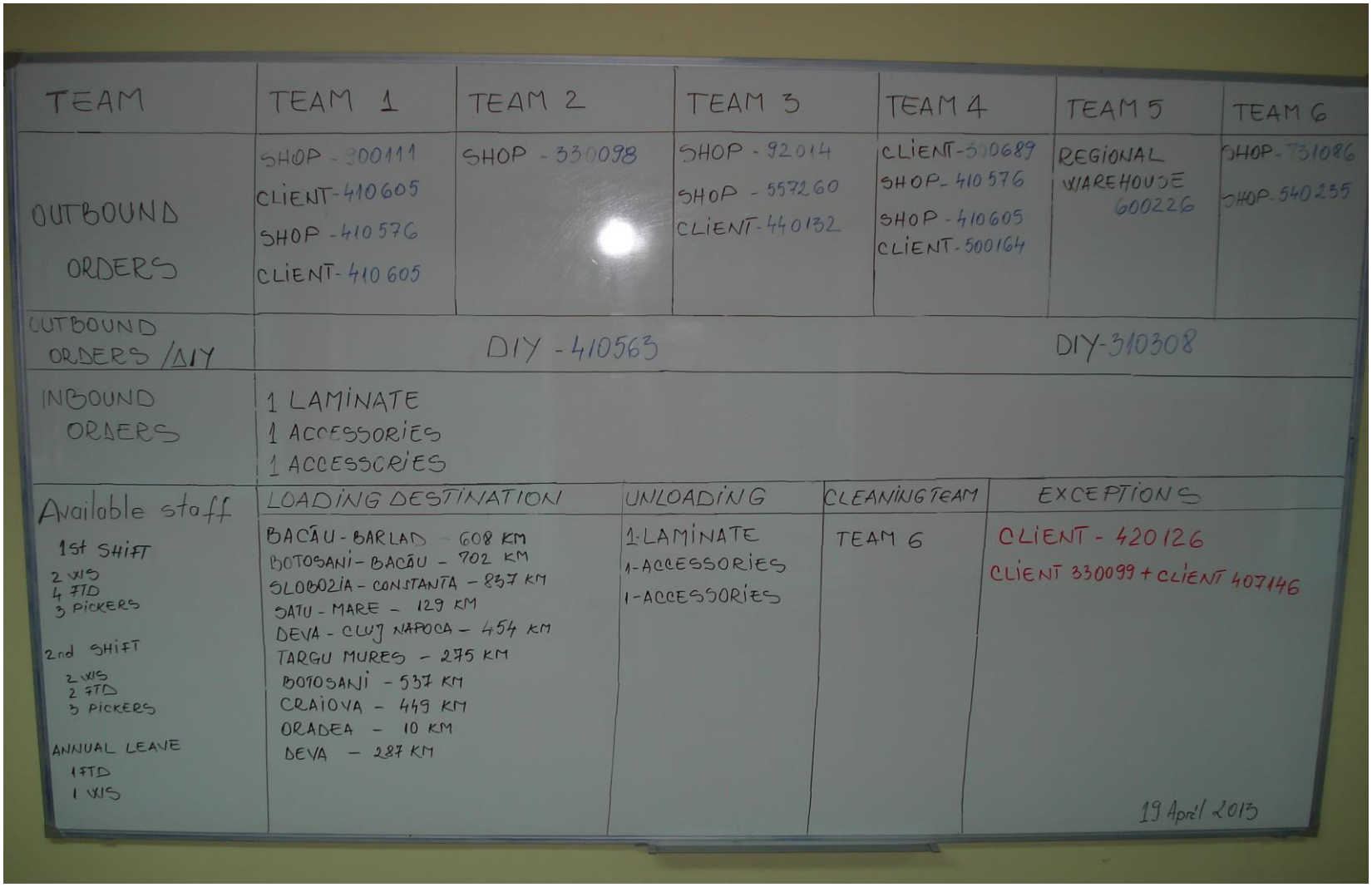
APPENDIX 8



APPENDIX 9



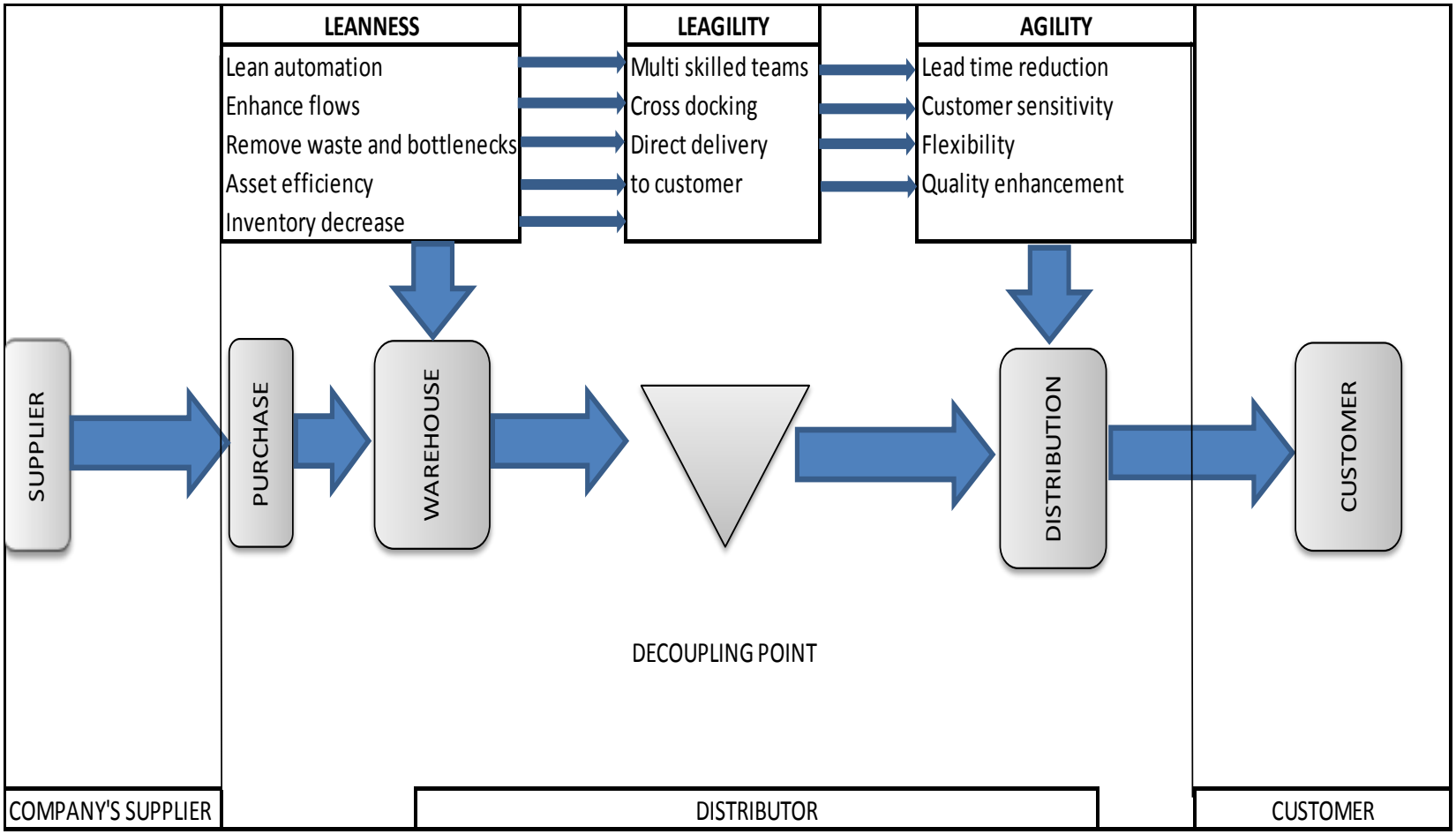
APPENDIX 10



TEAM	TEAM 1	TEAM 2	TEAM 3	TEAM 4	TEAM 5	TEAM 6
OUTBOUND ORDERS	SHOP - 300111 CLIENT - 410605 SHOP - 410576 CLIENT - 410605	SHOP - 330098	SHOP - 92014 SHOP - 557260 CLIENT - 440132	CLIENT - 510689 SHOP - 410576 SHOP - 410605 CLIENT - 500164	REGIONAL WAREHOUSE 600226	SHOP - 731086 SHOP - 540235
OUTBOUND ORDERS / DIY	DIY - 410563				DIY - 310308	
INBOUND ORDERS	1 LAMINATE 1 ACCESSORIES 1 ACCESSORIES					

Available staff	LOADING DESTINATION	UNLOADING	CLEANING TEAM	EXCEPTIONS
1st SHIFT 2 WS 4 FD 3 PICKERS 2nd SHIFT 2 WS 2 FD 3 PICKERS ANNUAL LEAVE 1 FD 1 WS	BACĂU - BARLAD - 608 KM BOTOSANI - BACĂU - 702 KM SLOBOZIA - CONSTANȚA - 837 KM SATU - MARE - 129 KM DEVA - CLUJ NAPOCA - 454 KM TARGU MURES - 275 KM BOTOSANI - 537 KM CRAIOVA - 449 KM ORADEA - 10 KM DEVA - 287 KM	1 LAMINATE 1 - ACCESSORIES 1 - ACCESSORIES	TEAM 6	CLIENT - 420126 CLIENT 330099 + CLIENT 407146 19 April 2013

APPENDIX 11



Source: The author

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