

Lean as Universal Approach: False or True?

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Abstract Lean thinking approach was reported in many papers to be very efficient and straightforward way towards process improvements in terms of productivity and value adding activities ratio. Also, lean thinking has been implemented in many fields other than manufacturing. On other hand, it was also discovered that the system which is working very well in Toyota might not give similar effective results in other companies. Current study is trying to find answer to the question of universality of lean approach. One of the proposals is that lean thinking implementation process in general should be performed the same way in any company. The difference might appear only on certain tools or method implementation in particular company. Such proposal is based on comprehensive literature study and based on example of Scania company. Study results indicate that every company could approach lean thinking implementation framework the same way and no limitations are existent.

Keywords Lean Thinking, Universal, Continuous Improvement

1. Introduction

Lean thinking principles have been widely and deeply studied for more than 30 years. The bestseller “Machine, that changed the world”[73] introduced the concept to the world and since then numerous academic articles and practical books have been published on the topic of lean. Despite on this, till the present moment there is no common understanding of what is lean and what is lean not. Again and again many authors try to find arguments and evidences pro and cons lean. Modig and Åhlström[49] in their book “This is lean” once more go through all the basics of lean and explain them using different set of words. Several researches have indicated that there are problems of lean application due to inappropriate understanding of the lean concept[65], and due to the taking the philosophy as “black box”, which has many dangers inside[75] and due to the usage of lean in initiatives as a fad[63]. Arlbjørn and Freytag[7] in recent study again find that in many cases lean concept seems to be unclear and vague, and also is taken as toolbox. Based on this it seems that lean is some kind of enigmatic approach which is still unclear irregardless of all the papers written on the topic.

Additionally, prerequisites for starting lean implementation are indicated as follows ([13],[39],[18],[8]): production of standard goods/services, large volume, and relatively long product lifecycle. This leads to another conclusion of non-suitability of lean for high-mix low volume(or similar)

types of processes.

Per contra, a lot of evidence is existent about implementation of lean principles in other areas than manufacturing. As investigated by academic researchers, lean usage has spread from a focused application in manufacturing to service companies ([1],[62],[68]), healthcare ([43],[17],[44]), administrative processes[8], education ([21],[24]) and public administration ([9],[59]).

It is well known that the roots of lean thinking come from Toyota Production System (TPS). Ohno[54] defines it as the system of organising production processes in efficient and effective manner. Though lean seemed to work very well in Toyota factories, companies outside of Toyota were not able to achieve the same results. Lean was developed in Toyota and thus is natural thing for Toyota[48]. Other companies had to find their personal way to implement those ideas in a successful manner and it turned out to be very complicated. Since then lean topic was studied very widely and different aspects of lean implementation were investigated, though still there is no standard framework or roadmap of successful lean implementation ([38],[60],[63]).

At the present time the similar examples of TPS could be found almost in all automotive companies. Scania is known as one of the best examples of lean implementation outside Toyota corporation. The focus of Scania Production System is on continuous improvement in order to maintain strong, sustainable and efficient production. SPS is developed in-house by company’s employees based on Toyota Production System. SPS together with Scania Retail System (SRS) are the parts of philosophy at Scania – to focus on methods rather than results and results will come as a consequence of doing right things right. Scania started to develop and implement new approach to the trucks and bus

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production in mid 1990s and still continues this way[48].

It could be found on Scania web page: “In the early 1990s, when Scania had exhausted traditional production and management methods, it sent a team to the Toyota car company in Japan to study what was behind that company’s high productivity and quality. Scania engineers returned with important new knowledge that they had not been able to glean from the literature on Japanese car production methods. As it turned out, the success of the Japanese was primarily a matter of management and people rather than industrial robots. Toyota’s leadership system was based on a few clear basic values shared by all employees. The company also worked with a set of principles that the employees knew and understood.”

The purpose of the current research is to investigate the universality of lean thinking approach to the different areas. For this the following things will be done: first, the investigation of academic literature about the approaches of lean thinking implementation; second, the study of Scania approach of SPS implementation; third, the creation of general framework of lean thinking implementation based on studied literature and SPS; and then, discussion of applicability of the general framework to other areas than manufacturing as well as to high mix low volume manufacturing.

Author proposal is that lean approach is universal for any company if it is looked from high level of abstraction. This means, that general steps the company need to take in order to achieve successful lean application are the same in all cases. The difference will come in details: how one or another lean tool will be implemented in the particular company. The target of current study is to identify whether indicated proposal is true or false. Research was done as a part of doctoral thesis which in general was focusing on development of standard framework of lean thinking implementation process.

Main contribution of the study to the theory is identification of the importance of company’s own production system model in the form of lean house. Practice is contributed by straight direction for companies who wish or are implementing lean. Each company who is starting its lean road (or already going that road) should focus on its own production philosophy creation in the form of lean house. By this the results of lean implementation in the companies could be higher and more successful.

2. Methodology

In general, the two primary research paradigms are qualitative and quantitative studies. The process by which the researcher follows in studying the questions raised is shaped by those paradigms. Creswell[22] defines qualitative

study as a process of inquiry that is based on building a complex picture, formed with words and conducted in a natural setting. Also same author alternatively defines quantitative study as a process of inquiry that is based on testing a theory composed of variables, measured with numbers, and analysed with statistical procedures.

The data for this study are qualitative in nature; therefore, a qualitative design is most appropriate for the current. Creswell[22] lists six assumptions of qualitative research that should be addressed when conducting qualitative research. The following Table 1 lists the assumptions and how current research addresses them.

Table 1. Research characteristics (author’s constructed)

Assumption	Current research characteristic
Process oriented	Study of the lean thinking implementation process.
Focus on meaning	Focus on how the process of implementation is constructed and deployed in the company
Researcher is the primary instrument	Researcher reviews literature, collects data in selected company and analyses it
Involves fieldwork	Observations in the company
Descriptive in nature	Purpose is to define a framework of lean thinking implementation process
Inductive	There is no sufficient current theory on how companies should implement lean thinking in order to achieve success.

The first step of the study is a review of literature based on two different approaches: domain-based for academic articles and snow-balling for books and other sources. The main results of that step included a comprehensive theoretical framework for lean thinking implementation process.

The second step of the research is data collection in Scania through the usage of different approaches: the observation of daily activities with a focus on lean thinking, semi-structured interviews of company personnel and the study of company documents. Finally, the mass of collected data was analysed based on the content analysis method and the lean thinking implementation process steps were pointed out (Table 2). A more detailed overview of the methods is presented further.

Literature study

All views on literature studies, in general, have in common that “perception that choosing the right strategy for the literature study is of critical importance as it has a definite impact on the research project, the constructs developed, the methods applied, and the conclusions arrived at”[52], and they focus on five main steps: obtaining access to the source; material listing under selection criteria; relevance evaluation; validity evaluation; check for completeness[66].

Table 2. Research methodology (author constructed)

Research step	Methods	Result
Literature study	Domain-based for articles; Snow-balling for books and other sources;	Theoretical framework of lean thinking; Lean thinking implementation process framework constructed;
Data collection	Observation, company documents study, semi-structured interviews.	Significant amount of data collected.
Data analyses	Content analysis;	University of lean approach discussed

Table 3. Literature study methods and their application to the current study

Method Step	Domain-based	Current study	Snow-balling	Current study
Selection of source	Domain in question	<i>Lean thinking</i>	Not precisely defined, starts from e.g. overview article or “well-known” book.	<i>All “well-known” books on lean thinking, e.g. “Toyota Way” (Liker, 2004), “The Machine that Changed the World” (Womack et al., 1990) and others.</i>
Material listing	Dependent on study	<i>Lean thinking implementation</i>	Not precisely defined	-
Relevance	“Fit” for purpose of the study.	<i>Fits with the purpose of the study</i>	“Fit” with purpose of the study.	<i>Fits with the purpose of the study</i>
Validity	The subjective evaluation of the researcher	<i>Found material is valid for the study according to the author’s evaluation</i>	The subjective evaluation of the researcher	<i>Found material is valid for the study according to the authors evaluation</i>
Check for completeness	Relevant.	<i>A count of the contributions in and the check on whether the well-known articles are present was performed.</i>	Not relevant.	-

The choice of the method depends on the purpose of the study and the researcher’s experience in the field[42]. In the current case, the main purpose of the literature study was to identify the gaps in the domain of lean thinking with the focus on implementation process. According to[52], the appropriate methods include domain-based method and snow-balling method (Table 3). The main advantage of the domain-based approach is that the review is complete and that categories match the purpose of the research. Snow-balling strategy provides the least structured result, though it is very suitable for analyzing books and other non-academic sources[52].

Academic articles for the current research were studied by using domain-based method. The starting point of the latter is a definition of what is under research. The definition of domain might consist of a list of (academic) journals, an index range in the library, a keyword for e-database searches, news databases etc. that is most often combined with a criterion on the date of publication. In the current case, the domain is a keyword for lean thinking. Furthermore, the listing of material based on the purpose of identifying the framework of lean thinking was done and, according to the author, judgment relevance and the validity of the found sources were performed. The completeness check was done by a simple count of the contributions and a check on whether the famous articles are present, which is in accordance with the requirements of the study[22].

The snow-ball method was used for performing the literature study of books and other sources. The process of

performing a study of this type starts with the identification of at least one book of relevance and then reading the sources referenced[52]. The start was made by renowned books on lean (also referred being bestsellers on the topic of lean) and their references were studied further. In the case of the snow-ball method, the requirements are simpler than with the domain-based method and therefore relevance and validity were checked based on author judgment. A completeness check was not performed since it is not relevant for that method.

The results of the literature study is presented in theoretical framework part and they create the basis for the further research. The main output represent the body of implementation process.

Data collection

The target of the data collection is to identify the steps of lean thinking implementation process in selected company. Main collected data types are text, narrative data and visual data. A detailed description of each data type and its collection method is given next.

Text data should be represented in the form of different company documents ([10],[12]). The current study focused on different types of documents for each step of the lean thinking implementation process.

The second data type was narrative data, which came from interviews, informal discussions and field observations. Mainly persons involved in the lean implementation process (questionnaire and discussions) and process performance

(field notes) were under the focus of collecting narrative data.

Interviewing personnel outlined the main ideas of the lean projects in the studied companies and it allowed for an understanding of the view of personnel on companies' lean initiatives. The following questions were asked during semi structured interviews (adapted from [5]):

How do you understand lean thinking?

What has motivated the company to implement lean thinking?

Where has lean been implemented in your organization?

What were the criteria for choosing that area(s)?

How many people were involved in the process?

What training, if any, did the staff undertake? On-the-job-training?

What were the difficulties encountered in training and how were they overcome?

What were the difficulties during the implementation stage and how were they overcome?

What do you think has been the result of implementing lean? Why?

Aside from the direct information about the lean thinking implementation process, the questionnaire and discussions also showed the ability or inability of involved persons to communicate and express their knowledge about lean implementation.

Third type of data is visual data, which could be represented in the form of photos and videos ([10],[12]):

Photos of working area before implementing lean and after;

Videos of processes before and after implementing lean.

Again, not all companies had visual data available, though in almost all cases some data was found anyway. After data collection, the author moved on to the data analysis step.

Data analysis

Collected qualitative content (text, narrative and visual) was analyzed by using the content analysis method. According to Neuendorf ([52]) "content analysis is a summarizing, quantitative analysis of messages that relies on the scientific method and is not limited as to the types of variables that may be measured or the context in which the messages are created or presented". The content analysis method could incorporate the various kinds of analysis where communication content is categorized and further classified ([42]) and is a systematic, replicable technique for compressing many words of text into fewer content categories based on explicit rules of coding" ([66]).

Data analysis in the current research used the emergent coding approach with the application of recording units. In emergent coding, categories are established that follow some preliminary examination of the data: material is reviewed and a set of features in the form of a checklist is created, which is further applied for coding [31]. Recording units are defined syntactically, that is, to use the separations created by the author, such as words, sentences, or paragraphs [66].

Additionally, the question of validity is very important. As such, the validation of the inferences made on the basis of data from one analytic approach demands the use of multiple sources of information. This means that the researcher should try to have some sort of validation study built into the design, such as in the form of triangulation, which is often used in qualitative research. By triangulation, the credibility of the findings could be achieved by incorporating multiple sources of data [28]. In current research, three main types of data were used.

Based on the method of content analysis, the data were naturally categorized into categories of lean thinking implementation process steps (derived from theoretical framework). Next, categorized data were analyzed and overviews of the required information were brought out based on the data type – text (company documents), narrative (questionnaire and interviews) and visual (photos, video and field notes).

3. Theoretical Framework

Deep investigation of literature allows us to highlight the aspects of lean thinking implementation for constructing the general framework. First, as a basis for manufacturing process improvement, many authors ([53],[34],[75],[64] and others) point out standards. Taiichi Ohno ([54]) stated very clearly: "You have to have standards, even if they are bad standards". Standard process means that the same process is performed each time exactly the same way, independent of who is performing the process. And if process is performed every time the same way, we can easily predict how much time it will take and what the result will be. We can also call such a process controlled or a quality process ([6],[49],[34]). It is impossible to improve non-quality process due to the fact that it is not possible to measure it and therefore to define value non-adding activities. A lack of standard processes will make hard work to improve them ([29],[20],[36]).

Furthermore, many studies show that companies do not really understand what is lean and how it could be implemented. For example, only 10 per cent or less of companies succeeds at implementing lean manufacturing practices [14]. Furthermore "only 10 per cent has the philosophy properly instituted" ([65], p. 8). On the other side, new paradigms and best practices are often taken as a "black box", which has many dangers inside [75]. Also, if companies use lean initiatives almost as a fad, most of their efforts will fail to produce significant results ([63],[38]). Consequently, lean knowledge should be present in the company and disseminated, so that each employee understands what is lean thinking and for what it is used. Lean knowledge acquisition could be done in many different ways: books, articles, trainings, consultancy help, benchmarking other companies and many other ways.

Based on gathered lean knowledge, a company has to construct their own model of the new production system it

will take on – lean house. Question of either we should view lean concept as a philosophy of doing work or not is widely studied by different authors. They give ideas that lean should be viewed more as a philosophy or condition than as a process ([6],[14],[51],[55]). Laureani and Antony[45] advice is to accept lean more as a state of mind or philosophy, than just a process improvement tool. Toyota Production System (TPS) did not happen overnight but through a series of innovations during 30 years[54]. Lean philosophy means that all the company lives and thinks based on the lean ideas[69]. As soon as company and its personnel takes lean as “a new innovative project”, which is additional to the everyday work, then lean ideas do not work.

Philosophical aspect of lean is giving an idea that each company might have its own understanding of lean, or, we could say, their own lean philosophy. Indeed, Toyota went this path by describing Toyota philosophy in the form of lean house[47]. Lean house shows how the particular company understands lean philosophy ([47],[61]).

TPS house incorporates four basement blocks, or the foundation for the TPS: Toyota Way philosophy, Visual Management, Stable and Standardized Processes and Leveled Production. Next part of the Toyota house is two main pillars – Just-In-Time and Jidoka (In-station quality), or it is also called as right quality from the first time. Those pillars show very clearly why Toyota way achieves their goals, which are the roof of the house. Best Quality, Lowest Cost, Shortest Lead Time, Best Safety and High Morale are achieved do the focus to on time delivery and best quality, which as a result allow to shorter production time by eliminating the waste. Another good example of the similar lean house is the house of Scania Production System (SPS). Scania has its own vision and understanding of lean philosophy and this particular understanding is expressed in the form of SPS house.

Exemplified houses of lean are nothing else than companies approaches to their daily operations based on long-term thinking which is expressed by lean house. Changing the approach to the operations means changing the company's manufacturing paradigm[64] and many authors see lean as new manufacturing paradigm. For example, James-Moore and Gibbons[39] and Cooney[18] discuss the relevance of lean manufacturing for all types of manufacturing. Harrison [33] and Drickhamer[25] study the concept of world class manufacturing, its meaning and implication to manufacturing strategy development. Finally, Papadopoulou and Özbayrak[58] and Drucker[26] find that all new manufacturing paradigms and systems, developed after lean, are always assessed towards lean. Also, their findings include interesting facts: despite on high interest toward lean topic the literature failed to follow the development of lean and therefore the big part of literature relies on antiquated view of lean.

As was mentioned previously, lean house is an interpretation of the lean theory for the current company in the form of values, principles and tools. Lean house means that the company is rethinking lean principles through the

company activities prism and decides in which way and how they will implement lean[61]. Lean house is the basis for the whole lean process and if it is missing, then the lean implementation process will not be continuous and sustainable in the long term ([61],[47],[64],[75]).

Logically, a new form of lean knowledge should be spread around the company by the simple training of personnel. In lean house training, the company should focus on training in the way that the company understands lean[1].

As soon as lean house is created and communicated to the company, a lean implementation plan should be developed and executed. Without a long-term plan and its step-by-step execution, the whole lean implementation idea becomes a short project and it is inspired by momentary emotions[64]. As a result, nothing is achieved and the company is not changing its nature towards being lean ([4],[5],[14],[65]). Lean implementation could not be the project. Otherwise, the ultimate goal of continuous improvement will never be achieved – projects have their starts and ends; continuous improvement is endless ([54],[47] and others). The execution of plans constitutes a vital element for the success of the process ([34],[64]). The intended result of the discussed steps is successful lean thinking implementation.

Finally, to close the loop, the continuous improvement (CI) step should be presented. CI shows a company's ability to endlessly analyze processes in order to search for new wastes – since there is no ideal process due to continuous changes in the people, company, technology, world and so on, one can find wastes again and again. In Japanese, it is called *kaizen*. The tool or formal structure used for kaizen in manufacturing companies is called PDCA – Plan-Do-Check-Act – circle, also known as Deming cycle ([34],[47],[64] 2004 and others). PDCA is a simple framework for planning improvement activities in a continuous manner, not dependent on what kind of activity is being executed[63]. It could be the implementing of 5S ideas (the principle of creation of efficient and well organized workplace), or solving a practical problem of too high a scrap amount, or improving space usage in a particular production group and so on. Also, within each of the steps, different tools such as Value Stream Mapping (VSM) could be used. For example, if the target is to improve the space utilization and time, the VSM could be used as the focus of the circle.

In addition to 5Why?, the technique of CI (to determine root cause, it is proposed to ask at least five ‘why’ questions after each answer) is used to find out the problem's root cause and eliminate the problem. Companies often deal not with the root cause of the problem but with the consequences of the problem and eliminate those ([20],[43],[45]). As a result, it looks like a problem is solved now, but it is solved only for now – it could be repeated again and again since the root cause has not been eliminated ([51]). The summary of identified steps of lean thinking implementation framework is presented in (Figure 1).

Hines et al.[37] says that lean paradigm was consequently

focusing on topics arising in the field of operations management and, as it was already mentioned, moving from lean production status (improvement activities on shop-floor) through lean supply chain into lean thinking (system level). Despite on this major part of the companies, which are implementing lean thinking, are stuck in purely manufacturing process improvement part and forget about the philosophy. This may lead to the fail of lean implementation ([47],[75]). Every company has to have clear vision and target about lean implementation process. In other words they have to answer the question “Why are we doing this?” Thus, a systematic approach needs to be adopted, which optimizes systems as a whole, focusing the right strategies in the correct places.”[60].

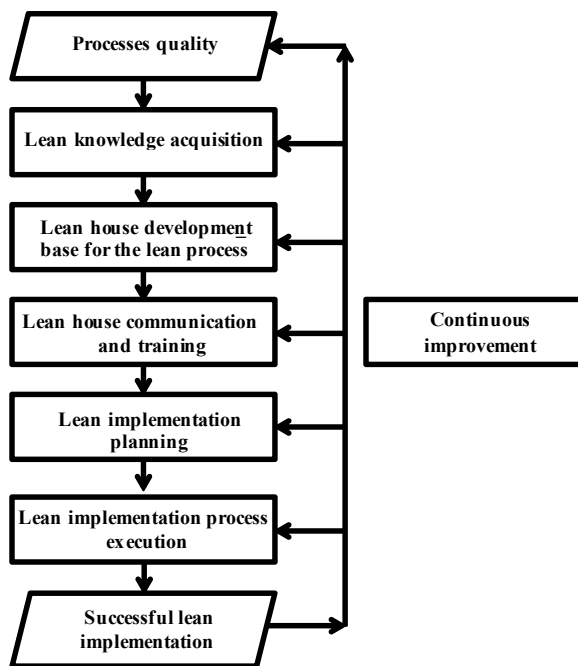


Figure 1. Lean implementation process

4. Analysis of Scania Production System

Scania was founded in 1891 and since then has produced more than 1.4 million buses and trucks around the world. At present, Scania operates in more than 100 countries and has 32,000 employees. Scania has three core values, which are maintained in all activities: customer first, respect for the individual and quality. Scania's objective is to deliver optimized heavy trucks and buses, engines and services, provide the best total operating economy for our customers, and thereby be the leading company in our industry. The foundation is core values together with a focus on methods and the dedicated people of Scania. (<http://www.scania.com/scania-group/scania-in-brief/>).

Scania is focused on continuous improvement in order to maintain strong, sustainable and efficient production. This is achieved via developed Scania Production System. SPS has been developed in-house by the company's employees based

on the Toyota Production System. SPS together with Scania Retail System (SRS) are the parts of the philosophy at Scania – to focus on methods rather than results, and results will come as a consequence of doing right things right.

There are three main values that are the foundations of the whole Scania Production System. All three values are equally important and are the foundation for everybody's work in Scania. They are: *Customer first* – the customer is in focus during the work and when decisions are made. As says one of the workers, “the customer first means that we make sure we deliver with the right quality at the right time. The immediate customer to whom we deliver is the next link in the production chain. Scania's final customer is our joint customer.” *Respect for the individual* – everybody is respected by managers and colleagues and can have an influence. Everyone has the opportunity for development based on personal preconditions. *Elimination of waste* – competitiveness is strengthened by the elimination of waste.

The principles of SPS help to make decisions and provide guidance on how employees should think in order to achieve the goals of efficient and sustainable production. SPS has four main principles: normal situation – standardised working method, right from me, consumption controlled production and continuous improvement. Standardised working methods come from TPS and were discussed earlier in the paper. This method is also described in SPS house by smaller blocks: Standardisation – create standards on manual work; Tact – define customer need; Levelled flow – even out the production volumes and distribute labour-intensive units across the working day; Balanced flow – as far as possible the work is uniformly distributed between those resources that will be doing the work; Visual – where we are in relation to the normal situation; Real time – react and act here and now.

Right from me is another interpretation of Toyota's *jidoka* principle – right quality from the first time. In Scania, right from me means that nobody accepts, provides or passes on a deviation to the customer. Each next step is regarded as a customer. If the problem occurs, then everybody is required to stop production, give quick feedback about the problems and deal with the problems.

Consumption controlled production is *kanban* – eliminating overproduction and starting things only when the customer (next step or final customer) gives a signal for need. Continuous improvement, as in lean thinking, is the head of everything and the ultimate target – constantly and continuously to examine the way the company works in order to define places for improvement via waste elimination.

In the center of SPS house, one can find priorities – everybody has the same priorities in order to make right decisions quickly. Priorities are: 1. Safety/Environment; 2. Quality; 3. Delivery; 4. Cost. Scania sees the priorities as a compulsory menu. Which is: priority is safety at the same time as right quality, correct delivery and competitive cost. But the order of the priorities comes into play as well – when one should prioritise abnormalities over each other.

Finally, we come to the practical application of the SPS. The general model of day to day working with the main parts of SPS is presented in Figure. SPS says that the company shares certain perceptions (values), agrees on basic ideas on how the work should be conducted (principles), therefore acting in a uniform way (methods) and achieving results.

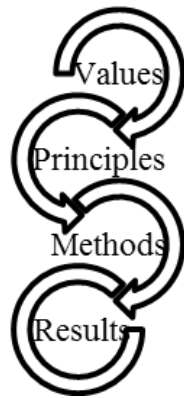


Figure 2. Practical application of SPS (SPS booklet, 20 March 2007 version 2)

The foundation of Scania's lean framework is that in all the activities the employees follow priorities from SPS and discuss those in the continuous improvement cycle in *kaizen* groups. They consist of 5-6 persons: the production group leader, *andon* person (*andon* person are registering signals from workers about the problems on line and helps to solve them immediately) and group members. They have a meeting every day for 10 minutes to discuss the problems based on the priorities list – did they have problems during the last day with safety/environment issues first, then with quality, delivery and cost issues. In the safety part, SPS distinguishes the problems that happened and those that almost happened. During the meeting group, they should decide on which issue they will work today. The schedule for the *kaizen* meetings is as follows:

- Production groups with group leaders (approximately 30 groups),
- then group leaders with production leader of the line (11 lines),
- then production leaders with workshop manager (11 lines divided into 3 workshops),
- then workshop managers with production manager
- and finally the production manager attends a meeting with the plant manager and other department managers (logistics, human resources, finance and engineering).

The same *kaizen* group meetings are held in other departments as well and end up in the same place – a meeting with the plant manager. Furthermore, if the decision of the meeting is to implement some improvement and it has to be done as soon as possible during the working time, the group leader takes the work of employee who proposed the improvement – this employee has to implement the proposed improvement and has to have time for it. Additionally, every week all lines stop for 20 minutes in order to implement other improvements – those that need input from all

personnel.

In order to be sure that the standards are followed, the audit system is used. The audit questionnaire consists of 17 questions based on SPS values and priorities. Audits are performed by group leaders on the working places inside the group, by line managers to the groups, by workshop managers to the lines and by production manager to the workshops. Each manager performs one audit every day.

In general, SPS house is the same for all factories, while the methods used are a bit different. At the same time, all the factories are coming closer and closer regarding the methods, thereby creating the common standard of lean thinking implementation process.

To conclude, it is important to highlight that the implementation process of lean thinking principles at Scania follows exactly the path that is presented in constructed framework process of lean thinking implementation in part 3. Everything starts with standards and ends with standards. The closed loop of the model indicates the same: before the implementation of lean thinking principles, the standards of processes (in model it is indicated as a process quality) should be in place. After the implementation, the next level of standards should be set.

The next step of the model is lean knowledge acquisition. This is exactly what Scania did. Scania went to Toyota and studied lean principles there and as a result developed their own understanding of lean thinking and named it Scania Production System. By this, the following step of the model is reached – lean house development. Also, further steps of the empirical model were also followed by Scania – training about SPS for all employees, thorough planning of lean thinking implementation and execution of that plan. The result is in place – successful lean thinking implementation. The result for Scania (also as it is proposed in model) means less waste in the manufacturing process and the next level of process quality (standards). The closed loop of continuous improvement goes on.

5. Research Result and Discussion

Previous parts of the paper have discussed the problem of lean thinking implementation framework, then required steps in lean thinking implementation were identified through comprehensive literature study and at last Scania production system approach were under the loop. The final part of the paper is focusing on answering the question: is lean the universal approach or not?

In general, the answer to the stated questions is that lean is universal approach, but universality of lean is limited by the general lean implementation framework. In other words, the process identified in part 4 is universal, though, if to dig into details of each step, the different companies could have specific needs or approaches of lean tools. Table 4 is comparing literature study based lean thinking implementation approach with Scania approach and indicates the possibility of using the same step in any other

company (non-manufacturing companies and low volume-high mix manufacturing companies). The following discussion is explaining the Table 4.

Table 4. Possibility of lean framework for any organization

Step number	Process step based on literature research	Used in SPS approach?	Possibility for any other organisation?
Starting condition	Process quality	Yes	Yes
1	Lean knowledge acquisition	Yes	Yes
2	Lean house development	Yes	Yes
3	Lean house communication and training	Yes	Yes
4	Lean implementation process planning	Yes	Yes
5	Lean implementation process execution	Yes	Yes
Possible result	Successful lean implementation	Yes	Yes/No
Closing the loop	Continuous improvement	Yes	Yes

Activities of all companies (manufacturing, service, construction, education and any other) consist of processes. It is very important to state, that [46] was first who argued in early 1970s, that services could benefit from modern thinking in manufacturing. He saw that “production-line approach to services” is the way through which services could improve their indicators on most critical factors: cost, performance and quality. [46] summarized his ideas as “... if customer service is consciously treated as manufacturing in the field, it will get the same kind of detailed attention that manufacturing gets.... More important, the same kinds of technological, labour saving, and systems approaches that now thrive in manufacturing operations will begin to get a chance to thrive in customer service and service industries.”

Lean thinking at the very end focuses on improving the processes [75]. Ohno ([54]) was saying that company has to have process standards, even if they are bad standards. Thus, process quality as a required starting condition is applicable for any organization who wishes to start lean thinking implementation. Scania is showing that strong process quality is on place. Without that it would be impossible for it to achieve such significant results in overall operations and in lean thinking implementation.

Companies with good process quality have better possibilities to achieve desired results in lean thinking implementation since they have good ground to start the implementation process, they save already done improvements and thus creating next solid step for further improvements and they get improvement suggestions from daily operations. Those companies with low process quality are missing (or not controlling) the ground to start the process of lean implementation and most likely planned

results will not be achieved since they do not know what they are going to improve. Lean thinking implementation are giving the possibility to improve the process quality by using the tool of standard work (standardized processes) [3]. Taking the latter into account it could be said, that also companies with low process quality on start have the possibility to improve processes and to achieve intended results of lean thinking implementation [48]. Thus, good process quality as a starting point of lean thinking implementation is important factor to the companies.

The process of learning does not depend on the company type and area it works. Again, the applicability of the lean knowledge acquisition step is of no doubt for all organizations. People hear “lean” and automatically think manufacturing, but in fact lean creates process speed (by reducing cycle time) and efficiency (minimal time, capital invested, and costs) in any process [30]. Thus, the good understanding of what is lean is required first in any company. Scania indicated that it is doing very well in terms of personnel training on different topics and is keeping moderate level on benchmarking and books reading. The need of constant training is very well placed there. Situation with benchmarking is so due to the reason that Scania itself is already the object of benchmarking for others and also has achieved a lot of self-experience in terms of lean implementation that could easily live with self-benchmarking (intra-company benchmarking).

Practice of lean knowledge acquisition step shows that in general major part of companies is dealing with personnel trainings, understanding that without of those the lean thinking implementation is not possible. Though, in some companies the need for extended number of topics is required. Furthermore, situation with benchmarking of other's experience as well as getting more global view on lean from books could be improved significantly. The biggest challenge in services, for example, is learning to recognise waste [30]. There is need to hurry up a bit at this point and to say that lean knowledge acquisition are critical in terms of next step of proposed model – lean house development. If company has focused only on trainings of lean, then the picture of lean house, the picture of successful lean companies interpretations of lean in the form of their own production system could be missed. On this point it could be said, that lean knowledge acquisition step is one of critical success factors for the successful lean thinking implementation as it gives ultimately required base for the lean house development [48].

Third required step is lean house development or, in other words, the interpretation of lean thinking principles into language and needs of particular company. It does not necessarily should be in the form of house, but principles should be formulated through the prism of the company processes. Such action could be performed in organization working in any area with different products or services. For sure, the output of such action will be different, but step as such is applicable anywhere.

Approach of lean house is fully realised in reference company Scania. Scania Production System's lean house represents the foundation of work culture in the company. Every decision, every action and movement is based on values, priorities and tools derived from lean house at Scania.

Lean house is the result of good starting point and first step of lean thinking implementation process model. Without systematic approach to process management, the process of lean thinking implementation will not be addressed constitutionally as well, and due to this any company will not see the requirement of elaborating the frame for latter process. Thereafter, reverse approach will naturally lead company to the necessity of company's lean framework either in the form of lean house (preferably), or in any other analogous form. Furthermore, requirement for lean house establishment will lead to the need of good comprehension of lean and such need could be realised only via thorough lean knowledge acquisition. Onward, existence of lean house (or similar form of that) guide the process of lean thinking implementation first, towards the need of training about lean house, and next, together with systematic approach to all process, towards lean implementation thorough planning and execution of that plan. Correspondingly, absence of lean house will not require the training of lean house at all. Additionally, the planning of lean thinking implementation is not needed very much because of deficiency of long-term vision about lean thinking and without plan there is no plan execution. In other words, good results of lean thinking implementation process start point and first step gives good input for lean house criterion and consequently derives desired results of proximate steps of the process. In the issue, lean thinking implementation is successful[48].

After the own understanding of lean principles is created, any organization should train it to each employee in the way, that everybody understand what is lean thinking in general, what is lean thinking for their company and how the company is going to implement lean. This is what theory says and in practice there is no difference which type of company will do it – the step is applicable everywhere. Exactly the same goes to lean thinking implementation planning and execution.

Scania has department dedicated to the development of SPS, which has main tasks as training of SPS, follow-up of its implementation, continuous improvement of SPS and consequent planning of implementation of new tools, value or principles from SPS and execution of those plans. Those tasks fit ideally into the determinants of last three steps of the model of lean thinking implementation.

Relying on discussion in present point the conclusion of critical nature of last three steps could be made. The presence of lean house is critical as well, but, as it was pointed out earlier, lean house does not necessarily mean that training of it will be performed. Without the understanding of lean thinking approach of the company, employees will not be able to achieve the way of working relied on lean principles instead of project type of lean application. Furthermore,

without the thorough planning of lean house (and thus lean thinking) implementation and the execution of the plan the existence of lean house is needless. Therefore successful lean thinking implementation critically requires the understanding of lean house throughout the organisation, the thorough planning of its implementation and step by step execution with clear goals and objectives.

Lean methods and tools apply to anyone who:

- Chases information in order to complete a task (an “information shortage” in service is equivalent to material shortage in manufacturing);
- Must jump through multiple decision loops;
- Is constantly interrupted when trying to complete a task;
- Is engaged in expediting (of reports, purchases, materials, etc.);
- Does work in batches (collect a certain number of items requiring the same kind of work before embarking on the pertinent tasks);
- Finds work lost in the “white space” between organizational silos;
- Doesn't know what they don't know[30].

The performing of lean implementation process model steps results in successful or unsuccessful adapting of lean principles in companies. Scania showed success. Which result will be achieved in any other company – this is the question to that company.

Last point – continuous improvement is a must for any company who would like to work with process improvement constantly. Scania clearly indicates its intention to have process of process improvement on continuous and sustainable basis. Again, in general, the step of continuous improvement has no limitations taken into account different conditions in companies.

6. Conclusions

Proposed empirical model of lean thinking implementation process embody the start point - good process quality, and five steps: lean knowledge acquisition, lean house development, lean house communication and training, lean implementation planning and execution of lean thinking implementation plan. The argumentation hereinabove has indicated that proposed model of lean thinking implementation process is valid and could be used by companies first to analyze their current status of processes and second for constructing their lean implementation process and incorporating understanding of lean. Thus, the initial proposal is partly true – lean thinking implementation general framework is a universal approach, but detailed application of tools and principles could be different from company to company and from area to area.

It has to be also mentioned that statement brought above is valid in terms of current research focus. Should the focus of the research be in more detailed investigation of lean thinking implementation of the companies, then the result would be different. More detailed means understanding how

one or another practical tool or method of lean could be and are implemented in the companies of different field. Nevertheless, performed research is one more step in finding the final truth about universality of lean and there are still many of aspect to investigate.

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