

M.Sc. in Services Management



Lean transportation

Applying Lean Thinking Basics to Transportation

Master's Thesis

By: Samira Gnich – xx.xx.xx-xxxx

Thesis Supervisor: Professor Britta Gammelgaard

STU: 31,824 – 95 pages

Summer 2012 : Copenhagen Business School

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Executive summary

This thesis is an attempt to find a **common ground** between transportation as a service, and lean as a management philosophy that took its rise in a manufacturing context. It discusses the applicability and the possible adaptation of basic lean concepts like JIT, Jidoka and waste elimination, etc. to a key logistic function like transportation.

The thesis contributes to literature by offering a broader view of lean application to transportation. It is broader because in the closest literature to the subject, i.e. lean logistics, there is a tendency towards focusing on JIT to the detriment of Jidoka, which may explain the difference between the success of Toyota in lean and the success or failure of those who tried to replicate the concept to their organizations, or the view that lean cannot or is hard to be applied to transportation.

The thesis also tries to give insights into transportation quality definition by analysing the service value in transportation. This is important due to the fact that lean is a customer or quality driven concept, where value and non-value, waste and non-waste is always defined from an end-user perspective.

The **suggested model** of lean transportation concludes the thesis and it encloses different elements and findings from the analysis, the author reflections and the last chapter insights into different organizational challenges and prerequisites for lean implementation to transportation.

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1 Introduction

Huge advances in technology and paradigm shift in communications, together with economic factors have all contributed to the remarkable increase in mobility and accessibility. Surprisingly, moving an object from A to B is not less challenging for firms today than it was before the pre-mentioned paradigms; Challenges gained other dimensions but space and time related constraints are always there and are even tougher in a “networked economy” where transportation is a corner stone (Castells, 2000).

Although it is possible to move an object from earth to moon in 8 hours and 35 minutes (O'Neill, 2008), it is impossible to move that same object from Copenhagen to London in a truck, a car, a bus or even a plane without being faced either by traffic congestions or transit issues or different regulations regarding pollution, speed, etc....

Transportation has a pivot role in today's networked economy ,not only because global systems of production and management will fail to relate different networks efficiently without efficient transportation systems (Castells, 2000)but also because the networked aspect of the economy is imposing a great need for efficient mobility. The latter is indeed vital to cope with the needs of a demanding consumer in terms of both agility and flexibility.

From a macro perspective, the need for optimizing transportation systems and facing transportation challenges arises from two main things:

The 1st is the importance of the internal and external mobility issues. These issues, as well as the question of ensuring the free movement of goods, persons, services and capital, and facilitating mobility are a basis for the EU single Market (Commision, 2011).

The 2nd is the relation between transportation and economic growth. Although complex, this relation has been investigated through several researches, and results show that transport do contributes positively in economic growth (Ozbay K., (2003)).

In fact, transportation, not only has influence on the connections between resources, workers, businesses and customers but it also affects land use development location and intensity and thus consumer Expenditures (Litman, 2010).

For these reasons, the investigations regarding transport and mobility management are and still always welcoming all contributions that can improve transport efficiency from the carrier perspective and the quality of transport services from the end user or shipper perspective.

Whether regarded as a philosophy, culture, a set of tool or all together, Lean is among the concepts that gained a great interest because of its contribution to efficiency and enhancement of competitiveness both in manufacturing and services. When driving the focus toward waste elimination and value enhancement through processes optimization, the hidden harmful costs of the company are decreased or even eliminated while responsiveness is increased. Thereby the quality of the service/product is improved and both parts are satisfied.

1.1 Research Question & Sub Questions

In this work, the focus will be on the implementation of the lean principles to the transportation. The main question to answer is therefore:

How Can We Make Goods Transport More Efficient Using Lean Thinking Principles?

In order to answer this question we need to further investigate a couple of issues presented in the following questions:

- 1- ***What are the transportation challenges and how can they be seen from a lean perspective? (chap 3)***
- 2- ***Which role does supply chain play in transport leaning? (Chap 4)***
- 3- ***What is the link between transportation systems/networks and service quality? (chap 5)***
- 4- ***How can lean production basics apply to transportation and how do they solve the transporter challenges? (chap 6)***
- 5- ***What are the organizational prerequisites when transport companies should implement lean? (chap 7)***

1.2 Research Objective, Utility and Scope

The research question “How Can We Make Good Transport More Efficient Using Lean Thinking Principles?” involves three key words that all the analysis section will revolve around, namely:

- **Goods transport**
- **Efficiency**
- **Lean thinking**

The first and second elements imply that the work will be centred on analysing features of goods transport. Transport features implicitly will drag the transport challenges into discussion, especially that the words features and challenges are sometimes mutually used. For example globalisation, urbanization, environmental issues, different legislations, capacity problems, etc.... are some of the transportation's challenges. ; Whereas traffic congestion or with a lean jargon bottlenecks, delays, long Lead times, punctuality, safety, responsiveness, agility, reliability...etc. are some of the features that we use to describe a transport operation or a transport system. Each of these features can be a consequence of one or more of the pre-mentioned challenges.

The term efficiency (doing things right) will, however, be tackled from the consumer point of view; the consumer is the buyer of transportation services or shipper. ; That is, it will be the shipper's perspective that will lead managers' decisions about how things are done right in transportation service.

The 3rd main element in the research question will be the present work suggestion of a gap fill between the first two elements: transportation services and efficiency. This gap fill will take the form of a suggested lean model for transportation that results from a mix between lean production basics and the different answers of the research sub questions. That is, transportation features and challenges as mentioned above together with lean production basics will lead to the suggested model for lean transportation.

Consequently, a thorough presentation about lean will be present in this thesis that attempts to project lean production basics on transportation services.

There is nothing new neither about lean, nor about lean services but the focus on "lean transportation" is the real challenge for this thesis:

- Firstly, because the focus of lean, in this context, is usually on supply chains or logistics which made the part of "lean transportation" minimal if not absent in previous researches.
- Secondly, because lean philosophy in its very nature, considers transportation as a waste to be eliminated. Whereas logisticians or supply chain managers argue transportation adds time and space utility.

Parting from the fact that waste reduction is a key element in relating lean to transport, a key challenge in this work will be eliminating the wastes of "waste "; another challenge will be in adapting the soft part of lean, namely Jidoka, to transport. The ideal transportation will then be one where goods can flow smoothly, without bottlenecks or wastes that can sub-optimize the

transportation process; it is also one where the shipper can enjoy a high quality transportation service.

To illustrate that, the thesis is suggesting a model of lean transportation that encompasses all the raised questions and research steps of this research.

The thesis will contribute to a more thorough theoretical understanding of lean production basics in relation to transportation by analysing the main elements of the transportation environment. These elements are the **challenges** of the sector, the **supply chain** within which transportation actors and the other logistics functions interacts, and the **customer** a being the central element in lean production school. In order to have a complete picture, the research will also treat the challenges and **organisational prerequisites** for lean implementation to transport.

Thus, the thesis structure will be as follow :

Chapter 1: Introduction
Chapter 2: Theoretical background
Chapter 3: Lean challenges in a lean language
Chapter 4: Lean transportation and the supply chain
Chapter 5: Transportation and service quality
Chapter 6: Lean model for transportation
Chapter 7: Organizational challenges and prerequisites for lean change.
Chapter 8: Conclusion

While the focus of this thesis is solely on the way lean basics could serve transportation function and enhance service quality, **it will not focus** on metrics , nor will it be limited to studying specific transportation modes .Transportation in this thesis will only cover goods transportation and will exclude passengers from the scope of the research .Regarding lean , the thesis will not perform a deep review of lean production tools unless it is deemed necessary for the analysis and relevant in transportation context.

1.3 Method & Methodology

Since the purpose of the thesis is to explore how lean production basics can be applied to goods transport, and considering the data that could be gathered both from literature and on the field,

a qualitative research strategy is selected to analyse the problem posed and to meet research objective.

This thesis can be placed under the umbrella of basic, reflection researches and it is held at a descriptive and analytical (explanatory) level. (T.V.U , 2005). Not only because it tries to re-examines an existing concept (Lean) in a different context than the original one (manufacturing). But also because it aims mainly to gain insights, understandings and a more complete view to the research question transportation.

To design this research, a combination of **content analysis of secondary data**, **archive study** and an **expert interview** was used to guide the analysis phase and in order to answer the different questions raised in this research.

The data collected under the research design has been used to understand how lean can be perceived and implemented in relation to goods transport in order to meet high quality standards as perceived by the users.

Had trials to elaborate interviews with more experts and practitioners from the industry been successful, the research method would have been different. Exploring lean manufacturing basics 'applicability to transport and answering the research questions would have been based on experiences, conclusions and understandings of field practitioners ; and in that case a grounded theory approach would have been used. Conclusions would have been drawn in an inductive approach leading to a better formulated theory or explanation for the relation core of this work "lean-transportation". The potential theoretical formulation or grounded theory may appear from analysing the relation between the practitioners' views and practices from one side and different theories from another side. For instance, DSV is a rich source of information that could be used in this thesis, part because it is a transportation company and part because it experienced lean implementation. Trial to do interviews were in vain because the lean group no longer exists in DSV ,nor was it possible to know the reasons behind the closing of lean group in DSV to analyse them and use them critically.

1.4 Data Collection

Different seminars about transport in Denmark and particularly those about eco –mobility project in the Øresund region allowed me to get insights into the importance of transportation debate at the moment.

Although there was no direct relation between eco-mobility issues and the core focus of the thesis which is lean, those seminars were supposed to be my gate to the potential interviewee and thus to my primary Data sources. Besides, the overall focus on green issues in transportation told me how important it is to rethink transportation efficiency.

The primary **data source** used in this thesis is an **expert-interview** conducted with **Anker Nørlund**¹Secondary data sources were used abundantly to get insights into both lean and transportation from different perspectives. These sources like for example books, web pages, academic journals, specialized journals, whitepaper, newspapers and magazine articles served as a theoretical and hybrid source for the thesis.

The use of different sources of data and the mix of expert-interview with scientific research papers and different like interviews from specialized magazines is meant to improve the research quality and validity and to broaden the scope of the analysis.

2 Theoretical Background

This part will introduce lean concept in general because a deep understanding of the philosophy behind lean will lead to a better understanding of its application to fields other than car manufacturing ; for instance its application to services and more precisely to transportation services.

The first section introduces lean in manufacturing, the development of TPS, and its pillars or sub systems. The second section will present different literature contributions about lean transportation.

2.1 The Evolution of the Lean Concept

The competitiveness of the Japanese car manufacturer Toyota is due to its production system that succeeded to survive competition while using the limited available resources of Toyota. In the post-war period the Japanese automobile industry had suffered from market restrictions and low demand which prohibited the imitation of the American and European mass production strategy (Ohno, 1978).

The real challenge was then to maintain productivity in such internal and external constraints, and to do something different from mass producing and pushing cars to the market. Surprisingly Toyota could maintain consistent earnings and despite of all the constraints also after oil crisis (Ohno, 1978)

¹Anker Nørlund, Logio Consulting A / S.

According to (Liker J. , 2004)in his book “the Toyota way” this success is due to a culture and a gained knowledge where everyone is aware and trained to be a **problem solver** ,continuously ,and independently of his task in the process. It has also been explained that the continuous improvement of Toyota is based on **Toyota people** and not on Toyota technology .The essence of this **continuous improvement** is the ability to recognize and delete all **non-value added waste** in each and every process. (Liker J. , 2004) (Ohno, 1978).

When faced with the facts that most business processes are 90% waste and 10% added value (Liker J. , 2004), one could understand the importance given to waste elimination in the T.P.S.

This concept -elaborated by Ohno Taiichi’s -is known as lean in the non-Japanese cultures and it is developed by integrating two pillars (supporting sub-systems) of Toyota production.

These pillars were promoted by the Toyodas, the father in the textile industry, and his son in the car industry: The former by developing an automated loom that stopped exactly when the tread is broken and the latter by only producing what is needed in the right timing with the right quantity. In fact, the automated loom is not important per se, yet the concept behind it i.e. Jidoka (autonomation) is.

Literally, Jidoka means “automation with human touch” and this implies that quality issues should be checked instantly in the production processes rather than being corrected later.

This also implies that employees will be trained and **used to** stop the whole process whenever the mistake, the defect or the non-conformance to quality goals happens and independently of the automated work of the machine.

Indeed, it is this combination between the human touch and the machine work that guarantee quality excellence in Toyota (Baudin, 2007) (Ohno, 1978) (Shingo, 1989) and consequently competitiveness, at least at a quality level.

The production of exactly what is needed in the right time and quantity, called Just –In-Time, is the second pillar of TPS. JIT is vital for the TPS not only because it allows operations to get rid of huge inventories and other kind of wastes, but also because it enables quicker response to demand both internally –between processes- and externally between customers and suppliers (Ohno, 1978).

In fact, holding huge inventories characterizes traditional non-JIT system, and it is a good way to hide production problems. These problems and inefficiencies in production processes, according to (Ohno, 1978) (Shingo, 1989) , are due to hidden wastes in for example: inventories, unnecessary motion, unnecessary handling or movement of materials, waiting, defects, and before all else they are due to overproducing and pushing products independently of customer demand.

Having presented the two pillars of lean (JIT and Jidoka) and the essence of lean thinking that is a value-driven waste elimination, the following schematization of Lean house and philosophy are selected and commented:

2.1.1 The Toyota way

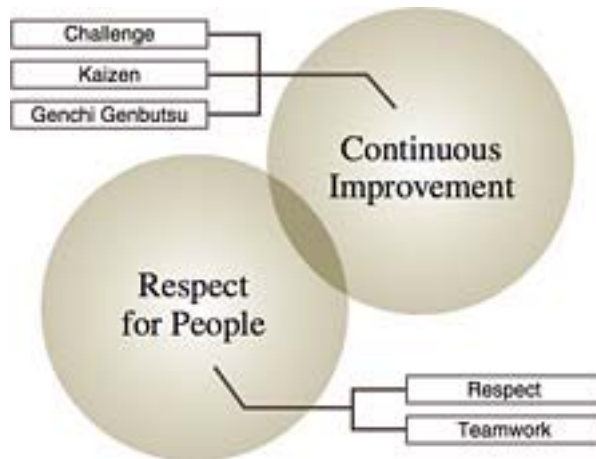


Figure 1 The Toyota way (toyotaglobal, 2012)

“The Toyota way” is a schematization of the basic ideas supporting Lean production systems, i.e., continuous improvement and respect for people:

2.1.1.1 *Continuous Improvement" and "Respect for People"*

It is worth mentioning that continuous improvement and respect for people go hand in hand and are equally important. In fact, companies that try to emulate the TPS or implement lean could fail if they focus only on continuous improvement tools and neglect people readiness and support for this change. Similarly, they could fail in their lean efforts, if they focus only on people variable without being ready or in the stand of integrating lean tools in the organization.²

For instance, founding sound Kanban system alone, operating in JIT alone, mastering value stream maps execution alone, or having multi-tasks and qualified employees alone will not make organisations lean.

It is about system integrity (Stenzel, 2007) and not about tools or best practices duplication. It is also about learning how to continuously put forward new ideas to improve business in a framework of respect for individual effort and good teamwork (toyotaglobal, 2012).

²This will be further developed in the last chapter about prerequisites for lean and challenges

2.1.2 The Toyota House:

Being one of the most studied systems in the world (Stenzel, 2007), many authors attempted to model the TPS and its main components in different scientific articles and books. The Toyota house or the lean house is among these models that try to summarise the system and offer an overview of its key characteristics.

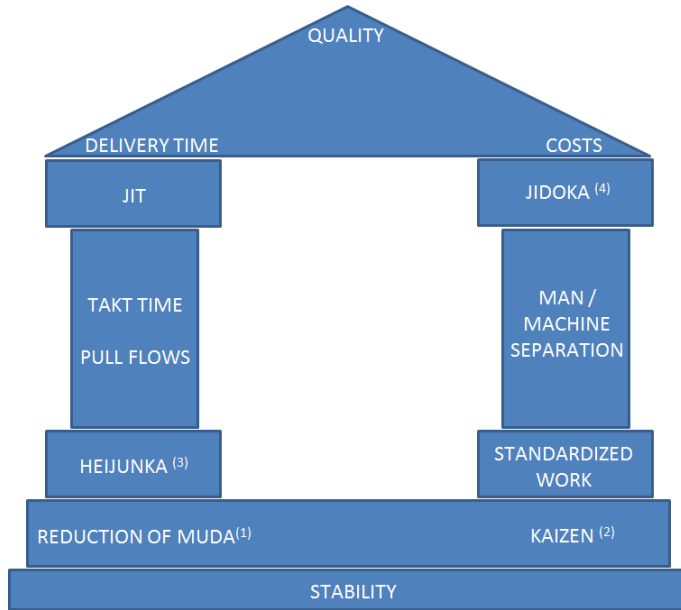


Figure 2: The Lean house (IPS Inc., 2012)

The house components have been the subjects of different literature about lean. Although abundant, this literature has divergent focus depending on the author perspective and the field studied. For instance, while the early Japanese authors like Ohno, Shingo and Monden, focused on thoroughly describing the TPS logic and basics (The two pillars JIT and Jidoka, the reduction of waste and kaizen) and tools (Kanban, poka-yoke, Andon,...etc.) for the world, later literature like (Womack J. P., 1990) (Liker J. , 2004), (Jones, Hines, & Rich, 1997) a. a. had different perspectives and scopes when they treated the TPS.

In fact, because the focus on waste elimination is in the heart of TPS, (Jones, Hines, & Rich, 1997) emphasized the need for coherent system while treating lean logistics, (Liker J. , 2004) however, focused on the managerial aspect of the TPS by suggesting 14 principles of management as being the management secret of the TPS success.

Waste elimination through time line shortening (Ohno, 1978) is highly emphasized as being the main concern of lean. Evidence in support of this position, can be found in the choice of each and

every elements of the lean house. Thus the following section will present the basics of lean house in relation to the central and basic element of waste elimination.

2.1.2.1 *JIT and waste elimination*

JIT is based on the idea of producing only what needed, when it is needed in the quantity needed. Its implementation is possible when pulling demand back from a subsequent process to its preceding process .The former goes and brings or transports the needed parts exactly and only when these are needed .Once produced, these parts are put at the same place and new production will just replaces what has been taken by the subsequent process (Ohno, 1978), (Lu & Kyōkai, 1989).

Oppositely to push system, this pull system will enable waste elimination by removing every cost that does not add value for the customer. Simply put, in the lean school all unnecessary costs related to traditional push systems are classified as wastes and have to be removed.

These cost burdens, resulting from pushing production in the line, can be related to, huge work in process, waiting, transporting and handling items unnecessarily and mainly to overproduction reflected in huge inventories.

In JIT systems employees can figure out what to produce next and in which amount just by looking to what is missing or to what had been taken by the next process; The ability to act based only on sight has evolved into Kanban system. This system helps communicating the information about what to do next without wasting time or resources of any kind (Lu & Kyōkai, 1989) .

In relation to work pace, JIT system also allows workers to see whether they are too slow or too fast and adjust takt time accordingly, which again will avoid time waste (Shingo, 1989).

It could be **concluded** that, in its essence the JIT subsystem is based on a time saving perspective, that enhance efficiency through elimination of waste resulting from inefficient use of time. In fact, it is suggested that there is a time factor in all the wastes suggested by the lean school which may incite to suggest that time is one of the main wastes that can affect service or production efficiency.

2.1.2.2 *Jidoka and waste elimination*

Parting from the idea of waste elimination, the automation with human touch (Jidoka) is more related to two of the 7 wastes namely defects and waiting: giving the human intelligence or human-touch to the machine does not only imply the existence of a stopping device that detects defective products in the process; It also means that workers become positively involved and active actors in the mistake proofing process each time they stop the line. They will not idle just watching machines

(Ohno, 1978) and waiting for abnormality to happen, which will enable production processes to get rid of both wastes and *waiting defects*.

Similarly, worker can attend more than one machine which means that it is possible to reduce the number of operators, and from the other side to” force awareness “when workers understand the problem and teamwork to solve it immediately and radically so it won’t happen in the future (Ohno, 1978).

2.1.2.3 *House Supporting tools*

The implementation of lean has been eased by abundant tools which aim to support JIT, Jidoka and incremental and continuous improvement. Nonetheless, firms need to be selective when using the available tools because not all of these should be used, nor all of these are relevant to all firms in all industries. Think for example about the applicability of some of the tools (exp. 5 whys) to consultancy firms.

Visual management or management by sight tools are vital for supporting JIT and Jidoka especially in relation to waste prevention. Kanban system of communication and Andon are examples of these tools. Similarly, asking why five times as soon as a problem occurs, gives the team the ability to detect problems and find root causes and radical solution for them.

Other tools like standard work procedures allow firms to integrate cycle time, work sequence and “the minimum amount of goods needed to keep the on-going process” (Ohno, 1978).

By the same token, it is worth mentioning that production levelling is among the important concepts in JIT implementation. Production levelling (Heijunka) means finding the balance between work load and capacity, it aims to smoothing production and helps in converting “*uneven customers pull into even and predictable manufacturing process*” p.3 (Amy & Kweku , 2004) . Quick changeovers and small lot production are examples of tools that support Heijunka (production levelling) and JIT.

In short, it could be concluded that the weaknesses of traditional system is behind all the thoughts about what a lean system and its basics are like: automation and push system are not in shortage of costs that do not add value to the final customer , these costs with no adding value were classified as wastes and they are accused for causing inefficiencies in the system; Thus , in order to be lean and efficient , old Toyota pro just reversed the picture: pull and do not push, try to avoid defects instead of correcting them , check quality in processes and do not control at the end of the process, humans and machines are integrated, improvement is a journey and not an end , and respect for people is the key word for walking the talk. This way they could banish wastes and improve efficiency.

2.2 Lean Transportation

Having said that, it is important now to investigate the link between lean production basics and transportation industry i.e. to think over the applicability of lean to contexts other than manufacturing. The section will be organized according to the basics of lean as seen in the previous part and as summarised in the lean house. These main elements are JIT, quality and waste elimination which is reflected in Jidoka.

According to (Womack, The Machine That Changed the World : Based on the Massachusetts Institute of Technology 5-Million-Dollar 5-Year Study on the Future of the Automobile, 1990) and (Badurdeen, 2008) an important feature of TPS or lean system is its applicability to any industry, any service and any context. The claim of the universality of lean, although criticized, is based on the idea that the whole principle behind TPS is comprehensive, very simple and even common sense (Ohno, 1978).

When it comes to a key logistic function like transportation, a strong link may exist between the scope of lean and its basics from one side and transportation from the other side:

2.2.1 Transportation and JIT

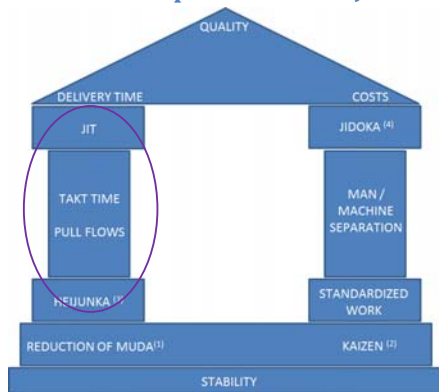


Figure 3: transportation and JIT adapted from (IPS Inc., 2012)

The sound relation between transportation and JIT system stems from two things. The first is the pivot role of transportation function in supply chains (see chapter 4); it is indeed the only way to move goods between different nodes of the chain. The second is the JIT system requirements regarding time, flow and delivery. Thus, succeeding a JIT system cannot be achieved without a **supporting** transportation system which enables the smooth flow of goods and their delivery just in time.

This implies that transportation managers need to align this function to the JIT logic of the firm/ supply chain, as opposed to trying to optimize it independently.

Based on the previous section, this alignment can be achieved by f. exp. supporting the continuous flow of goods, and finding the perfect takt time which creates balance between transportation capacity and demand (Heijunka).

From another side, the fact that transportation managers 'criteria for selecting shippers and carriers are affected by JIT implementation (Regan & Garrido, 2000) proves the importance of transportation function in supporting JIT system.

Comparing to traditional systems where transportation management was isolated from purchasing and inventory process, in JIT system, transportation is more focused, streamlined and tailored. This reflects the need for more control for transportation process in order to fulfil a more efficient, dependable and suitable transportation for JIT systems (Perry, 1988).

2.2.2 Transportation and quality

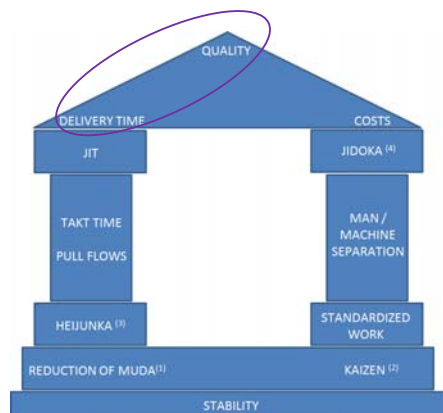


Figure4 Transportation and quality adapted from (IPS Inc., 2012)

Quality assurance is among the primary purposes of lean; it is a way to make sure that only good units are flowing between processes (Monden, 2011). In transportation, delivery time can be considered as a key quality dimension. In fact, together with other quality dimensions (chapter 5) delivery time can reflect whether JIT and Jidoka has been successfully implemented and whether the quality challenge has been totally faced by delivering the right goods at the right place and time.

Thus, it could be inferred that poor transportation services (in regard to responsiveness, people, reliability, etc.), unmanaged transportation networks ,and /or a price-based choice of carrier

can destroy the quality that has been built internally due to lean implementation that value quality assurance in all transportation processes.

Transportation should consequently **support** the idea of wastes elimination and quality assurance that is adopted inside the firm for other functions or processes; that is to say lean transportation is the way to bring lean out **from the firm to the whole supply chain**.

Support of this interpretation can be found in the “lean enterprise” concept where the leanness should be extended from the firm to the of whole supply chain in order to create value in all processes from raw material to delivery to the customer (Womack & Jones, 2003).

This value created or added is the guarantee that quality will not be lost between supply chain nodes while performing transportation, loading or unloading of goods.

2.2.3 Transportation and Waste elimination

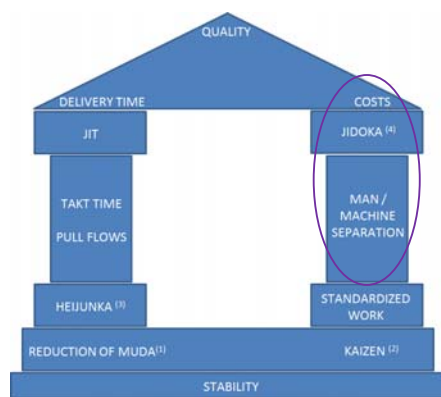


Figure5 Transportation and waste elimination adapted from (IPS Inc., 2012)

Lean production school, had coined the importance of transportation when it classified it as one of the seven production’s wastes that should be eliminated. It could be argued however, that the transportation waste described in literature about lean refers to internal transportation that occurs between processes and not to the broader transportation that occurs between supply chain nodes.

Nonetheless, being the main activity that links suppliers to customers and consequently a major contributor in the value creation and delivery processes in the supply chain, it cannot be assumed (without analysis or experimentations) that the transportation function has no wastes or that it does not need efforts for waste detection and elimination; The main issue here is the ability to keep the focus on eliminating transportation waste instead of the narrower and safer view of “eliminating ” transportation cost.

Detecting wastes of transportation function requires classifying transportation processes into value-adding, non-value adding and necessary but non-value adding (Hines & Rich, 1997). This analysis of transportation activities will lead to waste recognition and elimination which is broader and more efficient than cost reduction.

The importance of approaching wastes in transportation stems from the fact that this function is a key element in product delivery, besides it is the 2nd biggest cost in logistic and it adds lead time (Levinson & Rerick, 2002) which affects the delivery process and the perception about the service quality.

It could be inferred that in lean transportation the focus should be on relentlessly working with carriers on continuous improvement of transportation, while eliminating wastes and reducing cost as Toyota for instance has been always doing (WCL Consulting, 2003).

The issue is now more about the way lean tools or way of thinking can be **shared** between carriers and shippers in the transportation industry so they can improve efficiency and enhance the service quality of this key logistic function.

Review of literature

A literature search on lean transportation turned very few and no intensive results. This may mean that the subject has not been investigated thoroughly and/or that it is still believed that there is no much lean to do in transportation... **Besides**, the fact that transportation has always been treated as an element of the logistic or supply chain, made most of the focus on lean logistics or lean supply chain in general and not specifically on lean transportation.

However, today's increased focus on global supply chains efficiency, environmental issues, oil prices, global economic downturn as well as increased competitiveness and customer expectations, make leaning transportation worth investigations due to lean promises of incremental and continuous change that leads to increased quality, decreased cost and higher responsiveness (see Figure 2: The Lean house). Finding rooms for improvement of transportation network, operations and strategy management that enhance quality will then be the mission of lean journey into transportation industry.

Parting from the analysis in the previous section the following definition for lean transportation is suggested:

“Lean transportation encompasses all the characteristics, decisions and tools related to the activity of moving goods between different points in a supply chain, where the carrier/s –internal or external- and the shipper act partially or totally in a lean environment. I.e. an environment where the main interest of carriers as well as shippers are conform with the lean principles of: customer oriented value definition, continuous improvement, waste elimination and flow of pulled processes “

Thus by making transportation activities flow smoothly,” wastlessly” in a lean supply chain -as do products in a lean production chain- ,lean transportation will play its major role as an enabler of transportation system support for lean objectives in general (J.Trent, 2008).

An aspect of this support for lean objectives related to transportation is the provision of **smaller, more frequent and predictable deliveries** to a specific point of use (J.Trent, 2008) (Goldsby & Marichenko, 2006) (Taylor & Martichenko, 2006).However , the mass production philosophy still dominates the way many manage transportation and is reflected in the way they cut transportation cost by over transporting i.e. by pushing larger shipments ,less frequently in the supply chain which is exactly the opposite of what a pull system is.

Though it is important not to focus only on cost minimisation, since it is possible to see transportation costs increase in a lean transportation system.; This is due to the fact that transportation is an integral part of some supply chain trade-offs and the possible cost raise resulting from more frequent deliveries should be acceptable if the inventory related costs decrease by a greater amount (J.Trent, 2008).

Arguing that *“lean transportation is more about supporting supply chain and corporate objective”*p.53 (J.Trent, 2008) implies that managing supply chain that involves lean transportation should be based on a total cost perspective (Goldsby & Marichenko, 2006).This holistic view command transportation managers to be able to prioritize in order to address the trade-offs where transportation is involved, hence it is important for them to have a clear transportation strategy and to coordinate management efforts along the supply chain (J.Trent, 2008).

For instance, has it been decided to operate a closed-loop system (J.Trent, 2008) where different pick-ups of different materials from different suppliers should be performed in a scheduled time; it is then important for this system to be designed basing on effort coordination between the carrier and shipper and /or the supplier and the customer. This **effort coordination** will result in greater precision and more predictability as to the timing, volumes, equipment, quantities, human

resources, form of the contract, routes...etc. for all the actors involved in the transportation system. **Such predictability will decrease risk or increase counter-measures in case of disruption.**

Waste elimination in transportation is another aspect that has been raised by different authors: (Goldsby & Marichenko, 2006) advanced that transportation wastes are inherent in the way transportation assets are used by most companies. That is, using more assets than needed to cover variation in transportation or using the existing assets inefficiently are major cause for time and administration related wastes in this function (Goldsby & Marichenko, 2006) (Taylor & Martichenko, 2006). **Consolidated shipments**, **truckload shipments** and the use of **intermodal transport** that combine efficiencies from different transportation modes, are all possible solutions that enables waste elimination in transportation systems (J.Trent, 2008).

(Taylor & Martichenko, 2006), suggest four transportation laws that can guide managers through waste elimination in transportation; these are the law of transportation waste, the law of transportation strategy, the law of daily event management and the law of transformation performance. These laws will support the lean delivery requirement where smaller and more frequent arrivals of materials are scheduled through the transportation network and through the whole supply chain.

2.3 Conclusion

In short, it has been noticed after the analysis in this chapter that all the seven wastes known in the lean school can be translated into time waste of transportation processes. Thus managers should fight all kind of inefficiencies which create a time waste instead of limiting themselves to the seven or eight wastes suggested by lean school. Being demand driven, lean transportation is supposed to support a whole lean system in which transportation is a vital link.

Limiting lean transportation to smaller, more frequent and predictable deliveries may drive the focus of managers away from the whole picture of lean where continuous improvement and respect for people should not be neglected in order not to find themselves adopting Fordism with just a different name.

3 Transportation Challenges in Lean Language

This chapter will introduce transportation sector challenges and its major issues. In fact, the success criterion for any adopted principles or implemented tools to transportation –like lean in this thesis – will be the extent to which these principles or tools can solve the sector challenges and issues. That is, lean school answers should fit transportation questions and problems, otherwise it won't make sense to apply lean to transportation.

For these reasons, the main objective of this chapter is **to translate transportation challenges into a lean language** so we can select the suitable lean solutions for each challenge based on the previous chapter.

The chapter starts with a macro analysis of factors affecting transportation, and then a classification of challenges according to these driving macro factors will follow. Analysis will then the Danish context and will end with a more specification about the sector everyday challenges in a lean language.

As mentioned earlier, choosing lean as a management principle will only be justified by the problems it can solve and the improvements it can bring in to transportation firm. Consequently, it's important to get insights about what transportation practitioners think their problems are. This will, help seeing whether and how lean principles and tools can face these challenges.

In the top list of drivers of transportation challenges we find globalization, environmental issues, population ageing, and urbanization. The EU commission summarised the ultimate goal and meaning of an efficient transport in being sustainable so that it support economic growth, environmental issues and social paradigms.

3.1 Transportation Challenges: A macro level

Due to **globalization**, challenges related to **safety and security** may arise while old challenges like for example **energy prices and oil dependency**, still there. In an increasing global **competitiveness**, the EU puts a lot of emphasis on designing transportation systems that guaranties the free movement of people and goods while maintaining the competitiveness of transportation in the region.

By the same token , not only led globalization to questioning the efficiency of transportation system when different modes and continents are involved , it also resulted in a greater need for **effort**

collaboration and communication in different plans (legally , economically , politically, etc...)in order to meet the needs of more exigent shippers and customers .

Environmental issues imply that transportation challenges related to scarcity of resources, pollution, and GHG emissions may arise. In fact, while the challenge for transport is to reduce GHG by at least 60% by 2050 comparing to 1990, the steady increase in the sector emissions between 1990 and 2011, would put them, 8% above the 1990 level (commission, 2011). Thus, **integrating environmental issues into transportation system design** is a real challenge for all involved actors in transportation and supply chain.

An equally significant social aspect is the **ageing** of population (Europe.eu, 2011) and the inherent challenges it brings to transportation industry. Not only it adds to safety requirements to public transport but it also affects the **availability of “competent young stuff”** (scm.dk, 2012) in the transportation sector.

Indeed, it is difficult to imagine the risk of accidents decrease with older drivers if not accompanied by sound measures from transportation practitioners.

A critical challenge for the transportation industry is thus related to the fact that its **workforce development is much slower than the development of the transportation sector** (PWC) .

Working as a truck driver or in a warehouse is not among the most attractive career paths. Generally, young tend to associate these kinds of jobs with unpleasant work. (PWC). Consequently, **the retention of internal customers** is another urgent challenge for transportation companies especially if they want to work with **kaizen (continuous improvement)**.

Another significant challenge for transportation practitioners is **congestion which is an aspect related to increased urbanization**. Congestion costs Europe about 1% of Gross Domestic Product (GDP) every year (ec.europa.eu) . Facing such a challenge in a decade where freight demand is growing by more than GDP will lead to a smoother and faster move of goods and people (Europa.eu, 2011).

3.2 The Danish Context

In the Danish context, many challenges seem to be the same as in the EU context. However, according to the agreement between the different political parties about the Danish transport politic, environmental issues seems to lead most of the decisions related to transport in Denmark. The “**grøn**

transportpolitik” agreement signed in 2009³ is the concretisation of the green vision as a guiding line to solve challenges in transport system.

The Øresund eco mobility project gathered opinions about the most urging transportation challenges in the resound region and their potential solutions from practitioners and people in the field view.

An important thing about these challenges is the causality relation between them and the pre-mentioned macro issues: For example, the above congestion problems will be reflected in a **longer time in transportation, higher use of oil**, and especially higher chance for **delays** and non-fulfilment of terms of the contract (Eco-mobility conferences, 2012).

Another word that has been repeated in almost all the Eco mobility seminars is transportation **capacity**, and how to best optimise this capacity. Should it be by **decreasing the number of trucks** in roads and increasing their sizes which has the advantage (from carrier p.o.v) of reducing costs and at the same time emissions? Or should it be by decreasing the size of trucks and **increasing the number of travels in roads?**

Each solution has its advantages: bigger trucks mean **less journeys** and lower cost; smaller ones mean more **flexibility** and better **accessibility** to the end user or distribution centres located in cities. Which advantages should be prioritized, who will decide and how should the decision be made is the task of transportation companies to answer according to their strategy and taking into account their environment.

Knowing that 97 % of participants in “danske speditører” cite **Capacity problems** as their main issues, one can understand the great focus of practitioners on this problem (UE.dk) ; Statistics from (statistikbanken, 2010) show that Danish truck capacity utilization in national transport is 62,2 % when it is less than 50% (45,2 %) in international transport.

In a recent interview (February 2012), conducted among a group of supply chain professionals and academics , different views regarding the greatest challenges facing transportation sector has been selected (SCM.dk, 2012):

It has been argued that *“3PL industry is under pressure, so the risk is in their ability to deliver the agreed capabilities and services at the agreed price.”*⁴ Anchor Nørlund

This challenge and other pressures to the sector can be related to other issues like:

³ A number of accords in 2009, 2010 and 2011 followed the agreement (Transportministeriet, 2011)

⁴Anchor Nørlund, partner Logio Consulting A / S

- The inherent **SC trade-offs** where transport is involved: “the inherent conflicts between multiple performance objectives (e.g. Lower cost, quality, **lead times** and flexibility).”⁵ Jan Stentoft Arlbjørn
- The need for “**flexibility** in a vulnerable environment”⁶ Mike Lewis
- The need for building and operating “*a flexible and cost effective supply chain.*”⁷ Henning de Haas
- the challenge of **innovation** : “*More focus on sustainable solutions and innovation around the vendors and customers*”⁸ Morten Bagge Hansen, “*A performance management tool that also rewards creativity and innovation in the way of creating value,*”⁹ Britta Gammelgaard
- And the clever use of management concepts to face the sector challenges; “*Avoid naive use of management concepts.*”⁵

Other transportation challenges in the local context can be related to specific regulations (for example cabotage rules which regulate the foreign lorries access to national roads), to competitiveness (ITD, 2011) and to infrastructure (Paulsson, Wandel, & Skjøtt-Larsen, 2003).

Many industry respondents expressed their dissatisfaction about value-adding activities of the existing transport and logistics providers in the region (*ibid*).

3.3 Company level

Customer service or the service level is among the transportation challenges that can be met at a company level; it is a challenge because customer preferences tend to be divergent and their willingness to wait is decreasing.

This high demand variety when associated with higher expectations from carriers can result in capacity waste if the focus is solely on meeting customers’ expectations by providing wide –ranging service. Indeed, (Liu & Lyons, 2011) argued that firms should focus on excellence in operations rather than on offering wide-ranging services.

Similarly, at a company level and in relation to transportation function, firms need to face uncertainty, in for example due date compliance, poor machine or human reliability. Facing uncertainty challenge is important for finding the balance between the produced material and the

⁵Jan Stentoft Arlbjørn Professor supply chain & relationship management, University of Southern Denmark,

⁶ Mike Lewis

⁷Henning de Haas, head of academy & improvement programmer, kk electronic a / s

⁸ Morten Bagge Hansen

⁹ Britta Gammelgaard

demanded material. Similarly, in order to keep a flow of material, firms need to have enough flexibility in labour input (Oliver, 1991);

By the same token, taking waste from the supply chain by decreasing the amount of material in the system (inventories) will affect the company need for both machine and man in order to keep the flow. This point has been developed by (Oliver, 1991) where he argued that waste is reduced and redistributed and not totally eliminated from the system.

3.3.1 Lean answer to transportation

In the interview, Jan Stentoft Arlbjörn (SCM.dk, 2012) cited the clever use of management concepts as an issue facing the supply chain and its different functions; this section will discuss whether lean is among the concepts that **should be used cleverly to solve transportation challenges** or not

Interviewees (Niels Rytter¹⁰, Preben Hildebrandt¹¹, Anker Nørlund¹, Asger Rønnow¹²) and different seminars¹³ had directly or indirectly pinpointed lean and some of the tools related to it as a potential solution for the sector challenges:

Transportation sector's need for innovation, new management and lessons from other industries has been raised:

“And so it is a conservative industry that rarely draws inspiration from other industries. It feels more academic dealing with the topic” Niels Rytter¹⁰ ; Similarly suggestions about gaining new insight into the transportation sector from lean and six sigma or related concepts like kaizen has been proposed:

“Should transport see consistently in disciplines such as lean, six sigma, e-business, revenue management and green logistics?” Niels Rytter¹⁰

“So why not revitalize Kaizen and focus on small continuous improvements?” Asger Rønnow¹³

Building on the previous chapter definitions and analysis it could be argued that **Kaizen** concept and focus on continuous improvement can help transportation industry to get through crisis

¹⁰Niels Rytter

¹¹Preben Hildebrandt

¹²Asger Rønnow

¹³Øresund Eco mobility seminars

time provided that it succeeds to involve employees to detect and integrate possibilities for improvement into their daily actions (like products handling , service encounter , etc...)

Equally important is the **waste elimination** principle; Even though it is not mentioned directly in the interviews it could be understood that when firms thrive and maintain only productive employees,

“Ensuring that the company's strong employees thrive and thus maintained, while less productive employees phased out” Karl Poulsen ¹⁴ they actually **eliminate the 8thwaste** or underutilized talents.

From the above section and basing on the analysis of lean concepts presented in the previous chapter the following interpretation of transportation challenges from a lean thinking perspective can be proposed:

It is obvious that macro aspects like globalization, ageing, urbanization, and pollution cannot be addressed by lean or any other management tool on its own. Nonetheless, some of the challenges that are created by these macro issues can be addressed by lean tools and principles.

That is: **Congestion problems** can be translated into **bottlenecks** in transportation process. It is so because bottlenecks –that disable a key concept of lean, namely the **smooth flow** of materials –are one of the key issues that have been addressed by TPS.

Capacity problems reflect the **Heijunka** challenge in lean systems and the importance of **production levelling**. In a transportation context, levelling the amount of goods transported or the number of runs or journeys in a manner that creates balance between shipper demand and carrier capacity is the same challenge of TPS yet in a transportation context.

In fact, even though the risk factor is important in transportation and in the whole supply chain, reducing **transportation lead time** and increasing **agility** in the supply chain are in the heart of the Heijunka principle, and can help facing the consequences of high **variation in transportation demand** and reduce the consequence of **uncertainty and variability**.

Complexity is another challenge facing the whole supply chain and not only transportation
“The strongest tool is "Kill Complexity" - a systematic method for simplifying and streamlining
“Lythcke-Jørgensen”¹⁵

¹⁴Karl Poulsen, head of group logistics & operations director for Central Europe, Kwintet.

¹⁵Lythcke-Jørgensen

This challenge is the subject of the 4th law in "six sigma" namely "the law of complexity and cost" which state that a complex product -or service in our case- is a potential source for higher costs , slack and WIP and that this complexity can have worse effect than slow or poor quality processes (businessknowledgesource, 2010). Thus , it could be said that at company level six-sigma tool can address the complexity challenge in transportation especially that complex transportation processes will add **wastes** and **increase costs** which are major focus area in the lean school.

An equally important challenge for company is **delivering no less than the agreed upon service**. In transportation terms this means no **delays in deliveries** and no **damaged freight** and **no mistakes**; in lean terms this is similar to eliminating wastes that can result in delays and **preventing** defects or **damages during the process**. Yet, being able to detect and prevent mistakes or inconsistencies during the transportation process need a well-trained staff on the principle of **mistake proofing** (poka-yoke) and a strategic use of the principle of continuous improvement among others.

Having brought down transportation challenges to a lean terminology, it is important now **to link transportation to its context** in the logistic system and the supply chain. The rationale behind the next chapter is to understand the link between transportation and other elements in the logistic system as this can affect transportation journey toward lean.

3.4 Conclusion

In this chapter the challenges facing transportation sector have been presented, and thoughts about the similarity between these challenges and the questions lean is answering has been developed. The following model summarizes some of the results: (own creation)

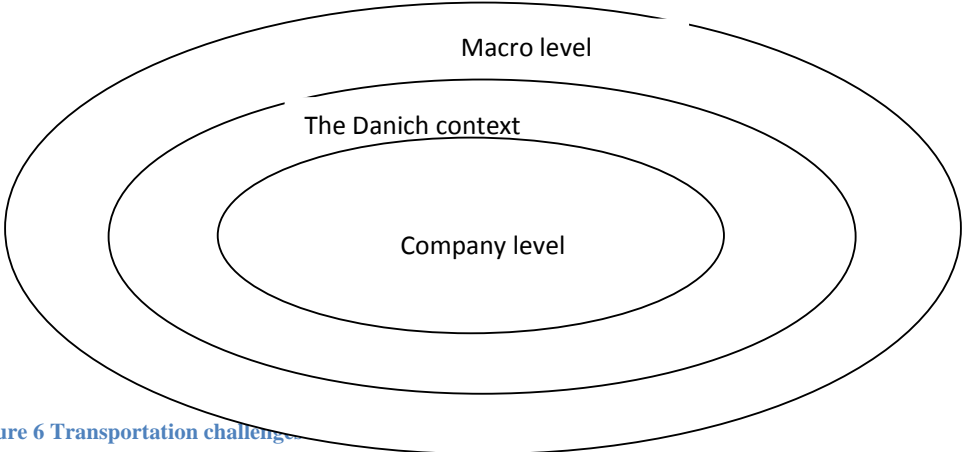


Figure 6 Transportation challenge

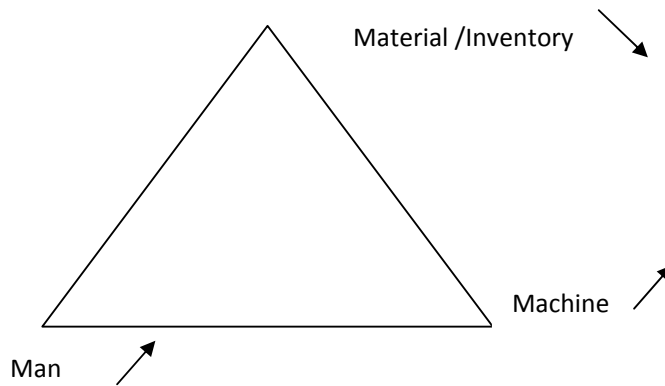


Figure 7: 3M and waste redistribution adapted from (Oliver, 1991) (supervisor inspiration)

4 Lean Transportation and the Supply Chain

This chapter will help framing lean transportation within its logistic context and in the overall supply chain. Such delimitation will help to better understand the functions that can affect or can be affected when leaning transportation.

Thinking about the supply chain while focusing on transportation recalls a T.O.C perspective that promotes an entire system view instead of focusing on single functions optimisation (Inman, 2012) ; Supply chain members including carriers should recognize that there are several dilemmas to solve before having a win-win situation (Schrageheim, Dettmer, & Patterso, 2009) .

The chapter will analyse what it means to be lean for the other supply chain functions. It will start by briefly explaining the role of transportation in logistics and then it will analyse how the time sensitiveness in lean transportation systems from one side and the high frequency of deliveries from another side can impact the overall supply chain. This analysis aims to placing lean transportation in the broader context of the supply chain and to understanding the potential interaction with the other functions.

4.1 The Role of Transportation in Logistics

Global business trends have put more pressure on transportation networks as they play a pivot role in supporting the whole supply chain performance. Longer distances between supply chain actors upstream and downstream put the success and efficiency of transportation systems among the key elements of the success and efficiency of logistics operations without which there is no talk about supply chain.

Logistics management can be seen as one of the key elements of supply chain management; it has been defined as *“that part of 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 customers' requirements.”* (CSCMP, 2012).

The movement of goods from the point of origin to the point of consumption will necessarily involve different but interconnected activities of transportation , warehousing and storage , material handling (like packaging...) and order processing. Historically, businesses tend to manage and sub-optimize these functions separately, but then shifted toward a coordinated management that integrates all these activities in the supply chain (Alan Rushton, 1992).

Thus, with such interrelation, functions performances are highly dependent of each other's and decisions regarding one function can significantly affect the other function. For example , the decision to move from a make-to-stock system to a make-to-order system will not be without effect on inventories and warehousing functions ; Also ,the consequences on deliveries in a new make to order system will change the way transportation function is managed and executed. For instance, transportation managers will need to support the whole system of make to order while making the decision about transportation mode, whether to use of private fleet or outsource transportation to a carrier, the type of contract, the route choice, alternative choices in case of disruptions etc...

Besides, for the supply chain to be **responsive** transportation system has to be flexible enough to support supply chain responsiveness. In fact, adding to its connective role in the supply chain and its size that fills 75% of the logistic cost , the increasing cost and service impact of this function on the overall supply chain cost has been cited as the top pressure 65% of transportation executives (Bob Heaney, 2010).

Thus the more efficient, effective and integrated the transportation function is ,the more likely for it to fulfil its role as a time a space value adding function all along the supply chain.

4.2 Lean Transportation and the Supply Chain

As explained in the above chapter, lean transportation is also about more frequent delivery on a time-sensitive basis. **Time-based features** of lean transportation i.e. time sensitivity and delivery frequency, have some consequences on the whole supply chain that will be presented below:

4.2.1 Time- sensitive transportation

In a lean transportation system Information sharing is a key determinant of how time-sensitive transportation will operate (Morash, 1997):

Thus, one of the consequences of opting for lean transportation is a more urgent need for exchanging a more integrated, value driven information that flows all along the supply chain. This flow of information should be **synchronized** and elaborated between different parts involved in the transportation process upstream and downstream: the carrier, the shipper, the transportation managers and the supply chain managers.

In fact, regular pick-up and delivery times of a lean transportation system need **availability** of the **right information** at the **right time**. For example This information can be about the exact need of the shippers inventory which is dictated by real customer demand .With other words, every pulled item by the customer downstream should generate a reverse information flow upward the supply chain, and it is the transportation role to translate this flow of information into movement of goods downstream to replace or replenish the previously pulled item from shipper inventories. Information can also be about potential traffic problems in the freight itinerary, about employees strike, weather conditions, etc. that may affect the time-sensitiveness of regular transportation.

On the other side of the system, the shipper also needs to use the available, shared and integrated information efficiently and have a JIT reflex to JIT transportation. She can for example be prepared with the right number of people, at the right place, in the right time for the planned arrival of the carrier. Similarly shipper can cooperate with the carrier in the network design or in the new product development (J.Trent, 2008).

In fact, being ready for receiving the transported material at any level of the supply chain is vital for supporting lean transportation. It is vital because it helps: 1) to eliminate “waiting” i.e. a waste, and a non-value adding activity to transportation and 2) because it prevents the creation of that idle time when trucks are in the shipper’s place waiting for someone to unload them.

Thus, since time –sensitivity is a key element of lean transportation, “**Time –waste** “is the most significant kind of muda that affect the regular basis of deliveries and consequently the time and place value added by the transportation function. Just a non-prepared shipper, or a small truck maintenance problem can cause a delay in the transportation journey .This time related waste (delay)will result in the accumulation of delays in the transportation system, these delays will be

aggregated all along the supply chain and will negatively affect its performance and the service level offered .

Predetermined arrival times require a more collaboration between the involved actors in the supply chain. Collaboration is important for the decision about the suitable time of pick-ups and arrivals of a. a. raw materials to manufacturers, parts to assemblers and finished goods to distributors (Morash, 1997).

It could be inferred that: because of its time sensitiveness, lean transportation requires a higher degree of collaboration and integration between the different actors and functions of the supply chain. This integration will support the flow of information necessary to keep moving the flow of materials between Supply chain nodes. Otherwise this time precision will be no more than a very demanding and costly procedure for shipper, and carrier.

Based on the above section the below figure gives an overview of the main idea presented:

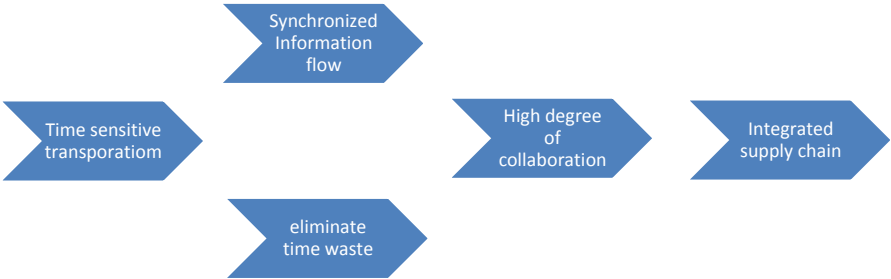


Figure 8: lean transportation, time sensitivity and supply chain (own creation)

4.2.2 Deliveries frequency

Frequency is another feature of lean transportation. More frequent transportation journeys between two or more nodes in the supply chain means lower lead time or faster transit times and this may allow customers to hold fewer inventories and get rid of costs related to inventory’s low velocity (Morash, 1997). Consequently, lean transportation can lead to the disappearance of traditional warehouses or their substitution by “flow-through centres, never-out-of-stock centres or direct-to-store shipments.” (Peters); A phenomenon that affects the whole supply chain design and performance in term of time and cost compression.

Furthermore, more frequent deliveries and the resulted increase in inventories velocity (Morash, 1997) can affect the traditional supply chain by eliminating warehouses to provide direct delivery.

Thus it could be said that lean transportation will help to increase inventory velocity, which is a good reason for replacing the old spacious expensive warehouses with the kind of facility that supports the idea of small continuous flows as opposed to infrequent big batches. These new facilities like for example cross-docking centres have to guarantee that the arriving trailers are just on site, at the right door at the right time (Khan, 2010) to support lean transportation.

Similarly the resulting decrease in shipping and receiving cycle times, the increase in shipments and inventory accuracy and the decrease in lead time variability will improve customer services in addition to reducing costs. (S.J. Mason et al., 2003).

4.3 Conclusion

A part of lean transportation can be concretized by a shift from the push logic (make to stock or move to stock in this case) that tries to minimize transportation cost by minimizing the number of travelled miles, minimizing the number of empty miles and maximizing capacity use of materials by transporting large lot sizes, toward a pull logic that supports the idea of work flow through the supply chain by providing predictable, more frequent and smaller quantities at a specific point of use (J.Trent, 2008).

This shift will inevitably have repercussions on the other functions in the supply chain. For the reason that in traditional push-based transportation systems, transportation costs are the major issues for managers, they tried to keep them down by moving full truckload trucks, less frequently to link different actors in the supply chain. The other side of the coin was the high inventory levels that presents a large part of logistics cost.

The high cost of holding inventories is also due to the lack of flexibility toward demand fluctuations. There is a cost of risk that can be reflected in a change of demand patterns (Hetzl) or in the case the product become obsolete.

Yet, leaning transportation will minimize the need for warehousing facilities between the point of origin and the point of use; which in return will result in decreasing inventory holding costs. The challenge for managers is to assess whether the decrease in inventory holding costs related to higher

pick-up and delivery frequency can cover the accompanying increase in transportation cost (J.Trent, 2008).

The characteristics of the product being moved such as its size ,value, and typical demand pattern (seasonal or regular) will help solving this challenge and determine if the savings in inventory pays for the increase in transportation cost. (S.J. Mason et al., 2003). Thus, assessing how lean transportation will affect a supply chain will depend greatly on the degree of collaboration between different actors in order to see the cumulated benefit or loss for the whole chain and not for the isolated functions. The total logistic cost view or the system view that integrates all functions is not something specific for lean transportation but it simply becomes more urgent as the need of integrating SC functions increases.

In fact for managers that have been used to focus solely on minimizing transportation cost , lean transportation may seem counter-intuitive :from one side there is a decrease in inventories holding cost, a substitution of warehousing facilities by flow –through facilities or their elimination, a decrease in lead time which affects customer services and Supply chain responsiveness’ ; and from the other side there is a potential increase in transportation costs , an increase in stock-out risk and a greater need for collaboration and information sharing with all involved parts in transportation and consequently greater dependency.

Whether it pays for the whole supply chain to link its different parts with lean transportation will depend on factors related to the product itself ,its design and complexity, its demand pattern ,the degree to which parts are ready for information sharing , how dispersed are the supply chain nodes, etc.

5 Transportation and Service Quality

As explained in the previous chapter, the importance of transportation and its key role in supply chain integration puts transportation efficiency and visibility at the heart of managers’ effort (AG, 2006). The macro context within which supply chain and transportation operates (chapter 3) and the critical role of transportation in the supply chain integration and performance (chapter 4) further complicates transportation systems and increase competitions in the sector.

This competition is two-fold:

- To survive and face all the challenges and paradigms facing today’s transportation companies

And

- To gain- not only customer satisfaction by meeting their demand -but also customer loyalty so they either repeat their purchase or increase the future contact duration with the carrier.

Yet, gaining customer loyalty will depend not only on the carrier service quality, but also on the consistency of this quality with changing conditions and environments. From the carrier side offering a high service quality that leads to customer loyalty will depend on a good understanding of shipper's perspective and acting accordingly (Murphy, Daley , & Patr, 1996).

In literature different carrier selection studies have been conducted to see what determines the choice of a carrier. Although it has been argued that selection factors will vary across situations depending on shippers markets and industries (Murphy P. R., (1995)), both carrier and shippers could agree that reliability and equipment availability are the most important determinant of transportation service quality. (Murphy, Daley , & Patr, 1996).

Since the focus of the thesis is on Lean transportation, the service quality or the quality concept will be tackled from a lean perspective:

In fact, as explained in chapter 2 and as pictured in figure 2, placing quality in the top of lean house reflects its central role in the lean school. In this school, quality is viewed as a built-in feature resulting from a JIT approach (affects delivery time) and a Heijunka system (affects costs through waste elimination). An equally important aspect of quality in the lean context relates to the fact that it reflects of the end-users view of the added-value they are willing to pay for.

The customer is then the main definer of value, and consequently he should be the main definer of non-value or waste.

In a logistics context, (Millen, 1999) demonstrated the importance Logistic Service Quality have in building customer satisfaction (Irene Gil Saura, 2008), which proves the positive relation between delivering a high service level and meeting customer expectations about the provider's performance.

In order to dig deeper in this issue transportation service attributes will be presented and an analysis of transportation service quality will follow.

5.1 Transportation Service Attributes

Transportation is classified as a service or as a part of a service, expressly the logistics service. (Zeithaml, Bitner , & Dwayne , 2008) have attributed four characteristic to services these are intangibility, variability, inseparability and perishability. Because understanding these attributes is important for the study of services buyer behaviour (Russell Wolak, 1998), the below figure attempts to apply the four services attributes to transportation:

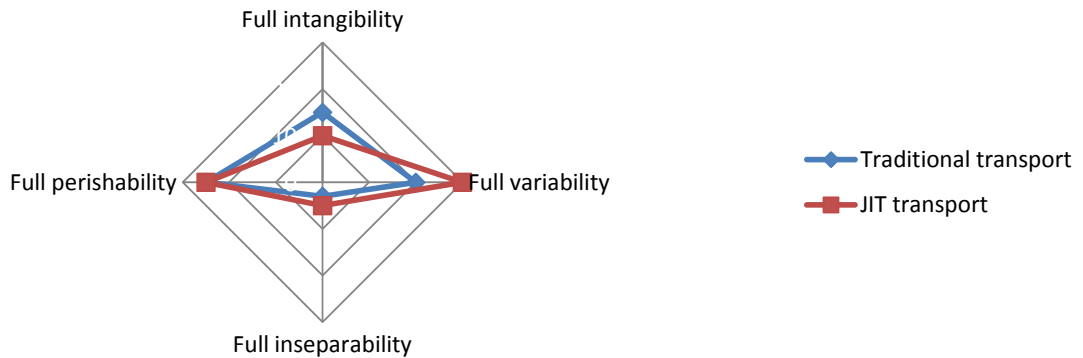


Figure 9 transportation service attributes (own creation)

5.1.1 Tangibles and transportation service quality

Among services attributes, Intangibility has been emphasized in literature because it affects the way consumers evaluate services (Zeithaml, Bitner , & Dwayne , 2008) ,the contrast is that tangibles are a basic service quality dimension (Jessica Santos, 2002). Thus, analysing transportation tangibility can be useful in understanding how managers can use tangibles for enhancing transportation quality perception:

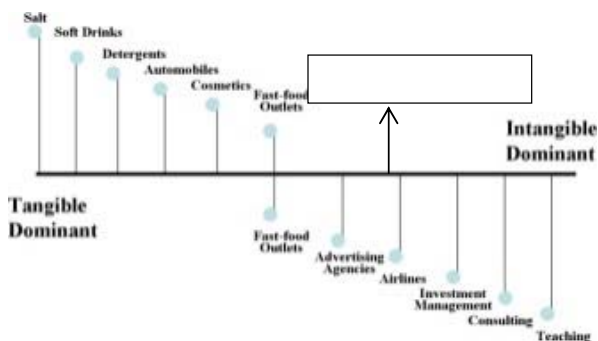


Figure 10 Tangibility spectrum adapted from (Zeithaml, Bitner , & Dwayne , 2008)

Basing on the above tangibility spectrum (Zeithaml, Bitner , & Dwayne , 2008) , goods transportation is placed in between airlines and advertising agency. In fact transportation services are not as intangible as consulting services or teaching for example; and they are not dominated by tangibles as in automobiles manufacturing.

There are some tangibles related to transportation services like the transported goods, the transporting material, the network, documents, containers, loading and unloading material ...etc. This implies that, contrarily to pure intangible services, the service encounter quality does not depend solely on people involved in transportation (e. g. drivers). That is, managers can - adding to educating people - use the transportation tangibles to enhance customer perception of carrier services quality.

That is to say that the degree of tangibility related to transportation service e.g. related to the appearance and state of the physical facilities, tools and equipment, personnel, communication materials, other physical features used to provide the service, the state of transportation vehicles, state of arrived goods, delays, transportation documents are important for customers in building their perception and judgement about transportation service quality. This result can find support in literature, where (Jessica Santos, 2002) study proved that the level of tangible components affects positively the perceived importance of the tangible dimension in service quality.

Applying the article findings to the thesis subject allows drawing the following results: Transportation is a time and space value adding process to goods ; It is achieved by performing tangible actions directed at goods (loading, unloading , packing , packaging, consolidating, and moving them from A to B).Besides ,the fact that people are physically involved in these tangible actions in the transportation process (staff in the carrier and the shipper side) will affect the importance of features like security and reliability in defining transportation service quality .

This discussion is important because it relates to service quality definition and because it will be used in defining what is valued by customer and what is not.

What customer values will be kept, improved, and be the focus of lean efforts and tools. What is not valued by customer will be the waste subject to elimination while value streaming and analysing transportation processes.

In fact, service providers tend to underestimate the importance of tangibles in services, which can be a cause for customer dissatisfaction due to their misunderstanding of what build customer perception (Jessica Santos, 2002).

5.2 Transportation Service Quality

Having discussed the attributes of transportation service, this section will discuss transportation service quality determinants in relation to lean Transportation as discussed in this thesis is met in two of the three activities that constitute logistics service namely materials management, and physical distribution management (Williamson, 1990)

The quality attributes of logistics services has been defined as time, place and form related utilities.

Transportation enhances form utility by delivering the correct quantity of finished products without damage and it enhances time and place utility by transporting the product to the required place at the required time (Bienstock, Mentzer, & Bird, 1997).

Due to the importance of customer perception of transportation service quality and its positive relation with purchasing decisions and consequently business profitability, a three dimensions model of PDSQ has been developed using the predefined transportation utilities of time, place and form. The model's dimensions are timeliness, availability and condition (Bienstock, Mentzer, & Bird, 1997) ;

These dimensions have been updated and extended later to four new dimensions : order accuracy , order condition, order timeliness, and order quality (John T. Mentzer, October 2001) and an extended LSQ where :personnel contact quality, order release quantities, information quality, ordering procedures, and order discrepancy handling have been proved to have the main effect on customers perceptions of : transportation process quality , their degree of satisfaction and consequently corporate performance (John T. Mentzer, October 2001) .

The main dimensions of timeliness, availability and condition are believed to have focus rather on the industrial setting of distribution service quality, than on the consumer context (Bienstock, Mentzer, & Bird, 1997) . Relating to the context of this thesis, it could be understood that these quality dimensions are more suitable for inbound transportation because it reflects the business

to business part of transportation service. These dimensions are then what determines or reflect the industrial customers' quality perceptions (Bienstock, Mentzer, & Bird, 1997) .

This implies that the ideal perceived transportation service quality from the shippers' p.o.v is to receive what they want, undamaged and exactly when they wanted it. Among these dimensions- described as outcome dimensions of quality- (Bienstock, Mentzer, & Bird, 1997) argues that timeliness is the most important according to transportation service consumers

Transportation has also another type of customers covered by its outbound operations. It is the retail sector or the end-use customer. This customer has some specific and context-adapted dimensions of service quality.

The SERVQUAL model (Zeithaml, Bitner , & Dwayne , 2008) has been elaborated in an end-use consumer context where the focus is on the process /functional dimension of the service. (Bienstock, Mentzer, & Bird, 1997)

Comments on giving timeliness higher importance than availability and condition

The (Bienstock, Mentzer, & Bird, 1997) distinction between industrial/ business to business context and consumer context (Or as in some texts outcome/technical dimensions and process/functional dimensions) cannot fit perfectly with transportation. This is due to the inseparability attribute of transportation services which implies the difficulty of disassociating the technical and process dimension of the service because production and consumption of transportation service are generally simultaneous.

Similarly a carrier 's core business outcome (timeliness, availability and condition) as classified by Mentzer will not change if the shipper is a retail store and not a factory. Both types of customers need that outcome and these dimensions.

Moreover this distinction between business to business quality dimensions of (timeliness, availability and condition) and the business to consumer dimensions (SERVQUAL: responsiveness , reliability ,assurance , empathy and tangibles) may lead the reader to think that the first dimensions cannot be applied in the retail context which does not seem very true. It is hard to imagine that the dimensions of timeliness, availability and conditions are only specific to industrial context; likewise, there is nothing that makes SERVQUAL attributes solely applicable in non-business to business context. Will empathy be something undesirable when we are in a business to business context? Will for expel drivers knowledge about the shippers need ,their willingness to help and tangibles be something that business to business customers don't perceive positively?

Saying that timeliness is the most important may lead the reader to think that it is possible to trade-off condition or availability against time, which does not seem very true ; It is believed here that In transportation and especially in lean transportation, there is no space for trading off between time, condition and availability ; All type of customers in different contexts need *at least* these 3 conditions simultaneously : the right goods , on time and in good condition .It could be inferred that in lean transportation the degree of tolerance in these dimensions is simply zero .

5.2.1 SERVQUAL Model and Transportation

The SERVQUAL model (Zeithaml, Bitner , & Dwayne , 2008)emphasises the difference between the customer perceptions of a provider’s service and their expectations about that service. These differences or gaps are the key components of the Gap model (figure 11) that guides managers in what to do in order to improve service quality and meet or exceed customer expectations. In the scope of this thesis shippers perceptions about a carrier service should meet or exceed their expectations about a value adding transportation service.

Furthermore ,managers can rely on logistics service capabilities to improve and enhance corporate Competiveness and positioning (Daugherty, (1998) .Thus, better logistics capabilities have a positive impact on customer’s service perception and quality level which in turn foster firms’ competitiveness.

In order to assess carrier transportation capabilities, shippers’ expectations should be compared to their perceptions about the service they really receive from that carrier.

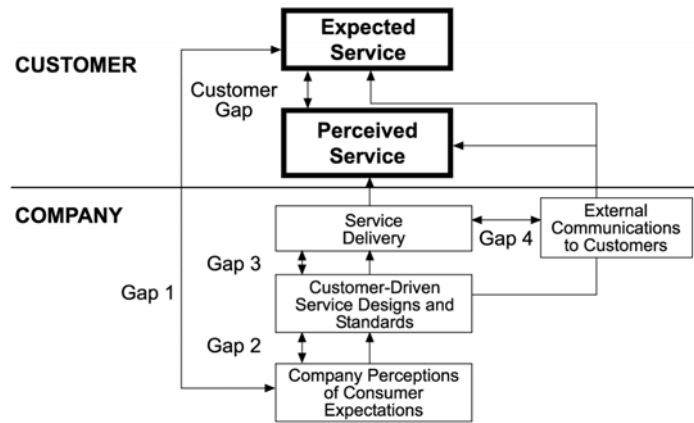
In the following paragraph, transportation service will be assessed using the five quality dimensions of the SERVQUAL model (Zeithaml, Bitner , & Dwayne , 2008) (Reliability, Responsiveness, assurance, empathy and tangibles):

- **Reliability:** in transportation, reliability reflects whether the carrier is able to perform the promised service dependably and accurately, in the thesis context dependability and accuracy will depend greatly on carrier’s capabilities to levelling production (Heijunka), and smoothing demand fluctuations because production variability and demand variation can be an obstacle for carriers to perform as promised. Similarly, carrier should have reliable material that can support lean operations .This reliability can be ensured by scheduled

preventive maintenance for all the material. The (Bienstock, Mentzer, & Bird, 1997) model's three dimensions of timeliness, form and availability can be classified under this quality dimension of SERVQUAL.

- **Responsiveness** : in transportation , responsiveness reflects the willingness of the carrier to help customers and to provide prompt service; Information sharing (see chapter4)and the real-time communication between shipper and carrier is a good way to achieve responsiveness In transportation. This is mainly due to the fact that service provider and receiver are physically distant or said differently it is due to the low inseparability of transportation service.
- **Assurance/courtesy/guarantee/ safety**: in transportation, this dimension is strongly related to the human factor , especially those with direct contact with shippers; In fact, divers need to be able to convey trust and confidence so that in case of problems or damages during material handlings or different transportation processes . Their knowledge can insure this quality dimension but since it is about lean, this knowledge has to be used to insure quality at the source and in all processes.
- **Empathy**: because of the physical separation between carrier and shipper and because actions in transportation are mainly directed at goods (Bienstock, Mentzer, & Bird, 1997), empathy dimension can be joined to the previous quality dimension. In fact, caring and individualized attention to customers is more suitable for services with high inseparability degree which is not the case in transportation.
- **Tangibles** : in services , this quality dimension relates to the appearance of physical facilities, equipment, personnel, and service related materials. In transportation tangibles can cover the appearance of employees , their attitudes ,the TMS, , the documents used (e.g. the contract) , the communication material , the carrier offices ,materials associated with goods handling, containers, and the ServiceScape in general. In a lean context, tangibles which are directly involved in the moving process (e.g. trucks, lorries, etc.) should not break down during the transportation process because this will make the whole JIT system fail. Break downs can be considered as defects, and while in manufacturing processes defects must be corrected immediately , in transportation process break down should rather be prevented and avoided instead of immediately corrected. This recall the importance of preventive maintenance in lean transportation. As explained in the previous section there is zero tolerance in transportation quality of reliability (timeliness, condition and form.)

In order to assess what shippers value, or in lean language what customers are willing to pay for, managers should assess each of these quality dimensions at two levels: the expected and the perceived, the differences can be collected in the gap model presented below:



Source: Zeithaml *et al.* (2006, p. 35)
 Figure 11 Service Gap Model

In their attempt to see what quality dimensions are most important for shippers and carriers (Murphy, Daley, & Patr, 1996) found the following:

Table 2. Shipper-carrier comparisons

Factor	Mean score ^a	
	Shipper	Carrier
Reliability	1.22 (1) ^b	1.28 (1)
Equipment availability	1.36 (2)	1.79 (2)
Transit time	1.45 (3)	1.83 (4)
PU and D	1.60 (4)	1.93 (5)
Financial stability	1.63 (5)	2.07 (8,5)
Operating personnel	1.66 (6)	1.81 (3)
Loss and damage	1.69 (7)	2.11 (11)
Rates	1.71 (8)	2.57 (14)
Service frequency	1.83 (9)	2.09 (10)
Scheduling flexibility	1.85 (10)	1.96 (6)
Expediting	1.88 (11,5)	2.07 (8,5)
Rate changes	1.88 (11,5)	2.58 (15)
Service changes	1.89 (13)	2.05 (7)
Tracing	1.91 (14)	2.63 (16)
Linehaul services	1.98 (15)	2.33 (12)
Claims	2.05 (16)	2.72 (17)
Carrier salesmanship	2.68 (17)	2.89 (18)
Special equipment	3.05 (18)	2.51 (13)
Grand mean	1.81	2.18

^a1 = highest importance; 5 = lowest importance.

Figure 12 Shipper carrier quality dimensions

Among several quality dimensions, reliability and equipment availability are found to be the most important from both carrier and shipper p.o.v.

Basing on the SERVQUAL analysis, it could be said that theoretically there is little chance to have gap 1 (see figure 11) in transportation service. The reason is that in this case carriers are not unable to recognize the shippers' expectation about reliability and equipment availability.

From another side, shippers rate Transit time, PU and D higher than carriers do. This is a critical situation that can result in a customer gap (the expected is lower than the perceived) in these

dimensions, namely because carriers underestimate shippers sensitivity to prices and transit time. JIT transportation offers a possibility close this gap by regular in pick-up and delivery time which means a predetermined and fix transit time.

5.3 Conclusion

The fact that shipper (customer) ,who is a central element in the lean school , rank reliability, transit time and equipment availability as the most important dimensions in this study (Murphy, Daley , & Patr, 1996) ; reminds us of the (Bienstock, Mentzer, & Bird, 1997) conclusion about the tree suggested dimensions of timeliness, availability and condition. It also shows that **reliability** is the dimension that has been repeated independently of the authors focus : functional /process In SERVQUAL (Zeithaml, Bitner , & Dwayne , 2008) technical/outcome (Bienstock, Mentzer, & Bird, 1997) , or carrier/shipper perception about service (Murphy, Daley , & Patr, 1996).

In fact, being reliable means offering the agreed upon service dependably and accurately and this pre-suppose that there will not be delays, damages or bad surprises. Furthermore, dependability and accuracy require an adequate degree of flexibility to perform as promised independently of the system uncertainties.

In the context of lean transportation, operations frequency is higher and **precision in** timing is a key word for the success of the transportation process. In such a context and adding to longer distances between sellers and buyers and the challenges facing the sector (environment, security...etc.) and the greater need of for supply chain integration(Chapter 3),new service quality dimensions in transportation may arise ; if not, traditional quality dimensions may be altered or gain higher ranking in the shippers p.o.v ; For instance , the ability of tracing the shipment , innovation in loading and unloading goods , innovation in containers design ,special equipment , information systems or any aspect that help in minimizing time waste and supports the lean systems may be more emphasized and their existence may affect transportation quality perception in a lean environment and due to the need of high integration in supply chains.

Similarly, more frequent transportation journeys between suppliers and consumers will further emphasize the quality dimensions related to assurance and trust (SERVQUAL) because of the higher dependency between the two parts in lean environment. Consequently carriers, and due to a more use of human factor and an increase in the service encounter with the shipper , need to continuously

improve employees' skills in the same way they improve and update their TMS in order to live up to shipper's expectation of responsiveness, reliability and assurance. This continuous improvement and focus on the human factor is in conformity with lean principles as explained earlier in this thesis (chapter 2).

All these dimensions will gain higher importance in lean context, because they may be the differentiator between carriers in lean environment where there is a null zone of tolerance about outcome qualities of timeliness, condition and availability. That is, since there is no trade-offs shippers can allow between these three core dimensions ,quality differences will be seen in the other factors analysed above; besides the better carriers are in eliminating wastes ,the higher their financial performance will be.

In this chapter, and in the literature used there as not a strong focus on prices, this may mean that shippers do not use price as a major criterion for their purchasing decisions; Otherwise practitioners view are not in conflict with the defined quality dimensions in this chapter; in a word they say it: precision, responsiveness, and reliability are the most important because todays firms have more tendencies to move inventories from warehouses to carrier's trailers. (SCM.DK, | 23.08.2011).

Yet, as it is possible to join transportation precision and responsiveness features under reliability, it is suggested to add to this transportation service quality features :flexibility which take into account the environment of transportation and consistency which offers a kind of stability and a guarantee that -at least- the service level will not deteriorate. These three elements will be used in the lean transportation model in the last chapter.

6 Lean Model for Transportation

Today's companies are pushed toward finding new transportation management solutions. Not only because of transportation challenges (chap 3) , tendencies toward supply chain integration (chap4) and increased customer requirement for flexibility and reliability (chap5) ; but also because the global context characterized by uncertainties and risks may threaten firms competitiveness and survival if they are not able to adopt and adapt to new management solutions.

These management solutions should lower the effect of rising transportation costs while meeting stakeholders needs for: service quality (customers), profitability (shareholders) and attractive work conditions (internal customers or employees)

Thus, companies seeking efficient transportation must **make significant changes** in every phase **in the transportation process** and implement **new** transportation and distribution **strategies** (AG, 2006). This will help them increasing their real time reaction to market and consequently enhance customer perception of their services. In fact, the better the understanding of customer's definition of transportation' quality or value is, the clearer are the improvements that can enhance the service process and the business success (rethinkmarketing, 2012) by discarding all what is not valued by the customer.

Oppositely to mass production, lean success is due to its ability "to deliver near perfect quality without extensive end of the line inspections and large amount of the rework " (James P. Womack, 2007) p 36 .The principles and basics which are behind this success had been fully worked out by Toyota by the early 60's (ibid) (see also chap 2).

Despite criticism, the success of lean in different industries -including services- pushes companies that want to improve their performance and survive competition toward adopting lean principles in their operations (Jay Jina, 1997) and preferably in the whole supply chain in order to support the lean paradigm in the organization. Indeed, it has been argued that lean not only can result in operational, administrative, and strategic improvements (Kilpatrick, 2003) but it can also act as a survival strategy in recessions period (Bhim Singh, 2009).

Earlier in the thesis (chap 2), it has been explained that JIT and Jidoka form the two subsystem of lean, yet a characteristic feature of lean should be achieved for the whole lean system to succeed, it is stability (Jay Jina, 1997).

Heijunka or production levelling, by its effect on balancing the work pace needed for achieving JIT operations, is an example of support to stability. The overall objective of this chapter is to try to implement the theoretical framework of lean principles to transportation using different results from previous chapters as well as results from the analysis that will follow in this chapter:

6.1 Lean Transportation: JIT Transportation

Being one of the two sub-systems of lean, JIT is the "most important productivity enhancing management innovation since the turn of the century." (Rosemary R. Fullerton, 2001). Ohno defines

JIT as having the right part at precisely the right time, and in the right quantity, to go into assembly (Sang M. Lee, (1993)) . Yet the signal that initiates the movement of the part has to come from downstream process and not from an upstream process like in traditional push system.

Integrating JIT 's “3 right” (place, time and quantity) to service delivery will form the seven rights of fulfilment, where the right customer, condition, cost and place are added to create a perfect delivery (Professionals, 2011) .

An equally significant aspect of JIT is the production of defect-free parts, subassemblies and finished goods (right condition) (Peges, 1993) which implies that a single defect, delay or unconformity to quality standards can delay or disrupt the whole supply chain. This reflects not only the importance of waste elimination at the source for the success of JIT systems, but also the importance of being prepared for the worst scenarios that may cause delays or unconformities in the system. Doing so is important if managers want JIT benefits to exceed its damages.

In this context ,one may remember last year's tsunami that hit Japan and caused all Toyota factories in US to shut down due to parts supply shortage (dailymail, 2011) , and implicitly because there were few or no inventories kept with American part assemblers operation in JIT .While traditional systems focus on batch production , JIT system focuses on the flow of value creation where production or services processes are executed in “rhythmic balance” (Heijunka) and at the same rate of end-user pull to offer the customer the expected result (Jones, Hines, & Rich, 1997) (Peges, 1993).

Organizing activities around value and in support of interrupted flow of work, means that system components should be rethought in order to fit the flow, Thus production or service process, layout design, warehouses, transportation networks , work patterns and even people skills will inevitably be subject to alteration and change while trying to fit and balance the flow of work ; During this process, layers of hidden waste will be exposed and removed continuously (Jones, Hines, & Rich, 1997) (Peges, 1993).

Relating this to transportation led to the following analysis:

In lean context, the crucial role of transportation in supporting and linking the whole supply chain together will push managers to rethink the way this function is performed in the supply chain and ensure it does not constrain lean. Therefore, transportation processes should be redesigned and reorganized to support the continuous flow of work and minimize lead time , from one side (JIT side of lean) and to continuously recognize and eliminate non-value adding activities from all

transportation function elements (processes ,networks ,and tangibles), from the other side (Jidoka side of lean) (Jones, Hines, & Rich, 1997).

Such redesign and reorganization of transportation function around lean may put the carriers under the pressure of new tougher requirements. That is , when managers want to operate a JIT transportation system featuring more frequent movement of goods ,in smaller quantities and in a tighter schedule, carriers will surely question whether this JIT system can optimise their capacity ,whether they have the right structure to support it, and especially whether it can compete with the traditional full loaded , less frequent deliveries that –as they used to think - minimize their costs , risks (fuel , manpower , material, congestion ..etc. (chap 3)) and matches better the economy of scale mind-set.

Solving this dilemma, requires a broader diffusion of JIT understanding in the whole supply chain and more collaboration and integration between shippers and carriers to assess what is better for whom and how to optimise the whole system to have more win-win situations. Such lesson was well understood by Toyota that tough its subcontractor to process parts in a single-piece flow from (Jones, Hines, & Rich, 1997).In fact, it is important for carriers, shippers and manufacturers to see the benefits of removing huge inventories and warehouses and other wastes in order to be engaged and committed to JIT transportation.

The following figure summarizes this system view and how important lean logistics, including lean transportation, in supporting lean systems:

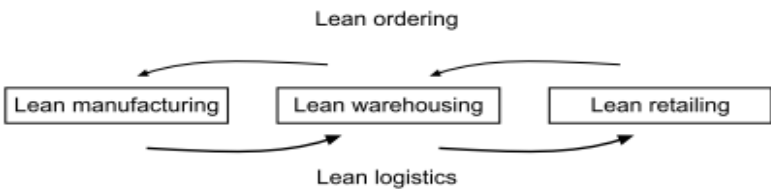


Figure 13 lean logistics support for the whole supply chain Source (Jones, Hines, & Rich, 1997)

JIT transportation VS Traditional transportation

In order to understand the features of JIT transportation it is important to compare it to a traditional non JIT transportation:

In a traditional transportation system, the carriers move direct full truck load a limited number of times in week or month, to a large number of different destinations, in order to get few parts at each, for instance, some manufacturers used to move their fleet every 3-4 days in full loaded trucks toward 500 suppliers in order to have only 9 parts (Jones, Hines, & Rich, 1997). Besides delivery windows provided by carriers could be in days instead of specific delivery dates (J.Trent, 2008) .

This way of planning transportation journeys is in congruence with traditional push system where the idea of economies of scale is predominant. Manufacturers produce in large batches to realise economies of scale, buyers buy in huge quantities to minimize unit cost and they keep inventories as a protective measure against risks or uncertainties, similarly transporters carry goods in large batches and not frequently to gain from economies of scale, use their capacity at its maximum and minimize empty miles. Transportation service providers' strategies are but a consequence of the predominant production system.

For instance, since carriers are used to think that the bigger the lot size the more cost effective it is to carry a large part of them at once (Suzaki, 1993) , they will argue that JIT transportation is synonym with minimized travelled miles and less frequent deliveries of full loaded trucks (J.Trent, 2008); With other words, as waste and cost are sometimes used interchangeably, many transportation managers will argue that JIT transportation is the same as minimizing transportation cost(*ibid*) . However, it is believed, and as mentioned in chapter 4 that the focus should be on the total cost and not on the transportation cost alone.

In fact, focusing the Total cost of ownership TCO gives managers the opportunity to describe the full cost and effect of adopting JIT transportation on the whole supply chain ; that way it is possible to affirm that “the possible increase” in transportation cost (J.Trent, 2008) can be much lower than the decrease in the TCO. (Burt, 2004) . This focus emphasizes the importance of collaboration between carriers and shippers and all parts in the supply chain to have reliable measures of the TCO (Starling, 2005).

In non JIT transportation system, pushing full loaded trucks to market will minimize unit transportation cost, However It will increase the risk of non-answered demand if production cannot accommodate with occasional demand mutation . Resulting so in late deliveries, bad will from the customer and wastes (Womack & Jones, 2003) .

In the other side, JIT transportation systems are supposed to support JIT basics of continuous flow, takt time and Pull system in order to eliminate the function wastes. Thus transportation managers need to rethink their transportation processes and network and to formulate a strategy where:

- the continuous flow of transported goods ¹⁶
- Pulled by customers¹⁷
- In a regular basis or fixed takt time ¹⁸

can optimize transportation function and decrease TCO in the supply chain.

The resulting JIT transportation system where goods are carried more frequently, continuously i.e. with non-stops and in smaller quantities while linking more than one supplier is known as milk runs and it is the JIT version for traditional full loaded, less frequent and pushed transportation.

The figure below is an illustration of a JIT milk run transportation network and a traditional transportation one:

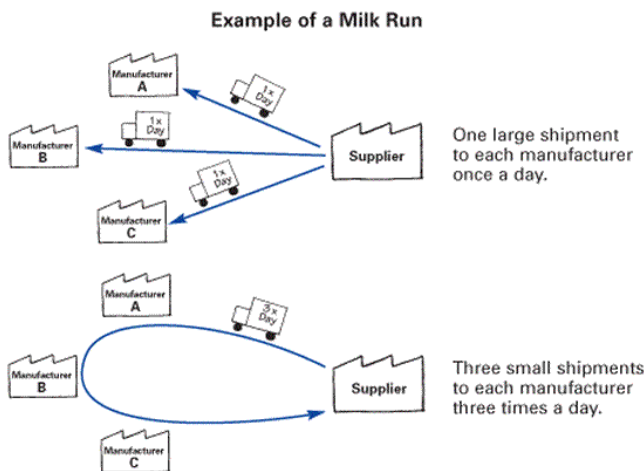


Figure 14. Milk run vs. traditional transportation (www.lean.org)

¹⁶ **One-piece flow:** the concept of reducing production batch/lot sizes to minimal size, preferable to a single unit. This can have dramatic effects on raw material, WIP, and finished goods inventories, as well as on production lead times, quality, and costs (Networks)

¹⁷ **3 (pull system - a manufacturing planning system based on communication of actual real-time needs from downstream operations (ultimately final assembly or the equivalent). Contrast with PUSH systems, which schedule operations according to theoretical downstream result, based on a 'best-guess' planning, MRP, or equivalent.)**ibid

¹⁸ **Takt time - takt,** is a German term for rhythm. Takt time is the rate at which customers are demanding a product. This is NOT the same as cycle time, which is the normal time to complete an operation on a product (which should be less than or equal to takt time).ibid

6.1.1 Milk run

Called also closed loop systems, Milk runs are a concretisation of lean transportation; not only because they incorporate the basics of takt time, flow of work and pull, but also because of their ability to decrease wasteful activities and enhance value creating process by monitoring the time variable. The resulting time gain from regularity and fixed higher frequency journeys will improve quality aspects related to availability and timeliness in transportation (chapter 5). There will be less or no place for extra costly unexpected journeys, and delivery time windows will shrink from days to hours or even minutes. Evidence for in support of this position, can be found in (Donald J. Bowersox, 2002) who argues that regular and higher frequency journeys in transportation minimize takt time in transportation, and help in avoiding supply chain operational problems..

Milk run transportation can be defined as: a cycle where transport contractors consolidate goods in sequence from different suppliers A, B and C at a specific time following a specific route. This logistic system method of good collection features multi-frequency, low volume and time sensitive pick-up in a pull mode between the original supplier and the customers (EXPRESS) . So instead of every of many suppliers sending a vehicle each week to fulfil the weekly demand of a client, one vehicle visits every provider on a daily basis and picks up deliveries for that client (logisticsglobo, 2011).

In order to further optimize this alternative, companies need to discuss the possibilities of their suppliers to offer more parts each. The resulting decrease in the number of suppliers will decrease the number of transportation journeys and thus the cost related to those journeys.

Furthermore, order consolidation, which a feature of milk runs, enhances transportation efficiency (Donald J. Bowersox, 2002) and help eliminating empty runs by combining different suppliers' orders in one journey. Different kind of consolidation spatial, product and/or temporal (Fang, 2006) can help managers in:

- Optimizing transportation routing
- Optimizing vehicle capacity and saving empty runs and
- Answering quality requirements for timeliness and flexibility

In Milk run systems “the overall volume and sequence of parts are stable, yet the exact volume of each part required are flexible, they are determined a day or two ahead” (Jones, Hines, & Rich,

1997). Moreover, capacity can be adjusted to the predefined quantities that should be carried and this allows carriers to:

- 1) Avoid Capacity losses deriving from demand variability and unpredictability and
- 2) Remove the extra costs of emergency shipments (Jones, Hines, & Rich, 1997)

Agreeing and knowing in advance the quantities that will be carried, and spread them evenly in a particular time schedule reminds of Heijunka (Production levelling) which is a basic element in JIT systems.

This balance incorporated in milk run systems offers the kind of **stability** needed to operate lean transportation.

. It allows carriers to be ready with the needed men, machine and material to satisfy to demand and avoid all time waste related to imprecisions in arrival or departure of carriers .Furthermore, knowing that milk run system requires only 8 steps comparing to 33 steps in traditional transportation (J.Trent, 2008) prove that there is a lot of **waste** and **complexity** that can be removed from transportation processes when shifting to milk runs.

6.1.2 Transportation wastes

Anker Nørlund defined the wastes that can be met in transportation process as: wrong documentations, wrong destination, and waiting due to early deliveries, damaged goods, ignorance and slow processes.

Transportation wastes can negatively affect transportation efficiency and harm service quality. The focus should be on those non-necessary and non-value adding activity. Documentation mentioned by Anker Nørlund is for example a non-value adding activity however it is necessary for fulfilling the transportation process. Streamlining all the processes and coining documentation will help managers minimize them in a first step; then, effort collaboration and information sharing between carriers and shippers will help preventing mistakes in documentation in a second step.

“The idea of leanness in this sense is that the pre-mentioned wasteful activities are reduced or eliminated and that value-creating processes are performed more quickly” (Waters, 2007) .

Since ,waste elimination from transportation processes will be reflected in shorter lead times, one could say that the valuable gains from JIT system are reflected into the amount of time carriers could save while performing the waste free operations.

Similarly, applying different tools like value stream mapping, 5 S, Kanban...etc. will allow managers to detect sources of unevenness or simply irregularities in the transportation processes and act to eliminate their sources.

However due to the importance of flexibility and timeliness qualities in transportation service, it seems that asking why 5 times when a problem occur cannot be coherent with the nature of transport operation :It is suggested instead that transportation managers together with the shipper ask “what if...” minimum 3 times (in a non –global supply chain for example). The reason is that transportation is about **precision in time, in handling and in information** and none of people involved in transportation has time to ask 5 why’s once a problem occurs and while trucks are in their way to customers.

It is simply always too late if carrier don’t know the solution before the problem occurs, especially with the milk runs tight delivery windows. .That is , “ 5 why’s “ tool may not be suitable for the nature of transportation service and process , “ What if “should be the tool that carriers together with shippers use to avoid as much problems as possible and be ready with alternative plans to implement. This is to say JIT tools applicability to transportation should be questioned before being adopted , a key word in transportation in prevention and having alternative plans for each and every element involved (people, networks , material ..Etc...)

Transportation tangibles are also a good field for waste elimination. These can be containers , vehicles, documents etc...; For instance ,a vehicle break down, a non-availability of loading/unloading material ,broken containers , a delay in containers handling are some example of transportation waste to be eliminated. They have in common their relation to tangibles that have an effect on service perception as explained in chapter 5. Thus the state, the cleanliness, the ease of use, the design and the efficiency of these elements are important both for service perception and waste prevention or elimination.

(J.Trent, 2008) cites reusable containers, totes and pallets as example of tangibles that support the JIT system, not only because they can be reused during 5 years but also because they guarantee a” financial payback. For instance, corrugated containers requires transportation (a waste) an extra handling (a waste) and probably they will sit there in the floor waiting for someone to take them

which is not very lean if one consider a tool like 5 S. Oppositely, reusable containers can prevent time and handling waste due to their ability to” interlock when stacked “, (J.Trent, 2008) and this will help in:

- Reducing shifting during transportation.
- Preventing loads from collapsing upon each other
- Minimizing the risk of damaged freight under handling or transportation

Similarly, elements like the ease of access to goods in trucks or trailers, and skilful employees are significant for waste elimination efforts. For instance the easier the access to goods in trucks or trailer , the less time will material handling take (ibid),and the more skilful employees while loading or unloading goods the less chance there is for defects and damages to occur.

Thus , transportation manager’s worries about capacity, costs, time, and invisibility can have an answer in a well understood JIT transportation system that involve all parts- in order to make it possible to face the pre-mentioned challenges and improve transportation service perception at the same time.

In short: There is no shortage of elements that incorporate waste in transportation process as seen above, the most important is the ability of all parts involved in the transportation process to cooperate in order to sustain the success of milk runs implementation. Cooperation is needed in order to plan the transportation route and network, to anticipate problems before they occur (3 what if’s), to understand what the customers value and to work continuously to eliminate all what does not enhance quality internally and externally.

Milk runs have the benefit of decreasing the customer need for maintaining inventories (Donald J. Bowersox, 2002), and the benefit of order consolidation that compensate the use of small lots (Saini, 2011). Moreover, shorter fixed takt time and effort synchronizations necessary for milk runs help respectively in decreasing lead time and improving supply chain visibility In fact, **consistency** offered by milk run can allow them to be a competitive advance (Donald J. Bowersox, 2002).

Thus, it is suggested basing on the analysis in this section and the previous chapters that **consistency and availability** of man, machine, material and management will be the basis for the lean transportation model. In fact it is known that lean system implementation need stability this is

why both elements are necessary in order to succeed in implementing JIT and meeting customer requirements. See Model

6.2 Lean Transportation: JIDOKA and Transportation

Having considered JIT, it is also reasonable to look at the second principle of lean which is autonomation or automation with human touch in order to see how it can relate to transportation.

In fact, lean transportation goes beyond JIT implementation, milk runs, order consolidations, reusable containers and fixed time schedule with short takt time. It also goes beyond the simple recognition of value -adding, non-adding value, and necessary but non value adding activities in order to eliminate wastes. It requires n employees involvement in the service process coupled with a thorough understanding and commitment to the principle of continuous improvement, team work, multi-skills and the ability to prevent or instantly react to anomalies, defects and waste in the service process.

The aim of Jidoka (chap 2) is to prevent the production of defective products by building quality into the different process (Taylor & Francis Group, 2007). It implies that processes have to be interrupted as soon as abnormalities appear . And it is the employee who has the responsibility of stopping and correcting the process, it is also important, not to delay any corrective measures and insure that all corrections touch the root cause of the problem.

JIDOKA is important because it promote a culture of continuous improvement without which it is not possible to sustain lean results and advantages. The best achievement is to turn JODOKA and the resulting culture of continuous improvement into a routine integrated in employee's daily work and activities. (Magnier-Watanabe, (2011))

According to Ohno, it is workers who are responsible for product quality; they are offered the authority to stop the process by enabling call lights (Andon) as an urgent need for help from the other team. Besides, specific blocs of time are offered daily to teams to think about the problems that happened during the day (Roberta S. Russell, 2011).

In a Jidoka system, Insuring quality at the source for transportation is even more urgent because of the quality features of transportation service (chap 5) .these qualities cannot as explained be trade off against each other nor they can be ordered by importance; simply

shippers need at minimum available machines and men that are able to bring goods on time, and in the perfect condition. This implies that the nature of defect transportation is different from a production defect. In fact when a production defect occur , the employee pulls the cord and the production stops in order to avoids mass producing of defects.

But how can employees correct a “defect transportation”, if it is ever possible to do that? :

Defect transportation” can be a late journey or an on time delivery with damaged goods or an on-time, with non-damaged goods but at the wrong destination or with wrong documentation...etc.

The principle of Jidoka dictates to detect these defects and correct or rework them **immediately** in real time.

The issue is that, in transportation there may be place for inspection (for the machines, for the state of goods, for the address destination ...etc.) but there is no space for rework especially at the end of the line (end of transportation process). How can a carrier rework a late, damaged or wrong items delivery once it is at the shipper ´s door?

That is to say , the in-process quality check and its different tools presented in the theoretical part Andon, poka –yoke...etc. has to be done even prior to the transportation operation by preventive maintenance, flexible route planning, while loading goods and while unloading them, etc... Priority should be given to defect transportation prevention instead of its correction. This emphasizes the importance of people skills, involvement and commitment to the idea of built in quality and continuous improvement. People can strongly affect transportation efficiency and service quality from the design phase by route planning, network design and flexible skills. This is why it is important for employees to:

- Be actively engaged in daily operations by learning how to see **wastes /problems and thinking** how to eliminate these.

and

- Be able to recognize quality first and foremost so that can be positively involved in continuous improvement process. (Robert J. Everett, (1993)).

Since in manufacturing, workers in the plant inspect not only of their own work but also that done by others on previous operation from (Peges, 1993) , in transportation drivers ,managers and

personal in general ,should be able to see abnormalities and eliminate them instantly whether they are caused by them or by others in the transportation process .This implies the need to instantly interact with each other in order to solve the problem and correct abnormalities.

Unlike manufacturing environment where work teams are s physically less dispersed , people in transportation process cannot be always in the same place to implement Andon or 5 why's , thus preventive measures will have a greater weight in transportation process : prevention starts from the early design of routing plans ,to material preventive maintenance , to thinking about the kind of containers ..Etc.

(Robert J. Everett, (1993)) emphasises the importance of adopting Jidoka philosophy, where people are a corner stone, for companies:

“Sooner or later management need to adopt Jidoka philosophy if they wish to maintain zero defect service “

But he also admitted that giving the employee has total responsibility of acting upon errors wastes and mistakes, is not an easy mission.

It is so, because it raises two important questions related to Jidoka implementation: the first is related to the extent to which operators employees can be trusted to stop the operations.

The second question is related to the reason for which employees will start to take the trouble to keep management updated about quality problem (Ibid).

In transportation and for the first question, stopping the service process when problems occur should be supported by skilled and well trained employees. Otherwise it will create time waste instead of eliminating it when the best solution is not known.

For the second a **rooted** culture that supports Jidoka , skilled employees who are able to see inefficiencies in the transportation process and a good communication system , should be in place in order to encourage employees to take the trouble of communicating inefficiencies. Yet, the lean basic of “respect for people” will play a role here; if the organization is able to retain the internal customer as well as its external then it is easier to have a well-established Jidoka system in transportation.

Indeed *success of transportation and Logistics operators depend decisively on the quality and qualifications of its employees* (PWC). *In a Jidoka system, the latter, should use their brains in*

addition to their bodies and be ready to take decisions (Cuatrecasas, 2002) about abnormalities or inefficiencies in the transportation process.

The whole idea behind JIDOKA in transportation is that carriers should **prevent** quality problems from reaching the shipper at the end of the "service line". (Robert J. Everett, (1993)) Examples of as equipment malfunction, quality issues, or late work need to be corrected in the service process so that transportation can acquire the Built in quality (Lean Logistics Terms). In this case, the driver would inform the supplier of the parts shortage and a solution would be developed right there on the spot." (Goldsby & Marichenko, 2006).

It is therefore important that the driver is well trained to verify all perfect order components of the supplier order, for instance, he should verify that the parts or the order, its quantity, the packaging, the labelling and any other important variables are as expected. If something is missing or not corresponding with the shippers' standards, the process is stopped immediately by the driver and the supplier is informed about the missing thing (Goldsby & Marichenko, 2006).

In short, Transportation personnel need understand how important their role is and how it can contribute to the transportation process success and the overall firm performance. Being one of the main elements in the service encounter (chapter 5), drivers, for instance , need to be aware of their role in the service delivery, their skills and capabilities say a lot about the carrier seriousness and professionalism, their ability to respond ,communicate and deal with problems is vital. The importance of this ability need to be communicated to them which may help in increasing commitment instead of doing mechanically what they are asked to do, if management want to pass the test of Jidoka in a lean transportation.

6.3 Conclusion

JIDOKA is the second lean subsystem .Trying to adapt JIDOKA principles to transportation to will result in the necessity for drivers and all employees to be involved in a continuous improvement process, aiming at insuring quality at the source and eliminating wastes from transportation processes.

It is true that the characteristics of this involvement (where, how and who) and its success will depend on the recruiting strategy, training and motivation strategy; But it also depends on the characteristic of transportation activity; that is, the importance of features like timeliness, condition and flexibility (chap 5) implies waste elimination should start in earlier stages than it does in other activities.

In this manner, in lean transportation efforts should be directed to prevent waste instead of eliminating them. In fact, this is due to the weight of time factor in JIT transportation. Preventing wastes “ As early as possible “ will be then be then the transportation substitute of “ in process quality check “ that is suitable for other processes which are less risky and less time depend than JIT transportation.

Furthermore, the risk and uncertainties inherent in transportation activity due to different challenges facing the sector (chapter 3) push carriers to be always prepared for unexpected wastes that can occur between two point A and B. The suggested tool for the lean transportation model is a substitute of the original 5 whys and it is called “minimum 3 what if’s “As explained in the previous section. For these reasons measures like, Preventive maintenance, will play a great role in minimizing break down risk and consequently increasing the chances to succeed JIT deliveries and thus succeeding the lean transportation model summarised in the conclusion

7 Organizational Challenges and Prerequisites of Lean

Despite all the benefits the two subsystems of Lean, JIT and JIDOKA, can bring to transportation (chap 6) there are still some organisational challenges that can be faced when management want to initiate a lean change. To solve these challenges it is important to have some organizational skills or know-how in order to succeed the lean paradigm.

7.1 Lean tools, traditional view of work and the lean change.

Because lean is “a way of giving people ,at all levels of an organisation ,the skills and a shared means of thinking to systematically drive out waste by designing better ways of working, improving connections and easing flows within supply chains “, It is hard to imagine that making all these elements work together (toward waste elimination , delivery of better customer value and resources optimization) can be made simply by designing tools (Lebow, 2007).Partly because adopting lean

thinking goes beyond tools design to seeing and managing the enterprise work as a system, and partly because lean basically “encompasses a challenge of change **in thinking** that management has to be ready to face “ (Ibid).

Consequently, organizations should first face the challenge of changing the management approach philosophy prior to tools and techniques application (Lebow, 2007). In fact ,the latter cannot be the final answer to transportation challenges and problems ; And , the approach of “ cherry picking” lean techniques can prove problematic because it tries to implement a bit of lean without understanding the whole (Crute, Ward, Brown , & Graves, 2003).

Therefore, in order to face the challenge related to lean implementation, management should create an environment that ensures any change is both understood and sustained. (Wood, Fevrier 2004)

However, communicating lean system and ensuring its understanding at all levels in organizations are not less important than replacing the old view of work as series of isolated and predesigned activities by the more integrated system view of work. In the latter, importance should be given to new ideas and respect for people by engaging them and enabling them to measure their performance and root out waste (Lebow, 2007).

Furthermore, for managers to support the understanding of lean and its communication in the organization, it turns out that an easy and clear measurements system is needed for: enhancing visibility by highlighting facts and showing improvement trends from one side; and supporting mind-set change while implementing lean from another side. For instance, having some concrete measures, like financial numbers or expenses reductions due to lean practices might be important to incite board managers to go through lean change (Crute, Ward, Brown , & Graves, 2003).

The fact that quality, waste elimination and people involvement are basics of lean system, further emphasizes the importance of having a thorough understanding of several elements like what value the firm is delivering, which activities are enhancing that value and which are not (waste), etc..., otherwise it is quite hard and absurd to engage employees in continuous improvement programs and drive the lean change successfully.

7.2 People resistance and lean change

Management have to deal with resistance to change as one of the “must-deal with “challenges related to lean implementation. Indeed ,it has been argued that individual plant and management

context and lack of management commitment have more impact on the easiness of lean implementation than sector specific factors (Gupta & Kundra, April 2012,) (Crute, Ward, Brown , & Graves, 2003).

Koenigsaecker (Lieber, 2004) argued that while implementing lean, managers will be challenged by supporting and addressing members who are less adaptable to change (anti-change group), and who are pulling the organization into the past by offsetting the efforts of the other members.

This same issue has been arisen under the name of people resistance (Oliver, Human factors in the implementation of JIT production , 1989). It has been also proved that challenges will arise when new practices like Kanban system has to be implemented in a work place, and that failure to maintain Heijunka may cause overburdened jobs and labour disputes which are major source of conflicts (Andreas Hu" ttmeir a, (2009)).

Because flexible working is a basic element of lean, it is obvious that "In the course of a true **lean** conversion, many jobs will either disappear or be totally restructured into something else" (Sheridan, 2000) . Whether preferred or imposed, resistance from flexible working opponents may exist and it will be based on reasons like the erosion of skills or the inconvenience of elementary activities. (Oliver, Human factors in the implementation of JIT production , 1989).

In transportation and with regards to the multiskilling requirement of lean systems, drivers role has to evolve from just driving , to ensuring quality at the source ,team working , correcting abnormalities , reporting them to managers, thinking about improvement, understanding the shipper need and its quality standards etc. .

In fact it has been argued, without multi-skilled personnel, management cannot have enough flexibility and freedom to continuously rethink every employee role and be ready to change it through the process of lean change (Lieber, 2004) and continuous improvement.

People resistance prior and during lean implementation can be explained by old habits and culture which has been instilled through time. An example of these old habits is workers tendency to be seen to be busy which will create work even when there is no need for it (Oliver, Human factors in the implementation of JIT production , 1989).

It could be inferred that even people attitude and work habits stems from a push culture where working equals moving , no matter what and how efficiently this move is , whether this

move is value driven or “waste driven “.In fact , **When people think they have to move - whatever the reason they move for- in order not to feel and seem unproductive , they are doing mainly two things : they are creating wastes (of moving inefficiently, overproducing) and they are hiding wastes (idling, waiting,) which is why** addressing people working culture and habits is a challenge no less important than learning tools and implementing them.

In this context, it has been suggested the new lean disciplines must also be instilled in the people in order for organizations to face this resistance, That is, “whatever operators demand from the system should be internalized.” (Oliver, Human factors in the implementation of JIT production , 1989)

Relating to transportation, it could be inferred that leaning this function should be supported by a management that is **able** to “integrate transportation personnel with other functional groups” in for example , the phase of product development with logistics representative with distribution and supply personal etc.... (J.Trent, 2008) Besides ,supporting the lean change by changing the people role in transportation may result in ensuring a “more respected occupation “for transportation personnel (Ref – figure) (Placeholder7) Which can positively affect their motivation and further reinforce them.

Lean related measures of role change and multiskilling will incite management to think about new strategies for recruitment (Oliver, Human factors in the implementation of JIT production , 1989)in order to: support change in people role in transportation function, enhance multi skills and to some extent face problems related to resistance to change. Three steps are required from management to succeed this role changes: (Lebow, 2007)

Step 1: help employees to focus on their processes as being part of a larger system which is in our case the supply chain. This will enhance commitment, creativity and enthusiasm.

Step 2: remove performance measures that undermine performance, and replace them with measures that help you improve the work within a process. Tools are used to understand root causes of problems not to solve them.

Step 3: rethink budgeting as a key of sustaining transformation.

7.3 The whole picture and the lean change

As explained in chapter 4 Transportation function cannot be dealt with independently from other logistics functions, or without considering the other actors in the supply chain. This characteristic urges organizations to:

- 1) Choose the right timing for approaching lean change (Graves, 2000),
- 2) Coordinate organizations approach to lean change according to transportation, challenges and environments (chapter 3 and 4.

And

- 3) Select the most relevant tools for the activity (Meyer, 16 August 2007).

In this change process transportation managers may be challenged by complexity¹⁹ and lack of agility in processes, in fact “Complexity equals opportunity for wastes” (ITC, July 2004) and it hinders agility which is vital for transportation and supply chain efficiency.

Similarly demand variation may upset management; however, the claims that Lean concepts work better where demand is relatively stable and hence predictable and where variety is low, does not mean that lean will not work in contexts where demand volatility and variety are high.

It simply means that much higher level of agility is required in order to support lean implementation. (Tiwari, (2006)).

For this reason, agility is considered as a basic in the suggested lean model of this thesis. From another side, it is important during the leaning process not to neglect political dimension engendered by possible organization redesign that may result in rewriting the organizational map (Oliver, Human factors in the implementation of JIT production , 1989). In transportation, this dimension has a considerable weight in due to issues related to security, safety and differences in legislations between countries, especially if more extended supply chains are considered (Chapter 4).

The involvement of everyone in the organization is a central concern in the lean change process, also for managers who need consequently to be put on improvement teams,” full time and week-long during the first year of conversion” (Lieber, 2004). Similarly Facing challenges related to this

¹⁹ "Once you start increasing distances, the complexity makes it really difficult to accomplish JIT," says Robert A. Novack, associate professor of business logistics at Pennsylvania State University.

“learning process “, requires both management commitment and consistency in its messages about lean change and how it is useful for the firm. (Crute, Ward, Brown , & Graves, 2003) .With regard to lean transportation it has been argued that the development of effective transportation strategies will support the realisation of lean objectives all along the supply chain. This implies that management needs to be able to formulate a strategy consisting of transportation objectives, constraints, plans and goals , besides it needs to integrate this transportation strategy with other functions and partners in the supply chain (J.Trent, 2008).

7.4 Conclusion:

What has been advanced in this chapter prove that success in lean implementation goes beyond the management adoption of lean tools, to having a comprehensive, holistic in scope and content strategy (Crute, Ward, Brown , & Graves, 2003).In transportation, a holistic view is even more urgent due to the supportive role of this function for the whole supply chain.

Management should then be able to base his strategy on the support of waste elimination and flow of value to the customers, and at the same time establishes a comprehensive and clear communication system that reflects how lean can help the organization: (Crute, Ward, Brown , & Graves, 2003).

Social and political skills will be needed in addition to logistical skills in order to face the challenges that may arise when implementing lean (Oliver, Human factors in the implementation of JIT production , 1989).

The strategic approach to lean implementation is required because there is strong correlation between the existence of a systematic and controlled change strategy and success in implementing lean (Crute, Ward, Brown , & Graves, 2003) .In fact , failure in lean implementation are mainly attributed to corporate culture and change management (Bhasin, 2012,).

This means that management need also to consider the soft side of lean by building the energy and engagement of employees (Meyer, 16 August 2007)and they should be aware that there is no a standard lean strategy for change “Every company need to find its own way to implement lean” and understand that lean is a never ending journey. (Bhasin, 2012,)

However, real case examples may show different conclusions. DSV journey to lean does not seem never ending after the removal of lean group just after 3 years of great success. Does that reflect a continuous improvement perspective or does that mean that they already internalized the lean philosophy and there is no more need for it in the firm?

8 Conclusion & Suggested Model

In the light of the general lean theory in manufacturing , this thesis attempted to discuss the usability and applicability of lean thinking basics to goods transportation and it gave birth to the lean model for transportation presented below (figure) .

Answering the research question needed an understanding of lean manufacturing basics and elements (chapter 2) prior to looking to the challenges facing the sector (chapter 3) and analysing the dynamics of the relation supply chain –transportation (chapter 4) .This approach in answering the question is based on :

The belief that efficiency (doing things right) is relative to the context of the studied subject or function. That is ,in order to really be lean , transportation managers need to incorporate all context related challenges and trade-offs that can constrain their efforts toward lean and create new wastes.For instance , with the raising awareness about environmental issues and the potential rise of new legislations,new elements should be considered while defining transportation process wastes. Similarly , the disparity of this awareness among countries may broaden the definition and scope of waste elimination in transportation function.

And

- The importance of adopting a system view dictated by the increased dependency among SC nodes when lean transportation is in play.This will allow organizations to analyse and understand how leaning transportation may affect the original supply chain trade-offs ,and as a result it will lead them to formulating a better transportation strategy that pertinently integrates lean basics to the transportation broad context . Besides ,higher interdependency between processes and functions in lean transportation requires a greater and more thought collaboration between carriers and shippers especially with regard to JIT implementation.

For these reasons, it is decided to incorporate the sector challenges and function trade-offs in the suggested model of lean transportation in order to have a realistic model that is well rooted in sector specific issues and problems. Such an integration recalls the imperative of formulating a transportation strategy for the lean change in order to define organizations goals and drive the change successfully. The importance of strategy in regard to lean transportation has also been emphasized in (J.Trent, 2008) and (Taylor & Martichenko, 2006).

Basing on the lean manufacturing model presented in the theory section, and due to the pivot role of quality (value) in lean systems, it was obvious for this research not to neglect the study of service quality in transportation. After the analysis it has been suggested that transportation quality equates reliability, consistency and flexibility (chapter 5). Thus, since customers value these 3 features, it is important for managers to drive lean efforts toward enhancing these qualities while designing their transportation system, selecting their partners and negotiating contracts, formulating their strategy, communicating change to employees, eliminating wastes, etc.... In fact, understanding customers definition and perception about transportation quality gives valuable insights in defining wastes and consequently eliminating them.

By the same token, the "cost" element of the general lean model is replaced with total logistic cost in the suggested lean transportation model. This substitution is based on the higher convenience of measures like total cost of ownership in assessing the total effect of leaning transport compared to measures of single cost variation. Once again, this measure is more convenient for the system view above mentioned.

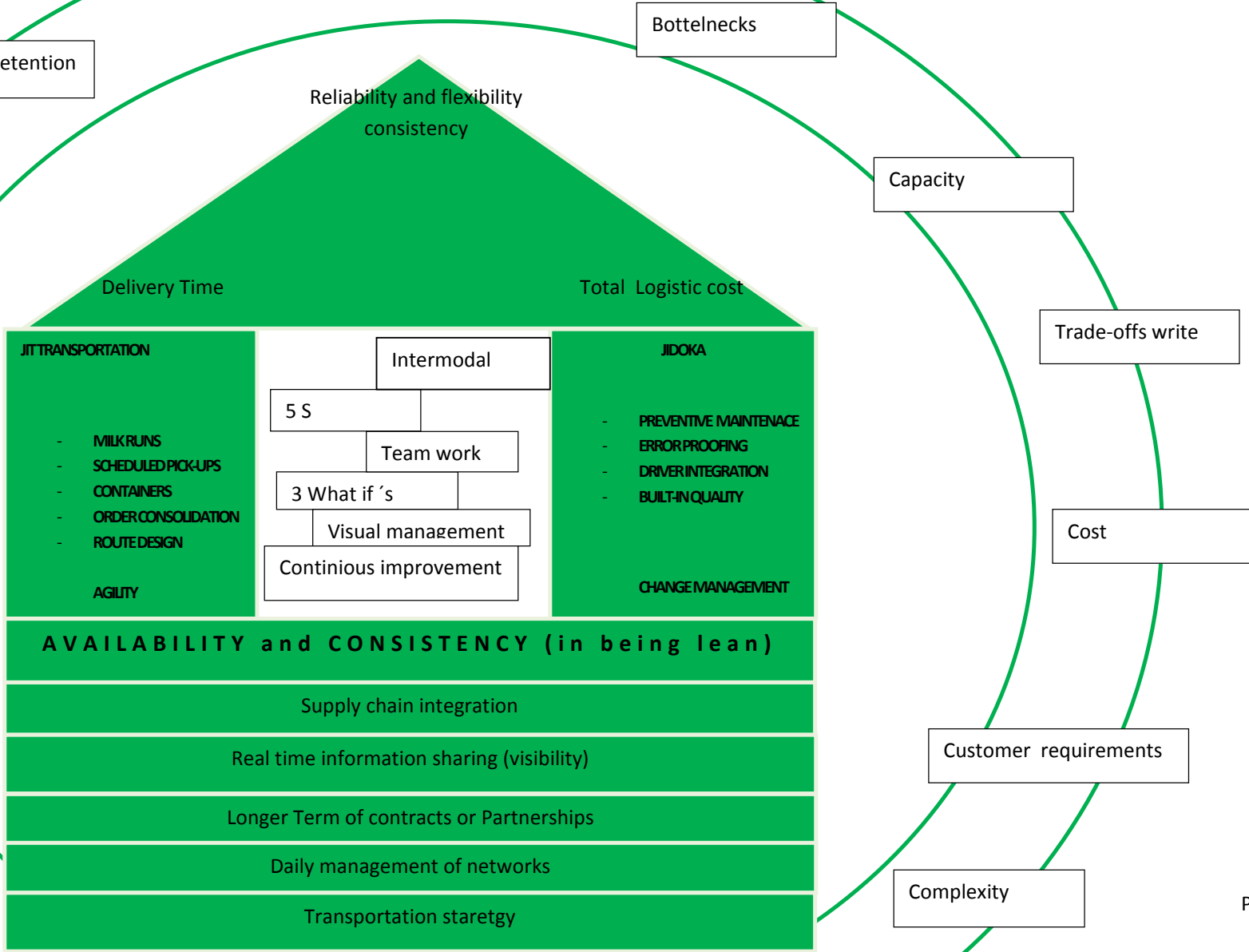
The two pillars of the lean transportation model are JIT and Jidoka, however, taking the specificity related to transportation function into account requires different and new points of focus, and some basics to respect. As explained in chapter 6, agility will be the basis for implementing JIT transportation where elements like milk runs, order consolidation, route design and containers type and design are important in eliminating wastes related to this function. In Jidoka, the main result of the analysis revolves around the importance of prevention in lean transportation. For instance, the 5 why's lean manufacturing tool gives way to the 5 what if's suggested tool. Moreover, the inseparability of quality requirements such as form, timeliness and availability makes changes or correction during processes a deadly mistake for such a time sensitive system as JIT transportation. This implies that measures like preventive maintenance will gain greater weight when lean transportation is in play and especially with regard to Jidoka system where built in quality is a key concept.

The analysis in chapter seven led to concluding that applying Jidoka system to transportation should be based on a sound change management. Change management is important in instauring the culture change necessary for succeeding the lean paradigm.

All the pre-mentioned elements of the model need themselves some solid basis to support them, adding to strategy as explained previously, It is suggested that availability and consistency are key concepts in lean transportation : Availability encompasses material , men , machine ,right partners, right contracts , strategy ,management , precise information , vision ,financial resource , etc..This is to say , without this availability customers cannot trust carriers to deliver what has been promised; Consistency, however, encompasses continuously improving process in order not to perform worse or decrease in efficiency . In fact , seeking continuous improvement , will guarantee consistency which is also an important element in building trust . This trust is indeed a prerequisite for building strong long term relationships between transportation service providers and customers .

Figure Model :

Tranportation challenges



Bottlenecks

Capacity

Trade-offs write

Cost

Customer requirements

Complexity

Personal retention

Drivers' shortage

lead time

Legal / Political issues

Environment

At this level of analysis it is important not to neglect the other face of lean and its pillars JIT and Jidoka. A face that has been emphasized in lean opponents' view about this management philosophy.

Whether it is the waste re-distribution in the system (Oliver, 1991) worker disempowerment and dilution of specialisation (Oliver, 1989) (Slaughter, 1990), management by stress (ibid) or the high dependency between supply chain nodes JIT system creates, that is reproached to this management philosophy and some of its tools. ... , it is suggested that lean transportation model has some key concepts which may strengthen its ability to overcome critics, like for instance continuous improvement, and change management.

Continuous improvement means that there is no a perfect solution and that transportation service providers need to find the better next way to perform their services. This implicitly means that if one of the lean tools prove to be not convenient then organizations need to either adapt it for the function and organization context or simply leave it. That is to say, lean transportation doesn't have to be a copy paste of lean manufacturing. It has just to be inspired by the most important idea of waste elimination and quality at the source and people integration and then find its own lean model or strategy.

Besides, being a non independent function lean transportation cannot be achieved independently without being a support for a broader lean supply chain. That is, how efficient is a carrier who wants to operate milk runs between a make-to-stock manufacturer and a buy to stock store !!!

Otherwise, it is always useful to value stream map processes and learn to follow value and waste in operations, it is also not less useful to lean transportation tools, 5 what ifs, preventive maintenance, 5 s, etc..eventhough the organization doesn't run JIT transportation. After all the success of lean in Toyota is due to the fact that it is tailored to its environment and operating constraints.

Regarding change management, the second element of success of lean model of transportation will guarantee that every change or improvement as explained in the previous section will not neglect the human part of the lean equation.

In short, It is believed that a lot of lean implementation failure may be due to organizations focusing on one part of the two lean subsystems, namely JIT and neglecting the second part (Jidoka) where all a good part of evil or the good resides. It is not only milk runs where the idea of smooth flows is respected it is also about change management and preventive maintenance ..etc .

Wouldn't it be less risky for transportation organization that want to implement lean, to take into account the internal customers into account when defining value and wastes? I think the answer should be yes, if managers don't want to deteriorate what has been built by JIT.

Similarly, as mentioned in the first chapter, couldn't be more useful for transportation organization, due to the importance of time value in the service process, to focus on time waste instead of limiting themselves to the 7 or 8 kind of wastes?

Has future research been possible, a case study about employees in transportation firms that implemented lean and their perception of this change would be interesting, it is true that lean is a management by stress in a function where are jobs already characterised by stress?

9 Appendix A: Expert Interview with Anker Nørlund

A: Mmm, this is the short version, we are as you know logistics consultant, we have been running Logio as we call it in Denmark, some of our customers try to give it an English pronunciation which is not intended, some say Lodjio, we are Logio. It is an abbreviation for logistics optimization and you can use that both in English and Danish.

We started first in February 2010, but the management team, which it here: this is Arne, it is Mark, and it is Jacob and myself, we have been together on the different logos, different companies since 2002, so we know each other quite good, and we decided in December -January around 2010 that we wanted to start together and we broke and started.

Mmm, well yes..., supply chain experience, well we all are more than 30 years old sowe try to capitalize on the experience we have, and of course we have to some extent an academic approach to how we design and how we analyse, but we are more practical engineers, supply chain engineers you could say, we have much respect for the little details..We know that the devil is in the detail.

S: Yes, it is!

A: We spend a lot of time to involve key persons within supply chain or of course in the analysis and also in the design of new solutions so that the people who have to live with it are also involved in designing it and ...yes ...and integrated anchoring, being ambassadors for customers etc.and I will tell more about what we do ...

We are nine now and we have sort of a leading star, that we aim at being the market leader within logistics development in Denmark.

You could say, Denmark, well it is bit narrow why don't you go abroadmmm we have been there, this is our little company, it must, it must be agile, not too big, no bureaucracy ...so we don't need an office in Stockholm, or in Shanghai or what you have, others are much better. I am not saying we are not going international because we will and we are already doing that, but that will be in the back of our customers on projects where they need us also to work with international supply chains.

So the focus is in Denmark and in customers having headquarters in Denmark or regional headquarters in Denmark, focusing on top 300 companies in Denmark, and I will tell you a bit more about who we worked with but you have seen that on the website already.

S: Yes.

Mmm ... the vision is to ensure our customers a competitive supply chain, well that is pretty basic you could say, but that is really what it is all about. Doing it simple, but solid and meeting customer requirements, satisfying customers, flexible processes, efficiency and transparency and many of the buzz words. Well, probably some of the same that you have in the vocabulary about the lean project or what have you.

S: Hmmm.

A: We don't say that we are lean consultants but there are so many good things in lean some are original but many of them are just plain, mmm yes...Doing it right. So of course we are applying that as well. We aim at building this to be an attractive place so that we can attract and retain the best consultants, well that is obvious and also the most interesting customers and projects; that means also that we say no to some customers and some projects.

S: Okay!

A: If we can see that there is not potential enough here so that it will be good project or that the business case also will not be good enough to pay our salaries or whatever, or if we have a feeling about the chemistry is wrong here.

S: So you say no.

A: Yes.

S: Isn't it also about the challenges the case can offer?

A: Yes, you can say that in standard consultancy work we have ,to some degree there is a lot of repeating process in every project, mmm, if you have a model that you apply ,I mean in the analysis faze, most of it is proven technology but it must never be something that we do like that (tok sound with finger) .We have to be focusing on the customer , each individual customer , and the customers' needs and that is where the lean linking is ,we always start with the customer ,what brings value and what is just fat. And then we actually walk the flow backwards in order to understand more.

S: And what adds value to customers in Transportation what do customers exactly want from transporter or from the 3rd logistic provider, what is value in transportation?

A: Well transportation is many things. You asked me to tell a little bit about myself which I forget. But I am 50 years old and I have a background within shipping, I have been 14 years with AP. Moller Maersk.

A: I said what kind of transportation we are talking about! I think I will use this (a white board) .This is the customer right? This is vendors mmm; this is the customer's customer (drawing).

S: Yes.

A: So should we be taking about normal transportation, trailers or container shipping or its distribution to the end user or to shops or...?

S: mmm it is transportation in general so ...both.

A: Then I could suggest that we start here then, by the customer. Start with the customer, mmm...choose a product!

S: Mmm... Let 's say Book note.

A : Okay, before it hits the end user, when we are at the retailer part, it could actually hit him or her by minimum two ways and that is e-business or traditional business. This is definitely booming and we know that, and that is definitely complicated because it's expensive for many traditional retailers to prepare themselves into being very smart and clever and cheap, e-business operators. Amazon.com, it took them many years before they went profitable ...I don't know where they actually have hit but they are one of the first .That is a book shop right?

S: Yes.

A: Because when you have pressed the button in your computer it could only go too slow until you get your book and that is very expensive ...I think we should pack this because we can talk hours about thatSo Let is just take the other side , when you went into the shop , let us say mmm a supermarket, that could be a Danish supermarket ,coop or whatever , you expect that they have this merchandize and this book and it just have to be there , it has to be available ,so availability and you want it to be able ,to examine it , and see what the price is , and take it , it should be easy doing business , buying something like that.

But from a Danish supermarket or Netto or whatever p.o.v, they have to be sure that it is never ever out of stock. But too many stocks in the shop on the shelves will kill your profitability. They are running operations with some kind of min maximum inventory, so that you control, how much you

should have there, and that will be done for their entire items mmm, meaning that for all their sales in the cash, they will log the history of... you know well about that may be ... But back to how transportation can be customer driven.

The transport company, (writing) the supermarket, the warehouse; Now in Aarhus where I live, they have to consolidate all these orders coming from the shop.

S: Exactly

A: They control them themselves, and maybe you should be aware that it is a closed loop delivery system. They can do it themselves or (writing on the board)here are wholesalers and they also own their retailers. If they were wholesalers and not owning this then, this kind of supply chain will definitely be different because you cannot control it in the same way; they are pushing much of the cargo out and working with push point system. That! You know something about it?

S: Yes.

A: They will be pushing mmm .Again to the transportation, they will be building the truckloads so that it fit they have the best economy in full loads .And then they will make sort of milk runs, do you know what milk run is?

S: Yes yes.

A: And they will probably do ,at least in Denmark ,night distribution with large trucks, so that each trucker will be visiting 5 or 6 Danish supermarket, stores ...or whatever mmm. And they will have arranged with them which exact hour they will discharge .They have to be absolutely sure that it is meeting customer requirement, not too late and not too early...

S: And what else? Not too late.

A: yes.

S: Not too early, (timeliness, availability, mmm) and not damaged good ...

A: Right, yes, and the right place also.

S: and no mistakes in the delivery.

A: yes, so that is the 6 or 5 corner stones that you have to meet in delivery requirement. So let 's say, that for this supermarket her, it has to be there at 6 o'clock. Then (writing) mmm the supermarket, they don't own their trucks, they have a sub-contractor.

S: Like a 3rd part logistic provider for example?

A: yes 3rd part.

S: What else is there any other possibility, 4th part logistic or...?

A: It could be 4th part also, but I will say with such a large player and in a small market like Denmark this fourth logistic provider, he should really be smart and clever, in order to provide Danish supermarket with a transportation product that is so smart, so good and so cheap, or quality wise extremely good that it will leave him a margin as well. So 4th part logistic, when you are talking only about transportation in a led like this, No, there is no money for it. Fourth part logistic provider and I know it because I have been in that role when I was with Maersk, when you have the contact to the client, you might have some assets of your own, but in the theory if you don't, you just organize the orchestra you could say, and you conduct it.

S: hmmm.

A: But the various, logisticians or whatever, they outsource too and you can have it outsourced as welland this is how you come up to forth. This case is too simple for a fourth part, so ...not in this case.

A: Let's say there is a drop point her and there and here, he has various schedules and you should meet customer requirement. They should not never ever think about whether it should be there or not. He has just to deliver; maybe he has a window of ... let us say something like that (writing on the board).

S: Hmm But not a window of days for example.

A: No, no, no way! Most shops would like of course never to be out of stock, but also to have as low inventory as possible.

S: Hmmm In order not to increase cost and because in this chain (closed loop) they are sure the carrier will be at the time on palace and there is no possibility that he does not show up. (I.e. no need for high inventories).

A: Right, but now we are moving from transportation to actually supply chain management. Because now we are talking about individual identities or processes that are very tightly linked together, with what you could call standard operating procedures, or service level agreement, where all parts in the supply chain (are involved). Here we have the final customer, you have the retailer, and you have the transporter.

S: yes.

A: You have the customer where you also have a warehouse right? And somebody has to pack the trucks, that will... for transporter, he will not be the one who decides what should be on the pallets, or what have you. They are the ones building the pallets, how many books and how many bold pens and how many computers who will, that is the logistic department who do that .So he will only be moving them, he only be trucking pallets.

S: isn't it possible for the transporter, in order to ensure the whole quality in the supply chain, to check the quality of the containers or of the goods before transporting them? Because in lean system of transportation, if we can say that, or even in JIT systems, you have no time to rework things once you are on the shipper's door .So mmm isn't it possible for the transporter with other parts in the chain to check quality before the transportation process starts?

A: Yes, Now we make another example, because I thought of this being very domestic, that was in Denmark. Now let s widen the scope and say this is now an international supply chain. That is also more interesting.

S: Hmm.

A: And let us say that is toys, and I was just talking to them .So you can say now you have top toy here.

S: Yes.

A: They have their own procurement offices in Hong Kong.

S: And they provide them with?

A: They are people sitting in office in Hong Kong, they do the buying, and they do the procurement , They arrange with the vendors, they find the vendors, they buy ,they make the deals, the contracts for Barbie dolls or whatever it is. But they also do the quality insurance.

And that is a very clever question you ask because you could have different kind of flows, many kind of flows, you can say you have flows with ocean good containers, you could have airfreight, you could have carrier and you could have a combination of air freight and sea freight. They can have full container load which is in their situation, most of it, and you can have less than container loads ...you could have FCL. Container full container Load coming directly from the vendor down to the port

S: mmm In Hong Kong?

A :In Hong Kong being shipped to this place in Aarhus because they use Maersk and sail it to us and they truck it to Greve, it is the same actually .But some containers or actually some clients, some shops are so big that they can actually adapt full container load. And when they are very clever, they actually can make it, this is, this is difficult, I know, because I have been there. Then they could have from this vendor, 1 x 20 foot Full container, and that is the same product, but they do the quality insurance at the vendor. Checking that is ok?

S: yes, before they move it.

A: Yes, They do that a little. China is a big country , production of toys are constantly moving off the coast or in land ,so you have large countries and few people do that difficult control ; but they could also make a twenty foot container ,where actually more vendors vendor one vendor two , vendor three ,they deliver all the merchandise to a freight forwarder. Or in top toy they have their own warehouse in Hong Kong they don't have that so they use third party. Right? He receives the various consignment from the various vender and he can do quality insurance , do I get the right numbers , right size , or what have you, he is not entitled to break the cartons and see if the quality is ok.

S: Ok.

A: But they can ask these people to come down and do the quality check or may be a third party quality insurance bureau and then They can ship the container to the large shops directly without going up there and it is obvious that by doing this that is smart, that is lean ...you leave out several processes, you cut op some fat, you cut up some days, you do it faster. But, if you fail here with the quality or whatever ...then the game is lost already here, and you don't know it because you haven't seen it, and if the ship journey here is prolonged or whatever, then you has to have a plan b or whatever to provide the same merchandise from the back up warehouse or what have you to be there in time.

S: hmmm

A: When it works super, when it goes wrong, catastrophe! So that is also where you need -when you do tricks like that -you need very good partners and that is the vendors ; a lot of trust , a lot of understanding of what is going to happen in the chain after the merchandise has left.

And I heard it from the guy in top toy, again today, and I could hear nothing has changed since the time that I was in chine. Most Chinese vendors they accept most, yes, yes, yes, but! They couldn't give a oot about what happen after. So, no fingers pointed because it is just different culture and you have to understand the culture, and lean is also very much about understanding, right?

S: yes

A: And also respecting the people are different , and understanding the total overview of processes and supply chains , why they are doing what they are doing , address it and try to make every little player in the supply chain understand how he add value but also how he could create problem.

S: Yes, and get him involved in the whole process.

A: yes, yes

S: When vendors for example don't care about happen later isn't it because there is not enough encouragement for them to do so or they cannot see how important is that for the whole supply chain?

A : Mmm, ok let's say you are achiness worker at a factory and you get 4 in hour or whatever that is, but very little ,and you simply haven't a clue about what Denmark is and toys there....And If your leader , if your managers is not telling you to do it this way do it right every time and involve you and train you, if you are not just an outstanding person who wanted to make it super every time ,what is then your encouragement to improve it? ..and also if in payment you have to pack as many cartons as you can, say you get 10 dollars for every 100 cartons you pack ,are you then encouraged to make it right every time or are you encouraged to pack as many cartons as you can.....

S: yes, if it is that way so as many cartons.

A: I haven t been in china for many years, but that could very well be the case.

S: Hmmm, Have you lived there?

A: No, no, when I was with Maersk, I just visited the country and visited Shippers and vendors and I got a good understanding about how do they what they did at that time

S: yes hmmm

A: So there is room left for improvement and there is a lot of possibilities but there is also a lot of players and sometimes,....That is my personal belief...that the lean culture or lean thinking, the lean enterprise do not address to a point that it should be doing, all the different agendas that all the players might have, apart from this big neutral supply chain. There is also a lot of bribe still in china where does that fit into lean ?

S: I cannot see,

A: Because of course you cannot cope with it, haha. ...Lean thinking and building lean enterprise and lean supply chain is what we all are aiming at, or should be aiming at, however you also have to be very focused on spending so much time to make very good and repeatedly a risk assessment of what can go wrong, and what is, plan b or plan c if this very compressed supply chain are shaking or something disrupted which we haven't thought about

The crises when it first hit us in 2008, at that time, well ...anything just goes under what happens, then the rules have to a large extent , they have just changed: the quantities fell from being sky high to just ...there is definitely less money in each process so you have to do it right

S: From the first time.

A: From the first time, there is no much room for failures, it is difficult in this case to buy large quantities because you also have the risk to sell it and whether there is the market for it. Now here we are talking only about one, may be two flows, the physical flow of merchandise and we are also talking a little bit about the flow of information. You could say if the papers or documents are not here when you have to clear customers in Arhus, then you cannot clear the customers and they are just sitting there in warehouse or left in the port.

S: and this is waste!

A : yes ,that is waste that is one of the seven waste right ?in lean .Well ... so that is a big risk actually ,and that lead me to talk about another flow and that is the financial flow because for much of these vendors here in china , where actually the merchandise are bought , the contract are typically based on terms saying , FOB Hong- Kong

S: Free on board.

A: Free on board right? And the terms are then often cash against documents or letter of credits. Do you know what that is?

S: No, not the letter of credit.

A: Cash against document you've heard about?

S: If I understood it well, when they get the documents they pay them. Haha.

A: the buyer and the manufacturer they have arranged that, let us say this container should be in the port of Hong Kong and you have to deliver it no later than... the first of June.

S: Hmm.

A: And then it will be shipped but we said that it was FOB right? So that means the shipper has to pay the handling charge, having lifting the container on to the vessel ...have you the picture in your head?

S: Not yet.

A : No, no ,once the container is on board of the vessel he misses his obligations ,then I will need the document and when he will get the document from the transportation company say that it is Maersk , then he can take that document and he can go to the bank and say here is the shipment document , you get the document , I get the payment for the merchandise. If you don't go to the bank with the documents then ...there are no documents here, then they cannot get the container. Can you follow that?

S: yes.

A: Ok, if there is something wrong with the document and they are not meeting what says in the letter of credit or in the contract....then, this money thing is also something that can stumble things.

If they are here , if it was not their own shops if it is was independent shop ,who wanted to buy some of these toy for the Christmas sale, if they have a low credit rank with top toy then top toy won't give them too much merchandise because , what if they can't pay ?So , this cash flow in the chain is definitely also something that can have a huge impact on how we can optimize the flow.

S: hmmm.

A: There is a lot of things right? Haha.

S: Haha.

A: What would you ask?

S: Let's take some examples of wastes in transportation.

A: We had a lot of them already now, so you could say...wrong or missing documentation. Wrong destination, claims on the cargo if the cargo has been damaged, and that can have a lot of risks that you don't handle with care when you pick it or whatever.

S: Waiting.

A: I was just about to say it, damaged goods, but in connection with waiting being there too early can also be a problem, because if the container has arrived too early to a port for example, the port authority or the terminal will allow the containers to sit there few of charge for only few days .After that the cargo owner have to pay space rent, you could say like in a parking..., we have few hours free and then we have to pay.

S: yes.

A: So being there too early , means you have to pay ,but that might not be waste if it is critical components and you actually consider the kind of safety stock , so it is better that you actually pay the rent for having them because they are crucial in your production . So, you have them earlier than expensive, in that case it could be ok, but in principle that it is a waste.

S: I agree that it is a waste also because this amount that you paid does not add value to the end customer; it is something you charged yourself with without having something that substitute value loss.

A: That could be argued, because as I said if it is a critical component, may be you have to pay... let say 50 dollar a day for a container storage at the port, but since they are critical and they are going to the production of something very expensive then it might cost the company say 100 thousand dollar for each day the production is standing still. So you could argue that it is not a waste but a kind of insurance that you pay.

S : Mmm , yes .Sometimes , I think that all kind of waste , document waste , waiting,... they all result in kind of time waste, they are related to time , if that is clear ?

A : mmm, yes ,I have something in mind : ignorance is also a kind of waste , if you don't have an overview of the total supply chain ,not by purpose but you just don t know , then you might have behaviour that is not optimal for the supply chain ,and do something that can create waste , so ignorance could be a kid of waste also. Slow processes , is also something that creates waste when the various processes are not interlinked with each other ,and that is something that has to do with time and you said that as well , ja so that is right mmm ,well .

A: All treated equally,

S: The customers?

A: Yes, you might have heard: well in our shop all or customers are treated equally...and by saying that they mean ,high and low we treat people with respect and give all he same service. In that meaning that is good that is positive and I respect that. But when you think about transportation and logistics it is rubbish ,because your customers are different and they have different requirements , so when you treat them equally you run a very high risk that you are not actually meeting the total 100 per cent requirement of one single customer .

because you can have one who might be cheap and that is may be part of your strategy to be discounted and well that is how it is , but if are capable of marrying and understanding each customer group ,or each segment individual requirements and telling your logistics and transportation meeting their requirement ,then you can do very efficient ,you get happy customers , you optimize and you avoid or reduce waste a lot .For instance , how frequently do you deliver to your customers , that is one of the main thing we talk about ,and many companies think oh! Our customer they want to have it now, when they call it must be their within hours.

In some industries for instance medicine this is important. There are 2 or 3 ---national distributor of medicines in Denmark. In most place of the country, at least here in Copenhagen, they have 3 deliveries daily. That is a lot! So they visit every pharmacy 3 times a day.

S: Why do you think it is a lot?

A: Because it is extremely expensive, there is not much volume in medicine but it has high value right? Often. And meeting or visiting customers 3 times a day, is a lot .Some customers only get deliveries every week or every 4th night and may be they are meeting their requirements, so that it is ok. But if you don't ask them you don't know. Thus the one who can live with a delivery twice a

month and the one who needs delivery 3 times a day if you give both the same service, then you will probably be out of business very soon.

So... that is definitely something that creates waste in transportation i.e. Not understanding the requirement of how frequently you should deliver goods to each customer group or segment.

S: Don't you think that the most you talk with your customers and sit with them and do plans with them about deliveries, then you can better face these problems, you cannot do it alone.

A: That is what you can do in alone. So integration across the supply chain ,mutual sharing of ideas and experience and works together .But that is also what all your books will tell you, the real world is just often very different because they sub-optimize , they are sitting in their individual silos and they cross their arms and say they are measured in doing whatever. And even in the same company there will typically be different understandings of what a good customer service is and how much you should be involved with the clients.

I am actually writing on an article now that is called the human element in logistics and you can read it in difl. And the edition in august where we talk to various to key players within logistic in the Danish market, like Lego ,lumbeck ,Leo pharma guys like that and it is really interesting talking about that, because what seems so obvious, well it should be a win-win situation right ?

We should work together, we should understand yes? but we are just measured differently and your sales department might not be very interested in that you as logisticians are talking directly to the customers, or that logistics people going bypassing the buyer he is selling to and having their relation with ...there is actually a lot of psychology and behaviour in it as well.

S: We talked about the kind wastes, well ,What are the measures transporters should take in order to face transportation challenges, or let's talk about transportation challenges and the problems transporters are facing in Denmark and in general ?

A: Transporters can be many things. That could be ocean carriers like Maersk, that could be trucking companies that could be forwarding companies that could be air freights and of course they have different challenges.

S: But there are some common challenges. Let us say trucking companies.

A: Rates. haha.

S: Capacity problems?

A: yaaa , when you say rates you can also say cost , when you look to the Danish trucking environment , there only may be 20 per cent of trucks where you have Danes drivers on the wheel , most of them are drivers coming from east Europe and they are cheaper but of course , there is a communication challenge culture challenge or what have you, and but the trucking companies feel they are forced to do it because otherwise they can't compete. Then, Danes truckers are competing also with cheaper east European truckers on rates and competition, fair or unfair...

Traditionally Many of the transporters are focusing in getting cargo , and getting a lot of it and move it from A to B .They have invested in vessels , containers ,trucks and trailers, and what is important for them is that they have some cargo to move , so they get some money and they can go to the bank and pay-off on their loads. Seen from the buyer's p.o.v, he wants transportation from A to B yes, but that is very basic, that is a given! You should honour what you have agreed but I want service as well. Service! But with the rate you are giving I cannot afford give you service.

S: And what is the service that he is asking for?

A: Well you just mentioned it; you mentioned 3rd part logistic providers, 4th part logistic provider. That means that you have to train people that are so clever, who understand what we are talking about here and not just are good at talking, that is an expense. And if you don t have customers that are willing to pay for that value added, then you have to pay it yourself.

And getting so good rates so that you can pay this smart logistic engineer or whatever he is, or category manager or key account manager, or what have you is the challenge for them. On the other hand they have to do something special, in order to be outstanding in the competition.

S: Like for example?

A: For instance to be intelligent , for instance offering some kind of consultancy service , providing a track and trace , well when I was in that business that was a value added ,but that is not an order qualifier any more. He has to be also a partner ,he must have some consulting thinking so he can understand and see the world through the customers eyes and try to meet his needs etc. .

So transporters they have to be cheap or they have to deliver value for many, they have to be competitive right? They have to be fast they need to have capacity they need to have a good service, have a key account management; they most often have to offer other value adding services so the customer can pick some or deny to pick some.

S: Yes.

A: Capacity is actually one of the good words , I was talking with somebody who is dealing with toys , he said this is January and this is December and his turnover in both was something that goes like that (down) so he need some capacity for whatever that is .

S: yes...do you think there are some prerequisites for management in order to start or apply some of lean thinking to transportation?

A: Yes haha and first of all , your management have to be totally committed to it and have an understanding of what it is all about and be willing to go all the way , willing to invest in training , in empowerment of the people on the shop floor , and in on the office, on the trucks or what have you and being willing to take the risk that they will eventually will do something wrong in the cycle of applying kaizen events or whatever. Then you are trying, you get an idea, you try it and you incorporate it if it is good, if it was not good then you have tested it and it was not good. So really understanding that once you have start your journey it is never ending so that you will be consisted and willing to continue the journey because there is no return.

S: So what do you think about DSV case where they just started a lean group in their company and it just disappeared, when you just said “being willing to continue the journey”?

A: I am not familiar with that case to start and cannot comment on that but, in general...In general if you start a lean and then stop, then.... it will give you a cold start with the next project and the next philosophy you start within the company, because there will always be something next .And the employees will say oh no not again! How long it will take until this drift is over and we can return to how we used to do and how we do it the right way! That will be the case with every kind of new start or new philosophy that you try to implement if you don't carry it through there will be a sort of failure or fiasco... That will impact the next think you try, and people will be very sort of arrgh!

S: Yes .mmm... I think that is it,

A: Good, Interesting.

S: Thank you so much.

A: You are welcome.

S: Do you have some ending comment?

A: Always start with the customer, because that is what it all about and you could say mmm that is the way we work , let me give you little about that: (presentation) here we start with a very basic

p analysis ,we collect a lot of data about the physical structure ,we have to understand and have to work with the flow ,or what have you , we do a lot of economy ,What is the cost of doing business , what is your logistic cost , total and parts....we analyse how is your flow and we map it so we understand the business, we build the models showing all this, so that we have an brief about this as-is situation and it costs you blablabla. Already now we can see that there are some ideas that we can build further, and build a catalogue of ideas as a basis of moving us toward the future state, in lean terms. Then we go in to the conceptual phase , where we arrange a new scenario where we use a lot of workshops ,where we have all range of key players that we can drag in to it in the company , production ,and sales ,and logistics ,and IT and HR and also if possible customer and supplier so we get the total chain. Then, we sort of test, various scenarios we test them if it is right, do we have the right source? Do you think that will be done and that it will work in the reality, we ask the blue collars or whatever so they are involved in designing the process.

S: So do you mean that employee involvement in any project we want to implement is important?

A: Yes, yes it's! Definitely! If you don't have that then just forget about it, and it is not only lean it is common knowledge, common thinking, so employee involvement yes, definitely!

In the analysis phase, here we are providing information and doing a lot when we interview them etc... That is mostly consultancy driven, because we need to grab about facts, and here we make some calculation, make business cases etc. , have steering groups, we have also various group that follow us some of them we will report to them and some of them will just be informed ...Hi guys now we are here what do you think about that? So we use a lot of workshop ...called also kaizen event and then we finish the business case and present it to the board. They say yes, or no, or something in between. And for the implementation, the employee involvement is even more important here because they are the ones will live with it.

S: Ok.

A: very interesting, it is.

S: thank you.

A: you are welcome.

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