



**Kaunas University of Technology**

School of Economics and Business

# **Challenges of Lean Model Implementation in a Manufacturing Company**

Master's Final Degree Project

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**Kaunas, 2020**



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International Business (6211LX029)

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**Kaunas, 2020**



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School of Economics and Business

Ilma Balakauskaitė

## **Challenges of Lean Model Implementation in a Manufacturing Company**

Declaration of Academic Integrity

I confirm that the final project of mine, Ilma Balakauskaitė, on the topic „Challenges of Lean Model Implementation in a Manufacturing Company“ is written completely by myself; all the provided data and research results are correct and have been obtained honestly. None of the parts of this thesis have been plagiarised from any printed, Internet-based or otherwise recorded sources. All direct and indirect quotations from external resources are indicated in the list of references. No monetary funds (unless required by Law) have been paid to anyone for any contribution to this project.

I fully and completely understand that any discovery of any manifestations/case/facts of dishonesty inevitably results in me incurring a penalty according to the procedure(s) effective at Kaunas University of Technology.

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## Summary

**Relevance of the topic.** As nowadays competition is getting stronger, business is forced to find new ways to overcome not even external challenges, but also internal. Facing hard and new competition, lean system is often being chosen by companies preferring to optimize their inner processes by eliminating wastes, as well as reducing production costs. Actually, lean system requires alignment with company's strategy focusing on creation of value to customers and creating a positive mind-set of employees who are willing to be a part of effective changes.

However, it is still unclear how lean should be adopted in manufacturing companies while facing implementation challenges, though specific obstacles and special requirements for each manufacturing system should be defined (Lathin and Michell, 2001). Empirical analysis in scientific literature does not reveal, if company should plan and manage lean model implementation on its own as well. There is still too little scientific research carried out justifying the application of lean model implementation based on: management engagement, trainings of employees, value stream mapping and proper sequence of lean tools, which contribute to efficient lean implementation.

It is sufficient to understand challenges and preconditions for successful lean model adaption in manufacturing companies, also the ways how to control and maintain the system in order to ensure effectiveness and continuity of improvement.

**Problem of the research.** The quality of the results of manufacturing companies directly depends on process management and are influenced to discovery effective process management systems to overcome approaching challenges. Scientific literature does not distinguish specific challenges, which Lithuanian manufacturing companies face and there is still too little substantiation on solutions, which are applied to cope with them. As a result, questions rise: what are the challenges, which manufacturing company faces in lean model implementation and how to deal with them.

**Object of the research** – challenges of lean model implementation in a manufacturing company.

**Aim of the research** – to determine challenges of lean model implementation and applicable solutions to eliminate them in LTP Texdan company.

### **Tasks of the research:**

1. To reveal the problematic of lean model implementation in a manufacturing company.
2. To apply theoretical analysis based on challenges of lean model implementation in a manufacturing company.
3. To substantiate lean model implementation by applied research methodology.
4. To conduct empirical research by distinguishing the challenges of lean model implementation in LTP Texdan manufacturing company and to propose recommendations for the implementation of lean system improvements.

### **Results of the research**

The following results are obtained during the final project:

1. The theoretical part of the research has revealed that the correct application of lean model provides an effective lean implementation and the stages should be followed in sequence. Moreover, in order to overcome challenges, the preconditions for successful lean implementation should also be assured.
2. After analysing the empirical research results, it has been conducted that the company, which case study has been analysed, is not familiar with application of lean model implementation. Although, it shows a positive approach towards lean and has all necessary resources to support an effective lean adoption. Therefore, recommendations are provided accordingly.

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## Santrauka

**Temos aktualumas.** Kai šiais laikais konkurencija vis stiprėja, verslas yra priverstas ieškoti naujų būdų įveikti ne tik išorinius, bet ir vidinius išūkius, su kuriais susiduriama. Lean sistema yra dažnai pasirenkama įmonių, kurios susiduria su stipria ir augančia konkurencija, todėl yra priverstos teikti pirmenybę jų vidinių procesų optimizavimui pašalinant nuostolius bei mažinant gamybos kaštus, taip išlaikant savo konkurencingumą rinkoje. Ištikrųjų, lean sistema turėtų būti suderinta su įmonės verslo strategija, skiriant dėmesio kliento vertės kėlimui ir pozityvios darbuotojų mąstysenos skatinimui, kurie norėtų tapti efektyvių pokyčių dalimi įmonėje.

Kol kas išlieka neaišku, kaip gamybos įmonėse lean sistema turėtų būti diegiama susiduriant su įgyvendinimo iššūkiais, nors kiekvienai gamybos sistemai reikėtų įvardinti konkrečias kliūtis ir apibrėžti atskirus reikalavimus (Lathin and Michell, 2001). Empirinė mokslinės literatūros analizė taip pat neatskleidžia ar įmonė turėtų savarankiškai planuoti ir kontroliuoti lean modelio diegimą. Vis dėlto, atlikta per mažai mokslinių tyrimų atskleidžiančių lean modelio pritaikomumą paremtą: vadovų įsitraukimu, darbuotojų mokymu, vertės srauto žemėlapiu ir lean įrankių sekos taikymu.

Svarbu suprasti iššūkius ir prielaidas, kurios įtakoja sėkmingą lean sistemos modelio įgyvendinimą gamybinėje įmonėje, o taip pat būdus kaip valdyti ir prižiūrėti sistemą siekiant užtikrinti efektyvumą ir tobulinimo tęstinumą.

**Tyrimo problema.** Gamybos įmonių veiklos rezultatai tiesiogiai priklauso nuo sklandaus procesų valdymo ir tikslingo jo diegimo, siekiant įveikti atsirandančius iššūkius. Mokslinėje literatūroje nėra išskiriami konkretūs lean įgyvendinamo modelio iššūkiai, su kuriais susiduria lietuviškos gamybos įmonės, ir vis dar yra per mažai pagrindimų, kaip juos įveikti. Dėl to kyla klausimų: su kokiais iššūkiais susiduria gamybos įmonės įgyvendindant lean modelį, ir kaip su juos sprendžia.

**Tyrimo objektas** – lean įgyvendinimo iššūkiai gamybinėje įmonėje.

**Tyrimo tikslas** – išsiaiškinti lean modelio įgyvendinimo iššūkius ir taikomus sprendimus jiems pašalinti LTP Texdan gamybinėje įmonėje.

**Tyrimo uždaviniai:**

1. Atskleisti įgyvendinamo lean modelio problematiką gamybinėje įmonėje.
2. Taikyti teorinę analizę, pagrįstą lean modelio diegimo iššūkiais.

3. Taikant pasirinktą tyrimo metodologiją, pagrįsti lean modelio įgyvendinimo iššūkius gamybinėje įmonėje.
4. Atlikti empirinį tyrimą, analizuojant lean modelio įgyvendinimo iššūkius LTP Texdan gamybinėje įmonėje, ir pasiūlyti rekomendacijas lean sistemos diegimo tobulinimui.

### **Tyrimo rezultatai**

1. Teorinė tyrimo dalis atskleidė, kad teisingai pritaikytas lean modelis užtikrina efektyvų šios sistemos įgyvendinimą, o lean modelio etapai turi turėti eiliškumo tvarką. Be to, norint išvengti iššūkių pasitaikančių diegiant lean sistemą, rekomenduojama atsižvelgti į prielaidas, kurios įtakoja jos sėkmę.
2. Išanalizavus empirinių tyrimų rezultatus nustatyta, kad įmonėje, kurioje atlikta atvejo analizė, netaiko lean modelio ir nėra susipažinusi su modelio principais. Tačiau įmonė rodo teisingą požiūrį į lean sistemą ir turi visus reikalingus resursus sėkmingam lean diegimui paremti. Todėl atitinkamai pateikiamos rekomendacijos, skatinančios gerinti lean diegimo efektyvumą.

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## Introduction

**Relevance of the topic.** As nowadays competition is getting stronger, business is forced to find new ways to overcome not even external challenges, but also internal. Facing hard and new competition, lean system is often being chosen by companies preferring to optimize their inner processes by eliminating wastes, as well as reducing production costs. Actually, lean system requires alignment with company's strategy focusing on creation of value to customers and creating a positive mind-set of employees who are willing to be a part of effective changes.

However, it is still unclear how lean should be adopted in manufacturing companies while facing implementation challenges, though specific obstacles and special requirements for each manufacturing system should be defined (Lathin and Michell, 2001). Empirical analysis in scientific literature does not reveal, if company should plan and manage lean model implementation on its own as well. There is too little scientific research carried out justifying the application of lean model implementation based on: management engagement, trainings of employees, value stream mapping and proper sequence of lean tools, which contribute to efficient lean implementation.

It is sufficient to understand challenges and preconditions for successful lean model adaption in manufacturing companies, also the ways how to control and maintain the system in order to ensure effectiveness and continuity of improvement.

**Problem of the research.** The quality of the results of manufacturing companies directly depends on process management and the companies are influenced to discovery effective process management systems to overcome approaching challenges. Scientific literature does not distinguish specific challenges, which Lithuanian manufacturing companies face and there is still too little substantiation on solutions, which are applied to cope with them. As a result, questions rise: what are the challenges, which manufacturing company faces in lean model implementation and how to deal with them.

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## **Methods of the research**

The following methods of the research have been used: the analysis of scientific literature, information sources, observations, generalization and critical evaluation. In addition, for empirical research, the case study analysis is used in descriptive aspects, as well as a qualitative research method: an interview with closed and open questions.

## **Restrictions of the research**

Too small number of interviewed informants may affect the reliability of the results provided. The application of semi-structured interview may have influence on the validity of the responses received. Time to carry out the research has been limited due to Covid-19 situation. The research provides a generic theoretical model of lean implementation, which still needs to be tested and validated in other type of industries. Therefore, received results of the research are applicable only for LTP Texdan company's case analysis.

## **Results of the research**

The following results are obtained during the final project:

1. The theoretical part of the research has revealed that the correct application of lean model provides an effective lean implementation and the stages should be followed in sequence. Moreover, in order to overcome challenges, the preconditions for successful lean implementation should also be assured.
2. After analysing the empirical research results, it has been conducted that the company, which case study has been analysed, is not familiar with application of lean model implementation. Although, it shows a positive approach towards lean and has all necessary resources to support an effective lean adoption. Therefore, recommendations are provided accordingly.

## **Structure of the research**

Final project consists of introduction, 4 main research topics, 8 sub-topics, the list of 17 tables, the list of 17 figures, recommendations and conclusions; also list of references and appendices. The total amount of master's final project is 67 pages.

## 1. Problem analysis of lean implementation

Many manufacturing companies discover lean as an effective method to improve production efficiency, to assure high quality of services or products and of course, to be a leading company in a competitive market. The ever-changing business requirements and challenges such as international competition, declining product life cycle and rising costs, force organizations to improve their processes to meet market requirements as well. Although, the intention to adapt to internal and external changes by deploying lean system is inevitable, but the process could also be bound to numerous challenges, which manufacturing company should overcome. Otherwise, challenges might provoke risks and lead to ineffective production. Therefore, it is necessary to underline the process management as an essential element in overcoming the obstacles of lean implementation.

The orientation towards process optimization is becoming even more widespread in organizations nowadays. In recent years, the organizations have been analysing process management by employing business process management initiatives. The perception of process maturity is becoming crucial as organizations start to realize the necessity to control organizational processes. It is obvious, that organization's ability to improve processes within business process management is dependable on directly reflection of product's quality and services (Schmiedel et al., 2012).

According to scientific literature analysis, the comprehension of process optimization could be presented as a thinking-philosophy of entire organization with its set of practices and principles needed for continuous improvement, precepted and maintained by employees. Moreover, commitment from managers and lean system's involvement into business strategy is inevitable. There is no specific formula or guidelines indicated when and under which circumstances should any manufacturing organization employ lean model required for a successful process management.

Lean is all about the culture that changes the mind-set of entire organization. The perception of lean should be realised more as a holistic strategy rather than restricted set of principles, techniques or tools (Čiarnienė and Vienažindienė, 2014).

Lean manufacturing implementation is one of the most substantial objects of any type of organization seeking to eliminate non-value adding activities within fundamental business processes, ensuring high quality, shortening production and delivery time (Laureani and Antoni, 2012).

Lean manufacturing is a sufficient system for managing change and transforming culture within organizations. It also encourages employees to trust in their competencies and shared experiences. Nevertheless, process management simulates interpersonal trust (Hung, 2006).

Each organization is different and the adoption of lean system would be also unique. An organization would reach a new level of changes only when employees would understand the necessity of lean system and would desire to grow up and change together with the organization (Hines et al., 2008). It is obvious, that employees' involvement is essential for success.

Lean is as an integrated system with its elements allows to be aware of rising issues in pre-implementation, implementation and post-implementation levels, that would assist managers to build an effective adoption plan (Bhamu and Sangwan, 2014). Therefore, it is important to develop indices of lean manufacturing evaluation to gain a support during each level.

To realise what is the purpose of lean implementation, there were 68 organizations explored and 7 case studies were carried out (Bhasin, 2012). It was expected to find out the aspirations of adopting lean system and to provide recommendations for substantial change strategy. Small, medium and large organizations were investigated to have a wider view of survey outcomes. Concluding survey responses among organizations of various sizes, top five reasons of implementation were presented:

- Improve process management;
- Focus on competitiveness;
- Increase employees' motivation;
- Customer pressure;
- Experience learned from other organizations.

Case studies and empirical research of lean manufacturing are still relevant in many of scientific literature, rising need to change the perception of lean applied in automotive towards other industries. Nowadays, understanding of lean is more extended in relations to cultural change, that underlines both production and management matters.

However, numerous case studies from literature surveys allow to determine inability of manufacturing organizations to focus on the process of lean implementation and as a result, they confront the challenges such as: the importance of human commitment is often connived, implementation of lean is not aligned with business strategy, no sufficient future directions of planning in sequence are determined by manufacturing companies (Kotter, 1995; Panizzolo, 1998; Bhasin, 2012, Sundar et al., 2014).

The literature review has also revealed the main root causes, which are related to challenges of failed lean implementation attempts (Al Manei et al., 2017), (table 1).

**Table 1.** The main causes of lean implementation failures.

The main causes of lean failures
1. Business systems
2. Employee involvement
3. Leadership
4. Tools and techniques
5. Lean supplier

Meanwhile, there were two similar companies' cases compared, but different in success of adopting lean, and to find out possible constrains of lean implementation in manufacturing organizations. Another reason of carried out research was to distinguish, if there were any preconditions for realising lean from business process change standpoint. The research was concluded by the following challenges, that manufacturing companies encountered (Rymaszewska, 2017):

- *Lack of commitment from management.* Top management showed too little support and engagement for further lean development;
- *Lack of clear goals.* Lean adoption was not aligned with company's business strategy;

- *Lack of communication and training.* Organizational culture and training were not well communicated in entire organization;
- *Lack of IT integration and knowledge promotion.* Kanban system was not implemented to gain suppliers' collaboration;
- *Lack of policies underlying process and change management.* Process and change management practices were not established.
- *Lack of common understanding of further lean development.* There were defined different opinions of top management regarding maintenance and development of lean manufacturing.

Analysing scientific literature further, the case study of Malaysian manufacturing company is provided where the challenges of lean manufacturing implementation are distinguished by the researchers (Cheah et al., 2012) as follows (table 2):

**Table 2.** Challenges of lean manufacturing implementation.

Challenges of lean manufacturing implementation
• Lack of common vision
• Pressure from customer
• Pressure from top management
• Uncertainties in demand
• Project implementation
• Effective communication
• Lean training
• Inefficient production

According to gained results, it can be stated that the major of indicated challenges are typical for both case studies mentioned above, but carried out by different researchers under different circumstances. It allows to presume that manufacturing companies face common obstacles of lean implementation.

However, to ensure effective lean system implementation, the manufacturing companies should also be aware both of risks and benefits. They should be also proper evaluated during different stages of lean adoption (Holweg, 2007; Kelly, 2012 and Wood, 2012), (fig. 1). Lean should rather be adopted in clear sequence and, moreover, a lean model should be used as an effective guideline for lean implementation (Sundar et al., 2014).

Advantages	Risks
Customer satisfaction	Customer dissatisfaction
Increased productivity	Decreased productivity
Willingness to change	Lack of acceptance by employees
Increased product's quality	Increased costs of implementation
Just in time delivery	Supply issues

**Figure 1.** Benefits and risks of lean model implementation. (Adopted according to Čiarnienė R., and Vienažindienė M., 2012).

Evaluating the presented issues of lean implementation, it could be concluded that the integration of various lean practices and tools in process management are not sufficient. One of the main barriers, which affects organizations culture, is lack of leadership commitment.

Analysing the outcomes of conducted scientific research by different authors, it could be stated, that process optimization has been actively analysed for many decades. Numerous of authors analyse restrictions influencing successful implementation of lean manufacturing, lean benefits, risks and importance across organizations.

The topic of lean is particularly relevant to manufacturing companies, as they need to develop new products in a timely, costs-effective and efficient manner to meet the need of a changing market and to be successful market player. Manufacturing companies not only have to adjust to market changes, but they also need to manage their own processes as effective as possible and overcome challenges successfully.

In order to be effective in managing lean processes within an organization, it requires to develop a clear strategy by determining process management issues that the organization faces today, to build a future vision and plan, implement and sustain changes over a long period involving different type of resources. Also, to evaluate challenges approaching within organization while implementing lean system.

As a result, it appears an importance to analyse the challenges, which Lithuanian manufacturing companies also face during the adoption of lean. It is vital to distinguish proper guidelines, which consolidate effective implementation of lean system in manufacturing organization. Therefore, theoretical and case study analysis are applied below in this final paper.

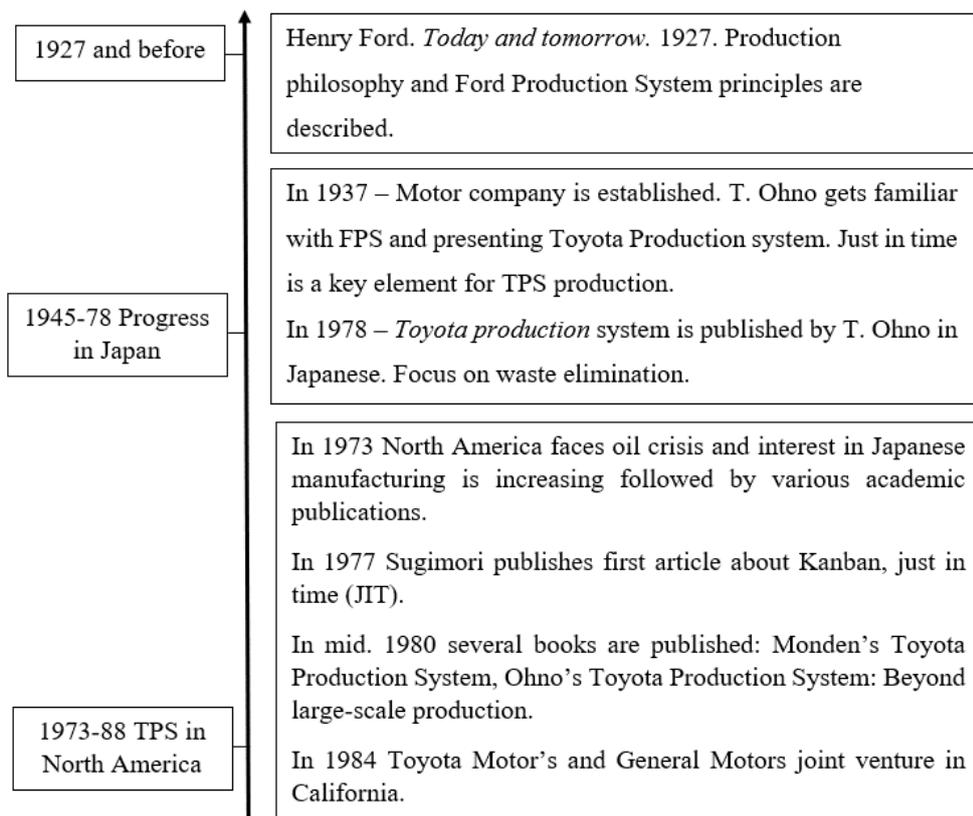
## 2. Theoretical aspects of challenges of lean model implementation in a manufacturing company

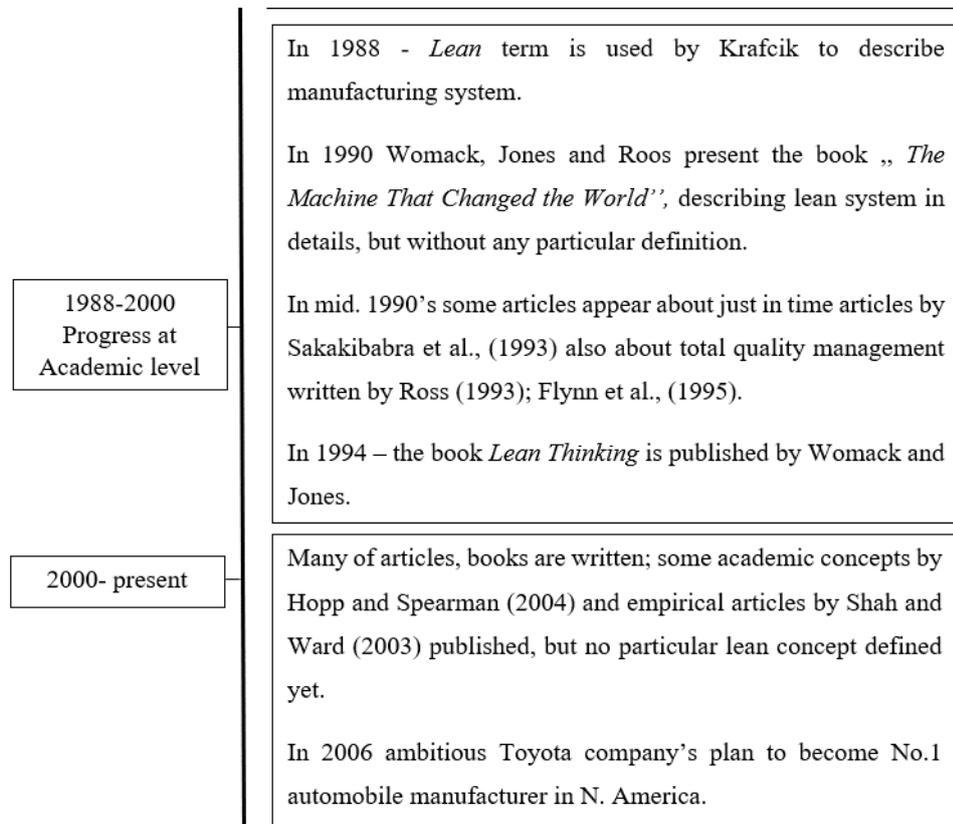
### 2.1. Conceptualization of lean system

Facing challenging times at Toyota during the Second World War, K. Toyoda and T. Ohno determined to visit Ford manufacturing plant and to observe daily operations in order to perceive how their rivals managed to produce and deliver products in shorter time. Toyota managed successfully to apply valuable American production management practices in their enterprises by adapting Japanese cultural aspects (Čiarnienė and Vienažindienė, 2012). Therefore, lean system's roots are related to Taiichi Ohno, who developed the Toyota Production System (TPS) to pursuit quality and to upgrade production in Toyota manufactory (Ohno, 1988), which pervaded and was successfully implemented in other Toyota's subsidiaries across the continents, though it took over 80 years since then to consummate lean as a holistic approach. Over the decades TPS has been widely discussed and followed by various organizations as a superior production management system (Bicheno and Holweg, 2009).

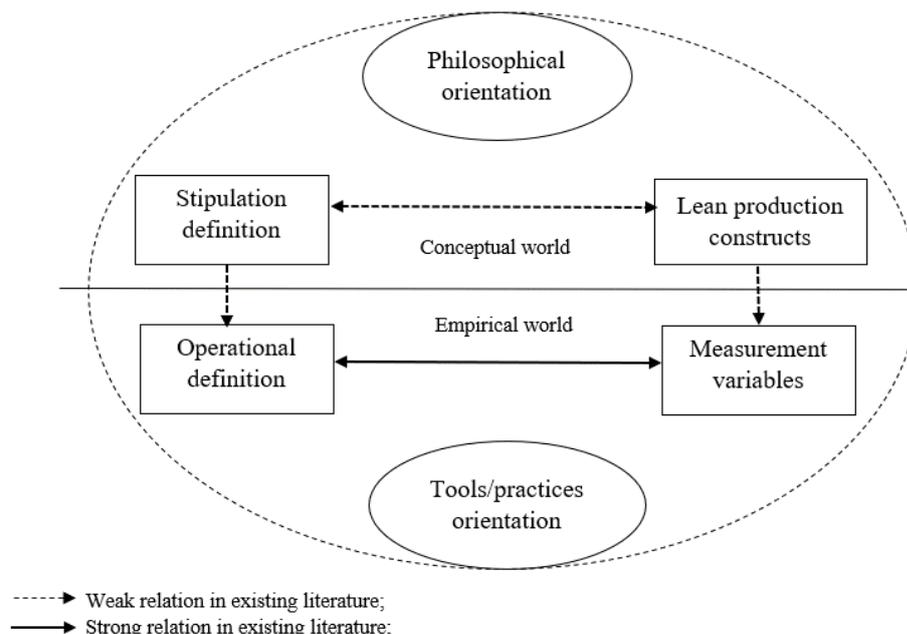
Lean system's historical evolutional key phases are distinguished from different time perspectives (Shah and Ward, 2007), (table 3). Though, numerous of publications of lean manufacturing exist, but still there is no clarification how lean system is formed and how lean manufacturing operations could be measured and defined.

**Table 3.** Lean system's development through time line. (Adopted according to Shah R., and Ward, 2007).





It is also important to highlight lean system’s conceptualization through holistic approach interfacing cohesion of philosophical and tools/practices orientation, showing transparency, communication at high level, stability in processes, uncommonness, inclusivity and variability (Shah and Ward, 2007), (fig. 2).

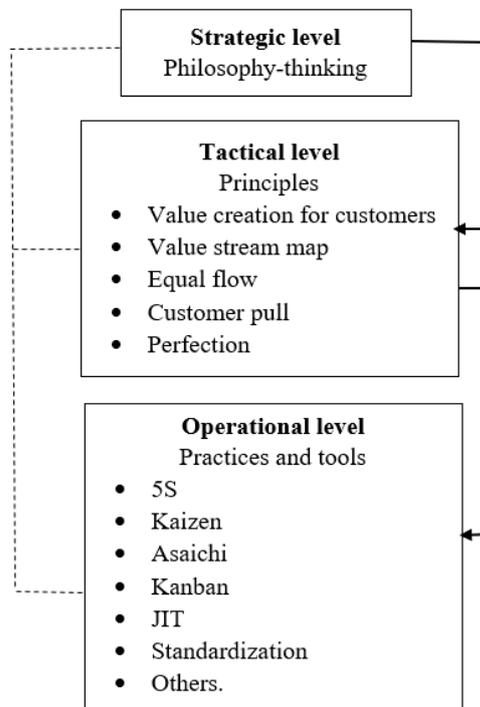


**Figure 2.** Empirical and conceptual perception of lean system. (Shah. R., and Ward. P., 2007).

Lean system is perceived as a cost saving in production and efficient for organization. The concept of cost effectiveness is a paradigm of business management, managing assets, being open to changes

and innovation with minimal costs. Lean manufacturing system is known worldwide as a holistic approach of philosophy, tools and principles, that create value for service or product at the lowest possible costs and increase organization's competitiveness at the market.

A multidimensional fundamental lean concept represented at three levels: strategic, tactical and operational level. Strategic level corresponds to philosophy-thinking as part of organization's culture; various set of principles are expressed on the tactical level while methods and practices are pivotal for the operational level (Čiarnienė and Vienažindienė, 2015), (fig. 3).



**Figure 3.** Multidimensional fundamental conceptualization of lean system. (Adopted according to Čiarnienė and Vienažindienė, 2015).

**Strategic level.** Lean philosophy thinking starts from workers' willingness and competence to solve issues from different point of perspectives, to take responsibility for activities they have never had before, in this way contributing to continuous improvements inside the organization. Lean is a long journey, that transforms organization's culture, where people beliefs and initiatives are at the centre of importance (Bhasin, 2012).

There are five main principles on tactical level, as follows (Čiarnienė and Vienažindienė, 2015):

**On tactical level** there five principles are determined:

*Value creation for customers.* It is essential to realize what activities in organization are non-value and value adding for the end customer.

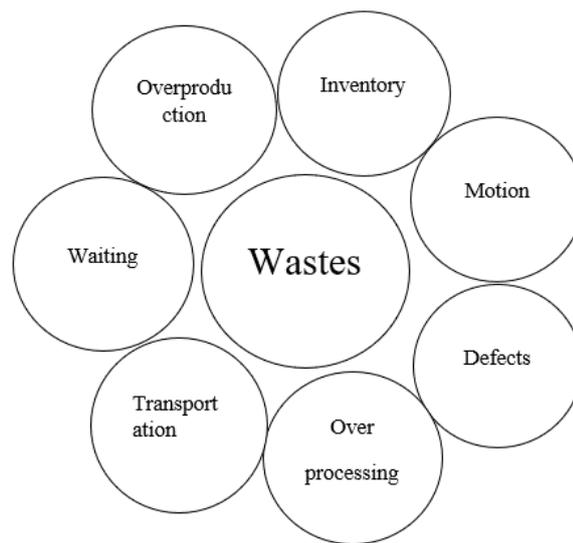
*Value stream map.* Organization creates value stream map across the entire business unit with mix of value added and non-value-added activities, that cannot be dismissed, and only non-value-added activities, that should be excluded. Suppliers, retailer and distributors could be added to map due to necessity if it contributes adding any value for organization's end customers.

*Equal flow.* It ensures, that products or services would proceed smoothly in each value adding activity. If any waste appears, it should be eliminated to avoid any interruptions.

*Customer pull.* Focus on production according to customers' needs in time and content's matter. Overproduction should be avoided.

*Perfection.* Flexibility and ability to replace steps of processes without distracting pull and flow, and ensuring constant improvement.

**Operational level** is based on various practices and tools such as 5s, Kaizen, Asaichi, JIT, standardized work and others, that assist creating value and successfully implement lean manufacturing. Value adding activities, that are identified through value stream map, are related to seven wastes' elimination (fig. 4).



**Figure 4.** Seven wastes of lean manufacturing.

- 1. Overproduction.** It is one of most harmful wastes, that could cause serious issues related to bigger storage area, additional networking capital spent or have a risk of spoilt products.
- 2. Inventory.** For inventory additional storage is needed, networking capital is depleted, additional human recourses involved, that should be paid for, but if an inventory is not sold quickly, extra cost is being added.
- 3. Motion.** Unnecessary and repetitive movements (lifting, walking, bending) of machinery or employee.
- 4. Defects.** It usually involves remaking of product, that appears due to lack of standardized work, also not keeping focus on frequent defects and having no clear process how to detect defects.
- 5. Over-processing.** When additional components, movements or extra work is included, though it is not required by the end customer.
- 6. Transportation.** It could include various movements of equipment, tools and workers, that lead to unnecessary work.
- 7. Waiting.** When continuous flow is not ensured by standardized work instructions or when workers have to wait for equipment or components. Design process and even production should be ensured.

Today lean is associated with employees' mindset of philosophy to contribute to continuous improvement through responsibility of service or products' quality they present with and other issues that they cope with in daily production at every level (Lasonci et al., 2011).

The aim of lean is to create additional value for the end customer by eliminating waste, dependency of stock abundance and to improve the production quality which allow to have a control of production processes based on long-term operational performance and be applicable in diverse industries (Čiarnienė and Vienažindienė, 2014).

## **2.2. Stages of lean implementation**

Responding to vast changes in the market, it requires any organization to strengthen the product or service's value by implementing lean production system as a fundamental competency and to maintain it.

There is no accurate way of how lean manufacturing should be implemented, because it would depend on various organization policies and internal culture, either it would be upheld or neglected. Each case is unique and there are no specific framework rules of implementation provided. Certain peculiarities of production system and internal organization mindset would determine further success of lean implementation. Lean should be thought about, seen and practiced by employing strategy and culture to supplement each other in order to gain defined goals. Human resource is another factor that plays a critical role in lean implementation as well (Moutabian, 2005).

Lean should be defined as a 'journey' with a roadmap where organization, first of all, should single out its goals and wastes by trying to understand the steps and procedures how to adapt required lean practices and tools, that would be essential for business excellence achievement (Anvari et al., 2011).

Lean implementation is described as a systematic process of certain influences at milestones where particular phases should be checked to ensure the previous phase's actions, that would allow to move to next stage (Crabill et al., 2000).

Lean implementation should be started by gaining professional knowledge, identifying required tools and know-how level, that would oblige the organization to proceed.

The loop of lean implementation starts with leadership commitment, employees training, analysis of existing vs. future value stream map and arranging tools in sequence (Lee, 2003).

As for the first steps it is suggested to begin with 5S and standardized work implementation (Liker and Meier, 2006).

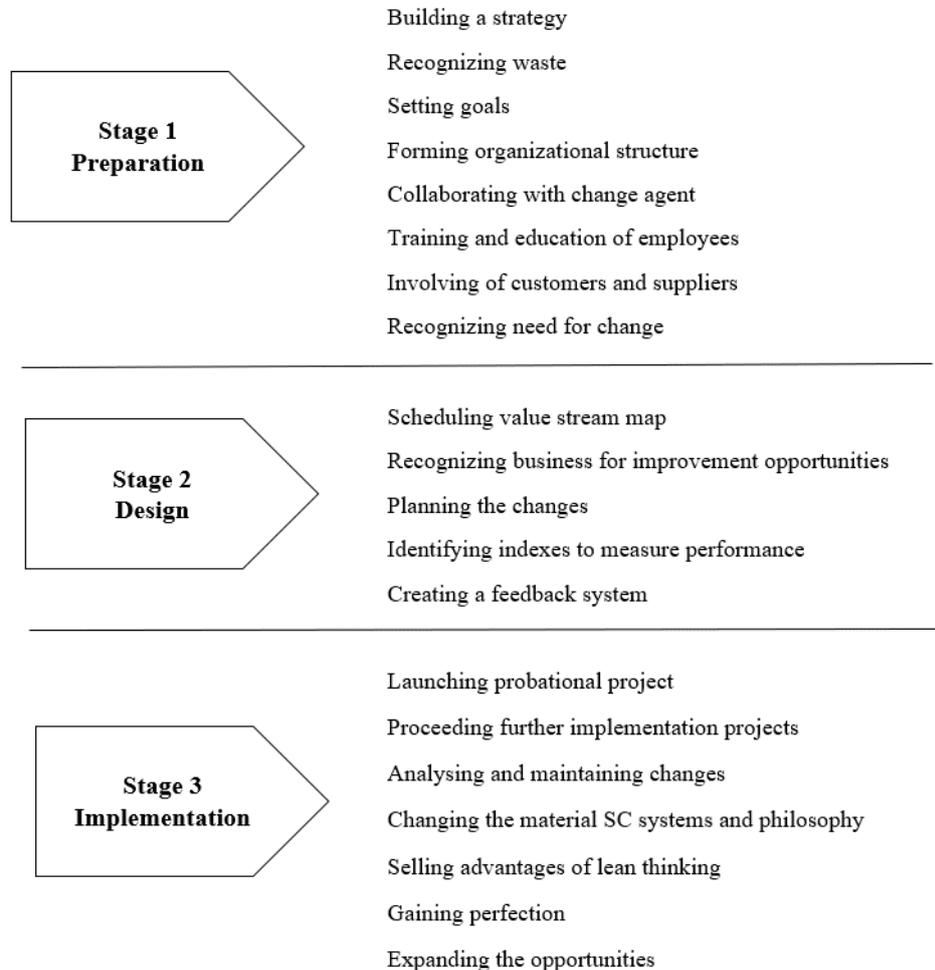
Improper employment of lean tools could lead to confusion of employees, losing trust of lean philosophy, wasted organization's resources and time (Marvel and Standridge, 2009).

There are three basic phases for lean implementation that would be applicable to any organization: arrangement, planning and accomplishment (Allen et al., 2001).

Also, various scientific literature provides similar stages of process optimization, that could be defined as follows: management engagement, educating employees, defining and mapping of value

stream, measuring performance of improvement, evaluating and designing desirable processes, identifying and launching Kaizen programs.

The analysis of 28 authors have been made and excluded into ponderable stages and steps of lean implementation (Anvari et al., 2011), (fig. 5).



**Figure 5.** Lean implementation in 3 phases and 22 steps. (Adopted according to Anvari et al., 2011).

Organization should be proceeded with next stage only when the previous stage is properly evaluated and effective performed. Otherwise, the implementation would get weak and as a result it would fail. Therefore, implementation could be unsuccessful at its first attempt. Organizations should be aware, that lean implementation is combined of multiple tasks. It is worth to take into account, that the second attempt of lean implementation could be more difficult to execute, because employees would associate it with negative memories. Also, it would take longer time and more efforts to reach organizational commitment, to change communication and work methods.

### 2.3. Methodologies applied for lean system implementation

Since organization's vast adoption to changing market and customer demands is crucial, it is important to respond to challenges encountered on organisation's way and to increase its product's or service's value. Therefore, value creation process is inevitable (Lee, 2007).

Lean is a superior productions system focused on waste reduction, utilizing as few resources as possible, allowing to increase organization’s competitiveness and adding value to the end customer. In order to identify and eliminate seven wastes, lean system exploits various effective tools and techniques (table 4).

**Table 4.** Lean tools. (Designed by the author of final project).

1. 5s	Organize workplace: <ul style="list-style-type: none"> <li>• Sort and eliminate what are not needed.</li> <li>• Set in order. Placing items in dedicated areas.</li> <li>• Shine. Tidy and visible wok area.</li> <li>• Standardize.</li> <li>• Sustain. Apply the standards for above statements.</li> </ul>
2. Andon	Visual system that gives feedback about production status and enforce employees to stop the manufacturing process.
3. Bottleneck analysis	Searching for production processes that limit overall throughput and improving it.
4. Continuous flow	Smooth flow of production with minimized/no buffers
5. Gemba	Spend more time on the plant floor to identify how the process of production is going on.
6. Heijunka	Withing the same process to produce in smaller batches and to make a sequence of products variety. Helps to reduce lead times and inventory.
7. Hoshin Kanri	Ensures the alignment of lean tools implementation with organization’s strategy.
8. Jidoka	Autonomation. Development of partial/full automation and automatically detect defects. Improving quality of products.
9. Just-In-Time (JIT)	Focus on customer demand. Can be combined with other lean tools. Reduces demand for space, inventory and improves cash flow.
10. Kaizen (Continuous improvement)	Employees suggest improvements in production processes by eliminating wastes, ensuring safety and products ‘quality.
11. Kanban (Pull system)	Regulates the flow of materials outside and inside of organization by the help of automatic replenishment. Ensures no overproduction and waste in inventory.
12. KPI (Key performance indicators)	Observes and ensures progress toward top-level strategic goals.
13. Muda (Waste)	Wastes in production. Focus on eliminating them.
14. Overall Equipment Effectiveness (OEE)	Tracking loss in availability, performance, quality categories. A set of means to track and eliminate wastes.
15. PDCA (Plan, Do, Check, Act)	Make a plan, implement it, evaluate results, review and try it once again.

16. Poke-Yoke (Error proofing)	The goal is to gain zero defects and wastes by designing defect detection and prevention in production.
17. Root cause analysis	To use ,5 why 'method and to identify the main issues. Focuses on truly eliminating problems.
18. Single-minute exchange of dies (SMED)	Elimination of changeover time including various techniques, helps to reduce inventory.
19. Six big losses	Guidelines for identifying causes of six categories of productivity loss.
20. SMART goals	Goals that are specific, measurable, attainable, relevant and time specific. Helps to ensure their effectiveness.
21. Standardized work	Visualized procedures for production. Helps to eliminate waste.
22. Takt time	Planned pace of production and aligned with customer demand.
23. Total productive maintenance (TPM)	Empowers employees to maintain and maximize the time of their equipment.
24. Value stream mapping	Helps to identify the current situation by visualizing the flow of production, eliminates wastes and notifies possibilities for improvements in the future.
25. Visual factory	Applies visual signs used in manufacturing plants in order to ensure clear communication.

There will be more detailed analysed and discussed several lean techniques in final project, that would allow to percept how they function and contribute to successful lean implementation no matter what type of organization they would be applied at: value stream mapping, 5S, Kaizen, Asaichi, SMED, JIT, Kanban and standardized work.

**Value stream mapping.** Value could be defined and reached by multiple actions required to attract the end customer through: issue solving, communication management and physical transformation (Sundar et al., 2014). Value stream mapping reveals the flow of information and material, involving operations of distributors, manufactures and suppliers that contribute to supply services or product to the end customer. Applying value stream map, any source of wastes should be determined and proper lean tools used to eliminate non-value adding activities. Having visual map of value added and non-value-added activities, it requires to develop a new perspective map with a focus on process improvement guidelines. In this way current and future activities are more comprehensible and it gives a better holistic overview of organization's processes.

It is worth to mention that value stream mapping consists of three main phases: evaluation and design of current value stream mapping, its development for future and layout of improvement actions (Forno et al., 2014).

There could be defined fundamental principles of value stream mapping (Venkataraman et al., 2014):

- The end customer's demands.
- Process phases.
- Process indexes.
- Inventory.

- Suppliers and flow of material.
- Information and its flow.
- Lead and takt time.

Application of Value stream mapping could be used as an explorative tool before lean implementation. It suggests open possibilities for wide range future improvements. distinguish Numerous advantages of value stream mapping tool are distinguished which are worth to take into account (Forno et al., 2014):

- Expresses the holistic view of information and material flow.
- Identifies wastes in processes.
- Depicts interaction of information and material flow.
- Delivers a clear framework of standardized procedures.
- Shows sequence of made decisions.
- Develops actions' plan.

There have also been analysed 57 papers in order to search what were the main barriers of implementing value stream mapping tool in early stages, and the research has been conducted with the following guidelines providing categories of problem causes: products, activities and employees. (Forno et al., 2014), (Table 2).

Possible benefits of implementing value stream mapping tool:

**Product:**

- Provided life cycle of products/services and evaluated their suitability for presenting.
- Group products in families, if needed and picked single product for value stream mapping. Check value stream mapping with different products in the same family to make sure that it was grouped correctly.
- ABC classification for implementation by prioritizing products at A level.

**Activities:**

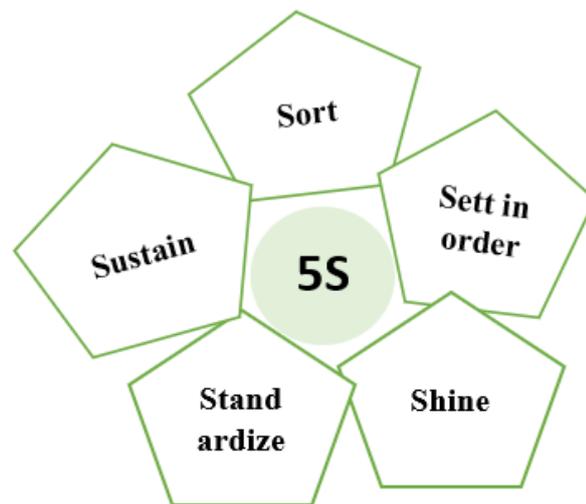
- Ensured stable process of value stream mapping by repeating the mapping at current phase and comparing the values. When it is stable go ahead with future planning.
- Reduced communication and information barriers by implementing value stream mapping plan.
- Created and controlled processes with value in order to gain stability.

**Employees:**

- Created tools to define metrics of processes that could be reproduced at any time by someone else.
- Employees empowerment and assurance of required skills before launching value stream mapping tool.
- Determined the turnover of employees related to the process.
- Check, if value stream mapping is integrated with management system (on strategic, tactical or operational level).

These provided guidelines assist in early phases of value stream mapping implementation to have a clear understanding and overview of decisions that should be made while choosing product, collecting necessary data and evaluating how it would be proceeded. If value stream tool is used correctly, it would provide benefits to identify non-value-added activities, wastes and would give new directions for better improvements.

**5S tool.** If it is correctly employed, 5s ensures the efficient performance, effectiveness and safety at workplace. The strong focus is on clean workplace that contributes saving employees' time and protecting them from risky accidents. This tool consists of five elements starting with 's' letter (fig. 6):



**Figure 6.** 5s elements. (Designed by the author of final project).

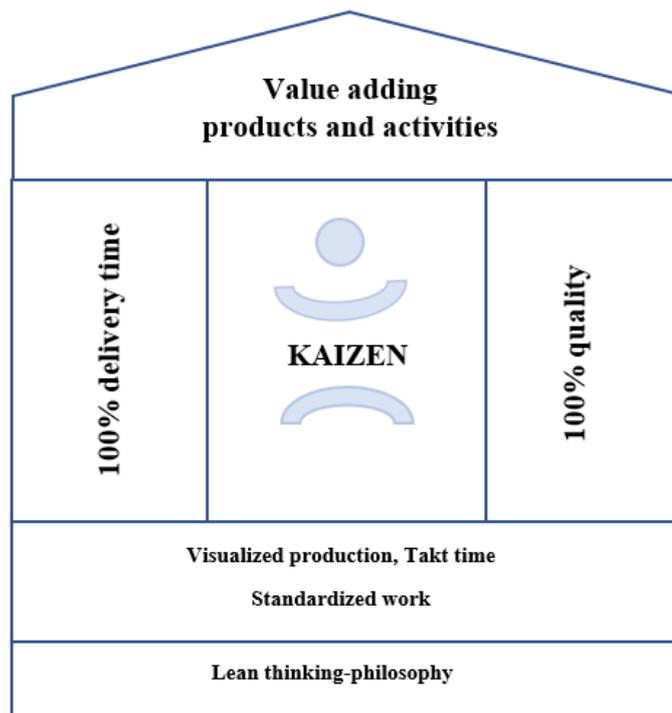
1. **Sort.** Reorganizing workplace by sorting and getting rid of unnecessary materials, tools and equipment. 5S leader should evaluate the necessity of daily, mostly used items which are essential and which are non-essential. The most used tools should be marked and catalogued, but rarely used equipment should be kept at marked stocking area in organization.
2. **Set in order.** All tools and equipment should be kept at their defined places in such way, that it would be easy and comfortable to reach. It would help to reduce or eliminate movement waste of employees. Materials should be marked with unique numbers, minimum and maximum quantities visible for working personnel.
3. **Shine.** The tidiness should be kept and maintained by removing trash every day before the employee leaves his/her working place at the end of the shift. Dirty working places could cause injury risks.
4. **Standardize.** For keeping working places standardized various documents such as: audit list, work instruction, standard work is used. This would help to ensure control and consistency.
5. **Sustain.** It is important to sustain elements mentioned above. Therefore, involvement of leadership with the right actions taken like: planning, educating, observing and auditing would lead to successful 5S tool implementation and continuity.

5S tool could contribute to employees by being aware of normal and abnormal changes at their working place. Issues are also quickly recognized, any of injury risks are lowered to minimum.

**Kaizen Teian.** This is one of lean tools which is often related to continuous improvement. The main goals of it are:

- To assure safety at working place;
- To eliminate seven wastes;
- To improve quality.

The Kaizen involves all employees at organization to be aware of processes that they are self-responsible to and apply solutions to improve them. In order to apply effective improvements employees should be well familiar with lean thinking-philosophy which is having totally different attitude and ways towards problems' solving and keeping respect to each other at workplace. Lean thinking-philosophy is fundamental for building up next stage: visualized production, takt time and standardized work. When all those two foundations are achieved, then two columns: one of 100% delivery, another of 100% quality, should be built on top. Only afterwards the roof, which illustrates: value adding products and activities, could be built on top completing the entire, so called 'Kaizen House'. This house illustrates which processes are most important for achieving successful improvements (fig. 7).



**Figure 7.** Kaizen Teian in lean-thinking philosophy. (Designed by the author of final project).

The main idea of Kaizen is small improvements of processes and work standards, which contribute by reaching significant outcomes in wastes elimination, quality increase, safety assurance and effective production. '5 why' method is used to find the main cause of issues and to apply correct Kaizen improvement.

For Kaizen implementation the following main elements are required:

- Kaizen leader who holds training for employees in organization;
- Employees who are well familiar with Kaizen tool;
- Kaizen team which follows up all incoming suggestions from employees;

- Kaizen board which is used to collect suggestions and other important information;
- Weekly meetings with Kaizen leader and team to discuss and share collected suggestions;
- Leadership commitment which supports the teamwork, motivates employees and executes audits of implemented Kaizens;
- Motivational system for recognition of employees' suggestions;
- A3 plan involves top management and Kaizen leader to arrange goals and achievements.

It is highly recommended to follow PDCA (plan-do-control-act) cycle to:

- **Plan.** Recognize issues and adopt suggestions;
- **Do.** Carry out suggestion by measuring outcomes;
- **Control.** Evaluate an effectiveness of primarily suggestion;
- **Act.** Effective suggestion should be implemented and standardized, if not – repeat the cycle with a new suggestion.

The Kaizen is not only about changes, it also speaks about the mindset of employees who are aware of issues and want to contribute with suggestions which help to improve their daily processes. In this way realising, that it would help the company to grow into bigger market player.

**Asaichi – ‘morning market’.** The purpose of this method is to held daily morning meetings to quickly review and announce about new defects and new problems. The team leader determines one person for each problem to solve until agreed date. Meanwhile, plant manager visits all meetings to get familiar with teams' problems.

Important elements of Asaichi method:

- Asaichi leader who trains employees how to held ‘morning meetings’;
- Team leaders who holds ‘morning meetings’;
- Tracking board;
- Short and effective daily ‘morning meetings’ to announce about new problems and to review the previous ones;
- To prepare for the meetings by collecting visual information;
- To follow PDCA cycle;
- Plant manager's commitment to attend in each meeting;
- Inspection/audit team to observe how the meetings are held.

**SMED** (‘single-minute exchange of die’). This lean method assist by reducing changeover times in production, less than within 10 minutes, also makes easier and streamlines needless steps.

Advantages of SMED tool:

- Reduced production costs;
- Production according to customer demand;
- Production in smaller batches;
- Reduced inventory;
- Quality and consistency improvements.

**JIT** (‘Just in Time’) enables to order and receive materials only when needed in production. In this way money on overhead inventory are saved and additional costs are reduced. JIT tool helps to ensure the flow in production, eliminates wastes and increases net working capital which can be used for

other purposes. There can also appear some of risks by using JIT i.e. increased demand from customers which was not aligned in advanced with suppliers or to full fill the order in fasters way, if the customer requests so.

**Kanban.** By the help of kanban system, the level of inventory is controled. Usually Kanban dual cards are employed by giving an alarm for production and transportation of inventory quantities. The buffer maintainance is suggested if there exists a demand uncertainty. The buffer will esnure smooth production flow, meanwhile Kanban system will lower the inventory.

Advantages of Kanban tool:

- Reduced lead time;
- Effective utilization of resources;
- Helps to reveal bottlenecks in production;
- Ensures flow of production;
- Implements feedbackloops;

Kanban tool is easy to implement and does not require much of efforts. Most important that continuous observation and key metrics would ensure the expected results.

**Standardized work** is often described as a combination of various analysis tools leading by the standard operating procedures (R. Sundar et al., 2014). It aslo ensures efficient means and safety to accomplish work in most saving time. During the reorganization of work, standardization is a must, because it helps to control and improve the work process. For efficient standardized work there three elements are essential: work sequence, takt time and standard inventory. In order to implement standardization companys should:

- Collect data on existing operations realising how they are executed;
- Make attention to allerations and issues;
- Determine the most effective, practical and easy method to proceed with operations;
- Collect data which is sufficient for document and procedures upgrade;
- Training programs for employees to be aligned with necessary procedures;
- Keep update of standardized work.

If standardization is implemented correctly, there useful benefits could be reached such as:

- Decrease of inequality;
- Improves working place;
- Ensures safety;
- Enhance continuous improvement;

There is no end for improvements in standardized work and the perfection can not be reached. Only with new intentions to change and make the processes even better, it provides the company with positive culture change, increased quality, cost saving and most of all, links to satisfying relationships with customers.

## 2.4. Challenges and preconditions for successful implementation of lean model

As competitiveness is getting intense nowadays and business environment is changing fast, a successful lean implementation requires to be aligned with enterprise's business strategy by substituting managing practices and manufacturing methods, also gaining competitive advantage through increased quality of production or services, shorter delivery times and becoming part of lean philosophy (Bhasin & Burcher, 2006). Enterprise's alteration performs through increasing its profits, focusing on processes and identifying new values which would meet customers' expectations (Jugulum and Samuel, 2008). Profits growth is deployed not only by sustaining it, but also balancing among sales growth, process improvement and product or process innovation. The real advantage of lean is to support the overall organization's system (Meier and Forester, 2002).

Lean system should align with business process change which is significant to its success under implementation (Rymaszewska, 2017). Meanwhile, business production management keeps its core attention to business processes and could have relevance to sustaining competitive advantage.

Lean system implementation closely interacts not only with manufacturing, but also with management process (Stålberg and Fundin, 2016). The entire organization should be involved in aiming to sustain continuous improvements in business processes. Though, it is still lack of scientific knowledge how to control challenges of lean implementation in manufacturing organizations from business process change perspective.

Lean implementation is precepted as a long-lasting journey with its stages and possibilities for new enhancements (Bhasin and Burcher, 2006). Many scientific research papers suggest to focus on different stages of implementation, which contributes adding value to customer and eliminating wastes. On the contrary, managers should monitor the progress of adoption applying certain settings.

Before starting an implementation of lean, the organization should evaluate and ensure at least fundamental factors consolidating lean success (table 5).

**Table 5.** Fundamental preconditions for success of lean model implementation. (Designed by the author of the final project).

	<b>Fundamental preconditions for success of lean system implementation</b>
1.	Motived employees willing to achieve vision, mission and goals of improvement
2.	Employees initiative
3.	Organization is able to manage changes
4.	Leadership commitment and communication spread in the whole organization
5.	Motivational system for recognition of employees' efforts
6.	Leaders prioritize lean and include in their business strategies
7.	Management decisions made based on facts
8.	Key business processes are documented
9.	Process performance metrics are applied
10.	Management is able to associate business processes with performance metrics
11.	Collecting sufficient data which drives the process performance
12.	Skilled and devoted management is assigned to strategic projects which deliver significant outcomes.

Employees' willingness to grow together with organization and their comprehension of its goals is essential factor for reaching measurable outcomes. Without employees' initiative it is impossible to gain improvements that last and add value. For this reason, leadership should have a responsibility to contribute to achieve these expecting changes and to spread knowledge about lean system in the whole organization. Only trained and motivated employees are able to understand the aim and benefits of lean system adoption. According to scientific literature analysis, it is distinguished that employees will initiate changes only if their efforts will be evaluated by top management. Also, management should control the process of performance by applying metrics and associating business processes with lean performance indexes. It is worth to mentioned, that collecting data is necessary to realise which factors drive the performance further and which constrain it.

Many organizations do not succeed to adopt lean from first attempt, only 10 present or less manage to overcome risk and barriers. At the beginning stage of lean implementation, organization can face challenges related to employees' sceptical attitude and lack of knowledge about lean manufacturing tools and principles. Moreover, proper implementation requires financial resources (Čiarnienė and Vienažindienė, 2014), (table 6). Even failures of previous lean implementation attempts can be precepted negatively by employees when organizations seek to try once again (Pirraglia, Saloni and Van Dyk, 2009; Bhasin, 2012).

**Table 6.** Risks and barriers of lean model implementation. (Adopted according to Čiarnienė and Vienažindienė, 2014).

<b>Type of barriers</b>	
<b>Human factors</b>	<ul style="list-style-type: none"> <li>• Sceptical stuff attitude</li> <li>• Opposition to change</li> <li>• Lack of trainings</li> <li>• Improvement team's identity</li> <li>• Lack of communication</li> </ul>
<b>Organizational factors</b>	<ul style="list-style-type: none"> <li>• Classification</li> <li>• Hierarchy and cultural challenges</li> <li>• Increased costs of implementation and lack of financial resources</li> <li>• Lack of business strategy alignment with implementation</li> <li>• Weak collection and control of performance metrics</li> <li>• Collection of history data</li> <li>• Reversion into old ways of working</li> <li>• Failure of previous lean adoption</li> </ul>

The main failures of lean implementation are typical human factors such as lack of trust and dedication. In order to avoid all risk and barriers, first of all, employees' positive attitude to changes is sufficient.

Since, there are no clear guidelines how to ensure success of lean adoption, thus it is suggested not to copy solutions of other organizations, because each organization is unique. Therefore, such decisions rarely are beneficial (Bhasin, 2012).

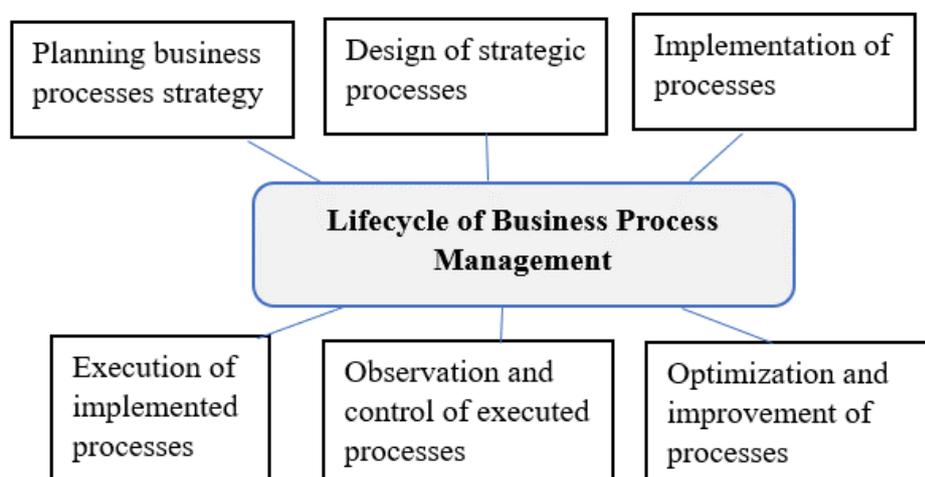
## 2.5. Conceptual model application of lean system implementation

Lean concept has developed from understanding it as a set of tools for improving manufacturing process, also creating added value or to overturn into a thinking philosophy, which empowers the whole organization to be open for changes. It is becoming vital to involve business organizational change in terms of implementing lean in any organization (Stone, 2012; Bhamu and Sangwan, 2014).

Today changes and challenges in business are inevitable, therefore organizations should manage any rising variations. Though, it is complicated to comprehend any challenges at various stages, but despite it, they should be precepted as a natural matter. It might appear failures or obstacles of creating lean-thinking, building an inconsistent system of management or lacking clear agreements in terms of top management role for change process, therefore, it requires an involvement of management to control and sustain the process of implementation in order to overcome those challenges (Bhasin and Burcher, 2006).

Lean should be integrated in other organizational theories like changes of business processes (Rymaszewska, 2017). Business process perception is related to business process management with its goal to redesign processes and to improve in performance (Zairi and Sinclair, 1995).

The success of business process depends on resources (technical, human), organizational structure, capabilities (project, software) effective strategy and culture. Smaller changes are typical both for lean and business process management, which deliver value to customer and seek to achieve strategic goals. In order to understand how business process management ensures improvement of processes, the lifecycle of business process management should be described (Jurisch et al., 2014), (fig. 8).



**Figure 8.** The Lifecycle of Business Process Management. (Adopted according to Rymaszewska, A., 2017).

Lifecycle of business process management is composed of phases, where in each of one, particular set of processes are carried out.

**Phase 1.** Planning strategy of business processes. It is important to set a plan in order to:

- Realise strategies and goals of the organization;
- Analysis (qualitative, quantitative) of existing processes (primary, secondary, management).

**Phase 2.** Design of strategic processes, if necessary, design or redesign (continuous or business process improvement) new processes.

**Phase 3.** Implementation of process is performed depending on type of business processes:

- Non-systemic implementation (business process management tools are not used);
- Systemic implementation (usage of technologies or software).

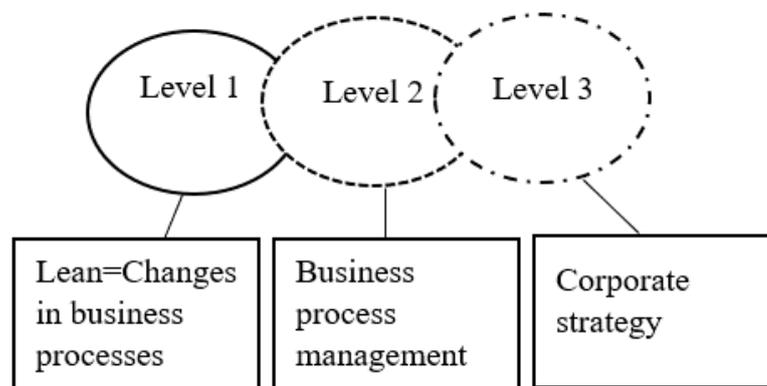
**Phase 4.** Execution of implemented processes.

**Phase 5.** Observation and control of executed processes:

- Collect information to evaluate if any changes are needed;
- Measure performance, if processes are aligned with organization's objectives and goals.

**Phase 6.** Optimization and improvements of processes assure ability to improve and innovate through changes.

Business process management and lean overlap each other, therefore, a conceptual framework from business process management and business process change perspective is combined (Rymaszewska, 2017), (fig. 9).



**Figure 9.** The conceptual framework from business process management and business process change perspective. (Adopted according to Rymaszewska, 2017).

Level 1. Changes in business processes

- Current business processes;
- Sequence of lean change;

- Duties;
- Observing the process.

#### Level 2. Business process management

- Recognition of changes towards lean;
- Updating processes;
- Change and continuous improvement.

#### Level 3. Corporate strategy

- Aligning lean program within organization;
- Spread of change;
- Organizational learning.

For successful start of adoption, at least basic lean knowledge should be applied within the entire organization and to consider the efficiency of human and financial resources. Ability to spread communication, to solve problems and focus on teamwork are predominant success factors for lean to remain (Philips, 2002). Moreover, the high respect to employees should be shown (Ohno, 1988).

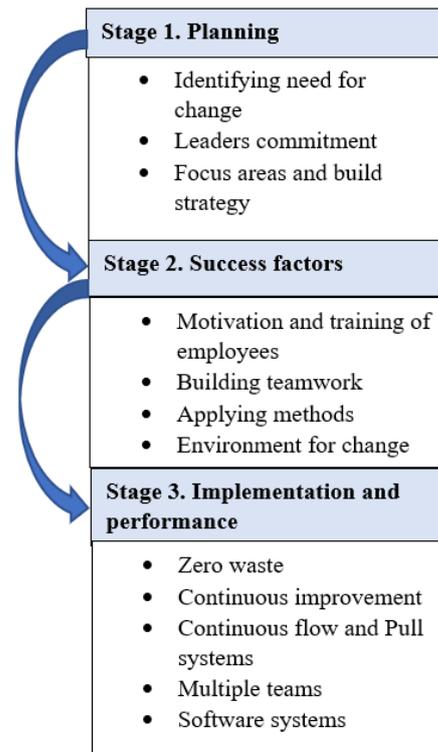
Preconditions, that contribute to success of lean implementation (Achanga et al., 2006; Bhasin, 2006):

- Leadership commitment;
- Financial and human resources;
- Acceptance to change;
- Education and skills;
- Positive cultural mind-set;
- Sequence in applying lean tools;
- Support lean principles all along the value chain.

As organization seeks to achieve lean implementation, the examination of the business should be considered involving orders procedures, purchase of materials and production. The analysis of scientific literature determines, that only 10 percent or less of organizations' attempts to implement lean are likely to succeed. The main reason why many organizations fail – is their lack of understanding while choosing only couple of lean tools, and expecting that the total value stream will be ensured. Meanwhile, all lean tools should be adopted simultaneously (Koenigsaecker, 2000).

There are no specific formulas explaining each step of lean implementation or how to adopt lean tools (Allen, 2000). Overall, the employees of organization should be opened for changes and they should show their initiatives to achieve continuous improvement, but top management should realize, that motivational system is a driver which encourages them to move forward. Therefore, one of the reasons to failure is too little attention to human resources (Chung, 1996).

Nevertheless, the model of lean implementation process was presented based on planning stage, depicting critical success factors stage, also implementing and measuring the performance of process stage (Anchanga, 2006; Sim and Rogerz, 2009), (fig. 10).



**Figure 10.** Model of lean implementation process. (Adopted according to Anchanga, P., et., al., 2006).

### 1. Planning stage.

- Everybody at organization should know the purpose of lean implementation, providing guidelines of change process that would also involve the entire organization.
- Leaders commitment and verbal support should motivate employees to act and feel a positive organizational culture impact.
- The change process of implementation should be defined in most critical areas and to prepare strategy by introducing lean techniques in sequence.

### 2. Preconditions for success assurance stage.

- Involving effective communication and training of employees to realise how the whole process of transformation functions and what kind of benefits it can be expected to achieve.
- In order to start transformation to lean, it requires a change agent to be involved, also to designate lean leader and team leaders of particular lean techniques to have a responsibility for it, to control and maintain the whole process.
- First of all, choosing couple of lean techniques, that the organization will start with. Lean techniques should be aligned with goals and objectives of organization's business.
- Positive and trust grounded environment between employees and management contributes to success of lean implementation.

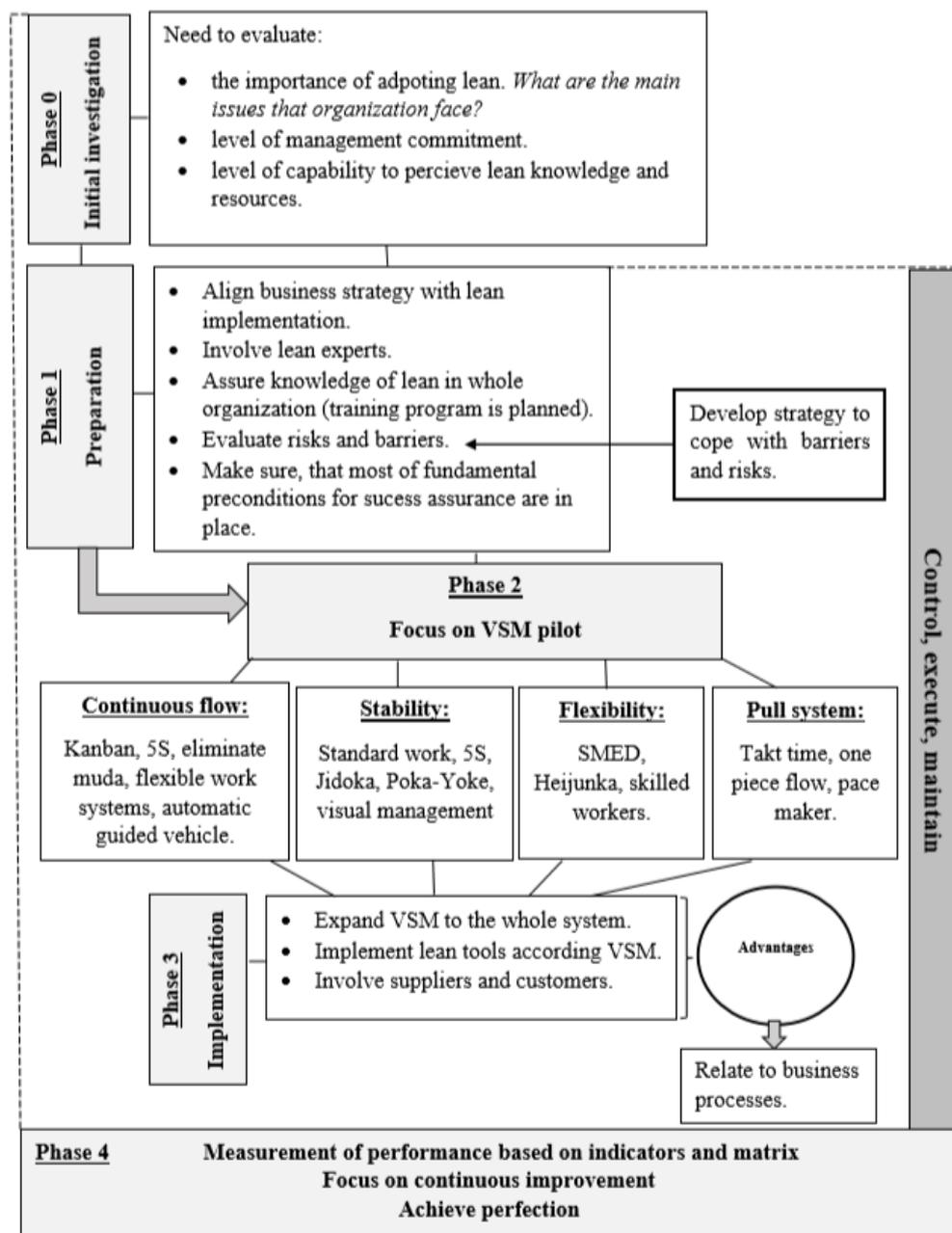
### 3. Implementation and performance stage.

Implementation process leading to continuous improvement:

- Focus on zero waste processes;
- Continuous improvement supported by Kaizen method;

- Monitoring and control of continuous flow, Pull systems;
- Multiple team work focused on different lean techniques;
- Integration of software systems that allows to track performance.

Although, scientific literature does not provide a clear framework to overcome challenges of lean model implementation in manufacturing companies due to the gap in empirical studies. Lean implementation has been analysed from different level of generalization and the perspective of business process management, providing slightly distinct specifications and contrasting stages of change processes (Achanga, 2006; Sim and Rogers, 2009; Čiarnienė and Vienažindienė, 2012; Antony, 2014; Rymaszewska, 2017). Therefore, there is a necessity to provide a full-scale framework model with the reference to various combined research suggestions and analysis, concluded by the author of this final project (fig. 11).



**Figure 11.** The framework model for lean implementation. (Designed by the author of the final project).

## **Phase 0. Initial investigation.**

Before organization gets involved in a process of lean transformation, demanding lots of efforts, there should be couple of aspects evaluated:

- *Necessity to become lean.*

What are the main reasons and critical issues to be solved? Organization, that attempt to copy good practices of other companies without evaluating its own critical status and possible challenges, would probably face implementation failure. Therefore, pivotal issues should be clear underlined.

- *Level of management commitment.*

Top leaders and medium level management should have a common understanding of goals and objectives, which organization seeks to achieve in order to save costs, increase positive organizational culture and to be competitive on the market. Also, get management acquainted with benefits, risk and barriers, which may also appear under implementation process.

- *Level of capability to perceive lean knowledge and resources.*

Before starting implementation, organization should evaluate how employees will get familiar with lean knowledge which is fundamental and supporting the process. How human and financial resources will be divided and integrated into the lean strategy.

When all those three above mentioned elements are properly evaluated and planned, it allows organization to get closer to arrangement of business strategy aligned with lean.

## **Phase 1. Preparation**

- *Apply lean into business strategy.*

It requires to include lean implementation action plan into business process management strategy, to foresee lean vision and goals.

- *Lean experts.*

Lean consultants should be involved in order to coach, supervise with a suitable process of lean techniques adoption, to support team leaders with appropriate lean knowledge and to attend in company's decision making while implementing.

- *Assure knowledge of lean in the whole organization.*

The company should plan and prepare on how the training will be conducted. It is important, that all employees, including top management, will get proper level of lean knowledge. Therefore, the spread of lean knowledge should be assured.

- *Evaluate risks and barriers.*

Evaluation of potential risks and barriers is compulsory. Therefore, the organization should prepare a strategy plan how to cope with these challenges in order to ensure smoothness of lean

implementation. It is worth to notice that organizations, which attempt to implement lean at the first time, usually will need a guidance indicating the potential risks and barriers, which organizations should be aware about. For now, such a guidance is not provided, hence misinterpretations are at the risk.

- *Preconditions for success assurance.*

It is sufficient to get acquainted with preconditions, which determine success of lean transformation (Table 3). Organization should make a check-list for internal evaluation, which will indicate the level of preparation.

## **Phase 2. Focus on Value Stream Mapping.**

Another step of planning implementation is focus on value stream mapping. Organization needs to realise the which processes of production/service are value added and non-value added. The purpose is to eliminate non-value-added activities. Further, it requires an investigation in processes which are most critical to start with, and deciding on type of lean tools that should be applied firstly. The decision of choosing lean techniques will slightly vary on the process and nature of organization. (The author of final project gives proposal of techniques and principles based on scientific research).

Main elements:

- *Continuous flow;*
- *Stability;*
- *Flexibility;*
- *Pull system.*

## **Phase 3. Implementation.**

- *Expand value stream mapping to the whole system. Apply it to other processes of organization.*
- *Implement lean tools.*

Start with couple of lean tools and in sequence apply other techniques. It is important to realise, that most of lean tools should be applied into processes step by step, because each tool contributes to various issues in manufacturing.

- *Involve suppliers and customers.*

The organization is recommended to collaborate with suppliers to increase total value by going i.e. into price agreements and to negotiate material prices with a purpose to decrease them. The organization should ensure, that the suppliers will become 'leaner' and will encourage them to apply tools such as:

- VSM learning and execution;
- 5S;
- Kaizen;
- Integrating Kanban system.

It is important to define, that inbound and outbound items' correlation is inevitable. Moreover, at the end both parties will experience win-win approach. Customers will be more satisfied and get trust in organization. Nevertheless, gained advantages of implementation should be also related to business process in order to realise, if the goals and objectives are achieved.

#### **Stage 4. Measurement of performance.**

- *Focus on indicators and metrics.*

Achieved outcomes should be collected and measured, though it is not always possible to get real numbers depending on the type of activities, but it would definitely assist to ensure smoothness and stability not only in implementation status, but also helping to realise lean as a long never-ending journey. Moreover, it is also recommended to apply measurement system (control, execute and maintain) in all stages of implementation, which would contribute to reach perfection and continuous improvements.

*Finalising, it can be presumed that suggested model of lean implementation, which is built according to the analysis of scientific research, allows the company to assure the fluence of lean adaption. Moreover, in order to overcome the challenges of transformation, the company should responsibly plan and take into account all implementation stages and their consistency. Although, it is not easy to proceed without any obstacles, but missing one of the stages, would obviously lead to emerging destructions that would complicate the adoption of lean system.*

*It is likely that suggested model of lean is generic and applicable in different industries, including also manufactory companies, because no specific indications are applied in the model, which are suitable only for manufacturing industry. However, deeper research and validation should be carried out in various industries to substantiate the applicability of the provided lean model and to improve it, if needed, according to the received results.*

### **3. The research methodology**

By the use of qualitative research tools, the aim and objective of the final project, the research case, data collection and data analysis method are described in this chapter. The basic guidelines for conducting a qualitative study are presented. The research seeks to assess the extent to which the theoretically presented information about the lean model implementation in the manufacturing company corresponds to actual situation. Moreover, the research evaluates, if challenges such as: managers involvement, motivation, advance planning in combination with the company's business strategy, allocation of resources, importance of training, willingness to change and the sequence of lean tools' implementation are fundamental to substantiate effective adaption of lean model. The aim of this research is to determine challenges of lean model implementation in a manufacturing company. Therefore, in order to consistently investigate the purpose of the empirical study, the research methods and the obtained results are further analysed.

**Object of the research** – management of challenges of lean model implementation in LTP Texdan.

**Aim of the research** – to determine the directions of improvements of the lean model implementation in LTP Texdan company.

#### **Tasks of the research:**

1. To identify obstacles, which LTP Texdan company faces during the process of implementation.
2. To reveal how LTP Texdan company overcome challenges of lean implementation.
3. To provide recommendations on how to improve the implementation of lean model.

#### **Method of the research:**

- Qualitative (semi-structured interview; grouping, comparing and summarizing).

Qualitative research allows to understand and assimilate the informants' experience and attitude. The process of qualitative data analysis can only be performed when gained information is redistributed into usable and interpretable data (Saunders et al., 2009). Therefore, the data needs to be transformed into a systematic order as follows:

- Allocation of data categories;
- Data unification;
- Coherency of connection;
- Development of testable statements.

#### **The research instrument, data analysis and ethics**

In an empirical study, a semi-structured interview has been chosen as the main research instrument and it has been carried out with four top managers. The semi- structured interview is performed by meeting them directly at their working place. The answers of the respondents were recorded applying pre-conceived open and closed questions. The period of qualitative research performance: 10<sup>th</sup> of February, 2020 – 24<sup>th</sup> of February, 2020.

## Instrument of the research

Interview is one of the most sufficient data collection methods, responding assumptions of qualitative methodology, that allows to delve into the respondent's perspectives, to collect abundant experience details and unique nuances of tangible data (Gaižauskaitė and Valavičienė, 2016).

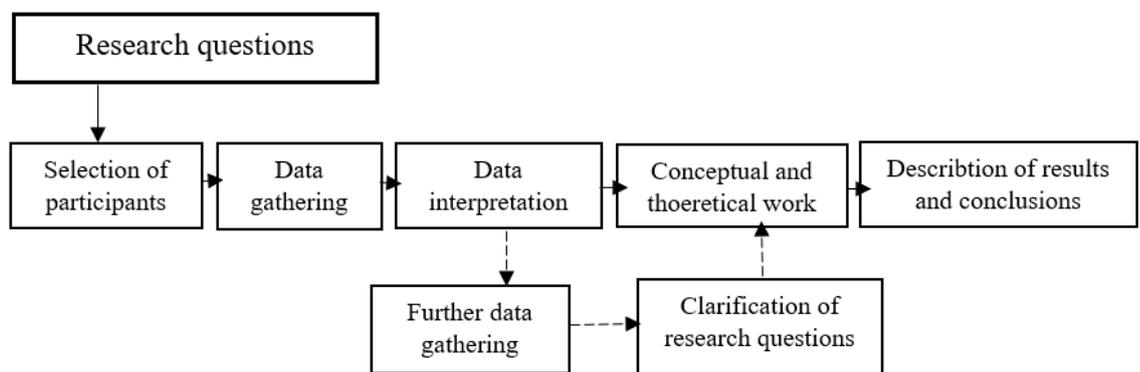
Moreover, semi-structured interview is used as the method of gathering information, because of the reasons:

- To determine deeper layers of the research problem;
- To provide an interpretative explanation arising from the analysis of situation.

## The analysis of research data

Qualitative research process seeks to convey its uniqueness through data gathering, data interpretation and the interconnection of the stages of conceptual work. The data gathering during the qualitative research process is sufficient to draw consistent conclusions, formulate logical theoretical statements and interrelationships (Gaižauskaitė and Valavičienė, 2016).

Research process of the qualitative research method has been planned as follows (fig. 12):



**Figure 12.** Qualitative research process (Designed according to Bryman, A., 2008).

First of all, according to research question, it was formulated 15 opened and 17 closed type questions of semi-structured interview in advance (table 7). Questions have been divided into 9 main questions 'categories, which correspond to preconditions of successful lean implementation, discussed in theoretical part. In order to obtain adequate results and achieve the goal of the empirical research, the interview is structured, but also freedom is left to supplement and reveal unmentioned preconditions influencing the successful implementation of lean system. Clarification questions are provided to reveal additional useful information, to highlight, also clarify the original stand point of the informants or to indicate what is only alluded to in the main question.

The collected data of the interviews was transcript (appendix 1). According to the traditional concept, transcription is considered to be a procedure when the source of a spoken language is changed to a written form. In order to be able to encode the available audio material and analyse its content, it had to be recorded (Bird, 2005).

**Table 7.** The main semi-structured interview questions. (Prepared by the author of the final project).

Categories of questions	The main questions
1. Perception of lean system	<ul style="list-style-type: none"> <li>• How do you understand lean system yourself?</li> <li>• What do you know about value stream mapping? Did lean agent introduce how to use it?</li> <li>• How long shall the company stay 'lean'? what do you think?</li> </ul>
2. Lean implementation planning	<ul style="list-style-type: none"> <li>• Did the company choose to implement lean before? What were the reasons it failed?</li> <li>• Is the company ready to adjust to happening changes at this time of the period?</li> <li>• Why has the company chosen to implement lean system?</li> <li>• Has the company planned human and financial recourses to support lean implementation?</li> </ul>
3. Lean alignment with business strategy	<ul style="list-style-type: none"> <li>• Should lean be related to company's business strategy? Why?</li> </ul>
4. Lean implementation	<ul style="list-style-type: none"> <li>• Is it necessary to have lean implementation strategy? Why?</li> <li>• Who should build lean implementation strategy?</li> <li>• Are you familiar with lean implementation stages? What are they?</li> <li>• How to ensure effectiveness of lean implementation?</li> <li>• Does the company have plan to adopt other lean tools?</li> <li>• Are company 's suppliers and customers involved in lean system implementation?</li> </ul>
5. Managers' support	<ul style="list-style-type: none"> <li>• What is the role of top management in lean implementation?</li> <li>• Do managers support the process?</li> </ul>
6. Lean implementation advantages and risks	<ul style="list-style-type: none"> <li>• What kind of advantages does lean bring to the company and employees?</li> <li>• Do those advantages have any impact to company's business strategy?</li> <li>• Does the company face any risks and barriers while implementing lean? What are they?</li> <li>• Has the company prepared any plan how to cope with the risks and barriers?</li> </ul>
7. Lean performance indicators	<ul style="list-style-type: none"> <li>• How does company know if it has achieved its lean goals?</li> <li>• What is company's formula to control and maintain lean system to successfully function?</li> </ul>
8. Lean training	<ul style="list-style-type: none"> <li>• Have you participated in all 3 lean tools training?</li> <li>• Have teachers clearly and understandable conveyed the course/training information?</li> </ul>
9. Motivation	<ul style="list-style-type: none"> <li>• What motivates employees at all levels to be involved in lean implementation process?</li> <li>• Please, name 3 factors that would motivate you to attend in continuous improvement process?</li> </ul>

The first category of questions '*Perception of lean*' is applied to reveal if top managers are well familiar with lean system in general.

The second category of questions '*Planning of lean system implementation*' seeks to determine, if lean implementation is planned and how it is planned in advanced. Moreover, to understand the reasons for choosing lean system adoption.

The purpose of the third category questions '*Lean strategy and alignment with business strategy*' is to obtain more information, if company aligns lean implementation with its business strategy and if lean strategy has been built by top management.

The fourth category of questions '*Lean implementation*' contributes in revealing top management's understanding, preparation and involvement in lean adoption. Also, if company adopts lean tools in sequence and understands the meaning of including suppliers and customers in lean processes.

The fifth category of questions '*Managers support*' purpose is to determine if top management is involved and how they contribute to lean process.

In the sixth category of questions '*Advantages and risks*' it is willing to indicate if company realises benefits which brings lean and what kind of risks it faces during the implementation.

The purpose of the seventh category of questions '*Performance indicators*' to show if company is able to measure data of lean achieved goals and how it is evaluated by top management.

The eighth category of questions '*Training*' seeks to reveal if company organize lean training for employees and if top management is familiar with adopted lean tools.

Meanwhile, the nineth category of questions '*Motivation*' shows how top management is motivated to contribute to lean processes and what motivates them to achieve lean goals together with the entire company.

### **Ethics of the research**

In line with research ethics, it is very important that the informant feels the naturalness of the interview and the sincerity of the conversation between researcher and respondent. Therefore, before the interview, informants were introduced with its form of conversation, the research problem and possibility to review questions in advanced, if it was preferable. Informants were also informed about anonymous survey, so their personal data was not announced. Instead of it, all 4 informants are marked as: I1, I2, I3 and I4. Moreover, informants agreed to participate in the research of their own free will, so they were not pressured or otherwise influenced to participate in the study answering all questions.

Following the principle of interview research ethics, it is important to (Gaižauskaitė and Valavičienė, 2016):

- Respect the informants' independence, freedom to participate in or refusal to participate in the research;
- To provide with sufficient information about the research in advance;

- To preserve the confidentiality of the subject, privacy and anonymity;

### **Restrictions of the research**

Too small number of interviewed informants may affect the reliability of the results provided. The application of semi-structured interview may have influence on the validity of the responses received. Time to carry out the research has been limited due to Covid-19 situation. The research provides a generic theoretical model of lean implementation, which still needs to be tested and validated in other type of industries. Therefore, received results of the research are applicable only for LTP Texdan company's case analysis.

### **Object of the research**

LTP Texdan company has been chosen as the object of the empirical research, in order to evaluate and compare the defined theoretical aspects in practice. The case study seeks to reveal challenges and application of lean model implementation provided in the theoretical part, which contributes to successful adoption of lean system in the manufacturing company.

### **Sample of the research**

LTP Texdan has been chosen as for case study due to lean system is being currently implemented and the company is already able to measure benefits provided by lean adoption.

It has been decided to interview 4 top managers, because there are no strict requirements for the sample during the qualitative research. In fact, respondents are invited to participate in the research until their responses begin to replicate. The main criteria for interviewing top managers are: their directly contribution, better acquaintance with the process of lean system implementation in the company than shop floor's, and they have competences needed to reflect on the processes, which the company initiates. Therefore, the selected respondents properly reflect the real situation of the case study.

### **Performance of the research**

The qualitative research is divided into several stages, during which theoretical statements are formed. Afterwards theoretical statements are evaluated and compared with the statements received by the respondents. The empirical research process is divided into 4 stages, as follows:

**1 stage.** Based on scientific literature resources, problem analysis is identified to disclose preconditions for successful lean implementation;

**2 stage.** Theoretical suggestions are formed to justify successful lean implementation, according to scientific literature resources;

**3 stage.** By concluded theoretical framework for successful lean implementation, semi-structured interview questions are formed, in order to reveal the critical success factors and applicable capabilities for adopting lean system in manufacturing company;

**4 stage.** The research results are analysed by grouping and comparing respondents' answers with theoretical statements, so as to substantiate theoretical model.

## 4. The research results of challenges of lean model implementation in a manufacturing company

### 4.1. Characteristic of LTP Texdan company

JSC LTP Texdan belongs to LTP Group – global privately owned company. In different production units, there are almost 2000 employees employed all over the world. The main activities of LTP Texdan company are cutting, upholstery of various seating and textile sewing. It is one of the leading upholstery producers for contract and design furniture in Europe. The company has a big focus on its customers by supporting them with excellence delivery performance, high quality services, responding to customers' needs and being socially responsible. All production facilities are equipped with new technologies and IT solutions.

#### We are LTP Group

LTP Group is a global privately owned production partner for demanding clothing and furniture brands.

We are specialists in handling textiles for many different industries and products. We are divided into 2 business units, LTP Garment and LTP Contract Furniture.

LTP Group A/S is based in Copenhagen, Denmark.



Figure 13. LTP Group.

LTP Texdan has been chosen for case study analysis, because of it is a manufacturing company where it has newly started transforming the organization by applying lean system and it has also a previous experience of failed implementation.

LTP Texdan has chosen lean system in order to optimize production processes when the production facilities have expanded, with the focus on adding higher value for the customers, improving competitiveness in furniture upholstery market and changing internal culture of communication and behaviour. Lean system has started functioning from 2019 autumn period, despite that, it is the second attempt of implementation, but it is quite new experience both for top management and shop floor workers, because at this time the company is supported by lean agents' consultancy in their decision-making and actions. Although, lean system has been functioning for almost one year, the first advantages and results of it, are clearly recognisable and measured. According to lean agents' advice, the company has firstly prioritised to adopt lean tools such as: 5S, Kaizen and Asaichi (fig.14).



**Figure 14.** Lean tools adopted in LTP Texdan.

Moreover, the Head of Lean and lean groups' leaders have been dedicated, because it is much easier to control all lean procedures and have a stronger focus on them through the involvement of more employees.

As mentioned above, the company has attempted to implement lean previously on their own initiative, but it failed. The top management agrees that at that time the company was not ready for changes due to various obstacles such as: incorrect perception of lean and its implementation, too few human resource was dedicated to support the system, little engagement of top management, there was no motivation system built in order to stimulate the shop floor involvement.

After the encouragement of shareholders to make a 'wow' factory, this time the company has taken the initiative once again, but now with more serious and thoughtful intention to change the culture of organization and its approach towards new strategic decisions.

#### **4.2. The results of the empirical research**

After the analysis of the scientific literature and the development of theoretical framework model for lean system implementation (Fig. 11), it is sufficient to substantiate it with conclusions based on performed qualitative research method. Therefore, data of empirical study was analysed and gathered during the semi-structured interviews from 4 top managers named as: *informant1*, *informant2*, *informant3* and *informant4*, who shares their experience and insights gained during the period of lean implementation. All 4 top managers were introduced with the topic, the aim, and even the interview questions of qualitative research in advanced. Moreover, verbal agreement was received from all informants, as it is also allowed to record the interviews and to announce them for the research purposes.

The questions “*How do you understand lean system?*”, “*What do you know about value steam mapping? Did lean agent introduce how to use it?*”, “*How long shall the company stay ‘lean’?* ” were applied to reveal how top managers were familiar with lean system and what were their personal perceptions and approaches towards it, which also substantiated, of course, what was the most important for them. According to the answers of the informants, there were several sub-categories submitted as follows: perception of lean, perception of value stream mapping, longevity of lean (table 8).

**Table 8.** The perception of lean.

Category	Sub-categories	Quotes
Lean system	Perception of lean	<p>“box of tools to improve business” (I1).</p> <p>“a common company’s management system, implementation of order” (I2).</p> <p>“search for opportunities how to simplify our daily work and to make them easier to do” (I3).</p> <p>“which invites us continuously revise, improve process, identify all kind of waste and eliminate. Also, to create value for our final customers” (I4).</p>
	Perception of value stream mapping	<p>“I have not heard about value steam mapping and it was not presented by lean agent” (I1).</p> <p>“I have no idea what it is, so, it was not introduced by lean agent” (I2).</p> <p>“I have heard about it while working in another company. It starts from processes evaluation and focuses more on it” (I3).</p> <p>“we are using it by our lean manager. She is measuring and observing the processes, which give less value and tries to find out how to improve and increase value for our customers” (I4).</p>
	Longevity of lean	<p>“company will be lean forever. Once we started it, we need to continue with it” (I1).</p> <p>“it will continue further depending on top management’s will, believe and enthusiasm... starting from General Manager’s and Head of Lean involvement” (I2).</p> <p>“it is a continuous process... Company is changing. It is never the same, meaning that it could appear new issues and new solutions to solve them” (I3).</p> <p>“lean is a journey and never-ending story, if you succeed to keep it” (I4).</p>

Though, all informants have a different approach of lean perception, but all answers lead to positive mind set of top managers having an organizational focus on creating value to customers and contributing to effective work places at the manufacturing company. The change is inevitable as “*company is growing and some internal processes might get hectic*” (I1). So, the first provided

category depicts lean as a box of tools and one of company's management system, which assists in simplifying and improving daily processes and moreover, delivers value to the final customers. It is sufficient, that lean is accepted by the top managers as a positive and necessary change for continuous improvement for the entire company.

The second sub-category reveals, that only 2 (I3 and I4) of 4 informants realise the essence of value stream mapping in lean implementation process, while the rest are not familiar with it. From gained responses, it can be concluded, that not all top managers have proper knowledge and perception of value stream mapping role in lean model implementation. It can be assumed, that neither top management nor lean agent has observed and measured internal processes, and lean is being implemented without a full understanding of company's value adding and non-adding activities. The communication gap among top managers exists as only one informant (I4) is familiar with value stream mapping application in the company: "we are using it by our lean manager. She is measuring and observing the processes, which give less value and tries to find out how to improve and increase value for our customers"(I4).

Analysing responses applied in the third sub-category, lean is depicted by all 4 managers as a journey or continuous process, which never ends, and most important, the longevity of lean depends on "top management's will, believe and enthusiasm. Starting from General Manager's and Head of Lean involvement" (I2).

The carried-out research seeks to analyse the level of lean implementation planning in manufacturing company, which is one of four essential stages applied in lean model. Therefore, there were four sub-categories distinguished: evaluation of previous lean implementation experience, level of preparation, the reasons for lean implementation, human and financial resources support (table 9).

**Table 9.** Planning lean implementation.

Category	Sub-categories	Quotes
Planning lean implementation	Evaluation of previous lean implementation experience	<p>"last time it was not like it should be. I think people were not motivated enough and were not so much on fire themselves" (I1).</p> <p>"tried to implement lean only having its own knowledge, but without a consultation of lean agent"(I2).</p> <p>"the whole organization was not ready, too few resources were used or involved"(I4).</p>
	The level of preparation	<p>"I think, company is ready for new changes, because it is growing fast and it needs improvements"(I1).</p> <p>"I think it is"(I2).</p> <p>"It feels, that employees are more motivated to meet changes"(I3).</p> <p>"We are strong to adapt to changes and lean is one of the methods, which helps us to reach it"(I4).</p>

Table 9 continuous in next page.

**Continuation of Table 9.** Planning lean implementation.

	Ensurance of effective lean implementation	<p>“because of the size of the company since it is growing rapidly. Processes cannot be controlled so well without having lean tools” (I1).</p> <p>“to improve. The company is growing fast and the support from outside is very necessary” (I2).</p> <p>“every company should aim for more efficient processes, to reduce waste and to be more attractive for our customers” (I3).</p> <p>“We have extended production facilities and we got a task from shareholders to make a factory look professional. Also, we have a pressure on the costs. Moreover, it needs to eliminate wastes, improve the processes, to do all savings that we can by being sharp and smart. The company focuses on customers by providing good and fast service: short lead time, delivery precision, low claim rate and other.” (I4).</p>
	Human and financial resources support	<p>“I know it is a planned budget for lean” (I1).</p> <p>“I believe the company has planned resources in advance” (I2).</p> <p>“We have this support for sure” (I3).</p> <p>“Yes” (I4).</p>

LTP Texdan company had a previous experience of lean implementation, which failed couple of years ago. In fact, the responses of informants, assisted in better understanding of what type of mistakes were made and what were the main challenges faced. During the research the pivotal reasons of failure are distinguished:

- Lack of employees’ motivation;
- Lack of knowledge;
- Absence of external lean agent consultancy’s support;
- Organisation’s resistance for positive changes;
- Too few human and financial resources involved.

All above mentioned statements are considered as critical success factors contributing to successful lean model implementation, also analysed in theoretical part of the research.

Top managers have a clear awareness of lessons learned in the past during the attempt of lean implementation and they realise that the company is ready for new changes again “*we are strong to adapt to changes and lean is one of the methods, which helps us to reach it*” (I4). As per responses gained in the third sub-category, it is observable that top managers have clear aims, which need to achieve through lean implementation as company is growing rapidly. First of all, to improve and control the internal processes by external lean agent support, which should ensure proper knowledge of lean implementation. Secondly, to do most possible savings, to increase company’s competitiveness and satisfy all customers with “*good and fast service: short lead time, delivery precision, low claim rate and other.*” (I4). Also, top managers indicate that for the second attempt of lean implementation human and financial resources are included into the budget of the company “*I believe the company has planned resources in advance*” (I2).

During the interview, question “Should lean implementation be related to company’s business strategy? Why?” was applied. All four informants replied positively emphasizing that it should be a total support and involvement by shareholders and top management, because ‘lean system ensures savings and might contribute to the growth of profit’ (I3, I4), (table 10).

**Table 10.** Lean alignment with business strategy.

Category	Sub-categories	Quotes
Business strategy	Lean alignment with business strategy	<p>“Yes. Owners of the company expect the growth of profit. (I1).</p> <p>“Of course. If there is no interest from management level, it will be no successful future. It should be 100% support and involvement from top management side” (I3).</p> <p>“Yes. If company aims to be successful, lean should be applied in all the highest levels of business strategies, supported by shareholders and top management’s interest” (I4).</p>

The fourth category of questions, aims to reveal how and under what circumstances top management has implemented lean in the company (table 11).

**Table 11.** Lean implementation.

Category	Sub-categories	Quotes
Lean implementation	Lean strategy	<p>“Lean agents should help to create lean strategy and timelines, not to make things too complicated, also management team, which is responsible for each department” (I1).</p> <p>“Lean strategy should ensure clearness how to implement and act step by step, because without a clear strategy it is going to fail. Top management, shop floor employees and lean agents should contribute to lean strategy” (I2).</p> <p>“Every project should have a plan. Also, to have a vision and its clear goals. By the help of lean agents’ top management should build lean strategy, also the entire organisation should be included” (I3).</p> <p>“Of course, lean strategy should be, though it is not simple to build. It should be driven from shop floor to top, but created at top management level” (I4).</p>

Table 11 continuous in next page.

Continuation of Table 11. Lean implementation.

	Lean implementation stages	<p>“Personally, I am not so much into the details of lean stages, but I know that we are implementing lean tools step by step” (I1).</p> <p>“I am familiar with lean tools’ implementation, but not lean itself.”(I2).</p> <p>“I am more familiar with lean tools than lean stages. I do not really know what should follow in implementation stages” (I3).</p> <p>“I do not know those stages, but lean agents learned how to start, how to implement lean tools, how to educate employees and how to maintain the system, but the rest we must do by ourselves. The most challenging thing is to keep what is done.”(I4).</p>
	Ensurance of effective lean implementation	<p>“Internal audits carried out by managers; motivated lean group leaders; the main lean leader should be responsible and follow all group leaders’ activities; employees need to see results and be awarded” (I1).</p> <p>“I am not able to advice how to ensure effective lean implementation due to lack of experience”(I2).</p> <p>“to control, if company has reached its lean targets or not. If there is no tendency showing the improvement inside the company, then it is something wrong. So, to measure indexes is important” (I3).</p> <p>“The effectiveness is shown through the results. All together in the company should contribute to improvements and good changes.”(I4).</p>
	Involvement of suppliers and customers	<p>“Suppliers and customers are involved, but not directly. Some suppliers have lean in their companies, but majority still do not have it” (I1).</p> <p>“Customers are informed about lean adoption in our company, but I am not sure about suppliers”(I2).</p> <p>“At the moment suppliers are not involved. But the necessity could appear for example: finding new solutions for packing which would make the process easier for employees” (I3).</p> <p>“Suppliers and customers are involved, but not directly. Customers are informed about lean adoption in our company”(I4).</p>

First of all, it is sufficient to understand, if the top management finds imperative to have lean implementation strategy “*Is it necessary to have lean implementation strategy? Why?*” and who’s responsibility to create it “*who should build lean implementation strategy?*”. Informant 1 underlines that in this case lean agent and top management should be involved, which would together create a proper model for successful lean implementation, with a compliance to agreed timelines.

The rest of informants (I2, I3, I4) also admit that the shop floor in some way should be involved in the process of strategy creation, but final decisions are dependable on top management “*It should be driven from shop floor to top, but created at top management level*” (I4). Gained responses depict top management’s reliance to employees’ standpoint and underline it, as an essential element in lean strategy creation.

Moreover, informant understands that “*it is not simple to build lean strategy*” (I4), but lean strategy should exist with “*it’s vision and goals*” (I3), in order to ensure clarity and stability. Otherwise, “*lean implementation is going to fail*” (I2) again.

Though, all informants mentioned the importance of lean agent’s involvement in lean strategy creation for effective implementation, but in company’s case lean agents only explained how to adopt different lean tools and there was no clear lean model for implementation provided or built together with the company. In fact, responding to question “*Are you familiar with lean implementation stages? What are they?*” none of informants were acquainted with it: “*I do not really know what should follow in lean implementation stages*” (I3), “*I do not know those stages*” (I4). Therefore, the research findings allow to percept that the main focus during implementation was on tools’ adoption and paying less attention to other stages such as: investigation, preparation and value stream evaluation.

Only one of fourth informants, was not sure how the company succeeded to ensure the effective lean adoption. Meanwhile, the rest of top managers indicated their opinion from different point of view, but all given responses were key importance for revealing how the company manages to monitor lean implementation process and to assure its advantages.

According to research findings, there were several factors mentioned by top management that are crucial for assurance of effective lean implementation in LTP Texdan company:

- Internal audits applied for different lean tools carried out by top management;
- Noticeable role of lean leadership;
- Control and measurement of lean indexes;
- Lean vision and goals’ alignment with achieved results;
- The involvement of entire organization.

The company applies internal audits for lean tools, which are carried out periodically by top leaders. In this way, company stimulates and rises the support and engagement of top managers.

During the research, there were some additional information sources collected, which show how the company collects and measures the performance of lean tools.

For control of tidiness in different departments, every week the 5S audit table is used (table 12). Top managers are assigned to particular departments and their main task is to check, if all working places are tidy. Afterwards, the results are controlled by 5S leader and communicated further at shop floor and management level.

**Table 12.** Template of 5S audit.

**Top managers' audits for completed 5S work places**

Manager	KK	RD	GR	AŽ	JB	VV	IU	GK	EM	EJ	RS
Weeks											
47											
48						12					
49											
50									1		
51											
52				14							
1						5					
2											
3											
4									8		
5											

- Upholstery department
- Glueing department
- Sewing department
- Sofas' upholstery department
- Cutting department

Daily morning meetings are being held and controlled by top managers time to time in various departments as well. Managers fill the template of Asaichi meetings with their evaluation for various statements to control if the meeting is being carried out according to agreements and to observe if problems are being solved. In case, the problems are not being solved by shop floor, then top manager gets involved in order to assist. Collected results are reviewed by Asaichi leader and appropriate decisions are made if needed (table 13).

**Table 13.** Template of Asaichi audit.

**Template of meeting audits**

Meeting	
Audit carried out by:	
Date	
Result:	

NR.	Evaluation statement	Yes	No
<b>Preparation for meeting</b>			
1			
2			
3			
<b>Performance of meeting</b>			
4			
5			
6			
7			
8			
9			
10			
<b>Time control</b>			
11			
12			
13			
<b>Culture</b>			
14			
15			
<b>Total:</b>			

<b>Evaluation</b>	
0 – Perfect	(0-1 no)
1 – Good	(2-4 ne)
2 – Normal	(5-7 no)
3 – Bad	(8-10 no)
4 – Very bad	(11-15 no)



**Table 15.** Management commitment.

Category	Quotes
Management commitment	<p data-bbox="592 300 1501 398">“To motivate and to show that lean is necessary. Management needs to understand the importance and they need to communicate that during the meetings, slogans or similar things” (I1).</p> <p data-bbox="592 432 1501 562">“Being fully involved in the entire process of implementation. Top management should have knowledge of lean and to communicate it further for those who has not learnt yet about it. Also, top management in involved in carrying out audits of all three lean methods at our company” (I2).</p> <p data-bbox="592 595 1321 629">“To support, to be involved and to understand the need” (I3).</p> <p data-bbox="592 663 1501 853">“to do whatever it takes to involve shop floor workers, to educate them, to support and it should be involved in all levels of business strategy. For example: while managers carry out audits, they communicate and give support to the shop floor workers. Moreover, shareholders time to time are also making audits. It shows to employees that top management also cares about lean and workers effort.” (I4).</p>

As the interview results show, the majority of informants distinguish the following elements, which give a support for successful lean implementation from top management standpoint and are defined as crucial:

- Top management’s will to adjust to changes (I1, I3);
- Motivation and support from top management (I1, I3);
- Necessary level of lean knowledge communicated by top management further to the shop floor level (I1);
- Top management’s involvement in lean processes, audits (I2);
- Shareholders interest and involvement in lean implementation processes (I4).

The responses clearly emphasize that the role of top management in lean implementation, first of all, starts from leaders’ intention to accept the initiated internal changes as a positive effect. Being self-motivated and giving a support when needed during the adoption processes, top management shows its involvement and care for shop floor problems. To ensure an effective support, managers should also have a necessary knowledge level of lean and its tools, in order to communicate it further for entire company. Otherwise, the trust of employees can be lost. Moreover, a proper level of lean knowledge is required to carry out internal lean audits, if not, it is easy to lose control and stability in processes of lean implementation.

It is worth to mention, that top management also expects to get an overall support and motivation from shareholders who contribute to lean adoption, as informant (I4) underlined it in her interview response. Time to time the company’s shareholders perform 5S audits during which they communicate with shop floor, give them a feedback and encourage them to contribute to continuous improvements at production facilities.

According to “Lean advantages and risks” category of questions (table 16), there were several questions provided: *“What kind of advantages does lean bring to the company and employees? Do*

those advantages have any impact to company's business strategy? Does the company face any risks and barriers while implementing lean? What are they? Has the company prepared any plan how to cope with the risks and barriers?'. The purpose of above applied interview questions is to reveal what type of advantages and risks the company faces and how it manages to cope with them.

**Table 16.** Lean advantages and risks.

Category	Sub-categories	Quotes
Lean advantages and risks	Advantages	<p>“Many. Beginning with Kaizen and 5S lean tools, which help to improve working places, to save money; employees might work more efficient, which is really crucial for production. &lt;...&gt; profit grows, improves production efficiency. &lt;...&gt; measurements of Asaichi help to plan actions before something happens” (I1).</p> <p>“First of all, tidy working places, improvement of processes, which is more related to Kaizen; assurance of better working conditions and effectiveness of production. &lt;...&gt; helps to rise existing problems and to solve them. All in all, it brings financial advantage for the company as well” (I2).</p> <p>“Reduction of waste, which is related to money saving. I think it is the main purpose and advantage” (I3).</p> <p>“&lt;...&gt; to increase our profit, &lt;...&gt; to make some actions easier and to improve employees’ tasks” (I4).</p>
	Risks	<p>“&lt;...&gt; I think we have some, starting from people who are not interested in or do not understand the purpose of lean &lt;...&gt; No, I do not know about the plan to cope with risks” (I1).</p> <p>“It is naturally that it could be some risks and barriers during the process of implementation, because it is new for employees. We learn from mistakes and get experience how to improve to proceed further. No, I have not heard about such plan.” (I2).</p> <p>“I have not experienced any risks myself yet. I am not familiar with plan to cope the risks” (I3).</p> <p>“The resistance of employees to be educated. But it is a natural thing that comes together with changes &lt;...&gt; so, top management and group leaders should find the way how to motivate them. Another risk is, to lose all we have created together and be unable to maintain the system in order to function properly. Yes, we are working on it together with lean agents how to support ourselves, asking for advices how to keep what is done” (I4).</p>

In accordance with informants gained responses, there were some advantages of lean implementation underlined:

- Improved working places and processes (I1);

- Increased profit (I2, I4);
- Assurance of production efficiency (I1);
- Improved overview of issues and control of problem solving (I1);
- Improved working conditions and tasks (I2, I4);
- Reduction of waste (I3);
- To maintain lean system to function (I4).

As per above mentioned advantages, it can be assumed that all informants clearly understand the benefits, which lean system might bring. Some of responses are compatible with advantages, which are more particular for employees, but at the same time it also contributes to company's prosperity. It is realised that through improved working places and processes, it is easier to ensure an effective production. Moreover, lean enables to have a better overview of existing issues and ability to have an improved control of problem solving, instead of overlooking them, especially when organisation is growing rapidly. It might be challenging to control all processes without a determined system which functions properly. Further, elimination of waste is closely related to possible savings that the company might achieve. Also, most challenging, according to informant 4, to maintain what was created in order to assure lean system functionality.

During the interview there were also questions provided with intention to realise how the company manages risks and barriers and what are they: *‘Does the company face any risks and barriers while implementing lean? What are they? Has the company prepared any plan how to cope with the risks and barriers?’*. As the main barriers in lean implementation, informant 1 and informant 4 indicate as follows:

- Lack of employees' motivation;
- Lack of proper lean knowledge and benefits it might bring.

Other informants were not familiar with risks that the company faces.

However, none of informants could distinguish a current plan to cope with risks and barriers, which might appear during the process of lean implementation: *‘no, I do not know about the plan (I1); I have not heard about such plan (I2); I am not familiar with the plan (I4)’*. According to responses, it can be assumed that the company has skipped the part where it plans in advance how to overcome risks in lean adoption, but some of informants had their opinion about what might assist in managing interferences. Informant 2 predicates that though the company does not have a plan how to cope with obstacles, but learning from mistakes is also a good experience. Moreover, informant 4 depicts possibility to receive a support from lean agents, if any challenges arise. Therefore, the role of lean agents is sufficient to underline. Another factor is named by the informant 4 – an assurance of employees' motivation, which top management and group leaders are responsible for.

The seventh category of questions seeks to understand how the company measures lean's success and if there are any indexes followed up: *‘How does company know if it has achieved lean goals? What is company's formula to control and maintain lean system to successfully function?’* (table 17).

**Table 17.** Lean performance indicators.

Category	Quotes
Lean performance indicators	<p data-bbox="663 271 1506 398">“&lt;...&gt; Kaizen helps to make savings in euros. &lt;...&gt; talking about Asaichi...problems are noted in whiteboard and must be solved. I am not sure what helps lean system to control and maintain, maybe General Manager or Lean leader could answer better” (I1).</p> <p data-bbox="663 434 1506 562">“During the process of lean we are able to observe the measurements gathered during morning meetings. Kaizen method shows financial savings. I am not sure what might help to control and maintain lean, but I believe audits which top management carries out help to do it” (I2).</p> <p data-bbox="663 598 1506 757">“Lean announcement meetings once a quarter or once a half year should be held for all employees to present financial status, lean statistics and to show how the company is doing. Employees should be involved to control and maintain lean system, also measurements should be followed and to have enough motivation not to give up.” (I3).</p> <p data-bbox="663 792 1506 909">“We count savings brought from each improvement suggestions made by our employees. But other lean tools are easier to measure the savings in numbers. First of all, involvement of top management and shop floor by educating them, not making any pressure” (I4).</p>

Received responses show that all informants are acquainted with how each lean tool’s outcomes are measured: “<...> Kaizen helps to make savings in euros. <...> talking about Asaichi...problems are noted in whiteboard and must be solved (I1); During the process of lean, we are able to observe the measurements gathered during morning meetings. Kaizen method shows financial savings. We count savings brought from each improvement suggestions made by our employees. But other lean tools are easier to measure the savings in numbers”. There was also proposed to held lean meetings periodically, in order to involve the entire company, not only top management: “Lean announcement meetings once a quarter or once a half year should be held for all employees to present financial status, lean statistics and to show how the company is doing”.

Some of informants indicate top management’s involvement and education of employees as significant elements in maintaining and controlling lean system.

During the interview it was easy to recognise that more or less all informants were familiar with lean tools and knew how it should function. But it was also important to analyse, if the company arranges lean training and if top management has any remarks on how the training was held, which might reveal the level of training preparation in the company. Therefore, couple of questions related to lean education were applied (table 18): “Have you participated in all 3 lean tools training? Have teachers clearly and understandable conveyed the course/training information?”.

**Table 18.** Lean training.

Category	Quotes
Lean training	<p>“I have attended in two of three lean tools’ trainings. Teachers were perfect. They know how to do it” (I1).</p> <p>“Yes, I have participated in all three trainings. Teachers understandable conveyed the information” (I2).</p> <p>“I have participated only in one of three trainings. Teachers clearly explained the information” (I3).</p> <p>“Yes, I attended in all three training and teachers were good to explain” (I4).</p>

Surprisingly, not all informants (two of four) have participated in all three lean trainings yet, indicating, first of all, that it is too little attention paid to educate top management before showing a support for shop floor and carrying out lean audits, which require a proper level of lean knowledge. Therefore, it might be foreseen risks of lean control and maintenance performed by top management. Also, it arises a doubt, if managers are able to motivate other employees without a proper understanding how a specific lean tool should function.

Otherwise, all informants were satisfied with the content of lean training, and there were no additional remarks given.

Since motivation is a strong foundation for successful lean implementation, which might be stimulated by various factors and would determine the further direction of the process, it is necessary to analyse the core elements of employees’ motivation. In last category of questions top managers were asked to define: *“What motivates employees at all levels to be involved in lean implementation process? and name 3 factors that would motivate you to attend in continuous improvement process?”* (table 19).

**Table 19.** Motivation.

Category	Quotes
Motivation	<p>“Production employees are motivated financially. It is more difficult to measure at administration level, what makes them to be involved. First of all, visibility of results. If I do not see results, lean would die step by step for me. &lt;...&gt; otherwise, it does not motivate to take any actions.” (I1).</p> <p>“It gives possibility for employees that their problems will be heard and they could improve own working places and save their time. Positive changes that are visible and effective. These are the most motivating me” (I2).</p> <p>“Employees should see benefits and results, which bring value and motivate them to be engaged in the processes. Visible benefits, results, solutions which help to make processes easier and great ideas are most motivating for me” (I3).</p> <p>“I believe the process itself motivates, because I got previously some comments from our workers that they are too little involved in various processes. So, now it is the best time to be involved. In general, I like the philosophy of lean and its idea. I like lean’s attitude towards people, because it is close to my personal values as well.” (I4).</p>

According to gained responses, there several motivation factors are defined:

- Financial benefits;
- Transparency and visibility of achieved results;
- Possibility to express own problems and propose solutions;
- Involvement in decision making process;
- Alignment with interpersonal values.

*The research findings have revealed that LTP Texdan company has a correct perception of lean concept and possible advantages it might bring. However, it is determined that the company does not use value stream mapping as an important element for identifying its non and value adding activities. Interview responses show that the company pays no attention yet to customers and suppliers' involvement into the processes of lean, meaning that either the company lacks of knowledge how to achieve it or has no skills and competences needed. Moreover, none of top managers are aware of the challenges, which the company faces during the implementation. It reveals too little involvement and control of lean performance from management's side. Also, the company does not apply any particular lean implementation model and is not familiar with it. According to the carried-out research in LTP Texdan company, the main challenges of lean implementation are depicted: 1. too little support from top management; 2. lack of understanding on which challenges the company faces at the moment; 3. lack of knowledge on how to adopt lean model. 4. customers and suppliers are still not involved in lean implementation.*

*To sum up, the research findings based on motivation, allow to assume that individual and organizational goals have a significant role for creating a motivational culture inside the company's boundaries. A high level of employees' motivation empowers and unites the entire company to be strong and competitive.*

#### **4.3. Recommendations for implementation of the lean model in a manufacturing company**

After analysing the challenges faced by LTP Texdan manufacturing company in implementation of lean, it has shown the places where they can be improved. Therefore, in accordance with provided results in the empirical part of the research, the following recommendations for the company are provided as follows:

- To apply value stream mapping in order to analyse value adding and non-adding activities, that will help to focus on proper direction by improving the flow of manufacturing and its processes. Moreover, it will engage employees into lean improvement;
- To build and follow an explicit lean strategy/model together with top management and lean agents, also aligned with company's vision, mission, values and objectives. Lean implementation model will assist in planning the sequence of actions that should be done. It would be easier for employees to have a clear view over the processes of lean implementation.
- To involve all top managers into the processes of lean through their directly engagement in ensuring human, financial resources, and creating strategic leadership. Observe the level of their support and engagement;

- To prepare a plan together with top management how to cope with challenges, if the necessity appears. It would require their proactiveness and effective participation assuring the process of generating and executing the strategies;
- Periodically arrange lean announcements both for top management and shop floor in order to provide transparency and achieved results, which would empower them to achieve further improvements and contribute to lean transformation;
- To integrate customers and suppliers into the process optimization. It would assure the broader scope of company's value stream, improved flow, increased customer satisfaction through high quality services and products. It would also foster opportunities for further cooperation.

## Conclusions

1. After analysing the problematic of lean implementation in manufacturing companies, it can be stated that the process management has been actively analysed for more than a decade. Many researchers analyse the challenges and preconditions, which are faced by unspecified type of organizations. The topic of managing the challenges appears with implementation and is paramount relevant in manufacturing companies, which either provide production services or own products, in this way meeting the needs of a changing market. Manufacturing companies must also adapt to market changes in a timely manner, strive to manage internal processes as effectively as possible in order to increase customers' satisfaction, to achieve efficient production, to assure the quality of services or products, and to fulfil the lead times.
2. From a theoretical point of view, it can be stated that the challenges, which are depicted by the researchers, are more or less common for manufacturing industry. Most common are described as: unmotivated employees; lack of top management's commitment; knowledge of lean is poorly spread inside an organization; lean implementation is not aligned with a company's business strategy; no metrics of lean process performance are applied. Management of lean implementation challenges is essential when aiming to achieve continuous improvement. It can be measured through the quality of the product and customer satisfaction.
3. The empirical study is performed on the basis of the proposed generic theoretical model for lean implementation, which would allow to control the process of lean implementation better and to overcome rising challenges. The theoretical model can be described through four phases such as: initial investigation, preparation, focus on pilot of value stream mapping, implementation and measurement of performance. It also allows to follow a correct sequence of actions during the transformation process, assure an effective elimination of waste and overcome challenges the company might face. However, deeper research and validation should be carried out in various industries to substantiate the applicability of the provided lean model and to adjust it, if needed, according to the received results.
4. The main purpose of the research is to reveal what kind of challenges manufacturing company faces and what type of solutions are made while adopting lean. For this reason, a case study analysis in LTP Texdan manufacturing company is carried out. Data of qualitative research is gathered during the semi-structured interviews, observations and the analysis of documentation. According to the results of the empirical research, it is observed that LTP Texdan company has a correct perception of lean concept and possible advantages it might bring. However, it is determined that the company does not use value stream mapping as an important element for identifying its non and value adding activities. Interview responses show that the company pays no attention yet to customers and suppliers' involvement into the processes of lean, meaning that either the company lacks of knowledge how to achieve it or has no skills and competences needed. Moreover, none of top managers are aware of the challenges, which the company faces during the implementation. It reveals too little involvement and control of lean performance from management's side. Also, the company does not apply any particular lean implementation model and is not familiar with it. According to the carried-out research in LTP Texdan company, the main challenges of lean implementation are depicted: 1. too little support from top management; 2. lack of understanding on which challenges the company faces at the moment; 3. lack of

knowledge on how to adopt lean model. 4. customers and suppliers are still not involved in lean implementation. The provided recommendations reflect on necessity of application of lean model implementation and assurance of top managements' support through their involvement in lean directly processes; set a clear vision and goals of lean; to pursue an effective implementation by lean model application; to involve customers and suppliers in lean adoption.

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## Appendices

### Appendix 1.

The transcription of audio recorded interview (1).

*Informant 1. Interview has been carried out in LTP Texdan company.*

I: Hello, I would like to ask several questions how lean system is being implemented in LTP Texdan company. How do you understand lean system yourself?

J: Ok, well. I understand it as box of tools to improve business, especially when companies are growing and some processes might get hectic. Therefore, some companies need to start using some tools to improve the processes.

I: Have you ever been familiar with lean system before?

J: Yes, couple of years ago this company started doing or at least looking at it. I remember that we made some rules to make morning meetings, but somehow it was not like it should be.

I: What were the reasons it failed last time?

J: I do not really know, but I think that people were not motivated enough to keep going, but people tried to implement, though they were not so much on fire themselves.

I: It was lack of motivation?

J: Exactly.

I: Is LTP Texdan able to adjust to changes at this time of the period?

J: I think, yes. LTP has chosen three of lean tools to implement, and I do not think it is too many, but if we will choose more, then it might be difficult. But for now, it is optimal, and is the right time to do it.

I: What were the reasons LTP has chosen to implement lean system?

J: Because of the size of the company, because it is growing rapidly. Processes can not be controlled so well without having such lean tools.

I: What processes do you mean?

J: Processes in production, simply how we make meetings, what kind of indexes we measure which we did not know about before. Therefore, lean is necessary.

I: What is your opinion about LTP's choice to adopt lean?

J: It is very positive. We are already adopting it and I think it is already working in some chains, not in all departments, but you can already see the results.

I: Should lean implementation be related to LTP's business strategy? Why?

J: It is, because of the same reasons. Owners see growth of the company and expects the turnover to grow, and we are looking not only where to sell our services, but also how to improve internal processes.

I: Is it necessary to have lean implementation strategy and why?

J: Sure. If it will be hectic again, it might happen as last year we had. Lean agents attend at LTP occasionally, they creative strategy and timelines together to not make things too complicated. And it works.

I: Who should build lean implementation strategy?

J: Lean agents should help to do it. That is why we are buying services from them. Also, our management team that is responsible for each department.

I: Are you familiar with lean implementation stages?

J: More or less, yes. Maybe I am not personally so much into details, but I know that we are implementing lean tools step by step.

I: How many stages it could be?

J: I can not answer deeply.

I: Was the importance of lean evaluated before lean implementation?

J: I did not attend at it personally, but I think yes. It is related with investments; owners of the company always investigate if is necessary or not.

I: Do you know if LTP planned human and financial resources to support lean implementation?

J: yes, I know there is budget for it.

I: Are you satisfied with how lean system is being implemented?

J: yes, but there are some things to improve, especially asaichi tool, but we are working on that. It should be fine soon.

I: How to ensure effectiveness of lean implementation? What it is necessary for it?

J: It is bunch of actions need to be done. Also, these internal audits that are being carried out. Leaders of each tool should be motivated. I think it responsibility of lean leader to observe how each leader of tools are working, and how they succeed. People need to see results and be awarded.

I: How does LTP know if it has achieved its goals through all these three tools of lean which are being implemented at the moment?

J: I think it is difficult. We are still working on measurements. I know that Kaizen helps to make savings in euros. Just in doubt if it is real numbers or theoretical. Talking about asaichi – it works. Before someone told that problems are not being solved, now it is working. Problems are noted in whiteboards and must be solved.

I: Has LTP used lean agent to implement lean system?

J: Yes, it has been.

I: What is the role of top management in lean implementation?

J: Motivation and to show that lean is necessary. Management needs to understand the importance and they need to communicate that through meetings, slogans or similar things. Then the system will work.

I: Does LTP face any risks and barriers while implementing lean? What are they?

J: That's a good question. I think we have some, starting from people who are not interested in or do not understand the purpose of lean. But it is a matter of time. We will see how it works later.

I: Do you know if LTP has prepared any plan how to cope with those risks and barriers?

J: No, I do not know. But maybe general manager could answer better.

I: What do you know about value stream mapping?

J: I have never heard about it. But I would like to know what it is.

I: Was it introduced by lean agent how to use it?

J: No, at least I have not heard about it.

I: Does LTP has plan to adopt other lean tools?

J: We have four tools in pipeline. One of them is TWI (training within industries) as top priority. There is a risk not to take too many of tool at once, so we will start step by step.

I: Are LTP's suppliers and customers are involved in lean system implementation?

J: Not directly, but I should say, yes. I believe through Kaizen solutions suppliers and customers are involved, or it concerns them in some way as well. Some of our suppliers have lean system in their companies, but majority still do not have.

I: What kind of advantages could lean bring to LTP company and employees?

J: Many. Beginning with Kaizen and 5S which help to improve the workplace, save money; employees might work more efficient which is really crucial for production.

I: Do those advantages have any impact to LTP's business strategy?

J: Sure. Helps to make savings, profit grows, improves production efficiency, we can produce more. Measurements of asaichi help to plan actions before something happens.

I: What is LTP's formula to control and maintain lean system to function?

J: I do not know exactly. I am sure it exists, but it could be better answered by general manager or lean leader.

I: Have you participated in all three lean tools' training?

J: I have attended in two of three tools.

I: Have teachers clearly and understandable conveyed the course information?

J: Sure, teachers were perfect. They knew how to do it.

I: What motivates employees at all levels to be involved in lean implementation process?

J: It depends. Production employees are being motivated financially. It is more difficult to measure at administration level what makes them to be involved.

I: Please, name three factors that would motivate you to attend in continuous improvement process?

J: First of all, visibility of results, and if I do not see results, lean would die step by step for me. Lean should be visible in the company, otherwise, it does not motivate to take any actions.

I: How long shall LTP stay lean? What do you think?

J: Forever. Once we started it, we need to continue it.

I: Thank you for conversation.

The transcription of audio recorded interview (2).

***Informant 2.*** Interview has been carried out in LTP Texdan company.

I: How lean system is being implemented in LTP Texdan company. How do you understand lean system yourself?

G: As I understand it is a common management of the company, implementation of order. Lean was totally new for me; I have heard for the first time about it.

I: Have you ever been familiar with lean system before?

G: No.

I: Did LTP try to implement the lean before?

G: Yes.

I: What was the reasons it failed?

G: Maybe the company tried to implement this system only having it owns knowledge and understanding, but without a consultation of lean agents.

I: Is LTP Texdan able to adjust to changes at this time of the period?

G: I think, it is.

I: What were the reasons LTP has chosen to implement lean system?

G: To improve and once again to improve. The company is growing fast and the support from outside is very necessary.

I: What is your opinion about LTP's choice to adopt lean?

G: Only positive.

I: Should lean implementation be related to LTP's business strategy? Why?

G: Of course. The more the company will control its internal processes, systems and rules, the better and easier it would be for all to work.

I: Is it necessary to have lean implementation strategy and why?

G: Yes, it is. Lean implementation strategy should ensure the clearness how to implement it step by step. We have a previous implementation example, that without clear strategy it is going to fail. Lean implementation strategy should guideline how to act.

I: Who should build lean implementation strategy?

G: Absolutely everybody in the company. Starting from top management to shop floor workers and an external resource such as lean agents.

I: Are you familiar with lean implementation stages?

G: I am only familiar with lean tools' implementation, but not with the implementation of entire lean.

I: Was the importance of lean evaluated before lean implementation?

G: I think it is top management's competence and responsibility to evaluate such conditions before starting the implementation process.

I: Do you know if LTP planned human and financial resources to support lean implementation?

G: I believe, the company has planned it at advance.

I: Are you satisfied with how lean system is being implemented?

G: Yes, I am totally satisfied.

I: How to ensure effectiveness of lean implementation? What it is necessary for it?

G: Since I do not have practice with lean and its new for me, so, I am not able to advice how to ensure effectiveness of lean implementation.

I: How does LTP know if it has achieved its goals through all these three tools of lean which are being implemented at the moment?

G: During the processes of lean we are able to observe the measurements gathered during the morning meetings. Kaizen method shows financial savings.

Has LTP used lean agent to implement lean system?

G: Yes, it has used lean agents' services.

I: What is the role of top management in lean implementation?

G: Being fully involved in the entire process of implementation. Top management should have knowledge of lean and to communicate it further to those who has not learnt yet about it. Also, top management is involved in carrying out audits of the all three lean methods.

I: Does LTP face any risks and barriers while implementing lean? What are they?

G: It is naturally that it could be some risks and barriers during the process of implementation, because it is new for employees. We learn from mistakes and get experience how to improve to proceed further.

I: Do you know if LTP has prepared any plan how to cope with those risks and barriers?

G: No, I have not heard about such plan.

I: What do you know about value stream mapping?

G: I have not heard about it before. I have no idea.

I: Was it introduced by lean agent how to use it?

G: No, they did not introduce it.

I: Does LTP has plan to adopt other lean tools?

G: Yes, it has. At the moment top management is considering what kind of other lean tools could be implemented or should existing tools be more improved.

I: Are LTP's suppliers and customers are involved in lean system implementation?

G: LTP company's customers are informed about lean system adoption in our company, but I do not have information if our suppliers are familiar with lean.

I: What kind of advantages could lean bring to LTP company and employees?

G: First of all, tidy working places, control of processes which is more related with Kaizen, to ensure better working conditions and effectiveness of production. Asaichi helps to rise out existing problems and to solve them. All in all, it also brings financial advantage to the company as well.

I: Do those advantages have any impact to LTP's business strategy?

G: Yes, of course.

I: What is LTP's formula to control and maintain lean system to function?

G: I am not sure what it could be, but I believe that audits which top management carry out helps to control and maintain lean system to function further.

I: Have you participated in all three lean tools' training?

G: Yes, I have.

I: Have teachers clearly and understandable conveyed the course information?

G: Absolutely, yes.

I: What motivates employees at all levels to be involved in lean implementation process?

G: It gives possibility that all employee's problems could be heard and they could improve their working places and time.

I: Please, name three factors that would motivate you to attend in continuous improvement process?

G: positive changes that are visible and effective. These are the most motivating for me.

I: How long shall LTP stay lean? What do you think?

G: Once lean system is started is should continue further depending on top managements' will, believe and enthusiasm. First of all, starting from General Manager, then Head of Lean involvement.

The transcription of audio recorded interview (3).

***Informant 3. Interview has been carried out in LTP Texdan company.***

I: Hello, I would like to ask you some questions regarding lean system implementation. How do you understand lean system yourself?

J: Lean should help for employees, for the company to make processes smoother, leaner, flatter, more efficient. We should search for opportunities how to simplify our daily work and to make them easier to do.

I: Have you ever been familiar with lean system before?

J: Yes, I was luckily to join lean system always from the beginning of processes implementation whatever company I have worked.

I: Has LTP Texdan tried to implement system before? Are you familiar with that?

J: No, I have not heard about it.

I: Is LTP Texdan able to adjust to changes at this time of the period?

J: I am impressed that many workers easily except those changes regarding lean. It feels that they are more motivated to meet changes. It is easy to compare since I have experience from other companies.

I: What were the reasons LTP has chosen to implement lean system?

J: I do not know. But I think every company should aim for more efficient processes, to reduce waste and to be more attractive for our customers.

I: What is your opinion about LTP's choice to adopt lean?

J: Only positive, it is the right choice that has been done.

I: Should lean implementation be related to LTP's business strategy? Why?

J: Of course. If there is no interest from management level, though it requires a lot of time resources, it will be no successful future. It should be 100% support and involvement from top management side.

I: Is it necessary to have lean implementation strategy and why?

J: Every project should have a plan. The company should also have vision where it is going to and to have its clear goals.

I: Who should build lean implementation strategy?

J: Top management by the help of lean agents. But also, including employees of the entire company.

I: Are you familiar with lean implementation stages?

J: Maybe not in detail. I am more familiar lean tools then the implementation of lean as a whole system. I do not really know what should follow in implementation stages.

I: If you could imagine, so how do you personally think lean implementation stages should look like?

J: First of all, it requires to understand lean philosophy. It is also important to communicate further to all employees what are company's goals and intentions with adopting lean. Moreover, to train employees how to use lean tools. Step by step with small improvements, workers will get used to the lean system. Visualizing and sharing the existing problems and outcomes of each lean tool with all workers, helps better to understand the possibilities and advantages of lean. So, it is important to adapt the right tools to the right issues.

I: Was the importance of lean evaluated before lean implementation?

J: I think, in the beginning you have to have some background with statistics, to collect data in order to know in what kind of status the company is. Only after evaluating the internal situation in company, the targets should be set.

I: Do you know if LTP planned human and financial resources to support lean implementation?

J: We have this support for sure.

I: Are you satisfied with how lean system is being implemented? What would you change if you could?

J: Yes, I am satisfied in general with lean adoption. I really like that lean agents consult the company when it is needed. Talking about problem solving, I would go deeper.

I: How to ensure effectiveness of lean implementation? What it is necessary for it?

J: The company has to control if it has reached its lean target or not. If there is no tendency showing the improvement inside the company, then it is something wrong. So, to measure indexes is important.

I: How does LTP know if it has achieved its goals through all these three tools of lean which are being implemented at the moment?

J: Lean announcement meetings once a quarter or once a half year should be held to all employees, presenting financial status, lean statistics and how company is doing.

I: Has LTP used lean agent to implement lean system?

J: Yes, it has been.

I: What is the role of top management in lean implementation?

J: To support, be involved and to understand the need.

I: Does LTP face any risks and barriers while implementing lean? What are they?

J: I have experience that myself yet.

I: Do you know it LTP has prepared any plan how to cope with those risks and barriers?

J: I am not so much familiar with that.

I: What do you know about value stream mapping?

J: I have experience it while working at another company. VSM starts from process evaluation and focuses more on it.

I: Was it introduced by lean agent how to use it?  
 J: No, I did not hear about it in this company.  
 I: Does LTP has plan to adopt other lean tools?  
 J: Yes, it has. But first of all, the need of other tools is being evaluated by top management.  
 I: Are LTP's suppliers and customers are involved in lean system implementation?  
 J: At the moment suppliers are not involved yet. But the necessity could appear later on. F. ex. using IT solutions in purchasing and receiving incoming materials, or finding new solutions for packing which would make the process easier for employees  
 I: What kind of advantages could lean bring to LTP company and employees?  
 J: Reduction of waste, which is related to money saving. I think it is the main purpose and advantage.  
 I: Do those advantages have any impact to LTP's business strategy?  
 J: Of course.  
 I: What is LTP's formula to control and maintain lean system to function?  
 J: Employees should be involved; the measurements should be followed and have enough motivation not to give up. Focusing on it as it is very important for the company.  
 I: Have you participated in all three lean tools' training?  
 J: I have participated only in one of three.  
 I: Have teachers clearly and understandable conveyed the course information?  
 J: Yes.  
 I: What motivates employees at all levels to be involved in lean implementation process?  
 J: Employees should see benefits and results, which bring value and motivate them to be engaged in the process.  
 I: Please, name three factors that would motivate you to attend in continuous improvement process?  
 J: Visible benefits, results, solutions which help to make processes easier and great ideas.  
 I: How long shall LTP stay lean? What do you think?  
 J: It is a continuous process. Employees should always have solutions how to solve issues in production, because everything around the working place and in company itself is also changing. It is never the same, meaning that it could appear new issues and new solutions to solve them.

The transcription of audio recorded interview (4).

***Informant 4.*** Interview has been carried out in LTP Texdan company.

I: Hello, I would like to ask several questions about lean system implementation in LTP Texdan company. How do you understand lean system yourself?  
 K: It is one of management systems and I see it as a journey, which invites us continuously revise, improve process, identify all kind of waste and eliminate. Also, to create value for our final customers.  
 I: Have you ever been familiar with lean system before? Did LTP choose to implement lean before?  
 K: Yes, I have heard about it long ago. LTP company has also lean manager working many years with it.  
 I: What were the reasons it failed last time?  
 K: All organization at that time was not ready, too few resources were used or involved in this process.  
 I: Is LTP Texdan able to adjust to changes at this time of the period?  
 K: We are strong ourselves to adapt to changes and lean is one of the methods which helps us to reach it.  
 I: What were the reasons LTP has chosen to implement lean system?

K: There are many reasons behind it. The most sufficient reason is that we have extended production facilities and we got a task from shareholders to make a factory look professional. Also, we have a pressure on the costs. Moreover, it needs to eliminate wastes, improve the processes, to do all savings that we can by being sharp and smart. The company focus on customers by providing good and fast service: short lead time, delivery precision, low claim rate and other.

I: What is your opinion about LTP's choice to adopt lean?

K: It was necessary to adopt, because the company focus on customers by providing good and fast service: short lead time, delivery precision, low claim rate and other.

I: Should lean implementation be related to LTP's business strategy? Why?

K: Yes, if company aims to be successful it should be implemented in all the highest-level business strategies, supported from shareholders and top management. Moreover, they should show interest in what we are doing now.

I: Is it necessary to have lean implementation strategy and why?

K: Yes, of course. It is an important event. Lean is not only a method, but it is also a change of our employees' culture. It is not simple to have lean strategy, but it should be in place.

I: Who should build lean implementation strategy?

K: In general lean should be driven from shop floor to top, but strategy should be created at top management level.

I: Are you familiar with lean implementation stages?

K: I do not know these stages, but I have my opinion how I see it. Also, lean agents introduced how to start and how to implement lean tools. They showed the way or methods how to do it, how to educate people and how to maintain the system, but we must do it all by ourselves. For me the main key things are: training, implementing and maintaining. But the most challenging thing is to keep what is done.

I: Was the importance of lean evaluated before lean implementation?

K: Yes. And the main factors that provoke to adapt lean was that we are growing rapidly, financial targets and we have expended new production facilities.

I: Do you know if LTP planned human and financial resources to support lean implementation?

K: Yes.

I: Are you satisfied with how lean system is being implemented?

K: The start seems to be very successful since we can compare it with previous attempts that we had before. Now it feels that group leaders are motivated, but we are working on to make it happen from shop floor to top. I hear good comments about lean at our company, so it means that it is really positive.

I: What would you change if you could, or you see that something could be done better?

K: Maybe some small things, but in general I am satisfied with the process.

I: How to ensure effectiveness of lean implementation? What it is necessary for it?

K: The effectiveness is shown through the results, so all together in the company should contribute to improvements and good changes. We have clear targets which we should reach through lean.

I: How does LTP know if it has achieved its goals through all these three tools of lean which are being implemented at the moment?

K: We counting savings brought from each improvement suggestions by our employees. But on other tools it is not easy to measure the savings in numbers. More likely it will be visible at the end of monthly results.

I: Has LTP used lean agent to implement lean system?

K: Yes, it has been.

I: What is the role of top management in lean implementation?

K: To do whatever it takes to involve shop floor workers, to educate them, to support them and it should be involved in all levels of business strategy. For example while managers carry out audits, they communicate and give support to the shop floor workers. Moreover, shareholders time to time are also making audits. That shows to employees that top management also cares about lean and workers efforts.

I: Does LTP face any risks and barriers while implementing lean? What are they?

K: The resistance of employees to be educated. But it is a natural thing that comes together with changes. Employees are not used to it, so top management and group leaders should find the way how to motivate them. Another risk is, to lose all we have created together and not be able to maintain the system in order to function properly.

I: Do you know if LTP has prepared any plan how to cope with those risks and barriers?

K: Yes, we are working on it together with lean agents how to support ourselves, asking for advices how to keep what is done.

I: What do you know about value stream mapping?

K: Yes, I have heard about it, and we are using by the assistance of our lean manager. She is measuring and observing the processes which give less value and trying to find out how to improve and increase value for our customers.

I: Was it introduced by lean agent how to use it?

K: No, it was not introduced this time.

I: Does LTP has plan to adopt other lean tools?

K: Yes, right now we are discussing to adopt new tools for upcoming year.

I: Are LTP's suppliers and customers are involved in lean system implementation?

K: Not directly. Customers know about our process of lean implementation and they are really happy about it.

I: What kind of advantages could lean bring to LTP company and employees?

K: From company perspective we are expecting to increase our profits, from employee's perspective, it would make easier to make some actions and to improve their tasks.

I: Do those advantages have any impact to LTP's business strategy?

K: Of course.

I: What is LTP's formula to control and maintain lean system to function?

K: First of all, involvement from top management, and to succeed to involve all shop-floor workers by educating them, but not making pressure.

I: Have you participated in all three lean tools' training?

K: Yes.

I: Have teachers clearly and understandable conveyed the course information?

K: Yes.

I: What motivates employees at all levels to be involved in lean implementation process?

K: I believe the process itself, because I got previously some comments from our workers that are too little involved in various processes, so now it is the best time to be involved.

I: Please, name three factors that would motivate you to attend in continuous improvement process?

K: In general, I like the philosophy of lean and its idea. I like lean's attitude towards people, because it is close to my personal values as well.

I: How long shall LTP stay lean? What do you think?

K: Lean is a journey and never-ending story if you succeed to keep it.