Developing of a Lean Warehousing Model

– A German Case Study

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Everyone thinks of changing the world, but no one thinks of changing himself.

(Leo Tolstoi, Author)

Abstract

Representing a crucial research gap Lean Warehousing (LW) is often understood as a toolbox rather than a strategic alignment and a philosophy. Therefore, the implementation of LW has systemic flaws due to the lack of philosophy understanding, transformational leadership, and change management, as well as, so far, not considered factors in Warehouse Management. To better understand sustainable Lean Warehousing transformation, it is necessary to synthesise knowledge of these theories.

This research aims to examine why most of the attempts to implement LW fail and why the current theories of LW do not suffice. As a result, there is a need to develop a comprehensible LW model.

The study started with a narrative literature review gathering data about Warehouse Management, Lean Warehousing methods, the standard functions of Warehouse Management Systems (WMS), corporate philosophy and culture, change management, and leadership to identify the scientific gaps and factors for a viable LW model.

The results were then synthesised by an initial conceptualisation and research hypotheses to be validated by empirical research.

This research approach pursues the quantitative survey and qualitative case methods to triangulate the research results. This combines the respective advantages of both methodologies and will lead to higher levels of reliability and validity. Therefore, this approach is considered conducive to developing new knowledge in the field as former studies either used case studies or quantitative surveys and not both.

The study shows a robust correlation between the Lean Maturity Index (LWMI) and the automation grade, which indicates that automation and Lean Philosophy do not exclude each other. Furthermore, the results from the survey with managers from the qualitative survey with those from the quantitative survey show substantial differences regarding the role of leadership and culture. So, on the one hand, the findings of this study confirm the literature which describes that general problems of

LW implementations are based on soft skills like corporate vision, strategy, culture, and leadership and, on the other hand, elicited innovative factors (hard skills) like automation and warehouse software which have a significant influence on LW.

Keywords

Lean Thinking, Lean Warehousing, Lean Logistics, Lean Leadership, Warehouse Management System, Logistics 4,0, Smart Factory, Warehouse Excellence.

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My appreciation also goes out to my family and friends for their encouragement and support throughout my studies, especially to my beloved wife Julia Kallinger.

Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of the University of Nicosia. This thesis has been composed solely by myself except where stated otherwise by reference or acknowledgment. It has not been previously submitted, in whole or in part, to this or any other institution for a degree, diploma or other qualifications.

Signed…………………………..Date…………14.06.2022…………….

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Abbreviations Index

AGV	Automated Guided Vehicle
CIP	Continuous Improvement Process
Cobot	Collaborative Robot
ERP-System	Enterprise Resource System
Host-System	A superordinate system, often the ERP
IOT	Industry of Things
I 4.0	Industry 4.0, the fourth industrial revolution
ERP-System	Enterprise Resource System
JIS	Just In Sequence
JIT	Just In Time
KPI	Key Performance Indicator
LSCM	Lean Supply Chain Management
LW	Lean Warehousing
LWMI	Lean Warehousing Maturity Index
MbO	Management by Objectives
MES	Manufacturing Execution System
PbV	Pick by Voice
PDCA	Plan Do Check Act (Deming Circle)
SCM	Supply Chain Management
SCOR (Model)	Supply Chain Operations Reference (Model)
SI(SI)	Suggestion Ideas (Successful Implemented)
SME	Small Medium Enterprise
TPS	Toyota Production System
TQC	Total Quality Control
WCS	Warehouse Control System
WMS	Warehouse Management System
3PL	Third (3) Party Logistics Provider

Chapter 1 Introduction

1.0 Introduction

Today's supply chains have to cope with volatile markets and high customer demands in a highly competitive global market. The consumer behavior and purchase have also changed regarding smaller but more often purchase offers, which leads to an extreme increase in data information and goods movement in warehouses. Against this backdrop, traditional warehousing is no longer capable of tackling these challenges, but it is vital to include warehouses in the definition of a supply chain as managing inventories is a critical component of effective supply chain management. (Patil, Halegowda and Patil, 2016) Production is faced with the same challenges as complexity in production systems, increasing more and more (Holweng, 2013). The reasons are increasing demand in quality, shorter lead times, shortened product life cycles, and the high increase in variances and lot size one. (Hofmann, 2014). Therefore, organisations strive for low inventory in warehouses to simultaneously reduce costs and increase profitability (Holweng, 2013). Hofmann (2014) proclaims a four-step process mature model. Following this model, production systems started in the early nineties with Computer Integrated Manufacturing (CIM), followed by the Lean Management or Lean Production integration to the segmented and fractal factory. The last step is the so-called industry 4.0 or smart factory. This last step should be a combination of Lean philosophy and automation (Lean Automation). So not only logisticians in distribution centers but also manufacturing warehouses have to deal with this complexity to serve their customers (internal or external) best.

According to ten Hompel, Schmidt and Nagel (2007), the experience shows that high performant logistics and fast material flow systems have a crucial influence on business success, especially in the logistics sector. The traditional distribution system is no more capable of meeting the requirements.

This means logistics are the backbone of global supply chains (Pejic' et al., 2016; Alsaad Yousif, and AlJedaiah 2018; Ab Talib, Abdul Hamid and Thoo 2015), and companies need to have a high-performance IT infrastructure and specialised software for intralogistics processes like Warehouse Management System (WMS) in place to be connected with supply chain partners and to execute complex warehouse operations. WMSs can manage, monitor, and optimise these complex warehouse and distribution systems and track the whole internal material flow.

Further, they are interacting with other software systems like SCE (Supply Chain Execution) systems, by which they are contributing to transparency and efficiency in the overall supply chain. However, the potential of warehousing is still underexploited, and in order to be compatible and profitable, companies are looking for strategies and methods tapping the full potential. Also, customer's expectations regarding delivery speed and accuracy demand even more accelerated and error-free logistics processes. "One efficient strategy for coordinating within and between firms with a focus on eliminating waste, achieving efficiency, or overburden and creating value in products is the concept of lean management." (Patil, Halegowda and Patil 2016, p.354)

Therefore, the latest approach called "Lean Warehousing" adopts Lean Production theory onto warehousing. By introducing lean techniques like 5S, KANBAN, MUDA, and KAIZEN, the efficiency in warehouse logistics processes should be further improved.

The literature review results show that current WMSs are already supporting many of the lean methods on a tactical level, but the elements of analysing and implementing at a strategic level are missing. At the same time, numerous failed attempts in integrating Lean Warehousing point to systemic flaws such as the lack of philosophy and a corresponding leadership style. Only 5 to 7 percent of the companies that attempt to implement lean do so successfully (Byrne, 2013 p. xxi). Garza-Reyes, Tangkeow and Kumar (2018) investigated the adoption status of Lean Manufacturing in the Transport and Logistics sector. They conclude that the application of Lean in this specific sector is still relatively unknown especially compared to the manufacturing sector. They also found out that the barriers for implementing Lean are the "...organizational structure, misalignment between the goals of individuals and their companies as well as a lack of sustainment of a lean culture..." (Garza-Reyes, Tangkeow and Kumar, 2018). Further reasons for failed attempts or not to implement are the lack of understanding of the Lean Philosophy and knowledge and experience. Most of the companies, therefore, trust technology-based tools to improve logistic operations.

The following figure (table 1.1) gives an overview about the research stages, methods, techniques, objectives, questions, hypotheses gaps and main literature sources.

Table 1-1: Research Overview

GAPS: 1. General: LW is still in an early phase and not standardised (Spee and Beuth, 2012, 2015), Kuther and Schaaf (2013), Dombrowski and Mielke (2012), Abushaikha (2018), Bozer (2012) 2. Specific: Missing studies about IT and WMS in context of LW: Shah and Khanzode (2017), Büyüözkan and Göcer (2018), Edirisuriya, Weerabahu and Wickramarachchi (2018)					
Research Objectives (shortened)	Stage	Method	Research Techniq-ues	Research Questions/Hypo-theses (shortened)	Main Literature Sources
RO1: New factors comprising the definition of LWH theory. RO2: Analysing the influence of familiar and new factors WMS, Automation, Asymmetric Relationships on LWMI.	Literature Review	Literature Review	Narrative	Guiding RQ1: Reasons for the lack of implementation of LW in practice? Guiding RQ2: Influence of automation and WMS on LWMI?	Augustin (2009), Kudernatsch (2014), Sobanski (2009), Bozer (2012), Spee and Beuth (2012), Achieng 2018), Kotcharat 2020, Srisuk and Tippayawong (2020), Bukhari, Asim and Manzoor (2020),

					McCrea (2019), Frazelle (2001), Hines (2011), Womack and Jones (2003), Bicheno and Holweg (2009), Koenigsacker (2013)
	Qualit-ative Research	Interview	Semi-structured Interview	RQ1: Differences between LM and LW theory? RQ2: Ideal leadership theory for LW? RQ3: Other detailed WMS factors? Is LW flexible enough for short-term changes? RQ4: Correlation of automation to LWMI? RQ6: Relation between industry sector and LWMI?	Diekmann (2007), Mayring (2015), Laforest (2009), Kurzrock (2014), Mayring (2014)

	Quanti-tative Research	Question-naire	Online and paper-based	H1: Grade of satisfaction of WMS positive effect on LWMI - H01: no positive effect; H2: Automation has a negative effect on LWMI - H02: not negative effect; H3: Leadership is significant for LW - H03: not significant; H4: LW independent on industry sector - H04: is dependent	Rocha Costa (2018), Anderson (2017), Funder and Ozer (2019), Kille and Schwemmer (2019), Duffy et al. (2020), Nemoto and Beglar (2014)
	Triangula-tion		Method and Data Triangula-tion	Manager level vs. Operational level. Are there differences in understanding LW?	Abdalla et al. (2018), Webb et al., Denzin (2009), Fusch et al. (2018), Ashour (2018)

Chapter 2 Research Questions and Gaps

2.0 Research Questions and Gaps

According to Bozer (2012, p. 3), an implementation gap of Lean Warehousing (LW) exists: "Although warehouses and distribution centres are vital facilities in the supply chain, applications of Lean in warehousing have been lagging compared to manufacturing and SCM. This created a gap in knowledge for Lean Warehousing." There are several surveys by researchers like Spee and Beuth (2012, 2015), who state that the field of lean warehousing is still in an early phase of development. Numerous studies like Ahmed und Heyder (2020), Abushaikha et al. (2018), Prasetyawan and Ibrahim (2019), Bashira et al. (2020), and many others measuring the level of efficiency and profitability after implementing lean methods. Although these surveys prove that lean warehousing can improve warehouse operations, there is still no generalisable approach. Until now, there is no holistic, systematic approach that describes the character of LW and how to understand and use it sustainably. This is supported by Abushaikha et al. (2018) in their study about improving distribution and business performance through LW. They describe that most previous studies have been in-depth analysis and survey-based research and therefore do not provide general findings.

This means the implementation gap identified by Bozer (2012) is still not closed, but the efficiency and performance increase after implementation are proven and still not how to implement sustainably.

Furthermore, the factors WMS and automation are still not considered sufficiently. Shah and Khanzode (2017) conducted a comprehensive review of warehouse operational issues and concluded that LW especially lacks empirical surveys and considering IT systems like WMS. They identified even one more gap about a JIT philosophy in terms of the emerging e-commerce market, which is only one method of Lean (Warehousing)

If you consider warehouses as one of the elementary links in the supply chain, the WMS (software) factor becomes even more critical. Büyüközkan and Göcer, 2018 depict this gap in connection with digital supply chains, for which they recommend further research after an intensive literature review survey.

For a general approach, it is also essential to consider all kinds of warehouse operations and not only distribution centers but also warehouses for production supply. In this area, according to Edirisuriya, Weerabahu and Wickramarachchi

(2018) and Psomas and Jiju (2019), there is also a gap and a need for further research to extend their framework for integrating lean concepts along with industry 4.0 technologies to the logistics industry.

Augustin (2009) underpins this in a conducted SWOT (Strengths-Weaknesses-Opportunities-Threats) analysis among companies surveying both experienced and inexperienced users of lean methods. According to this study, the greatest weakness of LW with 57% in the median is that the application is too time-consuming. Further handicaps are the complexity of the method, lack of experience in lean warehousing, and the perception that the implementation is too costly and capacity intensive.

Albeit based on a small sample (see following figure 2.1 and table 2.1), Augustin (2009) examined in his study about LW the diffusion rate of WMS in the industry and found out that from 53 survey participants, more than 80% are already using WMS both in small-medium enterprises (SMEs) and big corporations. Considering this fact, it is indispensable to include the functional scope and the theory about Warehouse Management Systems in this research. Augustin's (2009) study did not draw consequences from that.

Figure 2-1: Lean Warehousing Study (Augustin 2009)

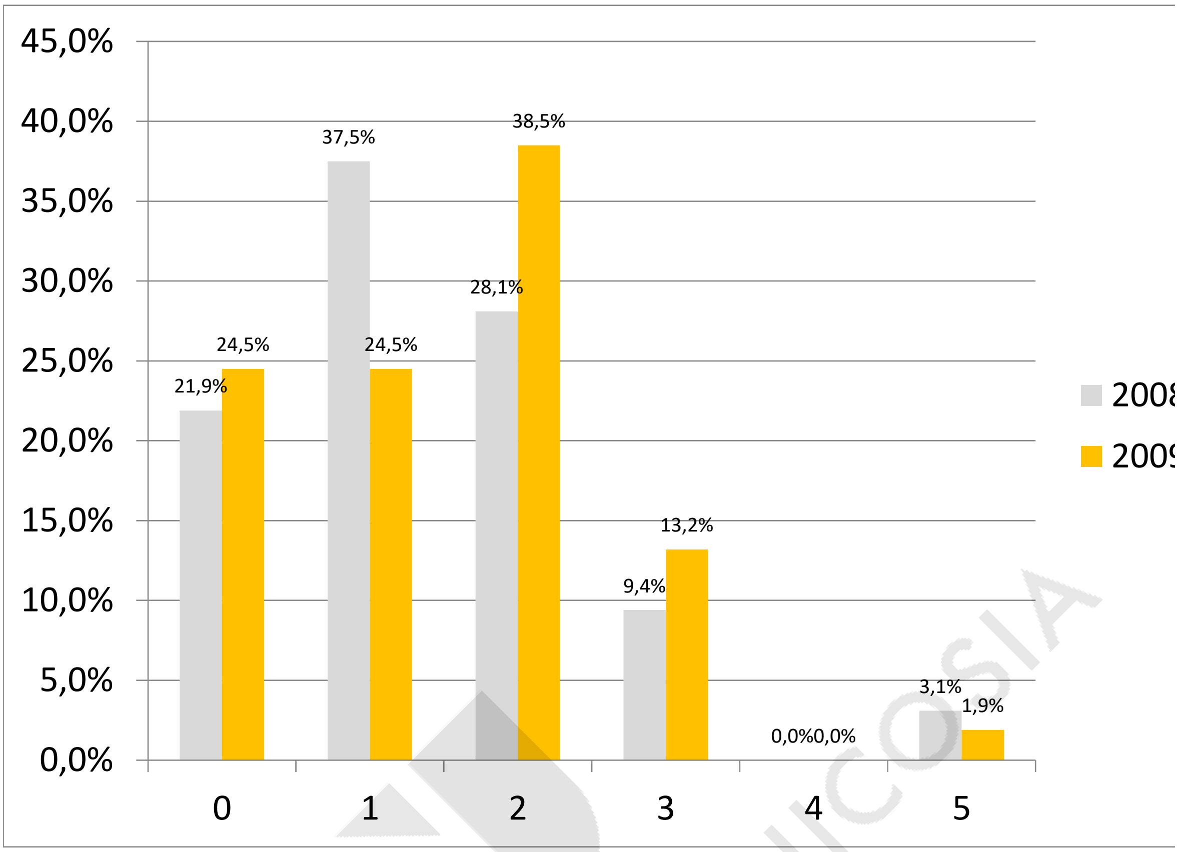


Table 2-1: Lean Maturity Level after Augustin (Kallinger, 2015)

LW Level	Description
0	No systematic. LW is not implemented
1	Lean methods are partially used
2	Some relevant methods are defined and used on management-level
3	All relevant methods are defined and regular used
4	Implemented as a holistic approach, standardised and documented
5	LW and Six Sigma are completely implemented

The toolset for a lean warehouse can be found in a WMS. Logistics software is a critical pillar for every management to run a warehouse efficiently in an increasingly interconnected global competition. Spee and Beuth (2012) think that the importance of logistics and, especially, warehouse logistics will benefit in the long term, and the IT systems will play an essential role. However, this means that the high complexity of processes will demand innovative warehouse management systems and require a more strategic leadership component. McCrea (2013) comes to a similar conclusion in stating that IT systems for manufacturing already provide performance management, but warehouse management system providers are still not at this point yet. Without a doubt, WMS vendors will develop the systems to meet the growing customer requirements. However, according to ten Hompel (2010), vendors are planning to widen the standard functions and to develop flexible interfaces for vertical integration of other systems like ERP (Enterprise Resource Planning), SCE (Supply Chain Execution), CRM (Customer Relationship Management), TMS (Transportation Management System), etc. This will mean that the Lean Warehousing "toolbox" will grow, but the implementation problems of LW as a holistic approach will not be solved by doing this.

These findings from the literature clearly imply that the transfer from lean management into warehouses is still not standardised and afflicted with mistrust, prejudices, and lack of knowledge about the fundamental lean philosophy (Kuther and Schaaf, 2013; Dombrowski, Hellmich and Evers, 2012). That thinking could be reasoned, that in the early nineties when the lean philosophy became widespread in the German industry, the implementation was primarily driven by the economic crisis and the necessity to cut costs and decrease the workforce.

This is supported by Liker (2011), pointing out that Lean Management is a holistic approach that penetrates the whole organisation and its culture and also by Womack and Jones (2003) as they are writing about "… managers who had drowned in techniques as they tried to implement isolated bits of a lean system without understanding the whole". One single method could improve operational success but reflects just one aspect of this comprehensive philosophy. In the same vein, Fueglistaller et al. (2009) mention lack of employee involvement to be another reason for failed lean implementations. Unmotivated people are reflected in company staff turnover rates and absenteeism rates. "It is also a proven fact from analysis of distribution centres in large company networks, that those centres with high levels of absenteeism and staff turnover also have relatively low rates of productivity with higher operating costs.” (Emmet, S. 2005, p. 227)

Vollmer (2012, p.3) describes it very similarly in stating that "not one single transformation has failed by the employees' resistance, but much more on beliefs, which prevails in the company." Conclusively, he maintains that each transformation needs a mindset and a toolset. If one of them is missing, it will fail. Hines and Lethbridge (2008) explain this by the Lean Iceberg model (see figure 2.3). The small top above the iceberg's waterline stands for lean technology, tools, techniques, and processes. This is the smallest part of the lean implementation, which is relatively easily implemented but does not lead to sustainability. The invisible part of the iceberg under the waterline represents strategy alignment, leadership, behavior, and engagement, which is equivalent to the Toyota philosophy as the base in the House of Lean (see figure 4.3).

Figure 2-2: Lean Iceberg Model (Hines and Lethbridge 2008)

In Augustin (2009), a chart about the maturity of LW implementations confirms that from 53 surveyed companies, 98% already implemented LW tools and methods but not as a holistic approach with a continuous LW culture and an established continuous improvement process. The same chart even shows a slight shrinking of companies who have implemented LW comprehensively. The maturity chart of LW shows on the fifth level a decrease from 3.1% to 1.9% from the year 2008 to 2009.

A study about the lean-maturity level of enterprises by Kudernatsch (2014) basically underpins these findings, although, since 2009, there was a slight increase in the highest maturity level with 5% of participants, which could serve as a result as a lean best practice. Seven hundred thirty-two managers or consultants from Germany, Switzerland, and Austria were asked about the reached lean-maturity level (see table 2.2) and if a lean-leadership culture is successfully and sustainably established (see figure 2.3).

Figure 2.3: Lean Maturity Level after Kudernatsch (Kallinger 2015)

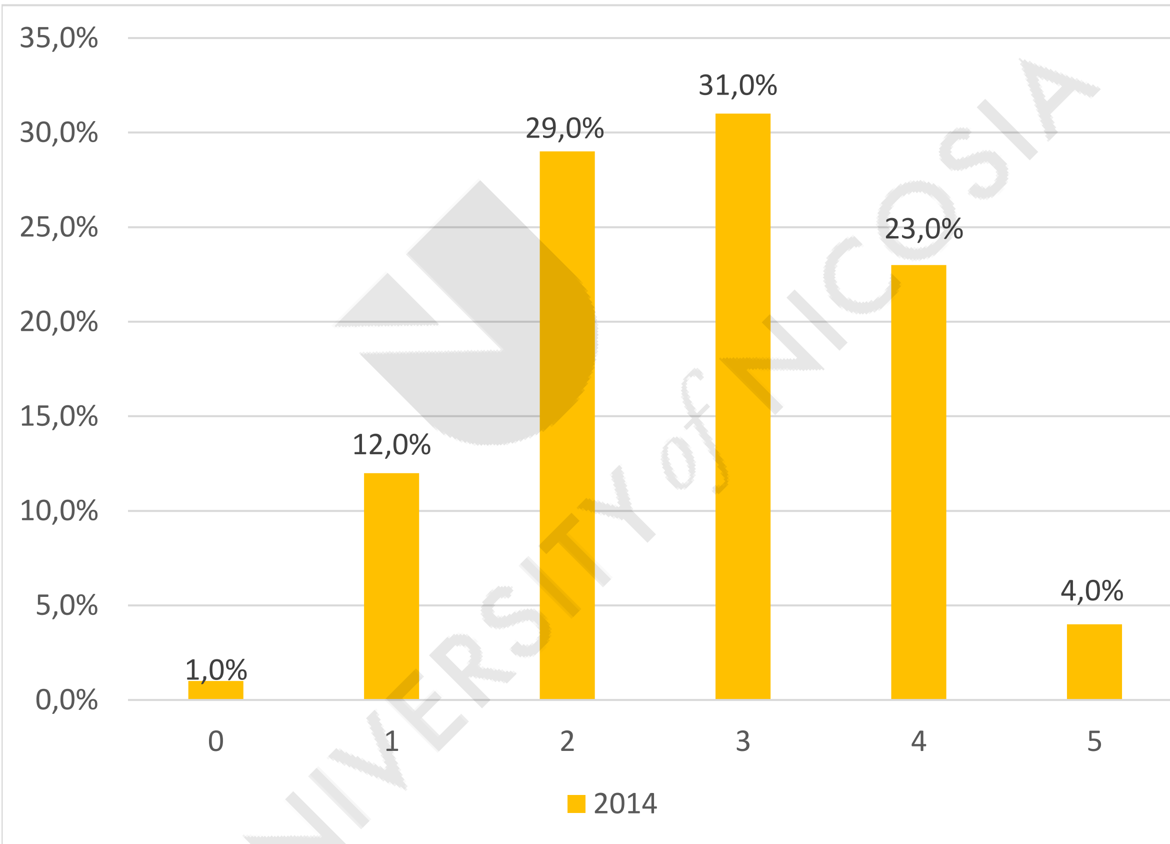


Table 2-2: Lean Maturity Level after Kudernatsch (Kallinger 2015)

Lean Maturity Level	Description
0	No data
1	Critical gaps in Lean-Leadership/ Lean-Maturity-Level
2	Major gaps in Lean-Leadership/Lean Maturity-Level
3	Some serious gaps in Lean-Leadership/Lean-Maturity-Level
4	Minor gaps in Lean-Leadership/Lean-Maturity-Level
5	Best Practice for Lean-Leadership/Lean-Maturity-Level

2.1 Summary

Summarising, the literature research showed that the general problems of Lean implementations are based on the ignorance of understanding and implementing the philosophy in total, which in the first instance means changing the mindset and establishing a new corporate strategy and culture of engaged employees. Employees must be integrated with the top management to master the transformation into a lean company. Therefore, this study will analyse existing frameworks of Lean Management in order to check them for compatibility in warehouse operations to reach better success rates for lean warehousing, which will finally result in a new lean warehousing theory. Specifically, for the implementation of Lean Warehousing, the toolset (WMS) has proven insufficient and needs further development. So, there will also be extensive research of what these systems can do concerning lean operations in warehouses and if they are suited for continuous improvement, which means to have highly flexible configuration possibilities. Also, in context with Industry 4.0, LW needs to be developed. (Evangelos and Jiju, 2019)

The particular relation between warehouse management systems and lean warehousing principles and their implementation will be examined to determine if any additional aspects are not yet identified in the literature.

According to Bozer (2012, p. 3), a general implementation gap of Lean Warehousing, implying, so far, insufficient theories, exists. In addition, several researchers (Spee and Beuth, 2012; Sobanski, 2009; Furmans and Wlcek, 2012) measured the level of efficiency and profitability of implemented lean methods. However, all these surveys do not differentiate Warehouse Management from Lean Warehousing and also do not differentiate between a diverse group of users like manufacturers, suppliers, and logistics service providers (Spee and Beuth, 2012). Especially 3PL (Third Party Logistics Service Provider) providers do have specific system requirements for Warehouse Management as they serve many different customers from different industry sectors in often asymmetric relationships. For example, the Rudolf Logistics Group, which is offering its services to companies in the automotive sector, decided to develop software independently because standard approaches could not fulfill all requirements (Spee and Beuth, 2012).

According to the identified gaps, the guiding research questions are:

What are the reasons for the lack of implementation of the Lean Warehousing theory in warehouse practice?

What influence does the grade of automation and WMS have on the Lean Warehousing Maturity Index?

Chapter 3 Research Aim and Objectives

3.0 Research Aim and Objectives

3.1 Research Aim

This research aims to examine why most of the attempts to implement LW do fail and why it is so rarely used and why the current theories of LW do not suffice. As a result, it is expected to develop a viable model for LW, which considers all relevant success factors.

The literature review showed that most companies only implemented some LW tools (“low hanging fruits”) and not the holistic Lean philosophy. Therefore this research focuses on all known and unknown factors which are barriers for a viable implementation of LW.

In contrast to LW, the Lean Manufacturing approach is commonly acknowledged, and numerous successful implementations testify its effectiveness (Achieng, 2018; Kotcharat, 2020; Srisuk and Tippayawong, 2020; Bukhari, Asim and Manzoor 2020; Sobanski, 2009) and would be a solid base to master the fourth revolution of industry the so-called Industry 4.0 (I4.0) Hence, taking the Lean Philosophy theory as a model guiding this research, the general research question is what differentiates LW from Lean Manufacturing theory which is commonly acknowledged and approved and what are the success factors? One fundamental difference is that warehouses often serve multiple customers and interests, not only the manufacturing shop floor. Therefore, a newly to be developed LW theory should embrace multiple stakeholders.

Representing a crucial research gap, LW is currently understood as a toolbox of methods and software rather than a strategic alignment theory and a philosophy. Therefore, the implementation of current LW results in systemic flaws due to a lack of understanding and integration of corporate philosophy and culture, leadership, and change management and, so far, not considered factors in Warehouse Management. To better understand viable Lean Warehousing transformation, it is necessary to synthesise knowledge of these theories.Due to the researchers' background as a Senior Consultant for WMS with excellent contacts in this industrial sector, this research will be "limited" to the German market but not limited to any industry sector. Moreover, Germany is by far the largest market for logistics in Europe by obtaining a sales turnover of 279 Billion Euros in 2020, representing more or less twice the turnover of France as the second-largest country (Keller, 2022). Also, the world bank research Connecting to compete for 2016 points to Germany as the best-performing country with a Logistics Performance Indicator (LPI) of 4.23 (Arvis et al., 2016). The LPI considers the following six components:

1) The efficiency of customs and border management clearance
2) The quality of trade and transport infrastructure
3) The ease of arranging competitively priced shipments
4) The competence and quality of logistics services
5) The ability to track and trace consignments
6) The frequency with which shipments reach consignees within the scheduled or expected delivery times (Arvis et al., 2016, p. 6)

As a result, it is expected to develop a viable LW model which closes the theoretical gaps and complements the current Warehouse Management theory. As a practical output, this study can be a guideline for companies planning to transform their warehouse to a Lean Warehouse that also meets the requirements of Industry 4.0 standards.

3.2 Research Objectives

Research Objective 1 (RO1):

To develop new factors comprising the definition of Lean Warehousing theory to develop an innovative Lean Warehousing theory.

Research Objective 2 (RO2):

Analysing the influence of shared and newly identified factors WMS, Automation, Asymmetric Relationships and industry sector on Lean Warehousing Maturity Index.

Chapter 4 Literature Review

4.0 Literature Review

4.1 Warehouse Management (Systems)

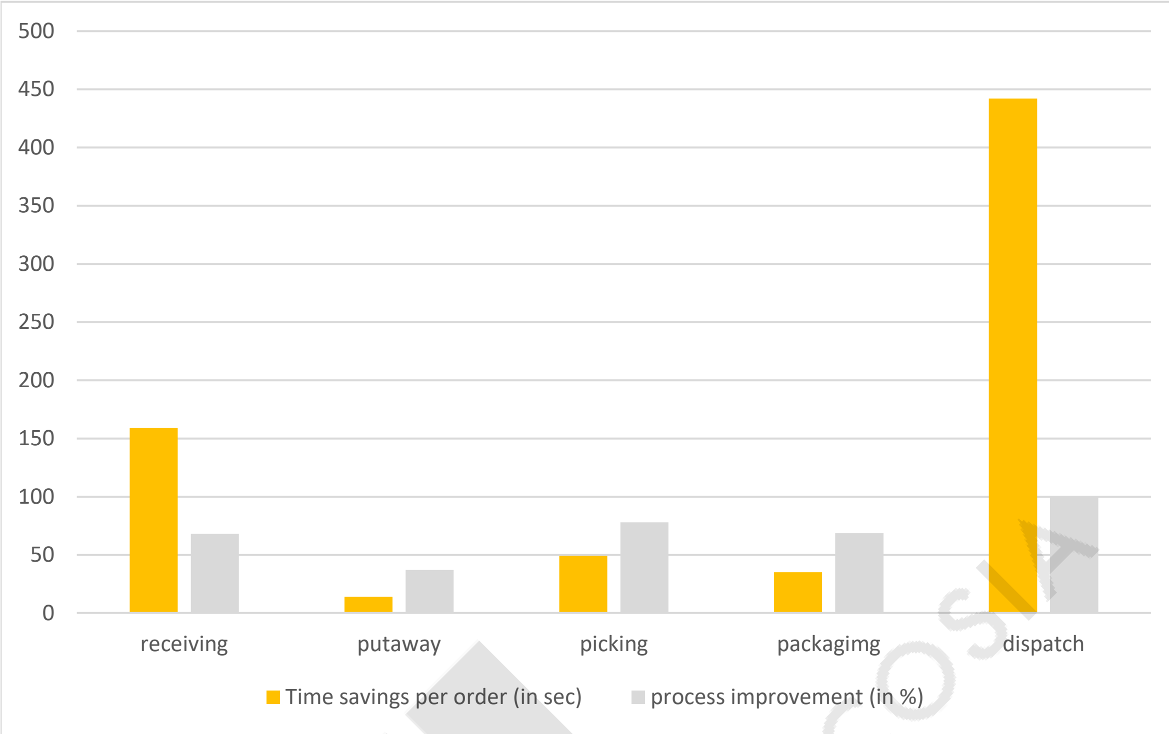
Keller and Keller (2014) define Warehouse management as follows: "Process management is the essence of successfully managing warehouse operations. Mapping out the dynamic flow of goods and the accompanying value-added services (VAS) in an active warehouse is the first step to attaining management success. It is imperative to eliminate process variations and ensure full employee understanding of the process — particularly their specific portion of the process. Establishing and tracking metrics along with the integration of available technology can enhance the efficiency of warehouse operations by enabling continuous improvements to processes." (Keller and Keller, 2014, p. 87)

The used term VAS already gives a hint that a WMS is a customer-oriented system that "helps to perform the value-added services as needed." (Andiyappillai, 2020, p. 25) and creates value in the supply chain, which is a fundamental principle of the lean theory. In general, Andiyappillai (2020) defines a WMS as an IT System that helps to manage inventory and communicates and collaborates with all logistics partners, thus implies the control and optimization of the physical and the informational flow and enhancing warehouse activities and resources at the same time (Minashkinaa and Happonen, 2020)

These definitions of Warehouse Management clarify that warehousing is a very complex area of business operations that needs permanent monitoring by measuring KPIs and also needs highly motivated operators to be enabled for continuous improvement.

Ramaa, Subramanya, and Rangaswamy (2012) provide a more technical definition of WMS in stating that "…a warehouse management system (WMS) is a database-driven computer application, to improve the efficiency of the warehouse by directing cutaways and maintaining accurate inventory by reducing warehouse transactions." The warehouse efficiency improvement was proved by case study (Ramaa, Subramanya and Ragaswamy, 2012) as they could measure the following warehouse process metrics (see figure 4.1)

Table 4-1: Warehouse Efficiency Improvement Study (own representation after Subramanya and Ragaswarmy, 2014)



Richard (2014) has a more simple definition of warehousing. "A warehouse should be viewed as a temporary place to store inventory and as a buffer in supply chains. It serves, as a static unit — in the main — matching product availability to consumer demand and as such has a primary aim which is to facilitate the movement of goods from supplier to customers, meeting demand in a timely and cost-effective manner" (Richard, 2014, p. 6). The definition of Richard seems to be more straightforward as he is not mentioning that it needs a highly flexible and efficient process to meet the customer demands but makes clear that a warehouse does play a vital role in the supply chain and is not an isolated link. Therefore, warehouses can be categorised according to their different tasks in the supply chain:

- Raw material and component warehouses
- Work-in-Process (WIP) warehouses
- Finished Goods warehouses
- Distribution Warehouses and distribution centres (DC)
- Fulfilment warehouses and fulfilment centres
- Local warehouses

- Valued-Added Service warehouses

(Frazelle, 2001, p.X)

Richard (2014) is adding some more categories:

- Consolidation centres and transit warehouses
- Transshipment or break-bulk centres
- Cross-dock centres
- Sortation centres
- Reverse logistics centres
- Public sector warehousing

However, regardless of what kind of warehouse, there is a set of basic activities in common:

- Receiving
- Pre-packing (optional)
- Put-away
- Storage
- Order Picking
- Packaging and or pricing (optional)
- Sortation and or accumulation
- Unitising and shipping

(Frazelle, 2001; Tompkins and Smith,1998; Zunic, Hasic and Delalic, 2020; and many others)

In the meaning of Lean, all unnecessary movement or every handling which does not create value for the customer is waste. (Klodawski et al., 2017) So handling and high stocks are waste and should be avoided because they add costs in the supply chain the customer is not willing to pay for. Costs can be differentiated between capital cost, insurance, technical equipment, human resources, and stock keeping costs (Khan and Yu, 2019), representing a large percentage of logistics costs. (Buonamico, 2017)

Logistics costs typically are between 5 to 10% and depend strongly on the industry sector and company size. This is confirmed by a study by Handfield et al. (2013). The highest cost occurs in materials and mining with 13% and chemicals and plastics industries with 10%. Another influencing value to logistics costs is the size of the enterprise. Smaller companies tend to have higher logistics cost than large companies because they can benefit from economies of scale. Another factor is the product value. Companies with high-value products tend to have proportionally lower logistics costs at about 3% than those with low product values at about 9%. For example, healthcare companies in the UK with very high-value products and typically large companies having overall logistics costs of 3.25%. Whereas the food and beverage industry with low-value products having overall logistics costs of 13.74% (Rushton, Croucher and Baker, 2014). This is confirmed by a study by Handfield et al. (2013)

Warehousing plus the carrying costs for the inventory typically account for 40 to 55% of the overall logistics costs (Rushton, Croucher and Baker, 2014), and warehousing costs alone take up between 2% and 5% of the sales of enterprises (Hwang and Cho, 2006).

"Warehouses have, in the past, been constantly referred to as cost centres and rarely adding value. The movement of production to the Far East, the growth of e-commerce, and increasing demands from consumers have seen a step-change in warehouse operations. Warehouses are now seen as a vital link within today's supply chains." (Richards, 2014, p.5) The study of Bagais and Aljaaidi (2020) evaluated the association of information technology (IT) supply chain management and logistics capability onto competitive advantage and could finally find significant positive correlations, so it assumed this is also valid for LW.

"Warehouse Management is often thought of as being just an active day-to-day job. However, it should also be involved in the longer strategic aspects of the business. Warehousing has a critical part to play in supply chain management, and it can only play this part if it is involved in strategic aspects of the business. This will involve being aware of the expected development of the business in terms of the future:

- Production
- Product
- Suppliers
- Customers
- and all the associated product volumes and throughputs." (Emmet, 2011, p. X)

These statements clearly point to the missing factor "Stakeholder" and imply close cooperation with all departments of an enterprise as well as the upstream and downstream links in the supply chain. This is from enormous interest in optimized processes with harmonised processes across all involved parties.

According to ten Hompel and Schmidt (2010), "Warehouse Management encompasses the control and optimization of complex warehouse and distribution processes, and it depends on the tasks to be performed, and on the market, the warehouse operates in…and both on the complexity of the warehouse task and on the dynamics of the market". (Faber, de Koster and Smidts, 2012, p. 1231) This hints that Lean Warehousing also depends on the market the enterprise is doing its business.

➔ **New WMS factor: Industry sector**

Due to the enormous costs of warehousing, managers are interested in concepts and methods like LW to decrease these costs and shape processes as efficiently as possible. Van den Berg (2007, p.24) describes it consequently with "The lean configuration could seriously harm the economies of scale in order processing, transportation, and warehouse handling, not to mention the potential impact on customer service levels."

To cope with increasing demands and costs in the supply chain and the need for efficient processes, van den Berg (2007) introduces a new warehouse management approach called Integral Warehouse Management, especially for use in a distribution center.

"Integral Warehouse Management proposes a systematic methodology for improving the performance of the distribution center. The methodology distinguishes itself from the current generation of techniques and methodologies for two reasons:

1) It advocates a new line of thinking about logistics optimization that looks beyond the more explicit directions.
2) It capitalises on the detailed data captured by modern information systems."

(Van den Berg, 2007, p. 11)

The model also provides a growth path from a poorly organised distribution center to a best-in-class operation. The growth path distinguishes four maturity stages:

1) Reactive Warehouse Management
2) Effective Warehouse Management
3) Responsive Warehouse Management
4) Collaborative Warehouse Management (van den Berg 2007)

Van den Berg (2007) already considers WMS as a vital management system for warehousing as WMS's control all the activities in the distribution center, such as put-away, storage, and order-picking, and records all activities in detail. However, at the same time, he claims that "current systems hardly take advantage of this opportunity". (van den Berg, 2007, p. 15) This considerable amount of data recorded by a WMS provides valuable input for more sophisticated performance indicators, which will be used in the approach of Integral Warehouse Management "…to compute more valuable management information." (van den Berg, 2007, p. 15) Analytics for performance evaluation, process analysis, supply chain collaboration as well as advanced planning and control methodologies "…that capitalise on these detailed data….".

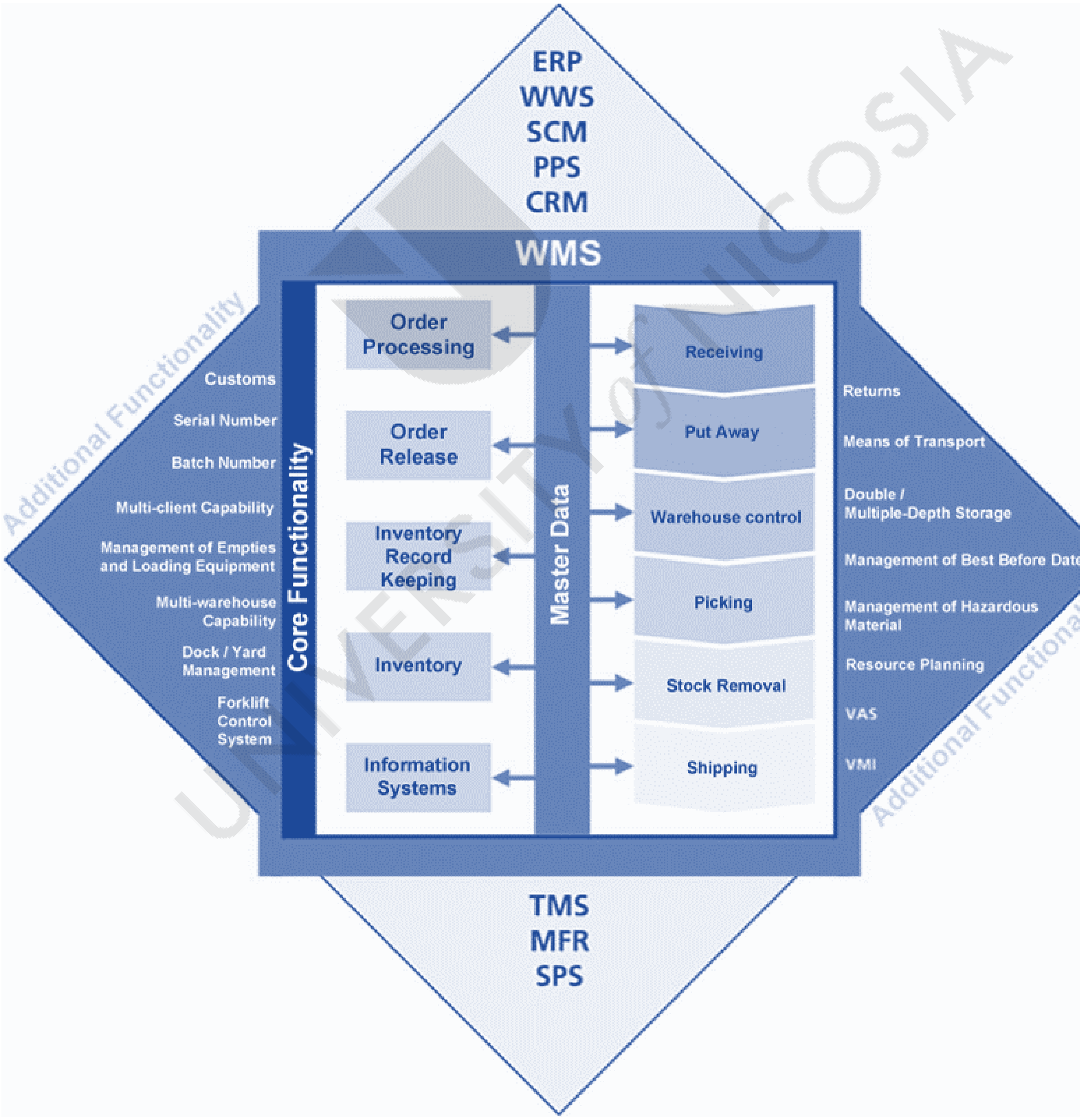
Further on, van den Berg states that "…modern information systems capture highly detailed data on the logistics activities. However, the current generation of warehouse management systems (WMS's) derive little benefit from these data." (van den Berg, 2007, p. 15) This lack of functionality in WMS's points to the missing factor "lack of functional toolset in WMS."

➔ **New WMS factor: Lack of toolset**

Since 1957, there are software systems for warehouses on the market. First, it was just used to administer quantities and storage locations and their relationship (ten Hompel et al., 2010). The systems on the market today are much more sophisticated and have a much broader scope of functions. They are responsible for managing, monitoring, and optimisation of complex warehouse and distribution systems. In addition to the fundamental functions of warehouse management, they also include various methods and means for controlling the system states and a broad selection of operating and optimization strategies. In terms of optimisation, warehouse management systems support the warehouse manager with necessary information. After ten Hompel and Schmidt (2010), the principal task of a WMS is to manage and optimise the internal warehouse systems. However, some specialised WMS vendors offer some additional functionalities which go further, e. g. in promoting modules like dock and yard management, resource planning, and modules to control automated warehouses with conveyor systems and stacker cranes.

Therefore, a WMS helps to make the supply chain lean in total. In logistics, efficient communications are becoming important, especially in the international context, because it is about the physical distribution of goods and the coordination of the flow of information (Hausladen, 2011). Günthner and Heptner (2007) supporting this definition and see in WMS more than just a simplification of the goods in and goods out process in having no more barcodes to read but with a system that can track the whole material flow along the complete supply chain. "Expansion modules, such as RFID software or Pick by Voice, are usually separate software packages that expand the functionality of a WMS or optimise the processes within a warehouse" Bodden-Streubühr et al. (2014). This could categorize the products into ABC categories after their cycle time to put the most needed items in lower levels and near the dispatch zone to reduce the handling effort. Baudin (2004) underpins this by stating that companies, who can identify their high movers from a pick history list, can locate them optimally within the shelving systems to maximise production efficiencies and minimize wasted time and effort. The following figure 4.2 shows the typical scope of functions of standard WMSs.

Figure 4-1: WMS Scope of Function (www.warehouse-logistics.com)



Frazelle (2001) describes World-Class Warehousing in his publication of the same tenor. He emphasises that the process of selecting, justifying, and implementing a WMS can raise a warehouse to world-class status or set the operation back ten years. He also claims that the reasons for a bad performing warehouse are prescriptions that are written and implemented without much examination and testing. Furthermore, due to the lack of knowledge, tools and time, many warehouse redesign projects started without understanding the root cause of the problems and without exploring the real opportunities for improvement. Frazelle (2001) also mentions warehouse practice related to lean as he writes about "Soko circles”. Soko is the Japanese word for warehouses and describes a quality circle where a group of workers meets to coordinate problem-solving for quality issues.

Nevertheless, in general, Frazelle (2012) and Richards (2011) discuss picking techniques, warehouse layout, storage, and handling equipment and personnel management. In contrast, Myerson (2012) focused on supply chain and logistics management and provided a comprehensive overview of Lean principles to improve supply chains and logistics efficiency. From his point of view, many companies start with lean implementation in the warehouse before rolling it out on the supply chain because warehouses become a strategic component to be used for a competitive advantage. According to Myerson (2012), there are several critical success factors for lean transformation. First, it is essential to establish lean training for the entire organization to understand the lean philosophy. Further, it needs support by the management, which is actively driving and supporting the change with solid leadership. It also requires a full-time Lean Champion, Lean Coordinator, or subject matter expert responsible for creating kaizen events, and finally, teamwork is fundamental.

The diversity of the solutions offered, and the diversity of the system requirements demand a comprehensive WMS knowledge and experience in designing and operating such systems. There is a confusing variety of aspects to weigh, and the decision may be critical to the success or failure when selecting a system. At the same time, the systems are inevitably matured to a level of complexity that overwhelms the user occasionally (ten Hompel and Schmidt, 2010). Nevertheless, some modules still need further development, like vertical integration of other IT-

Systems that are still not standardized (ten Hompel and Schmidt 2010). E.g., the module "Information Systems" (see figure 4) does not offer proper key performance indicators, which are vitally important for measuring lean standards.

"Logistic indicators are figures to reflect quantitative, measurable up-to-date situations in the logistics area in a concentrated form" (ten Hompel and Schmidt, 2010, p. 67). According to Richards (2014), the warehouse performance can be measured by just one primary KPI called OTIF, which stands for On Time In Full. This indicator contains beside the percentage of orders delivered in time, and for the perfect order metric (POM), you also add the percentage of damage-free orders and correct documentation, invoice, and label.

Example:

On-Time delivery = 98% and in full delivery = 97,5%

Damage free = 99% and accurate documentation = 99%

On **T**ime **I**n **F**ull (OTIF) = 95,6% (98% x 97,5%)

Perfect **O**rder **M**etric (POM) = 93,4% (98% x 97,5% x 99% x 99%)

A further significant key performance indicator (KPI) is the Warehouse Quality Performance Indicator (Frazelle, 2013) which considers put-away, inventory, picking, and shipping accuracy.

KPIs are standard metrics and graphs used to monitor if the targets or outcomes of the warehouse are according to the expectations. They also provide a benchmark for a comparison with what actually happened against the outcome expected. (Emmet, 2005)

Ackermann (2003) proclaims that you should take four areas into account for the performance measurement of a warehouse. These are reliability, flexibility, costs, and asset utilisation.

However, depending on what kind of warehouse should be measured, specific demands are needed to settle KPIs. Kolinska and Cudzilo (2014) depicts the following differences between distribution and manufacturing warehouses (see table 4.1)

Table 4-2: Comparison off KPIs Retailer and Manufacturer

Retail/3PL	Manufacturer
Cost as percentage of sales	Logistics costs absolute
Fixed cost/variable cost split and year on year change	Cost per line/order
Year on year cost increase versus year-on-year sales increase	Units/cases per person-hour
Inventory value change versus sales value change year on year	Management fee/incentive won/lost
Freight costs as a percentage of costs of goods sold	Pick accuracy
Costs as a % of sales per product	Service level — delivery to schedule
Waste costs (late delivery, return rate, etc.)	Direct/indirect hours
Segmented cost to serve, e.g., product/store format/channel	Lost time/costs
On-shelf availability/lost sales opportunity	Cost per pallet /seasonal flexibility

KPIs are vital to monitor and manage warehouse operations but having the right indicator at hand is also vital. In terms of a lean approach, the KPIs become even more vital as the initiated changes have to be tracked and if the operations are more efficient than before. According to (Faveto et. al., 2021) the average number of used indicators to evaluate a warehouse is 5.5. Indicators can be grouped into three clusters: 1. Economic aspects 2. Environmental aspects 3. Social apects. Nearly 80% of the identified indicators were economic related like quality, cost, delivery which is typically standard scope of a WMSs. However, the softer indicators of safety and motivation, which also represent the company's culture and leadership style, are not represented. Examples of safety measures are the number of accidents and the rate of suggestion ideas. Examples for morale measured: Examples for motivation measures are absence days, lateness, staff turnover rate, number of suggestion ideas, job satisfaction, promotions, training days, appraisal ratings, and contact's managers/staff. (Emmet, 2005, p. 237-238)

Furthermore, a KPI system for LW must also contain soft factors like health and safety metrics, customer and employee satisfaction, as well as the number of suggestions ideas (Japanese term: souikufuuseido), which seems to be a significant indicator for the employee for employee satisfaction as only motivated employees will make suggestion ideas (SI).

Toyota, for example, has had 40 Million SI in total since 1951, and between 1995 and 2011, 10 Million SI which means a median of 625.000 SI per year. In 2014 total Toyota has a total of 338.875 employees which means they have a SI rate of 1.84 (SI rate = SI per employee/year; 625.000 SI/year / 333.875 employees = 1.84). Further on, 90% of all SIs were considered and introduced (http://www.toyota-global.combal.com), which means a successful implementation rate of (SISI) of 1.656 (90% x 1.84).

In comparison, according to a survey from 2010/11 by DEKRA from 163 companies, the German industry median was a SI rate of 61 per hundred employees, which means 0,61 SI per employee and year. From all SIs, 69% were positively rated and considered, and implemented. Consequently, it correlates to a SISI score of 0,42, which is approximately one-fourth of the SISI score of Toyota. Nonetheless, the German industry could achieve overall savings of 1,46 Billion € by implementing these SI. Table 4.2 shows the number of SI´s per industry (Dekra, 2010/11)

Table 4-3: Number of SI compared per Industry Sector

Industry Sector	No. of SI per year/per hundred
Automotive Supplier	2,38
Electrical Industry	1,11
Machine Building	1,05

Lean warehousing is a general approach that could be used for any kind of warehouse and any kind of industry. Therefore, it is paramount for this study to use a general indicator to get general comparability. This indicator must comprise factors relevant for a logistics service provider, supplier, and manufacturer and give feedback not only for economic data but also social and environmental data.

➔ **New factor WMS: KPIs**

Further lacks were figured out by Tilp (2016). He claims that WMSs should be more directed into Logistics Assistance Systems, which help the warehouse manager in complex decision-making processes. Graphical control of process workflow and online visualisation of material flow are further needed developments. Tilp (2016) claimed these functional lacks at WMS vendors:

- Graphical control and process workflows
- Prioritising and Traceability of orders
- Displaying relevant indicators
- Visualisation (e.g., Andon-Boards)
- Shop-floor-Management
- CIP integration
- Knowledge platform (WMS Tutorial, Lean Methods, Warehouse Management, etc.)

Leading WMS vendors already announced new functionalities which try to close these gaps. Especially the self-configuration by the customer is being promoted, which allows the key-user to parametrise picking strategies, programming interfaces to new customers or sub-systems, and modeling new warehouse sites and functions for monitoring and analysing warehouse operations (Schrüfer, 2016).

➔ **New factor WMS: Missing functions**

4.2 Warehouse Automation

Due to increasing international competition as an effect of the still ongoing globalisation, companies are forced to (re)arrange internal logistical processes more efficiently, as warehouse processes determine delivery times and service levels and thus influence the efficiency of the entire supply chain (Behnisch et al., 2017). The logistics market is encountered by increased e-commerce, mass customization, omnichannel distribution, and just-in-time philosophy. According to Custodio and Machado (2020), companies applied more and more automation in a warehouse to meet these challenges and dynamic changes. On the other hand, they also address some research pointing to a certain lack of flexibility for those automated systems and being a bottleneck.

The proliferation of automation like robots and automated guided vehicles (AGV) in the warehouse is also driven by the need to manage short-cycle operations with limited human resources. A survey about the implementation and usage of automation solutions in warehouses in 2019 (McCrea, 2019) proves this development. The survey assessed what kind of automated systems are being used at present and which automatic systems companies are interested in for future usage in warehouses. The survey identified the main aspects ("very important") which companies are considering before they invest:

- durability, reliability, and uptime (90%)
- support/service response time (82%)
- total cost of ownership (TCO), return on investment (ROI), and maintenance costs (81%)

- integration and compatibility with existing equipment (72%)
- parts availability, risk of obsolescence (68%)
- purchase price (62%)
- warranty programme (55%)
- scalability (46%)
- turn-key solution (45%)
- relationship and experience with a vendor (41%)
- leading-edge solution (38%)
- energy efficiency (22%)

This ranking considers only financial aspects (ROI, TCO, purchase price) and aspects concerning system availability like uptime, service response time, parts availability, and the only exception as a process-driven aspect is scalability.

This is a hint that automation is not in complete harmony with the Lean Philosophy respectively Lean Warehousing as the permanent change and flexibility of the system is needed to adapt the processes to the always-changing requirements and to add value.

Balys et al. (2020) sum up the advantages of automation very drastically in saying that automation primarily saves space and labor costs and has an availability of 24 hours a day. This is also saving other operating costs such as heating and lighting. "In addition, automation provides the possibility of scalability and flexibility of capacity, which is extremely important in e-commerce environments, where one can find a large variation in demand.” (Balys et al. 2020, pp 271-272)

Also, Behnisch et al. (2017) outline that there are so many innovative technical solutions that would help companies tap the full potential, but most of the companies still have not exploited it.

McCrea's (2019) study reports that 42% of respondents have either a fully or partially automated conveyor, while 38% have fully or partially label applicator machines during the outbound process. These companies are also planning to increase their utilisation of warehouse space, picking efficiency, order accuracy, throughput time, and they also strive for a reduction of labor.

“Warehouse logistics was one of the first to respond to systemic changes in technology and introduced elements of robotics and artificial intelligence” (Marchuk, Harmash and Ovdiienko, 2020, p. 49) and invested and implemented new automation trends like robots, drones, or AGV's. The reason for this is the constant and still increasing demand in logistics and more efficiency in the warehouse and the supply chain in general. (Marchuk, Harmash and Ovdiienko, 2020). This means the authors arguing that logistics is driven to invest in automation as supply chain management is a fast-changing field of economic activity and needs to keep pace with the development of automated systems and concepts.

On the other hand, Marchuk, Harmash and Ovdiienko (2020) agrees that logistics has to deal “…with different types of companies, different goods, different countries and continents, different cultures and management styles." (Marchuk, Harmash and Ovdiienko, 2020, p.32). This also emphasizes social and technological aspects, which is also a vital pillar of the Lean Philosophy.

Therefore, it is of great importance to not only trust the automation and to "drown in technology" (Grassner, 2019) and focus on the people and not to over-engineer a process that would also be a waste in the sense of LW. Frazelle (2016) describes that automation is a way to streamline and manage a complex process or make a complex process more efficient.

On the other hand, Frazelle (2016) argues that automation is inherently complex and can generate a squared complexity if applied in complex processes. Instead, the correct approach would be to simplify and streamline a complex process first, and after that it could be probably useful to automate, or it is no more needed as the process is that simple and consistent enough. “Automation should not be the first, but rather the last resort." (Frazelle, 2001; p. 29)

A study from Wissenschaftszentrum Berlin for social research in the automotive industry concludes that lean management and reorganisation of work lead to more significant productivity gains as the use of the technique. The researcher observed the development within a period of more than 20 years, beginning from the early 1990s to 2016. (Steiger, 2016). On the other hand, companies are forced to long-term investments in automation due to the increasing labor shortages and high processes for construction grounds. (Faber et al., 2012).

Automation in Lean Production is well known and has its own wording like Jidoka, which means automation with a human touch (Ohno, 1988), and Chen (2010) called it Lean Automation and defined it as a robust, reliable, and simple automated solution that is about applying the right amount of automation to a given task.

4.2.1 Summary and conclusion

The market has changed from a mass market to a mass-customised market with a wide variety for each product, and small lot sizes down to lot size one. E-Commerce boom and omnichannel distribution and mass customization are challenging the typical warehouses' design with automated solutions as these systems are predominately not flexible enough for permanent changes and one-piece-flow as they have fixed structures. Exceptions for flexible and agile solutions are, for example, AGV's with swarm intelligence. This system uses artificial intelligence and communication to reach an optimum output and shortest routes without bottlenecks and waiting time.

An investment in automation is easier to calculate and promises an apparent gain in performance and is easy to measure. In contrast, an investment in Lean Warehousing is more or less incalculable as it means investing a lot of resources (time and money) in training and establishing the philosophy without knowing which output it will deliver and when. This seems to be the reason why managers prefer investments in automation and not into a lean transformation process (Grube et al., 2017). Bukhari, Asim and Manzoor (2020) also conclude that companies made progress in technology but have not focused on implementing lean warehousing. The criterion automation is a new factor to be considered for LW.

➔ **New WMS factor: Warehouse Automation**

4.3 Mega Trends in Logistics and Warehousing

For a holistic picture of the logistics sector, it is also necessary to know the current trends as they may have influence on LWI either as a show-stopper or as driver.

The study from Keller, S. (2020) describes artificial intelligence and automation as a viatal contribution for many innovation logistics. 34% of the companies surveyed, said that robots and automation were very important. Whereas 38% considered Augmented Reality AR and wearables to be less relevant. The following sub-chapters give an overview about the most important megatrends. (Keller, 2020; Zagurskiy, 2020)

4.2.2 Big Data

The business drivers of logistics and big data are gaining in quality and quantity (BVL 2014). The main drivers are cost pressure, rising customer demands, lack of skilled workers, process standardisation, but also digitalisation and automation of works order. Therefore, enterprises are looking at big data as it bears a great opportunity to gain deeper insight into operations and processes. With around $900 billions of waste in global manufacturing supply chains (N.N., IDC Manufacturing-Zebra, 2016), there is a vast untapped potential to create new values, to gather and assimilate unprecedented levels of manufacturing data. (N.N., Zebra White Paper, 2014). Having these data makes it far easier to increase efficiency where material handling and labor costs are concerned, but also to a network of connected devices across the entire system. According to Otto (Otto, 2014), Big Data has the potential to transform logistic systems. Logistic Management will be data-driven instead of model-driven with ad-hoc agility instead of planned flexibility. Logistic processes will be probabilistic instead of deterministic. The flow of information will be "streams" instead of "records," and also the flow of material will be self-managed instead of central-managed. Further, the people will decide instead of executing and will be more generalists than specialists.

Big Data is closely related to missing WMS modules because these data could be used for predictive analysis. With empirical values from the past, it is possible to forecast future decisions, and therefore it is also possible to realise process optimisation. E.g., the storage location of current stock will be checked and optimised to decrease picking time. Also, stock demand and resource planning can be optimised by big data. (N.N (b), 2016)

The current development can be described by some up-to-date topics like Big Data, Digitalisation, or Smart Supply Chain, but one term clarifies this development than transformation as the whole sector is in a flow. A central pillar for this is data or even more qualitative data. Through an entire capturing and meaningful usage of these data, complex processes could be done more efficiently and give transparency at the same time. (Bär, 2016) Büyüközkan and Göcer (2018) go much further in stating that in "... today's emerging market model data centers replace physical warehouses" (Büyüközkan and Göcer, 2018, p.157) and that "…bits replace the physical boxes and bandwidth replaces the physical trucks." (Büyüközkan and Göcer, 2018, p.157).

4.2.3 Climate change - Green Logistics

"Sustainability is emerging as the main consideration throughout the industrial world due to the environmental pollution and degradation happening in a major scale as a result of industrial wastes while lean management is becoming a popular management tool in minimizing waste." (Edirisuriya, Weerabahu and Wickramarachchi 2018, p. 1). This statement clearly describes a relation between lean management and green logistics. Therefore, transport and logistics sector is coming into focus on the green agenda due to the high impact of environmental pollution during their operations. (Lambrechts et al., 2019). More and more organizations try to develop their own social, environmental, and economic indicators in order to measure, improve, and report their sustainability (Farooque and Ahulu, 2017)

Also, the study from Edirisuriya, Weerabahu and Wickramarachchi (2018) confirm that companies in the logistics sector contribute considerably due to the wastes and pollution released, but it is also confirmed that implementing lean in parallel with a green concept is more successful and reduces waste as well as costs at the same time (Edirisuriya, Weerabahu and Wickramarachchi, 2018, Wiengarten, Fynes and Onofrei, 2013; Dieste et al. 2019, Rodrigues, Alves, and Silva, 2020).

So, for sure, the logistics sector has positive and negative influences on society. The economic and social gains like a growing industry which generates jobs and most notably the fast flow of goods is very comfortable for the consumer and have positive contributions worldwide. "On the other hand, the negative impacts on the environment, such CO2 emissions generated by the transportations of goods, are among the most concerns for the logistics sector." Rodrigues et al, 2020, no page).

This implies that companies should feel a certain kind of pressure from society and legal standards by the government.

In the future, warehouses will be more and more expected to be carbon-neutral, or even carbon positive, as the customer and legislation will demand a sustainable exposure of natural resources. Richards (2014) reports from a UK retailer who built a new distribution center intending to reduce its carbon footprint significantly. "Early results show savings of 18% in energy costs, 45% in water usage, an overall reduction of 40% in CO2 emissions and a cost saving of GBP 250.000 per annum." (Richard, 2014, p. 10)

This example is a good indicator of savings for warehouse buildings considering new construction methods, techniques, and materials if they are being built up under ecological criteria and being lighthouse projects for further projects. These savings can be further improved by lean methods, which will help achieve more efficient transports of goods use of resources and environment during logistics operations.

4.2.4 E-Commerce

Same Day Delivery – this term implies enormous logistic efforts on the delivery chains to fulfill this promise made to customers and the delivery chains. With the evolving development of material flow in the e-commerce business and affiliated increasing return advent, the grade of interconnectedness, automation, and system integration increases too. (Klempert, 2016). Online trade in Germany was growing by 23 % in 2020 (statista, 2021) representing a turnover of 96 Billion Euros.

The phenomenon of e-commerce will continue to grow for business-to-business (B2B) as well as business-to-consumer (B2C) sectors. From a convenience point of view and under tremendous environmental pressure, grocery home shopping and delivery will also grow significantly. To this result came a study by Oliver Wyman (2020) about the future of food retailing in Germany. Amazon started with an express delivery service called "Amazon Fresh" which promises delivery for food and household goods within one hour. (Dobos, 2016) "This will necessitate more fulfillment centres and returns processing facilities. Warehouses will be expected to be more efficient and cost-effective, with the likely closure of inflexible buildings and inefficient operations." (Richard, 2014, p. 105) As the market demands a higher scalable logistic performance, Würth Group invested in the further development of e-business solutions. In 2015 the turnover for e-commerce was growing by 17% and had reached 12% of the total turnover of Würth Group (Wöhrle, 2016c3). The EHI Retail Institute in Köln concludes in a study about the future of retail that there could be nine different scenarios and retail should play an active part in the digitalization process. The scenarios reach from the absolute end of the stationary retail up to a symbiotic scenario with huge flagship stores in the cities (urbanization) with a kind of adventure shopping for the customers to appraise the goods on-site and get it delivered by logistic partners of the retail, which will increase the complexity of logistics and also the return quote. (Bradl, 2016)

4.2.5 Industry 4.0 – Internet of Things (IoT)

In 2020 12 to 50 billion devices will be connected, and the market for machine-to-machine communication (M2M) will rise by 40 – 50% as the price of communication modules has decreased by 1/5 compared to the last five years. (Kubach, 2014). According to IoT Analytics from 650 IoT-projects across all business sectors, most of them are realised in industry and smart city (22 and 20%) and just 4% in logistics. (Ciupek, 2016). One significant advantage will be predictive maintenance which allows ordering the needed spare parts already before it comes to a breakdown. Therefore, predictive maintenance can reduce the maintenance and breakdown times in detecting the broken part or wear of critical parts. One example is the Jungheinrich ISM Online software, an information system for truck management that offers a comprehensive fleet management. The system allows a detailed analysis of the trucks, detects truck crashes, and shows possible saving potentials with reports and performance figures. Consequently, the transparency and safety of the truck fleet in the warehouse will increase. (Jungheinrich, 2021)

According to a white paper of KPMG (2016), it is no more sufficient to concentrate on short reaction times, high resource efficiency, and high quality to keep pace with faster product cycles, shorter lead times, and growing variants. In the factory of the future, the information and communication technology and the automation technology are fully integrated, and all sub-systems – even the not producing partners like sales partners, suppliers, OEMs, and customers are linked and merged into one system (KPMG, 2016). By introducing Internet of Things (IoT) technology, more than 40% of the respondents of a study by SAS expecting improved operational efficiency (Jones, A. et al., 2016).

Many processes can be automatized, but there are many good reasons still trust in the human workforce. "The human will never disappear because flexible systems are needed, and highly automated systems are not flexible!" This means the human worker needs to be in place to use the strengths of both systems (Ciupek, 2015; Wöhrle, 2016)

The digitalisation of the global supply chains will also mean establishing a partnership relationship between humans and machines in a future "social networked industry". According to ten Hompel (2017), in the future – the "social networked industry" - machines and humans will work together as partners with equal rights.

Kaspar and Schneider (2015) analysed the two approaches, Industry 4.0 and Lean, both seen as best practices for modern enterprises. They conclude that Lean and Industry 4.0 are not different from the basis as it seems from the first look and that they are aiming at the same goals and both bases on decentral control concept and they could complement one another. Finally, a lean organisation would be a good starting point and can be further optimised by Industry 4.0, and the same as Lean Industry 4.0 is evolutionary and not revolutionary like Lean is. Bick (2014) goes even further and states that I 4.0 critical needs Lean methods to decrease the complexity of dynamic systems and networks that companies face in these times. There is an ongoing integration between national economies and production networks on the macro level and on the micro-level the factory itself.

According to Hoffmann (2014b), Lean and people will reach their borders as the processes respectively the system evolve from complicated to complex. Complicated problems are calculable but complex problems could be influenced but are consequently not calculable or manageable anymore. This is generally true, but it will still be the man who decides what processes and workflow should be digitized, and even artificial intelligence (AI) cannot solve the problem as this technology cannot give answers. AI can help to a certain extent to improve single operations and processes but not the whole system. An example would be Automated Guided Vehicles (AGV's) which will find their optimum route to the next source or trough. AI will also be able to decide which order should be released and performed due to available resources and criteria like shipping dates and priorities. So, all in all, it will be more or less a kind of assistance system but will not be able to replace the human being or will be a complete replacement for the Lean Philosophy. There will always be the need for human decision-making, and it is all the more important to use all disposable lean methods to achieve the best results and ongoing striving for continuous improvement. (Hoffmann 2014b)

Kolberg and Zühlke (2015) conclude that Industry 4.0 or Smart factory phenomenon are complementary or even going hand in hand. If Lean Production is empowered by software and information technology, it enables a production system to evolve to a smart factory. Wanjari (2020) confirms in his case study that WMS and MES project implementation brings a substantial positive change in business performance.

4.2.6 Technology Trends

Picking per data glasses called "Pick by Vision" (PbV) is a relatively new approach that promises time benefits and reduces error rates during the picking process. The glass is connected via Wi-Fi and has an integrated display that shows the operator the pick location, article information, and the quantity for the current pick order. The integrated barcode scanner and the WMS in the background check the correct storage location and the product code automatically while the operator has the hands free to pick the goods with both hands and put them carefully on the picking load carrier. (Klempert, 2016). Schnellecke is a service provider for the automotive industry and strives to be the best logistic service provider by 2020. One of the visions is a so-called "plug' n play logistics," which allows them to roll out their services within a very short lead-time at any place in the world. To reach that state, it needs standardised processes and IT systems that were operated over the cloud. Another focus is automation and robotics to harmonize a continuous high-level quality with ergonomic workstations. An example is a new picking technology with augmented reality and Automated Guided Vehicles (AGV's) (Külps, 2016).

After a three-month testing phase at the VW main factory in Wolfsburg, the 3D-data glasses are used by 30 workers, and it is planned to expand this technology throughout other business areas (Wöhrle, 2016a1). A different outlook on the future warehouse technology gives Professor Michael ten Hompel with a drone called "Bin-Go", a shuttle system called "RackRacer," and the cyber-physical system called "Coaster" (Asche and Hartbrich, 2016).

Unmanned Aerial Vehicle (UAV) or drones are seen as the means of transport of the future. Examples of applications for drones in logistics already exist and will change logistics in the long term. (BVL, 2022) Examples are drones for stocktaking, surveillance or for transportation of goods and passengers.

4.2.7 Aging Workforce

Since the beginning of 2015, Audi is testing the "chairless chair" at the sites in Ingolstadt and Neckarsulm. This exoskeleton worn at the back of the legs is fixed by a belt around the thigs and the hips. During many operations, the worker could sit in an ergonomic position instead of standing. (Wöhrle, 2016a)

At the same time, supply chain partners have shortages of products, whereas e-commerce companies have shortages in personnel (Hasanat et al., 2020; Fernandes 2020). Reiser (2019) reports similar for the US market. In February 2019, the unemployment rate was at 3.8 percent, which is a historic low like in many European countries, but Germany and Netherlands have even unemployment rates below that. Meanwhile, e-commerce is proliferating, and this growth results in high demands on warehouse throughput and, of course, labor. Especially, companies with automated warehouses have difficulties finding qualified personnel to fill open positions and retain staff, which is finally hindering growth. (Reiser, 2019)

4.2.8 Summary

This chapter about megatrends in logistics and warehousing is very technology-heavy, even the topic of the aging workforce. As already stated in chapter 4.2.1, all this technology bears the danger of focusing on new technology and ignoring human beings simultaneously, and the Lean Philosophy is about people and culture. Emmet (2005) summarised it already in the early 2000s' as follows. "Warehousing can use all the best and efficient equipment, but the operations will fail without effective management. Even if the technical systems are the best, unmotivated people can still cause failures. Management is, therefore, ultimately all about people. Getting the best from people is the major and critical task for a business." (Emmet, 2005, p. 227).

Nevertheless, technology and megatrends playing an important role and influence viable LW, and the following factors were derived.

Insufficient toolset in terms of the functional scope of WMS

KPI's in the warehouse are mostly related to performance quality and cost and do not consider soft factors which give hints regarding the morale and motivation of the employees and could be a good substitute in the sense of a logistic assistance system.

The current trend for automation in warehouses bears the danger of over-engineer the processes – which is one form of the seven wastes - and does not care sufficiently about continuous improvement process anymore, which is fundamental in lean thinking.

Logistics underlies legal actions and a certain pressure of the society to protect the environment and fulfill the “new standard for green logistics".

The labour bottleneck is getting a severe issue driven by a more technical working environment and risen expectations on the qualification and skill set of new and “old” workers.

4.4 Lean Philosophy

All lean approaches like Lean Management, Lean Office or Administration, Lean Supply Chain, and others are based on Lean Production, also known as Toyota Production System (TPS).

As this study engages specifically with Lean Warehousing, the literature review consequently focuses on the original TPS approach and, in particular, on Lean Warehousing.

4.4.1 Lean Production - Frameworks and Methods

After the Second World War, in the early fifties, was the birth of the Toyota Production System (TPS). Toyota had a broad range of product variety driven by a lack of capital, so they invented new methods for economical production and avoidance of wastage with the infrastructure already being in place. In a study of the Massachusetts Institute of Technology (MIT), scientists examined the differences in the production of the different car manufacturers globally. Toyota was named there as an outstanding benchmark, and further on, mainly the working title of MIT – Lean Production – was used instead of TPS (Spee and Beuth, 2012).

Womack and Jones (2003) "…distil the essence of the lean approach into five key principles…"(Hines et al., 2011, p x). These principles are:

1) Specify value from the perspective of the customer
2) Identify the value stream
3) Make the value-creating steps flow
4) at the pull of the customer
5) Strive for perfection

Taiichi Ohno (1988) and Womack, Jones, and Roos (1990) defined seven common forms of waste (activities that add cost but no value):

1) production of goods not yet ordered
2) waiting
3) rectification of mistakes

4) excess processing

5) excess movement

6) excess transport

7) excess stock

Jones, Hines, and Rich (1997, p.171) already identified in their publication Lean Logistics "a number of missing pieces in knowledge and application on lean logistics." At least the last point: "How do we understand the change management steps required to move from batch and queue to flow and pull logic?" (Jones, Hines and Rich, 1997, p. 171), seems still not sufficient answered, since there are still so many companies who failed with integrating lean comprehensively. Following Womack, "…going lean does not require a swarm of consultants; a single champion will do. Compared to fixing complicated factories, rethinking logistics and distribution is something you can do quickly and spend little. Toyota did it for almost no cost." (Bradley, 2006, p. 35). This statement from Womack indicates that lean implementation is a leadership concept that must be anchored and lived in accompany and is nothing that could be implemented by applying some methods and tools.

"Lean cannot be just one of 10 elements of your strategy. It must be the foundational core of everything you are trying to do; that it is how it becomes your culture. Don't just do Lean; be Lean." (Byrne, 2013, p.23)

In Liker (2004 b), the Toyota Way is defined as a system designed to provide the tools for people to improve their work continually. This can be summarised in 14 principles which are split into four sections:

1) Long-term philosophy

2) The proper process will produce the right results

3) Add value to the organisation by developing people

4) Continuously solving root problems drives organisational learning

“A lean production system can be defined as an enterprise-specific compilation of rules, standards, methods and, as well as the appropriate underlying philosophy and culture for the comprehensive sustainable design of production” (Mitsuishi, 2008 p. 77). According to Wilson (2010 p. 11), "TPS is a manufacturing system that:

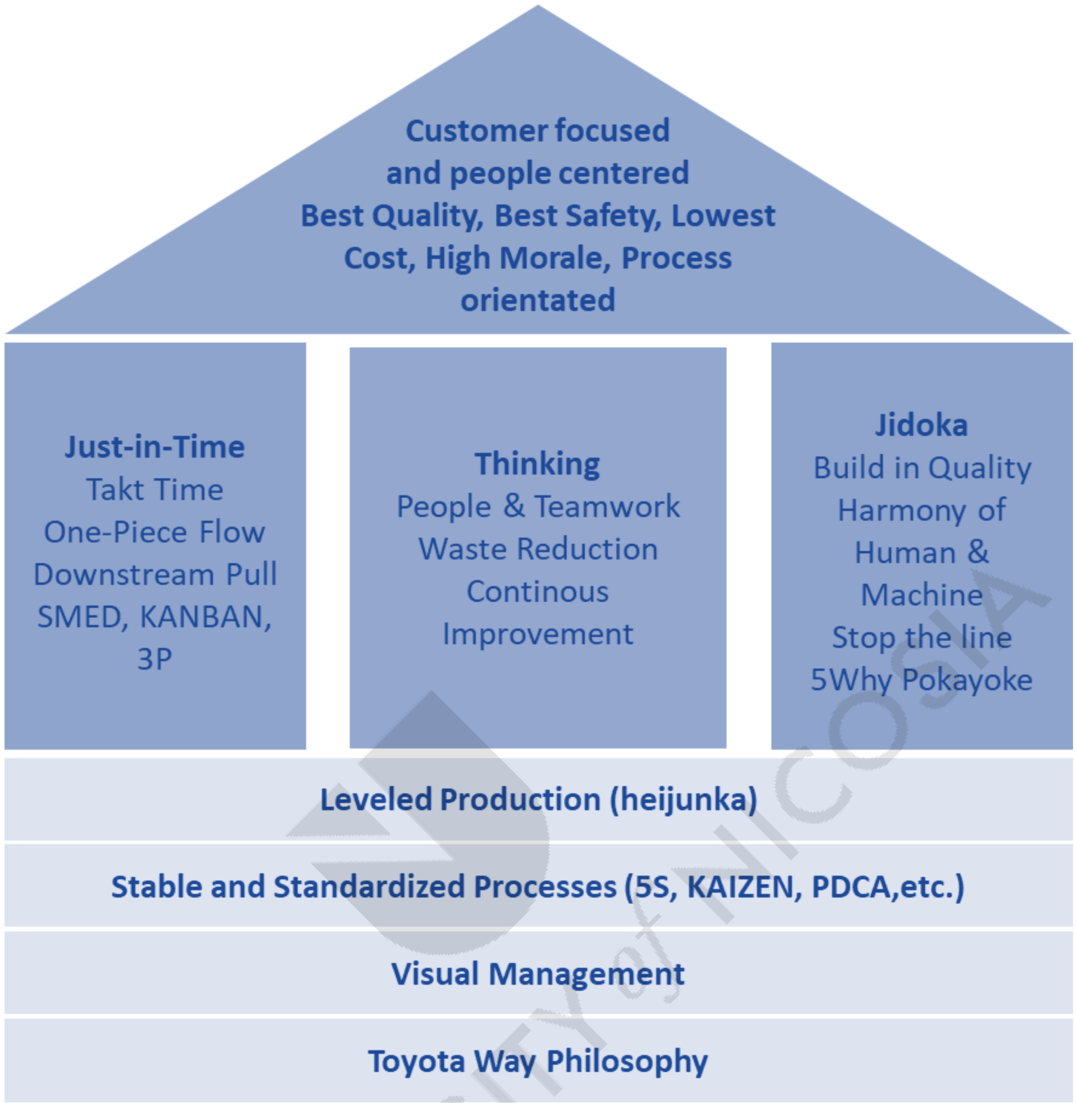
- Has a focus on quantity control to reduce cost by eliminating waste
- Is built on a solid foundation of process and product quality
- Is fully integrated
- Is continuing evolving
- Is perceptual by a robust and healthy culture that is managed consciously, continuously, and consistently.

The numerous definitions of TPS confirmed that Lean is a comprehensive and complex approach and a management philosophy and not just a toolkit for production or warehousing. Nevertheless, all definitions have in common that lean is about quality and the product as in processes by eliminating waste and in founding a lean culture with enabled and engaged people for a continuous improvement. Lean production is also no longer a method for the automotive industry and is applied in other industry and service sectors (Alsmadi, Almani and Jerisat, 2012; Cuatrecasas, 2004; Suarez-Barraza, Smith and Dahlgard-Park, 2012)

4.4.2 Lean Frameworks

A typical illustration of TPS and how it could be established is the so-called House of TPS (see following figure 4.3).

Figure 4-2: House of TPS (own representation after Liker, 2012)



However, there is no general acknowledged illustration, and over time "…Toyota, like many others have recognised the limitations of too much emphasis on tools" (Bicheno and Holweg, 2016, p. 4). Therefore, you can find a broad set on slightly different illustrations. "If you ask someone inside Toyota to describe the Toyota Production System – which would be its phrase for lean – you will typically get several straightforward explanations, each of which is correct and each of provides a substantially different perspective. This lack of a clear written description of

Toyota's practice is yet another of the reasons there have not been as many imitators of Toyota's practice as there should be by now." (Koenigsacker, 2013, p.10) "One such description is that lean is about two pillars:

1) The concept and practice of continuous improvement
2) The power of respect for people" (Koenigsacker, 2013 p. 10)

So, the modern illustration has just two pillars and is concentrated on philosophy and approach and not on tools anymore. Moreover, this illustration clearly shows that Lean is not strictly oriented to improvement in production. It is a general approach for all areas of an enterprise, and so also the translation of the abbreviation TPS has changed from Toyota Production System into Thinking People System. (Bicheno and Holweg 2016)

This shows that Lean is seen as a set of tools and methods instead of an approach that considers all process steps either as waste or as value-adding. This means Lean is a starting point to change the view of work and a starting point to identify waste. By respecting the people, they will get engaged and suggest new processes steps with less waste. (Koenigsacker, 2013, p. 11)

Another description of lean is to think of it as a system that "…is designed to identify problems, and then resolve them at a root-cause level. Given 99 percent or more of our daily problems are "resolved" at the level of the first symptom, and consequently recur, over and over and over, truly resolving them at a root level is a big deal. Within this description, the key to competitive success is to design your organisation to accelerate this spiral of finding and solving problems at the root cause. The problem-solving spiral encompasses this idea." (Koenigsacker, 2013 p. 13-14).

The Shingo Prize Framework (see table 4.3) is a comprehensive transformational model that recognises that the tools and techniques must be led by guiding principles to be truly successful. Furthermore, an organisation must also demonstrate that these guiding principles are embedded in its culture through the behaviour of all employees (Shingo-Institute 2012/Bicheno and Holweg, 2016, p. 6).

This price was introduced by the Jon M. Huntsman School of Business at Utah State University and recognises Shigeo Shingo's lifetime accomplishments in the field of operational excellence.

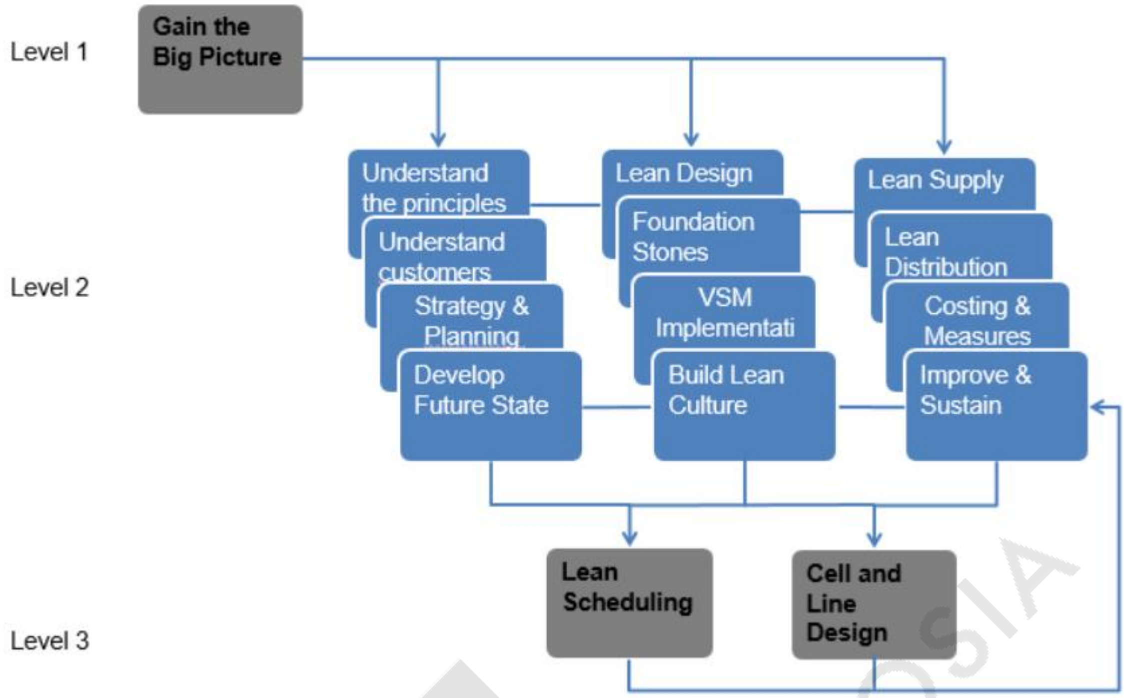
Table 4-4: Shingo Prize Model. (own representation after Bicheno and Holweg, 2016)

Shingo Prize Model Operational Excellence Scoring System			
Category	**Element**	**Score (Points)**	**Percent of Total Score**
Behaviours (800 Points)	**Cultural Enablers**	**250**	**25%**
	Continuous Process Improvement	**350**	**35%**
	Enterprise Alignment	**200**	**20%**
Results (200 Points)	**Quality**	**40**	**4%**
	Cost/Productivity	**40**	**4%**
	Delivery	**40**	**4%**
	Customer Satisfaction	**40**	**4%**
	Safety/Environment	**40**	**4%**

"The model asserts that lean transformation occurs not through tools as tools only answer "how", but rather through collective behaviour which is realised through understanding the interrelated and interdependent relationships between guiding principles, systems, tools and results so that we can answer the "why" (Shingo Institute 2014/Bicheno and Holweg, 2016, p. 6).

The Hierarchical Transformation Framework (see figure 4.4) is hierarchical and iterative as it consists of three levels that build on each other and always allow failure and retry. In the first level, the focus is on gaining the big picture, which means to figure out the most important topics for the transformation. So "…this level is concerned with doing the right things" and "…lower levels are concerned with doing things right." (Bicheno and Holweg, 2016, p. 8).

Figure 4-3: Hierarchical Transformation Framework (own representation after Bicheno and Holweg, 2016)



Level two is for getting into the detail of the "whats" and "hows" by applying the appropriate lean tool for each subcategory. The subcategories must not be tackled in strict sequence but may also be iterative. Based on the findings of level two in the next level (level three), a detailed schedule and the lean cell and line design have been developed. After transformation, it loops back to the subcategory "Improve & Sustain" on level two to start the next iterative lean transformation

4.4.3 Lean methods and principles

A whole range of Lean methods or tools enables companies to implement and live the Lean philosophy in their daily operations. The following table 4.4 provides the most important ones.

Table 4-5: Overview Methods and Principles of Lean

Design Principle	Lean Methods	Description/Translation

Procedures	PDCA	Plan-Do-Check-Act; Deming Circle
	CLIP	Continuous Improvement
	Rancho	Team leader who controls and leads its team
	Muda - Muri - Mura	Three principles of waste
	Ishikawa	cause(s) and effect(s) diagram
	Gemba	(shopfloor) "Go and see"
	5 Why	5 Whys problem-solving tool which helps to find the root cause in asking five times "Why"
	8-D -Report	The 8D methodology is a type of problem-solving that is similar to the DMAIC.
	DMAIC	DMAIC approach
	A3 Method	A3 problem solving is a structured approach to resolving problems using an A3 paper.
	Makigami	Similar to VSM (Value Stream Mapping) but with visualisation of each single sub-process
	Kaizen-Newspaper	A regular report about the improvements (target/goal comparison)
	Value Stream Analysis	value stream analysis
Stabilisation	5S	Sort, Set in order, Shine, Standardise, Sustain
	Chaku-Chaku	Chaku-Chaku is a Japanese term that means "load-load". The operator is loading one machine after another without the need for unloading.

FIFO	First in First out
Jidoka	Design equipment for partially automate the process (partial automation is typically much less expensive than full automation) and automatically stop when defects are detected—also known as "Autonomation".
Kanban	Traditional Kanban-Cards, which indicates a needed replenishment within a milk run system
. KPI's	Key Performance Indicators
Low-Cost Automation	Automation is simple as possible by using in-house resources.
Milk run	A round trip that facilitates either distribution or collection of the shop floor with needed material.
One-Piece Flow	One-piece flow bypassing the single unit to the following process when requested.
Pull system	A principle orientated on the actual demand of the customer or consumption.
Poka Yoke	Failure avoidance
Visualisation/Andon	dashboard to show the current state of the workload of the day
Shopfloor Management	Managers must be present on the shop floor to identify problems and being a role model.

Supermarket	a so-called pick-face or supermarket for milk run-tours
U-Layout	Work-cells are organised in the form of an "U" to eliminate the waste of walking and safes space.
JIT	Just in Time
Total Productive Maintenance	Total Productive Maintenance combines preventative maintenance with predictive maintenance to reduce overall downtime.
Team Corner	Team corner for team meetings and boards with up-to-date tasks and KPI's
Value Stream Design	Designing the optimised future state of production with shortened lead times, layout optimisations, etc.
Six Sigma	a set of techniques and tools for process improvement aiming to an error-free-rate of 99,99966%

4.4.4 Summary and Criticism

Lean is not just a set of tools. Instead, it is a philosophy and a general approach, and the whole enterprise should be set up according to the lean philosophy. By the time the Lean approach and the framework have evolved from a system for optimising production into a general approach for application onto the complete business process of an enterprise. Several frameworks and models like the House of Lean, The Lean Enterprise House, Shingo Prize Model, and the Hierarchical Transformation Framework suggested having a master plan on hand, like building up a house to master the transformation into a lean enterprise. However, getting lean is an iterative process that cannot be achieved, like following an assembly instruction (Bicheno and Holweg, 2016). So, it seems already the original Lean

Philosophy for application onto production is that complex due to the variety of frameworks and methods that an adaption onto other business processes and areas like warehousing will raise further difficulties and must be abstracted the more specific the application gets. Therefore, it is expected that the complexity of the approach seems to be one factor for efficient lean implementations.

Derived factors for a viable Lean Warehousing model derived from the literature review of the Lean Philosophy are:

Over time many different frameworks and models were developed which should be adapted to the specific needs of applicability in the field of warehousing

Lean methods and principles should be narrowed down to the specific needs of applicability in the warehouse.

4.4.5 Lean Warehousing

Lean warehousing is based on the techniques of Lean Production (Spee and Beuth, 2012), aiming to increase the efficiency and effectiveness of warehouse operations. This means it is using, in general, the same methods (see table 4.3) which were used for manufacturers and now applicate to warehouse processes.

A simple definition for lean warehousing quoted by Chua and Katayama (2009, p. 3) "…would be a warehouse that is capable of operating in such a manner that the throughput is optimised for warehousing activities". Schwab and Furmans (2014) are stressing precisely the systematic and comprehensible idea of lean warehousing in defining Lean Warehousing as "…leadership concept for continuous, systematic analysis and continous, measurable improvement of warehouse processes."

A further definition of Lean Warehousing by Dehdari et al. (2011) goes beyond the operational level and embraces employee engagement explicitly. Dehdari (2014) stressed employee engagement even more in quoting that all employees must be involved besides stability and a systematic, measurable improvement system. Some years earlier, Reichart and Holweg (2007) described Lean warehousing from a broader perspective by defining it as a concept of reducing waste upstream or downstream of the supply chain.

In the research field of lean warehousing area, many case studies combine different lean tools and therefore report different results but always end with a positive impact on warehouse operations.

Examples for improvement rates are Swank (2003), who could measure an effect of reduction in response time by 60%, reduction of labour costs by 28%, and finally a decrease of an error rate of 40%. Cook, Gibson and MacCurdy (2005) examined and developed a cross-docking scenario under lean principles and realised a 71% decrease in inbound cycle time, a decrease in inventory levels of 76%, and the needed storage space could be halved. Dehdari et al. (2011) proved an increase of warehouse productivity by at least 5% compared to a control group that does not use CIP. Whereas Dotoli et al. 2013 identified the "non-value-added activities" on the shop floor using VSM and Gemba. Also, Sun, Pan and Wang (2010) and Jaca et al. 2012 depict an overall improvement of warehouse productivity by 9.34%. Bosch business division automotive aftermarket has adopted the lean principles on their warehouse operations and is currently implementing this approach at 20 warehouse sites worldwide. Predated a pilot project in Brazil reached outstanding results with a failure rate under 0.02% (Seemann, 2016).

Further examples have already been outlined in chapters 1 to 3. However, finally, all of these case studies demonstrated just effectiveness of a specific set of lean methods in a particular experimental set-up and condition and a specific time period.

However, there are some restrictions in terms of the applicability of all methods and tools on warehousing. Because production and warehousing have fundamentally different demands. e.g., the production department wants the material in preferably minor units, whereas the logistics department wants to have preferably big and standardised storage units. As a result of these fundamental differences, you cannot transfer the TPS model in a one-to-one relationship in the field of warehousing.

As already stated in chapter 3, the Lean Warehousing theory is still in an early phase, and up to now, there is no generalisable approach, and it needs further scientific examination. Especially the transformation process to a lean warehousing culture, employee engagement, and WMS's influence are not sufficiently evaluated. Although Dehdari's (2014) definition includes the leadership concept and emphases its particular importance, state-of-the-art is still not reached at this point and leaves a gap for further research. The subsequent two citations are also pointing to the transformational aspect of the Lean Warehousing theory.

Furmans and Wlcek (2012) published a book about applying Lean Management in warehouses as a result of a study group initiated from the Bundesvereinigung für Logistik e.V. (BVL). It aimed to outline the ways lean methods and lean tools could be transferred onto warehousing and to demonstrate it in at least one pilot warehouse. Further aims were to gain experience on how these improvements in warehouse efficiency would lead to economic profit and reach a wider public for Lean Warehousing. The authors' themselves admitted that they did not reach all their goals. They could depict what lean tools are suited to be transferred into warehousing. They could also list some pilot warehouses and describe the specific experiences in introducing lean in different areas and processes like Spee and Beuth (2012). Nevertheless, they reached limited success in verifying which impact a Lean Warehousing implementation has on economic indicators. They missed the most crucial goal to describe a generalisable and convincing theory for Lean Warehousing to make it consumable for the broad public. The lack of sufficiently lean experience and not standardised processes makes it necessary to start researching basic lean methods from scratch. After reaching that level, more complex methods can be implemented, for example, KANBAN, etc.

The research of Sobanski (2009) provides a common framework and identification methodology for lean warehousing and the corresponding lean principles and lean practices. The developed lean implementation assessment tool was validated by applying it in twenty-eight warehouses within the Menlo Worldwide organisation - a logistics service provider. Sobanski (2009) analyses the underlying factors for lean warehousing implementation and the significant factors associated with measuring lean warehousing. As a result, he depicts continuous improvement and problem solving, which "correlated most significantly to (A3) One Page Reports, Management Style, Kaizen Events, Systems View, and Plan-Do-Check-Act (PDCA). Thus, these lean practices were found to be fundamental to implementing lean warehousing principles, and corresponding importance should be placed on them when training managers, supervisors, and associates." (Sobanski, 2009, p. 176). This indicates that the process of continuous improvement through engaging employees is crucial and probably the key to implementing Lean Warehousing comprehensively and from more importance than specific lean practices. Although already Ohno (1988), Shingo (1989), Womack et al. (1990), Womack and Jones (2003), and Liker (2004b) identified this as a fundamental principle of lean production and presently still seems to be the biggest hurdle for lean warehousing introduction.

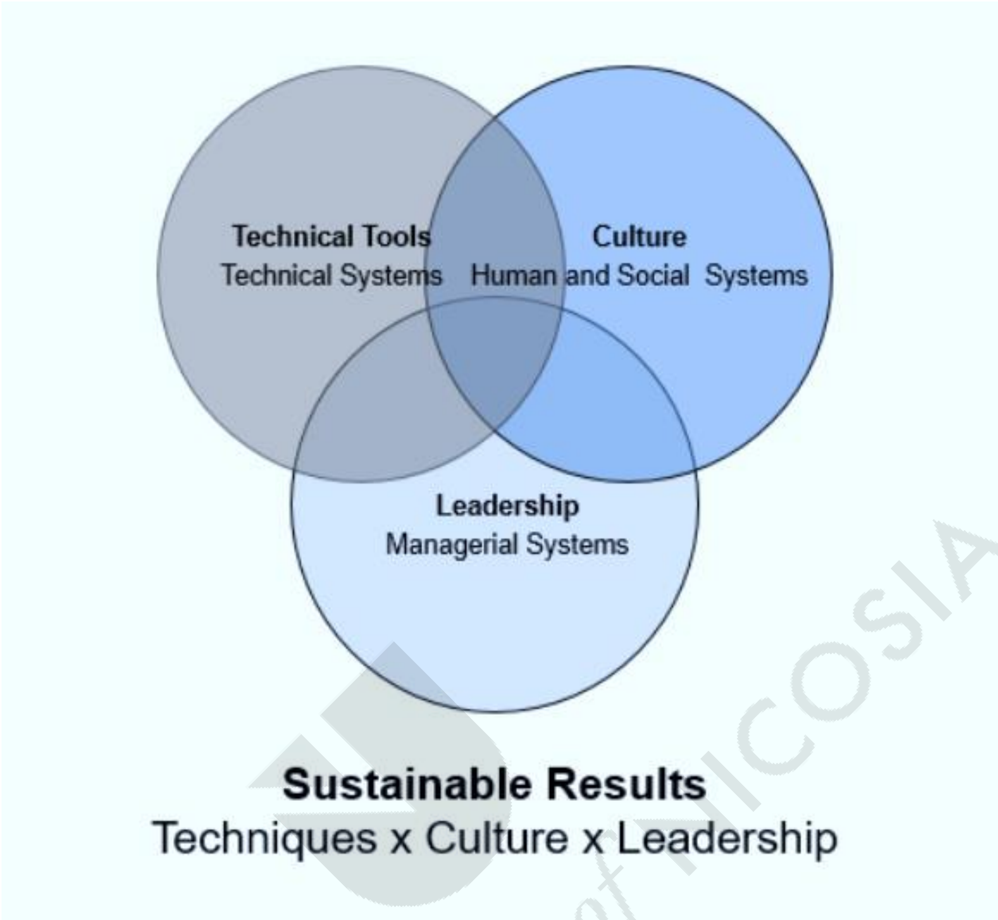
Besides the lack mentioned above of conceptualisations, Lean Warehousing is afflicted with mistrust, prejudices, and a lack of knowledge about the natural lean philosophy (Kuther and Schaaf, 2013; Dombrowski, Hellmich and Evers, 2012). Hines and Lethbridge (2008) explain this by the Lean Iceberg model with the visible top of an iceberg as lean technology, tools, techniques, and processes and the invisible part of the iceberg under the waterline representing strategy alignment, leadership behaviour, and engagement. This model implies the gap of corporate culture aspects but ignores that the current Warehouse Management technology is insufficient for a viable Lean Warehousing introduction. Womack and Jones (2003) also point to the strategic aspect of Lean Warehousing by stating: "… managers had drowned in techniques as they tried to implement isolated bits of a lean system without understanding the whole." Womack and Jones (2003, p. 10). The Toyota Production System (TPS) philosophy sees the value of products or services from a customer perspective as a starting point for all improvements.

Womack and Jones (2003) call this the first principle of lean. The whole organisation, including the senior management, has to focus on the place where the value is created - the shop floor. Arndt (2015) pointed out that to make Lean a core part of the corporate culture, a company must follow the bottom-up strategic management model. Chandra (2013, p. 36) states in this context: "Since the entire organisation is affected, cultural assumptions need to be addressed in order to ensure compliance with new organisational requirements. To deal with this gap, a transformational leader or "Lean Champion" is required (Vitalo et al., 2009; Hobbs, 2011; Alukal, 2006).

4.4.6 Lean Culture, Policy Deployment, and Leadership

As already outlined in a previous chapter 8 on page 19 by introducing the Lean Iceberg model, Lean is not only about technical tools and systems but also about behaviour, people engagement, and leadership. Leon (2010) describes the cultural aspect clearer in a efficient Lean Transformation model, which contains the three modules Technical Tools, Leadership, and culture (see figure 4.5)

Figure 4-4: Efficient Lean Transformation Model (own representation after Leon, 2010)



The following citations also point to the human factor and culture as essential factors for a successful and viable implementation.

Lean is a people-driven improvement system that can improve any work process (Koenigsacker, 2012), but "The ultimate goal of a lean transformation is to build a learning culture that solves customer problems forever." (Koenigsacker, 2013 p. 116)

"In any business, the only element that is capable of true transformation is people. Machines can be moved, the equipment can be reconfigured, and buildings can be sold or built, but none of these are true transformations. Only people can change in character and appreciate in value." (Byrne, 2013 p. 93). Freudenberg NOK Sealing Technologies has been practising lean for more than twenty-five years. The first lesson learned was to make the lean philosophy important to the company and the leadership. They trained more than 130 certified Lean System and Six Sigma Black Belt for this purpose.

A study by Jaca et al. (2012) confirms that implementing a lean culture in companies in the distribution sector enhances productivity, employee aptitudes, and employee participation. However, the implementation in this industry sector is complex due to the volatility of customer demand and the high rate of human activities in warehouse operations (Huq, 2005; Melacini, Perotti and Tumino, 2001; Rushton, Croucher and Baker, 2012)

4.4.6.1 Lean Culture

"An organisational culture is defined by the behaviors or habits of its leaders; in other words, the culture is formed by what these leaders do. "What they do" is essential to the company's success. When you add lots of these "What they do's" together, you see the fabric of a new culture." (Koenigsacker, 2013 p. 94)

"Organisations stand little chance of implementing Lean unless they have paid at least equal attention to creating the right culture, and the conditions and circumstances which can become the foundation for implementing change" (Atkinson, 2010). This is supported by Punnakitikashem, Buavaraporn, and Chen (2013). Their survey about critical factors of successful lean implementations concludes that organisational culture is the most crucial factor. According to Byrne (2013), another mistake is to keep existing systems and measurements in place and just lay lean on top of them.

To establish a lean culture, the transformation plan must include everyone in the company and not just the management team. So, lean gets on a strategic level, and every employee thinks and acts in this way. Therefore, it is necessary to promote and demand teamwork and thinking of the best processes for the whole organisation across departments and divisions. (Byrne, 2013)

"The Lean focus on removing waste creates a learning environment for everyone. It leads to great teamwork, which in turn creates a great work atmosphere. The focus on being responsive to customer needs naturally builds a customer-centric organisation where everyone is participating. In essence, the lean organisation understands the value of its people and treats them with respect. "(Byrne, 2013 p. 29)

Buavaraporn and Chen (2013) find out that organisational culture is the most important factor for the success of lean projects, and Othman (2016) confirms this by stating that successful Lean Production initiatives are found in companies that have a culture emphasising proactive improvements. Further on, Achanga, Shehab, and Nelder (2010) and Dora, Kumar and van Goubergen (2013) report from an open communication culture supported by the management as a further critical aspect.

Basically, the shift from a traditional organisation and strict top-down culture to a lean culture is simple, but the whole transformation process is a multi-year effort. According to the lean philosophy, the existing structure must be physically changed into a lean configuration with working cells and lean practice. The lean process typically consists out of three stages:

1) the acceptance stage,
2) the technical stage and
3) the sustainment stage (Byrne, 2013)

Liker and Hoseus (2008) examined the Toyota culture as it is “the heart and soul of the Toyota Way” and depict three cultural aspects. The first one is a “quality people value stream” with shared values and objectives. This is part of Toyotas' philosophy of lifelong learners and problem solvers employed in the long term. This generates a “lean staff," each employee contributing 187 ideas with an implementation rate of 98% on average per year. (Atkinsons, 2010). The second aspect is called the "people supporting process", built up by teamwork and communication within the groups and beyond through regular team meetings, lean reporting, kaizen newspaper, and the leadership element. The third and last cultural aspect according to Liker and Houses, 2008), is the “organisational-supporting process”. This aspect stresses the tools to reach that cultural level and sustain it and the strategic components in human resource management for stable employment with fair and measurable objectives for the team and each individual, Hoshin Kanri, in a lean enterprise.

However, each transformation will face resistance from people at each level, which is natural during a transition (Ezzamel, Willmott and Worthington 2001). Nunes and Machado (2007) demanding "…particular care with the issues related to human factors, to avoid health and safety problems to workers and losses to companies, due to increase of errors, productivity lost, absenteeism and diminishment of employees' morale, compensations, and lawsuits." (Figueira, Machado and Nunes, 2012, p. 1713) The main barriers are a general lack of understanding of lean and lean strategy and leadership. (Byrne, 2013). "Therefore, implementing a lean turnaround cannot be delegated down in the organisation." (Byrne, 2013 p.23)

4.4.6.2 (Lean) Leadership

Organisational culture and leadership interact with each other, and the leaders create and reinforce norms and behaviours within the culture. Leadership can be categorised in various categories like Senior and Fleming (2006) do:

- Result orientated
- Employee orientated
- Authoritarian Leadership
- Participative leadership
- Transactional leadership
- Transformational leadership

Whereas McCrimmon (2006) based the leadership styles on four paradigms which are:

- Classical (authoritarian, participative and laissez faire leadership)
- Transactional

- Transformational
- Organic (teamwork without formal distinction)

Samad's (2012) study points to transformational leadership as a significant factor in organisational performance. The culture develops according to the leader's leadership style and what kind of role models, values, and norms they promote, the people getting hired, and how they deal with a crisis. (Bass and Riggio, 2006) "An organisational culture, affects its leadership as much as its leadership affects its culture." (Bass and Riggio, 2006, p. 100). Therefore, leaders must pay attention to rites, beliefs, values, and assumptions in the organisational culture because they can accelerate or build barriers to an organisational change process (Bass and Riggio, 2006).

A lean transformation needs a leader with a clear set of goals (vision) who is actively driving the change (Byrne, 2013), "…but the CEO should still participate in kaizen events at least once a quarter at the most critical facilities. (Byrne, 2013 p. 24) Punnakitikashem, Buavaraporn, and Chen (2013) and Pokinska, Swartlinh, and Drotz (2013) identified excellence leadership and management as crucial factors for successful lean implementations.

This citation implies that a lean transformation process will need massive effort by the leadership team up to the top management. One of the biggest challenges will be to convince the workforce that Lean is really working in practice and not just by talking about it. Koenigsacker (2013) calls it a dilemma because it needs consensus at the base by using the teamwork approach. So, the team members will need to get some personal experience to learn how lean is working. "They have to experience the principles, and they may have to be strongly encouraged to get the personal experience that will lead them to a new view of how organisations can work effectively." (Koenigsacker, 2013 p. 102) "Experience has shown that the impact of learning to see waste – personally – and then realising how much waste can be removed in a week is transformational." Personal kaizen experience is the most significant building block for a successful lean transformation. At the same time, it is tough to get senior management to realise that it is essential." (Koenigsacker, 2013 p. 103)

Toyota's lean core values and leadership behaviour are:

- Serve the customer
- Seek what is right, regardless
- Decide carefully, Implement quickly
- Candidly admit imperfections
- Speak honestly and with deep respect
- Go, see, and listen to learn (Genchi Gembutsu)
- Deliver on a meaningful challenge
- Be a mentor and a role model

(Byrne, 2013, p.115)

According to Wilson (2013), Lean Leadership has six essential qualities, which coincide in parts with the cited core values from Byrnes'. The six qualities are:

1) Leaders as superior observers
2) Leaders as learners
3) Leaders as initiators
4) Leaders as teachers
5) Leaders as a role model
6) Leader as supporters

According to Byrne (2004), only a few companies – like Toyota - and their leaders see the full potential of lean-to transform their business. Lean is not just a method that works for manufacturing processes; instead, it should become the overall strategy. So, the main failure is to delegate Lean into operations and focus just on cost and inventory reduction. A lean transformation goal is not to have the lowest-cost products; instead, it will help differentiate an organisation through a customer-focused view delivering the best value in terms of delivery speed and accuracy.

Most customers are willing to pay premium prices for premium products or services. "Lean is about becoming the best competitor." (Byrne, 2004 p. 127)

To reach that level and keep that level, the transformational leadership theory argues it will need a transformational leader with a strong personality and specific leadership skills. According to Bass and Riggio (2006) or Givens (2008), a transformational leader can inspire people to follow a vision or business goal and spur them to be creative and innovative in problem-solving processes. A transformational leader arouses leadership capacity by the followers by coaching them, giving support, and challenging them for freethinking. This is how Mina (2009) characterises a transformational leader, and in addition, this leading personality also empowers others to become independent individuals able to exercise leadership themselves. Boutros and Purdie (2014, p.12) state pretty similar that "Leaders who communicate and inspire a clear, compelling vision for the future have teams that are more engaged and open to improvement opportunities".

Moreover, transformational leadership does lead to performance beyond expectations compared to transactional leadership. This is what (Bass and Riggio 2006) found out. They also depict that transformational leaders help develop followers to better contribute to the group result and be more creative, stress-resistant, flexible, and open to change. They are more likely to become transformational leaders themselves one day (Bass and Riggio, 2006). Liker and Convis (2012) provide a model for the leadership development at Toyota, which is based on their experience and observation during a stay at Toyota headquarter. Toyota never formally codified the leadership development process, but it is "…the force that allows Toyota to adapt to major environmental change" (Liker and Convis, 2012, p. 241)

This “force” is called the True North, and the corresponding performance metrics are:

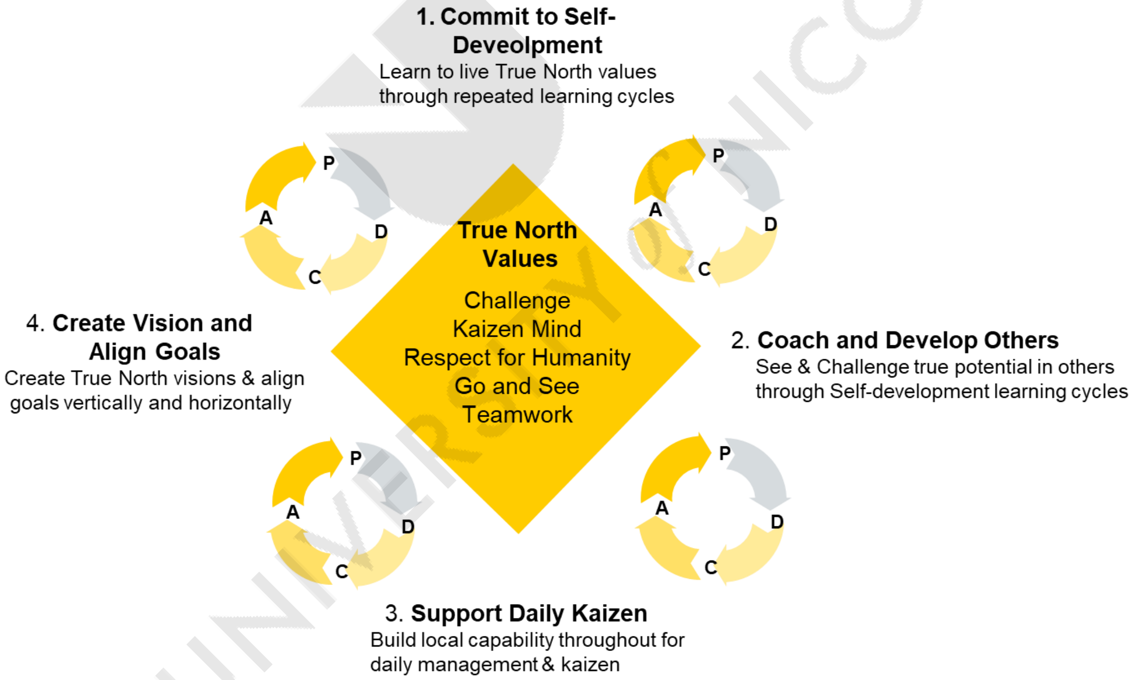
- Quality improvement
- Delivery/lead time/flow improvement
- Cost and productivity improvement

- Human development

"The true north relates to long-term objectives that guide the organisation that is, through generations." (Koenigsacker, 2013 p. 19)

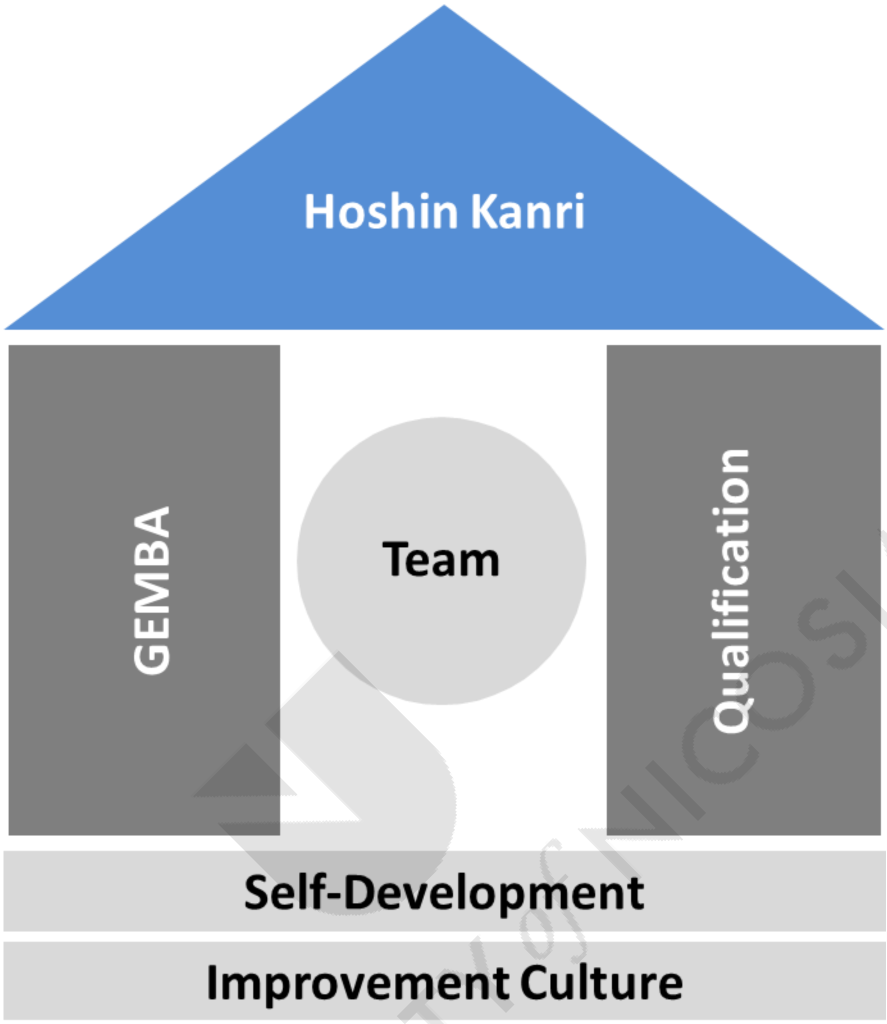
"Behind all the True North Metrics is the concept of people studying their work and improving it on a regular basis" and building a culture of continuous improvement. After Koenigsacker (2013), first, the organisation needs to learn lean tools, lean work-practice, and build a high degree of trust for the lean transformation change process (see figure 4.6).

Figure 4-5. Diamond Model of Lean Leadership Development (own representation after Liker and Convis, 2012)



Dombrowski and Mielke (2012) create a model for lean leadership (see figure 4.7). This is in line with the typical shape of a house like the House of Lean. This model emphasis that the development of people comes first as the base of the house according to a famous saying from Toyota: "Before we build cars, we build people." (Liker, 2004b).

Figure 4-6: Lean Leadership Model (own representation after Dombrowski and Mielke, 2012)



Dombrowski and Mielke (2012) derive from literature five basic principles.

1. Improvement Culture:
    - Striving to perfection
    - Failure is a possibility to improve

2. Self-Development:
    - Lean Leaders are role models
    - New leadership skills are necessary

3. Qualification:
    - Long-term development of employees

- Continuous learning

4. Gemba:

  - Shop floor management
  - Decisions based on firsthand knowledge

5. Hoshin Kanri:

  - Customer focus
  - Aligned goals on all levels

Cano (2014) found out that besides the critical factors on a clear perception of lean philosophy, requirements for good leadership, the importance of the role of champions, visibility of the lean process, demand for training and support from external networks and groups play an important role. One further success factor at the second implementation attempt in this case study in a university environment was not to focus on pure financial gain, which was elementary for better success, because it helped overcome resistance to change and secure support from all involved.

"One of the primary responsibilities of lean leadership is to identify and eliminate the obstacles to your success." (Byrne, 2004 p. 115) Improving your operations by eliminating waste should be the primary strategic focus. "Getting all of your people involved in this will not only greatly leverage your efforts, but eventually lead you to have a company culture of continuous improvement, or kaizen (as Toyota would say). Once you get to that state, you will be very hard to beat." (Byrne, 2004 p. xii)

As a conclusion of the topic about leadership, a citation by Womack (2005) points to the leadership role and the lean culture. They state that "In a successful lean enterprise, everyone takes responsibility for the value stream they participate in. Everyone needs to be a lean leader." (Womack, 2005). According to a study by Pelz (2012), the self-perception from the enterprise or management raised by an online survey strongly differs with the interpersonal perception which was drawn by interviewing the employees and therefore managers need to start the transformation and to monitor this process on a day-to-day basis. The identified leadership competencies are:

- Identification – authentic leaders
- Inspiration – high morale and motivation of employees
- Stimulation – skills, knowledge, and resources available -> empowered employees
- Consideration – transparency, open communication, and fair, realistic objectives
- Enabling – climate of personal responsibility
- Innovation – support of change initiatives and suggestion ideas (Pelz, 2012)

The fifth leadership principle of Dombrowski and Mielke (2013) is hoshin kanri, which is also known as target management or policy deployment. Their study says that hoshin kanri has the lowest degree of application from all the mentioned leadership principles with just 29% of the participating enterprises. In the group of German enterprises, only 10% apply this principle. Outside Germany, this rate is by 55%. Dombrowski and Mielke (2013) sum up their study that "Especially in Germany. Hoshin kanri is scarily known" and "existing metrics and reward systems should be redesigned regarding lean leadership principles", because actually "…enterprises have realised the importance of lean leadership but have not adapted their leadership system so far." (Dombrowski and Mielke, 2013, p. 574)

4.4.6.3 Lean Policy Deployment

“One of the most important aspects of policy deployment is that it aligns your leadership team around a well-defined set of objectives. It helps the team stay focused on your priorities, and it creates the linkage between these initiatives and how they fit your strategy and key metrics.” (Byrne, 2004 p. 97)

Koenigsacker (2013) does not see the Toyota Production System as Toyotas' unique contribution because they adopted Total Quality Control (TQC). The true north metric approach and hoshin kanri (policy deployment) are both coming right out of the QTC school of improvement. Finally, Koenigsacker concludes, that…."

The Toyota way is built upon the dual pillars of TQC and TPS, which in turn rest on the foundation of human development (Koenigsacker, 2013 p. 15).

“In order for your lean turnaround to be successful, you will have to understand and commit to three management principles that will serve as the foundation on which your transformation will be built:

- Lean is the strategy
- Lead from the top
- Transform the people” (Byrne, 2004 p. 19)

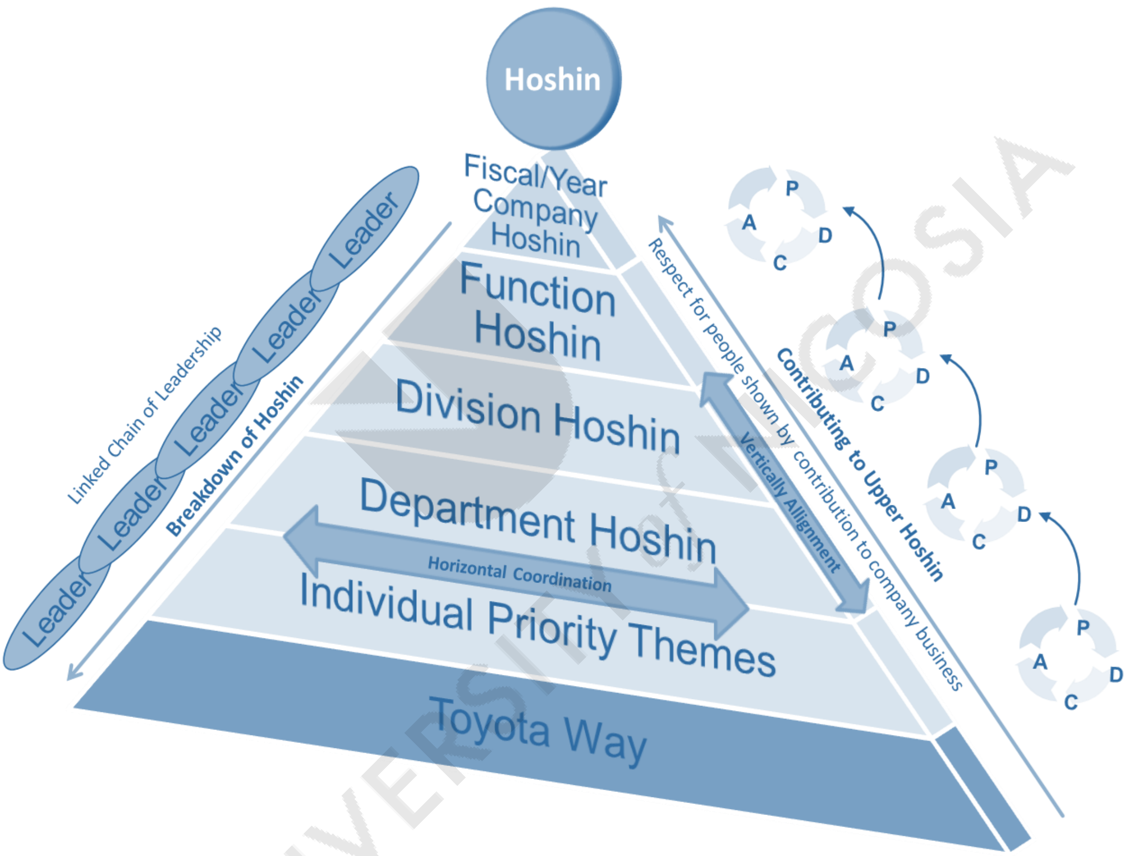
A study by Schwarz and Penning figured out that those companies who are integrating middle management into strategic planning are more successful than those who are just delegating the strategy top-down. (Schwarz and Penning, 2016) This is reasoned by the enormous complexity of markets and the environment. As a result, managing directors need to involve many competent people and must be enabled to adjust structures, processes, and workforce requirements. (Schwarz and Penning, 2016)

“A lean strategy, and the lean tools that come with it, will allow you to “see” the waste that exists and enable you to remove it quickly and efficiently.” (Byrne, 2004 p. 177)

The lean strategic organisational process of hoshin kanri is also called hoshin planning, management by policy, and policy deployment. So, this approach is close Management by objectives (MBO) (Liker and Convis, 2012) and suited to review key strategic efforts for the next year, to identify how lean improvement can accelerate and enable efforts, to set true north goals and also to support the strategic direction, establish the pace and pattern of improvement effort for the year to achieve these goals, and then establish a monthly review process.” (Koenigsacker, 2013 p. 85)

Definition after (Kudernatsch, 2013): "Hoshin Kanri provides a consistent and coordinated strategic plan prepared the starting translated by a vision, strategic breakthrough objectives in annual objectives at all levels, these tunes vertically and horizontally and defines measures to achieve the objectives. It is not related tools that come to the fore, but it comes intensively to develop leadership skills and know-how for significant process improvements at all levels to ensure that challenging targets can be achieved. The successful implementation of Hoshin Kanri requires a radical change of leadership and management style because working differently than before." (see figure 4.8)

Figure 4-7: Hoshin Kanri: Direction Management Vertically and Horizontally (own representation after Liker and Connvis, 2012)



Hoshin Kanri is a process that will develop leadership ability and know-how to improve the process significantly in order to reach challenging goals. This means leaders need to have powerful abilities in two areas: Knowledge of lean tools and to enable the employees to develop a self-recognition for CIP. However, Hoshin Kanri is not a tool. It is a leadership concept that is rooted in the understanding of leadership in the company. This process took between 5 and 10 years to align the whole organisation. (Kudernatsch, 2013)

“Hoshin” or “hoshin kanri” refers to the process of policy deployment. Hoshin kanri is a visual planning process that focuses on the most important priorities and aligns company resources around those priorities. This work is conducted within the context of the longer-term strategic plan, and it clearly defines the current-year projects (or hoshins) that need to be done. A hoshin team leader is assigned to head up one of these projects.” (Byrne, 2004 p. 190)

This means Hoshin Kanri is not a new instrument for strategic planning and execution. However, it provides an approach through a consequent development of leaders to orientate on challenging breakthrough goals and reaching ongoing competitiveness. Hoshin Kanri can provoke significant results in growth, costs, cash flow, Delivery, Quality, and productivity like for example:

- Growth: double turnover
- Cost: Reducing production cost
- Cash Flow: working capital + 50%
- Productivity: reducing effort per piece
- Delivery: OTIF + 100%
- Quality: reducing the error rate

The core element for hoshin is similar to is the PDCA cycle: Instead of plan (P), you do hoshin development, and instead of Do (D), you do hoshin implementation. Hoshin assessment is like checking (C) instead of act (A) you do hoshin standardising through daily management and reflection for the following year.

The main difference from Hoshin Kanri to other planning methods like MbO (Management by Objectives) is the catch ball process. This is how the objectives will be cascaded through all levels of a company. Goals and also how to reach these goals differ between MbO as Hoshin Kanri will be defined with the whole team and not as a top-down process. A translation of Hoshin Kanri into English would be policy deployment, Management by Policy (Mbps), or Management by Planning. Hoshin

Kanri is used if it is necessary to attain significant strategic changes or breakthroughs. In doing this, all available resources will be used in the most efficient way to attain these few but important goals every year. (Kudernatsch, 2013)

Management by Function ⇨ low process output

Management by Process ⇨ high process output (Vertical and horizontal harmonisation)

Hoshin bases on the lean philosophy and therefore has a strong relation to lean management. (e.g., Liker, J.K. & Convis, T.L. (2012); Cudney, W. A. 2009)

To conclude the topic of policy deployment Kudernatsch (2013) explains that Lean Management stands as a benchmark worldwide for highly efficient production. However, unfortunately, it turned out that most of the results realised by lean implementation are not viable. This fact is not rebutting lean management itself, but it means that the implementation is not just about implementing some tools. Instead, it needs deep knowledge and conviction of the lean philosophy and to set it as the new strategy with a culture of continuous improvement and aligned objectives in vertically and horizontally direction according to the Hoshin Kanri model.

4.4.7 Summary

Lean philosophy is not only a set of tools and methods but it is a holistic philosophy and the key essence of lean philosophy is not the lean tools but to establish a lean culture and a social change process of the organisation, where continuous improvement is part of the DNA of each employee. This means that lean leaders on each organisational level are responsible to be a role model and are the driving force to establish a lean philosophy, culture and a policy in an enterprise.

Therefore, the factor lean leadership will be included for the qualitative research phase, to see if there are still basic retentions against the lean philosophy. At the beginning of the lean implementation in Germany in the early nineties, the main drivers were reducing costs and saving labour force. This approach could have led to mistrust and denial against the lean philosophy (Kuther and Schaaf, 2013; Dombrowski, Hellmich and Evers, 2012)

4.5 Change Management

Austin and Adebayo (2021) discovered in their study several factors which are hindering implementation of lean. Most of them are linked with leadership respectively change management, like the lack of communication strategy within organisation, organizational culture, organisational knowledge, management support and policies on human development.

Therefore, for companies who focus on Lean it is recommendable to implement organisational change management. Kesterson (2017) approved a positive effect from organizational change management during a lean six sigma six introduction.

The concept of change management is familiar in most businesses today. However, how the change process is managed varies depending on the nature of the business, the change itself, and the people involved. Profound change means a change and redefinition of the potentials and employment of a company. This is far more than traditional project management like, for example, the implementation of a WMS. To succeed with a comprehensive organisational change, it is necessary to include process structures and systems and moreover reach behaviours and attitudes of managers and staff. "The strongest pressure against change, in my experience, usually comes from the middle management and finance." (Byrne, 2004 p.93) This transformation process could be seen as the backbone of change management. A learning organisation needs to disengage from traditional hierarchical structures and build up an environment where employees can share their knowledge with other people. Then an organisation could benefit from maintaining levels of innovation and remaining competitive. It will also be better placed to respond to external pressures and to have the knowledge to link resources better to customer needs. Improving the quality of outputs could be expected at all levels. The advantages and principles of a learning organisation and the lean philosophy do complement one another. The learning organisation provides an open and creative culture of change, and the lean philosophy has a broad range of practical tools to transfer the changes to the operation.

Nordin, Deros, Wahab and Rahman (2012) propose an organizational change framework for Lean manufacturing implementation, and it is assumed this is also recommendable for LW.

One of the first models for understanding organisational change was developed by Lewin (1947). His model is known as "Unfreeze – Change – Refreeze Model," which describes three stages during a change process. This model was a basis for further scientific approaches and models like the eight-steps-model by Kotter (1995), the five-phases-model by Krüger (2002), and the learning organisation model by Senge and Suzuki (1994). According to Senge and Suzuki (1994), a learning organisation exhibits five main characteristics: systems thinking, personal mastery, mental models, a shared vision, and team learning.

In lean terms, change is called either kaizen as a continuous and incremental form of change or kaikaku when it is more sporadic and radical. (Imai, 1986) Therefore Womack and Jones (1996) suggest using kaikaku for the initial change as material, and information flow changes completely, and to sustain these gains, they recommend using kaizen.

Pearce (2014) concentrates its work on lean implementation in New Zealand in SMEs and delivers a general approach to its success factors. Therefore, the results are beneficial as a basis in this research; however, it does not consider the specific conditions and demands or cultural aspects in warehousing.

Modrak and Semanco (2014) figured out the enablers for lean transformation practices in SME'sTop Manager that deeply understands the benefits of lean:

- Corporate culture oriented towards continuous improvement
- Working in an industry requiring low response time and high product variety
- Corporate organisation oriented to employees' development and enhancement
- The top five constraints of lean implementation are:
- Little support from the top management

- Resistance to change by middle management
- Poor understanding of strategic vision and goals
- Poor or non-qualified implementation training activities
- Lack of involvement of the supplier base".

Similar to Pearce (2014), the research figured out barriers and enablers for a successful lean implementation in SMEs in the areas of Lean Manufacturing and Lean Office, but not in the field of logistics or warehousing.

"Although lean management is becoming the standard for systematic productivity improvement, when lean is adopted in traditional organisations it requires a widespread organisational change." (Womack and Jones, 1996; Hines and Lethbridge, 2008, p, 55). Furthermore, this means if change management is not adopted in a professional way many businesses fail to sustain lean practices. Although lean has proven to be customisable to many different business types (Womack and Jones, 1996; Hines and Lethbridge, 2008), these high level of failed attempts remains. On the other hand, it is more or less to define failure rates like this that you would achieve the best Lean level by starting and ending a lean introduction project successfully.

However, as numerous stated, Lean is not a project; it is a cultural change and a business strategy. This means lean failures over time could prove successful. However, literature reports from 60% to 90% failure rates. (Goodyer, Grigg and Murti, 2011; Shin, Kalinowski and Abou El-Enein, 1998). This is consistent with the high failure rate of 80% in organisational change in general, which was reported by Kotter (Burnes, 2005). Burnes summarised that many lean implementations always fail as soon the focus is set on the tools or methods and not accepting the strategic thinking and its involved human aspects, which are from crucial meaning to when trying to adopt lean in business. Due to this misguided lean understanding, lean was criticised in various studies (Bordia et al., 2011; Hines and Lethbridge, 2008, 2004; Liker, 2004, pp. 87, 111; Schmidt, 2011; J. P. Womack, 2007)

4.4.8 Summary

Derived factors for a viable Lean Warehousing model from the literature review of Change Management are Support of Top Management, Leadership style, and employee knowledge.

Managers need to gain a thorough understanding of how to implement lean in a viable way (Womack and Jones, 1996; Hines and Lethbridge, 2008; Liker, 2004).

However, more research is needed that defines how managers can exploit the benefits of LW and illustrates how successful implementation can take place. The large number of failed projects underlines this point.

4.6 Summary of literature review and research questions

These questions and gaps in literature and practice, which were found and discussed in the previous chapters, are leading directly to the qualitative research questions and building the basis for the expert interviews. It is expected to achieve valuable information which will be of great use during the structured online questionnaire.

The sample feedback and the evaluation and conclusion will then inform the quantitative research phase.

Research Questions:

1) What are the differentiating factors between the original Lean Manufacturing theory and the still-evolving Lean Warehousing theory?

2) What leadership theory is best suited for a successful and comprehensive transformation to Lean Warehousing?

3) Are there other factors for WMS besides the ones which were already identified in the literature review?

4) Is the application of Lean Warehousing and the included set of factors flexible enough to adapt the process in terms of KAIZEN or due to new stakeholder requirements?

5) How do the grade of automation in warehouses and the lean warehousing maturity level correlate to one another?

6) What kind of relationship exists between the industry sector and the lean warehousing maturity level?

Chapter 5 Conclusion – Initial Model

5.0 Conclusion – Initial Model

Summarising, the literature review showed that the existing models do not comprise all factors needed for a viable Lean Warehousing model (see figure 5.1). The following model is an initial model that will be developed and adapted after each research phase: literature review, qualitative research, and quantitative research. The main four components, Leadership, Warehouse management, Change Management, and Stakeholder, are embedded into the corporate culture and philosophy. The literature review did not allow to draw a conclusion about the weight or influence which component do have or should have on Lean Warehousing. Therefore, at this research state, it is assumed that all components have equal influence on LW.

Figure 5-1: Initial Model of Lean Warehousing

The initial model covers the current lack of the identified factors from the literature review and considers them as interactive and equal elements in the new Lean Warehousing theory. Based on the findings of the quantitative and qualitative research results in the following research stages, the model itself and the weighting of its comprising factors will be continually adjusted.

The model synthesises the existing current theory of Lean Warehousing as to Warehouse Management, Corporate Philosophy, and Culture as well as Change Management and Leadership. The additional factors Stakeholder is not mentioned and investigated in relationship with Lean Warehousing before. In synthesising these new factors with the factors mentioned earlier, this research will contribute to new knowledge.

5.1 Leadership factor

The literature describes that a lean implementation supposes a cultural change and involves employees at all levels. As a result, the lean champion (transformational leader) becomes a crucial element in the model. The main tasks of this position are to bring and keep the lean culture alive, train the responsible lean manager of each department, and check if the partial improvements on the department level also fit the overall business objectives.

The Lean Champions, Lean Manager, or Transformational Leader is authorised by the top management and has full backing for the lean transformation. The main tasks are to keep the Lean Warehousing Culture alive and check if the partial improvements fit the overall business objectives.

For Liker and Hoseus (2008), people are the "heart and soul" of the Toyota Way. Wilson (2010, p. 59) states similar but in more detail that "the heart of lean…" and this model "...is its philosophy, which is a long-term philosophy of growth by generating value for the customer, society, and the economy with the objectives of reducing costs, improving delivery times, and improving quality through the total elimination of waste". This core aspect of this definition is the term "socio-technical", which emphasises the social components as equal to the process and technical elements.

5.2 Warehouse Management factor

The initial model provides some additional factors for effective Warehouse Management, which were hypothesised to be necessary relating to the provision of virtual training, testing and simulating environmental conditions and comparing the reached lean level with the set KPIs to advise on process improvement based on a comparison of past and future data. The new standards must be continuously integrated.

5.3 Stakeholders factor

The drivers for change and continuous improvement are either internal stakeholders like the management, employees, and business owner or, as well, external stakeholders like customers, suppliers, creditors and investors, markets, government (e.g., taxes and environmental protection), nature (natural resources) and the community (political parties, associations, unions, media, etc.).

The term customer has the meaning of an external customer and an internal customer, which could also be the following process. A customer can also be understood as every possible stakeholder, e.g., the public calls for sustainable use of resources.

5.4 Change Management factor

In general, all stakeholders' interests and requirements can lead to a change in the process or organisation. The company should strive for perfection across departments and the whole organisation.

Therefore, the initial model was inspired by the PDCA cycle according to the quality expert Deming. In Deming's opinion, the continuous improvement should perform quality-determining factors in the context of a revolving process, which consists of four phases PDCA cycle (Moen and Norman 2006). The PDCA cycle is mainly used for quality improvement but can be used as a general approach. There are also numerous lean methods for a continuous improvement (KAIZEN) for analysing like Team Meetings, Muda Walk, Benchmarking, audits, improvement proposals by team-leader (Rancho), long-term deviation from key performance indicators (e.g., WMS modules ABC-Analysis, KPI-Cockpit)

Chapter 6 Research Philosophy, Methodology and Methods

6.0 Research Philosophy, Methodology, and Methods

This study was conducted by the view of a critical realist, which combines positivism and phenomenology to gain a comprehensive picture of the Lean Warehousing theory as earlier studies used mainly structured questionnaires. However, "…the critical realist's position is that the social world is constantly changing is much more in line with the purpose of business and management research which is too often to understand the reason for phenomena as a precursor to recommending change" (Saunders et al., 2009, p.115). The critical realist also recognises the importance of multi-level study (e.g., at the level of the individual, the group, and the organisation) and of a greater variety of structures, procedures, and processes (Saunders et al., 2009).

The study started with a narrative literature review gathering data about Lean Warehousing methods and the standard functions of WMS, corporate philosophy and culture (Mann 2015; Hermalin, 2013), change management (Kotter and Seidenschwarz, 2013; Doppler and Lauterburg, 2014), and transformational leadership (Vitalo et al., 2009; Liker, 2011; Givens, 2008) to identify the scientific gaps. The search was using several internet search engines like Manager, WorldCat, and databases like EBSCO, ProQuest, and Emerald and conducted secondary research in the libraries of the University of Nicosia and at the University of Applied Sciences Landshut.

The results were then synthesised by an initial conceptualisation and research hypotheses to be validated by further empirical research. The data collection process started with conducting a pre-determined sample size of 15 semi-structured expert interviews with logistics managers, WMS vendors, and consultants specialised in lean transformation. This means another triangulation by mixing the groups within the same sample and same sample method. For each group, five interviews were conducted as the qualitative research focus on the views of fewer people in greater depth (Curry et al., 2009). As a specific research objective for the qualitative stage, this procedure promises to enclose eventually missing factors for a lean warehousing model, which were not mentioned in the literature until now. The sample size is in line with Baker and Edwards (2012), Denzin (2012), and Back (2012), who are following the data saturation pattern that the majority of information comes from initial interviews and less and less new information by later interviews. The transcription of the voice records will be analysed with the software programme MaxQdata in the form of a content analysis.

The qualitative findings then informed the following quantitative research stage. Eventually, missing factors were incorporated into a structured questionnaire to investigate the general research question and to tackle research objectives 1 and 2. This method allows collecting large amounts of information from a large sample size in a short period of time. The database of Hoppenstedt/Bisnode provides a list of 6.072 companies in the field of warehousing a full sample in Germany with a relevant storage size above 3.000 m². All companies from this research received an online questionnaire to get a significant sample size according the full sample number. The results were analysed with SPSS (regression analysis). They disclosed the specific demands and reasons for failed lean implementations for the group's manufacturer, suppliers, and logistics service provider to consider the relation to multiple stakeholders.

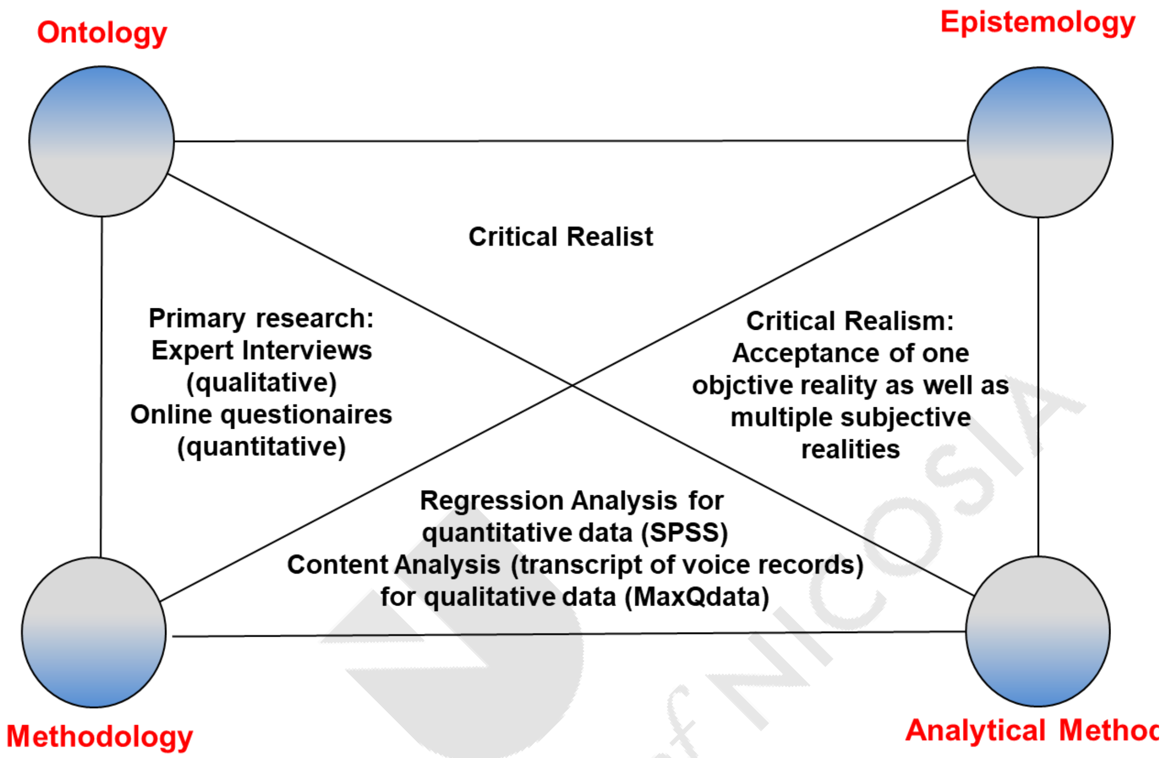
This research approach pursues the quantitative survey and qualitative case study methods to triangulate the research results. This combines the respective advantages of both methodologies and will lead to higher levels of reliability and validity (Weyers et al., 2011).

The synthesis of both research results - the quantitative and qualitative research sequence - led to a final model of Lean Warehousing (research objective 3).

This methodology is considered conducive to developing new knowledge in the field as the studies mentioned above only used observed case studies or surveys, respectively.

The following figure 6.1 shows the "Magic Square" of the researcher's ontology, epistemology, analytical methods, and methodology, which are all interrelated and correlated to the research aims and objectives.

Figure 6-1: "Magic Square" Research Philosophy and Methodology



Chapter 7 Data Collection and Analysis

7.0 Data Collection and Analysis

7.1 Expert Interview

Interviewing in qualitative research is a flexible and powerful tool to capture the voices and the ways people make meaning of their experiences. (Rabionet, 2011).

Also, Diekmann (2007) describes qualitative interviews as an ideal instrument to explore fields of knowledge, especially if it is unexplored and if there is no or just a little literature about like it is for the field of viable Lean Warehousing initiatives. The reason for that is the systematic analysis possibilities and conformability (Lamnek and Krell, 2016). Mayring (2015) emphasises that qualitative research does not make demands for testing hypotheses but generates hypotheses by exploration. Exploration means collecting data by exploring a field of knowledge in full depth and a holistic manner (Kromrey, Roose and Strübing, 2016).

The interviews have been held with self-chosen experts. These experts must have profound knowledge so the results can be applied to the whole population, giving it a general character (Friebertshäuser, 2006). Due to the research questions, the researcher identified three groups in the whole population. These companies themselves are confronted with the implementation of LW represented by Managers from the Logistics and SCM departments. As the second group, there are the Consultants who specialised in Lean and as a final group the vendors of WMS software as they (should) know the requirements and needed functions for efficient warehouse management. All participants dispose of not less than ten years' work experience in their field of expertise. This was enquired through the social network platform XING, in which the experts are listed and depict their work experience and employers, including the duration of employment, career level, etc. XING is a widespread social platform for business contacts and has become a reliable source for collecting research data and is comparable to LinkedIn (Papacharissi, 2009)

In expert interviews, interviewees respond in free speech but very often in subject-specific terminology. Therefore, the interviewer must have expert knowledge in this topic to be seen as an on-eye level dialogue partner. An interview guideline with open-ended questions and structured order will bring a topic-focused conversation going but not present pre-assembled answer categories like it is the case in structured questionnaires. That and the small number of respondents are why expert interviews belong to qualitative methods of data collection (Mieg and Nief, 2005). Like focus groups, direct observation, and literature reviews, semi-structured interviews are best suited to gather qualitative information. Interviews of this type are suited to working with small samples and are helpful for studying specific situations or for supplementing and validating information derived from other sources like literature reviews. (Laforest, 2009). "In addition, since they provide access to perceptions and opinions, they are effective for gaining insight into problems that are not immediately perceptible but that nonetheless cause concern in certain areas or in certain segments of the population." (Laforest, 2009, p.4). Expert interviews should be performed as follows (Mieg and Nief, 2005; Mayer, 2013; Laforest, 2009):

- Use open-ended question
- The interviewee should do most of the talking.
- Referring to statements made in other interviews or to findings based on other data sources and literature review
- Respect the respondent's pace, and do not be afraid of pauses or silences.
- Keep the interview focused on the topic and specific questions
- no closed questions.
- Cover all topics included in the interview guideline
- Clear and direct questions such as How? Where? When? Who? What? Why? How much? How many?
- Listen carefully to all answers and ask more questions to obtain additional information.
- Ensure that interviewees understand each question
- Check if all topics have been discussed or if the interviewee has anything to add

7.2 Procedure of Expert Interviews

As outlined in the previous chapter, the expert interviews have been performed accordingly. There was a random order between the different interview partner groups just depending on the availability of the single interview partner. However, before going into the actual interviews, there was a pre-test to check the interview guideline and the mode of execution to get feedback and ideas for some improvements. Each participant — also the pre-tester — got a guideline with a short introduction of the researcher and the research method and the structure, and the expected length of the interview itself. Further on, the topic was introduced, including the research question to arouse interest in the interviewees.

7.2.1 Pre-testing or Pilot Testing

Roller and Lavrasek (2015), as well as Magnusson and Marecek (2015), emphasise the great importance of having a pre-test before starting with the chosen random sample as it gives vital feedback to improve the following interviews and, finally, the quality of the gathered data in the end. Having a pre-test also has the advantage of improving the researcher's skills as an interviewer, independent of whether he or she is a beginner. So, the reflection of a pre-test will improve the procedure itself and the data of interviews. "If the guide (guideline) is not comprehensive or an accurate representation of the construct of interests, the usefulness of the data gathered, and the study's final recommendations will be limited and possibly undermined." (Roller and Lvarasek, 2015, p. 80)

Therefore, the researcher conducted an interview according to the designed guideline with a professional warehouse manager, who was informed about the research and that he was chosen for the pre-test and that he will not be part of the sample for the latter interviews. This was accepted and highly appreciated. In the following, the interview was conducted as though it were a real interview. Based on the feedback, the following slight adaptions were made:

- Change of order of questions

The block for statistical data was moved to the end because to start right from the beginning is not suited to get them into the topic, and people could get the feeling to get interrogated. In this section, the work experience and job description were verified to confirm the status as an expert. As required criteria for the expert status based on Mieg and Näf (2010), the respondents should have at least ten years of work experience in their field of knowledge.

- Once more, a brief personal introduction.

As a warming-up phase, it would have been ideal to give once more a brief personal introduction about the researchers' background and the expectations before starting with questions (Even though there was already a written introduction in the guideline.)

- Using of specific terms

Some specific terms — especially the Japanese expression — should not be used because even the experts do not know all of them and could feel they are taught. Furthermore, the pre-test was helpful to the researcher as he got trained in using the voice recorder and getting used to the guideline in a live situation.

7.2.2 Execution

Even though semi-structured interviews are flexible, it is vital to prepare the interview accurately and define a guideline. Furthermore, the respondents should be informed in writing about the topic and the interviewer as well as the purpose of the study. Also, the procedure of the interview and ensuring the data protection is essential to create confidence and to offer the results of the study will stimulate to agree to the interview (Laforest, 2009).

"Semi-structured interviews should last from 60 to 90 minutes. Sixty-minute interviews are perfectly acceptable and ensure that neither the interviewer nor the respondent lose their concentration." (Laforest, 2009, p. 11) Whereas Seidmann (2013) claims ninety minutes for an interview. So, the researcher decided to reach at least sixty minutes of audio records and preferably even longer up to ninety minutes. The table below shows a reached median of seventy-five minutes, which is precisely the median of the two different references. Most likely due to the researcher's profession as a senior consultant for WMS at an international vendor for intralogistics solutions, just two interview partners in the group of WMS vendors could be persuaded to state their aspects and thinking about the research questions.

The following table 7.1 shows the list of all interview partners with job status, career level, industry sector, and interview length.

Table 7-1: List of Interview Partners

Job Title/Description	Industry	Date	Duration (hh:mm)
Group of Warehouse Manager			
Head of Logistics	Mechanical Engineering	07.01.2016	01:35
Head of Warehousing Spare Parts	Medical Engineering	07.01.2016	01:25
CEO	3PL	15.02.2016	00:55
Managing Director	Fashion Logistics	23.02.2016	01:23
Key Account Manager	3PL	16.03.2016	00:53
General Manager Lean Deployment	Multi	22.02.2016	01:05
Sum of Interview Partners group of Warehouse Managers: 6			
Group of Consultants			
Senior Consultant SCM & Logistics	Consulting	07.01.2016	01:35
Consultant Warehouse & logistics	Consulting	28.02.2016	01:05
Senior Consultant and Authorised Officer	Consulting	17.02.2016	00:40
Consultant SCM; Professor	Consulting; University	12.02.2016	01:19

Sum of Interview Partners group of Consultants: 4			
Group of WMS vendors			
Head of Sales WMS	WMS vendor	19.02.2016	01:15
Senior Sales Manager WMS	WMS vendor	25.03.2016	01:16
Sum of Interview partners' WMS vendors: 2			
Total of interview partners: 12 **Average interview length: 1h15min**			

Upfront, the interview partners received the interview guideline to prepare for the interview and get them interested by a short introduction into the topic and the research question.

The focus was to get answers to the qualitative research questions (see chapter 4.5). Therefore, the interview was divided into sections according to the identified factors during the literature review, which is the basis for the initial model. The interview itself and the guideline were performed in German (see original in the appendix), though, at this point, an English translation is provided.

Expert interview on Lean Warehousing

1) Purpose of the interview:

As part of my Ph.D. at the Department of Management & MIS at the University of Nicosia in Cyprus, I am conducting a study on Lean Warehousing.

The empirical research thereby is divided into quantitative research as an online questionnaire and into a qualitative part in the form of expert interviews, which are conducted at the beginning.

2) Introduction to the topic:

In several studies (Overboom, de Haan and Naus, 2010; Sobanski, 2011; Mah-Fouz, 2012, Spee and Beuth 2012; Dehdari 2014), the positive effect on warehouse key performance indicators was already demonstrated. For example, an increase in productivity of 32% was measured in a study of a logistics service provider after ten months, and in another example, a reduction in stocks of 45% was achieved after the introduction of lean warehousing methods.

Nevertheless, it shows that many companies still fail to establish Lean Warehousing sustainably (Agustin 2011, Kudernatsch 2014). Many companies can only record short-term success, and processes worsen after a short time and are subject to strong fluctuations in quality as well as in warehousing indicators.

This allows the assumption that many companies establish lean tools and methods for standardised and efficient processes in the sense of a project, but not as a persistent lean culture with a robust lean leadership culture within the organisation. According to that, there was no transformation on a strategic level, and therefore, no continuous improvement potentials can be lifted, and the processes remain unstable.

As the subject of my research, I want to examine the causes of failure and factors of success for a viable implementation of Lean Warehousing.

Key question:

What factors influence the viable implementation of Lean Warehousing?

3) Procedure:

The interview takes about 60 minutes and is divided into the following thematic blocks respectively factors:

I. Company and stakeholders (industry, competition, customers, strategic orientation, corporate culture and philosophy, management/leadership style, influences of politics and trade unions (laws and regulations), etc.….)

II. Warehousing (type of warehouse and the goods, automation grade, IT-System (WMS), staff qualification, etc.….)

III. Lean method (transferability to the field of warehousing, complexity, state of research, etc. ...)

VI. Statistical data on interviewees (career level, industry sector, experience in the field of knowledge, etc.….)

There are neither right nor wrong answers because they are about opinions, motives, personal settings, and assumptions. The interview will be digitally recorded for the purpose of complete documentation and later evaluation and analysis.

4) Data protection:

By participating, you might agree that the examination results will be used only for scientific purposes. Your information will be kept strictly confidential and is stored anonymously so that no conclusion on your person or company is possible. Your data will be used in this study and will not be passed to third parties. The interviewee is free to withdraw consent to use the data for further scientific processing.

For questions or suggestions, please feel free at any time to contact me via email:

simon.kallinger@gmail.com

Upon request, after completion of this study, I will send you the results in your email.

Thank you for your participation and best regards,

Simon Kallinger

The following table shows the shortened questions and the corresponding section respectively factors out of the interview guideline in correlation with the qualitative research questions figured out beforehand. (see chapter 4.6) The interviews were held according to the interview guideline to ensure having the same conditions in each interview. Further on, the interviewer was just asking questions and not commenting on the interviewee's answers to avoid bias the interviewee's thinking.

Research Question	Covered in Guideline section (I, II, III, IV)
1. What differentiates factors between the original Lean Manufacturing theory and the still-evolving Lean Warehousing theory?	I Company and Stakeholders, III Lean Method
2. Which leadership theory is best suited for a successful and comprehensive transformation to Lean Warehousing?	I Company and Stakeholders, III Lean Method
3. Are there other missing factors for WMS besides virtual team corners and classrooms, real-time visualisation and testing, process simulation, interpreting and analysing KPIs, and system-based activities already identified in the literature review?	II Warehousing;
4. Are the application of Lean Warehousing and the included set of factors flexible enough to adapt processes in terms of KAIZEN or new stakeholder requirements?	II Warehousing; Lean Method
5. How do the grade of automation in warehouses and the lean warehousing maturity level correlate to one another?	II Warehousing; III Lean Method

6. What kind of relation exists between the industry sector and the lean warehousing maturity level?	I Company and Stakeholders, III Lean Method

7.2.3 Methods of Documentation and Analysis

The interviews were recorded consensually via a voice recorder to document the research and analyse the data. According to Mayring (2015), there are, in general, four methods of transcription.

1) word-for-word transcription

This method is used if the gathered data needs a detailed analysis there it is essential to capture the full text.

2) commented transcription

Using the commented transcription in addition to the text also pauses, emphasises, or laughing is transcribed in the form of additional characters.

3) selective journal/transcription

This method is used to reduce a considerable amount of data by running over unnecessary and digressive text passages.

4) Summarising journal/transcription

For analysing, it is not important to have the detailed context of speak but the thematically content. Like the method of selective transcription, it is suited for research with a vast amount of data. As the interviews with 12 interview partners resulted in nearly 14 hours of voice data, the method of summarising transcription was best suited even more as the categories respectively research objectives are already built. (Nevedal et al., 2021)

The steps used particularly in analysing data from semi-structured interviews are:

- transcribe and reread the recordings or notes made during the interviews

- classify the information gathered using an analytical framework based on the topics discussed
- identify the main ideas for each topic or thematic block
- identify the most critical points and classify them by safety topic.
- Validate the findings (Laforest, 2009)

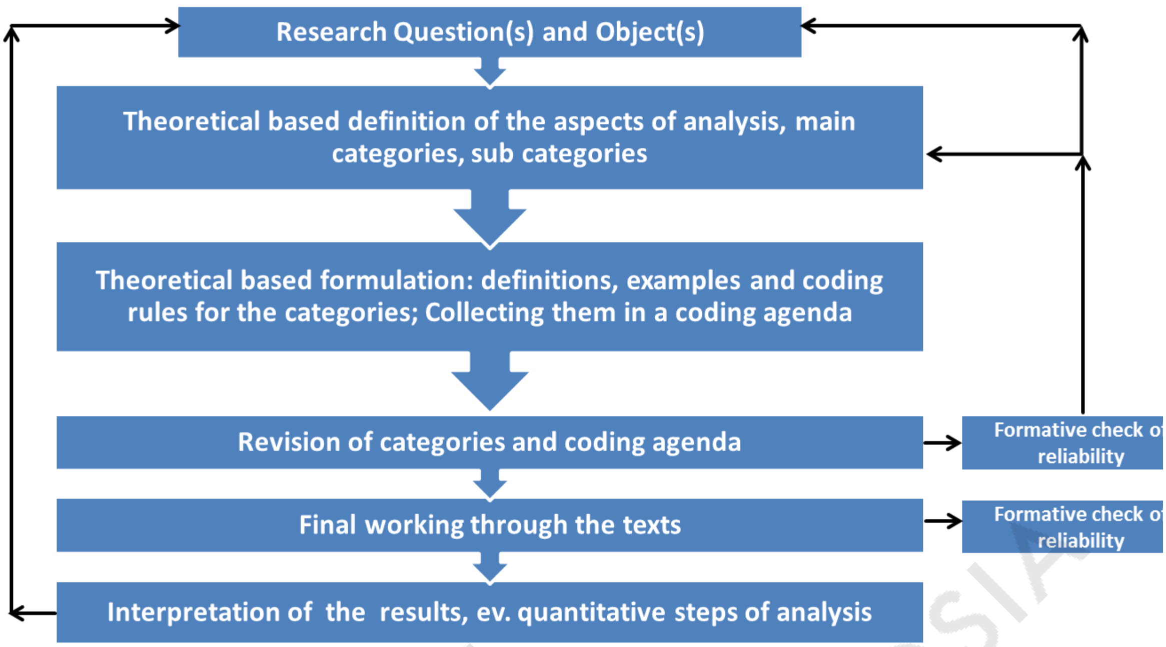
Brinkmann and Kvale (2018)

Kurzrock (2014) describe it similar but in some points even more explicit:

- Paraphrasing: classify text passages — paraphrasing in own words according to the thematic blocks
- Thematic allocation: finding keywords and headlines
- Thematic comparison: comparing text passages between different interviews — comparing headlines and building of thematic categories
- Conceptualisation: Comparison of categories with knowledge of the researcher, literature review, and other empirical studies
- Interpretation: interpretation of the results, but generalisation is reduced to the gathered data

Deductive category application works with prior formulated, theoretically derived aspects of analysis and bringing them in connection with the interview text. The qualitative analysis step consists of a methodologically controlled assignment of the category to a passage of text (Mayring, 2015). Figure 7.1 shows the model of the qualitative content analysis after Mayring. In the next chapter, steps two to six will be described in more detail.

Figure 7-1: Deductive content analysis model (own representation after Mayring, 2015)



7.2.4 Objectivity, Validity, and Reliability

For collecting and measuring data, any scientific research needs to fulfil specific quality criteria. The three acknowledged criteria are objectivity, reliability, and validity (Diekmann, 2003).

Titscher et al. (2000) state that content analysis withstands "…these traditional criteria of validity and reliability, where the latter is a precondition for the former (but not vice versa) (Titscher et al., 2000, p.65). Also, Mayring (2015) argues that validity takes priority over reliability because the content is held to be more important than methodical issues in qualitative analysis. Further, Mayring (2015) moans that content analyses lack evidence of reliability and validity about the results achieved. In general, there are two specific problems of content analysis in this context about problems of inference and of reliability (Titscher et al., 2000).

1) "Problems of inference relate to the possibility of drawing conclusions, on the one hand, about the whole text on the basis of the text sample and, on the other hand, about the underlying (theoretical) constructs such as motives, attitudes, norms, on the basis of the text. As a result, inference in content analysis confines itself only to specific features of external and internal validity.

2) Problems of reliability: here, particular attention is paid to the trustworthiness of the coding. The so-called inter-coder reliability shows to what extent different coders agree in the coding of the same text, and intra-coder reliability explains how stable the coding of one coder is." (Titscher et al., 2000, p.65)

Therefore, a critical discussion regarding quality criteria for the results in this research is crucial for a scientific approach even if Steinke (2004) proclaims that classical criteria cannot be simply transferred to qualitative approaches. Flick (2018) proclaims that validity in a broader sense is a minor issue within qualitative researches. Usually, it is subject-centred and close to everyday life, which means having a naturalistic perspective, especially when the research process remains theory-driven (construct validity). Mayring (2014) complements this statement that the rule-guided procedure can strengthen this criterion in qualitative research.

“Objectivity, defined as total independence of the research results from the researcher, is held to be difficult within qualitative approaches. But on the other side, they discuss the interaction researcher–subject and strengthen objectivity in a broader sense.” (Mayring, 2014, p.14)

Mayring (2014) further discusses the two poles of orientation a researcher could take up. The first one is:

1) being only part of the research instrument, applying content-analytical rules in a mechanical, automatic way, trying to be constant, observable, intersubjectively understandable, and able to be checked by intercoder reliability tests

or being

2) a free interpreter of the material, having content-analytical steps and rules only as orientation, establishing a subjective relation to the material. (Mayring, 2014, p.30)

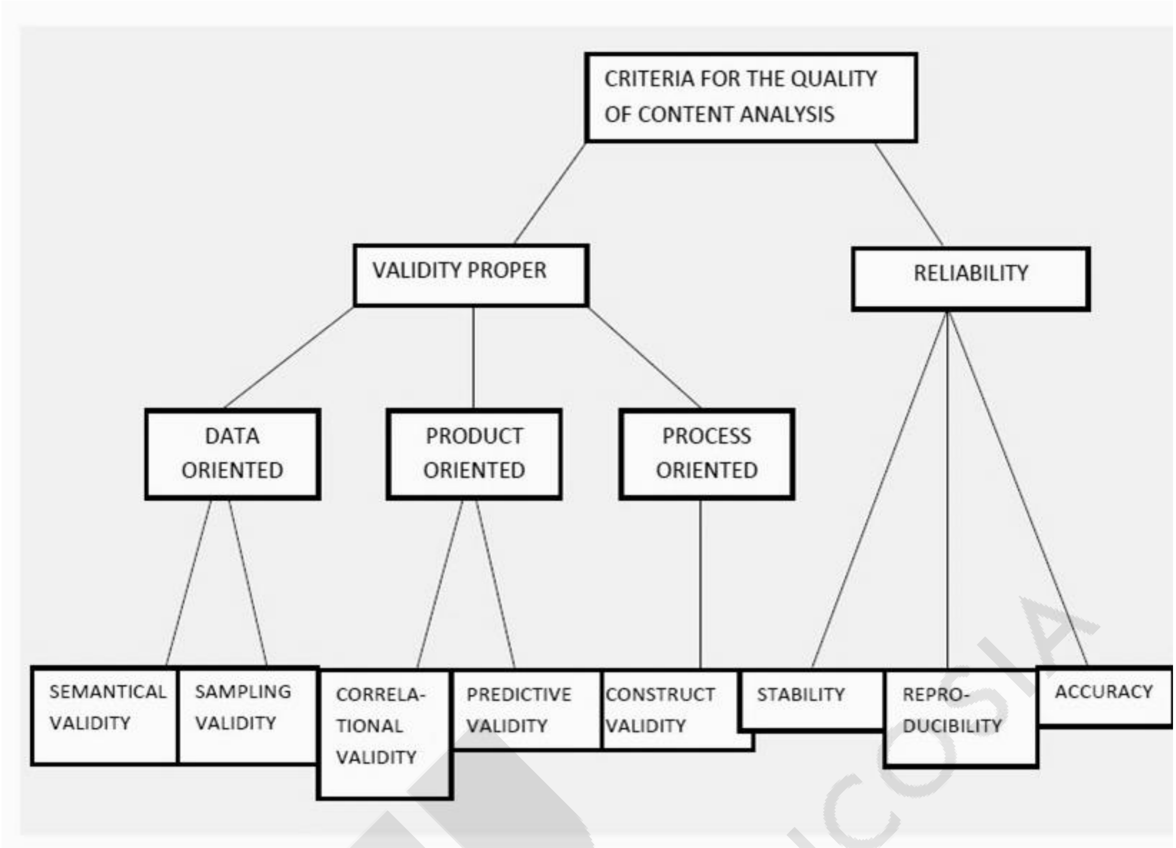
To ensure reliability Mayring (2014) suggests a pre-test which means to carry out the research operation once again and test if it comes to the same result. Also, a parallel test (with the same sample) could be conducted using a different instrument and review correspondence.

Regarding consistency, the data was split into two halves, and then it was checked whether both halves educe similar findings. In terms of validity, external criterions such as closely related research findings with proven validity are brought in as a standard of comparison.

Also, building extreme groups which are expected to reach extreme results should be tested if the results still point to the previous findings of the analysis. As the last suggestion, Mayring advises to test the findings for plausibility "…using established theories and the appropriateness of the operational definitions…" (Mayring, 2014, pp 107-108) based on the theoretical background. (Mayring, 2014)

The following figure (figure 7.2) shows the quality criteria in the content analysis according to Krippendorf (1980)

Figure 7-2: Content-Analytical Quality Criteria (Krippendorff 1980, p. 158)



"Semantic validity relates to the meaning reconstruction of the material and is expressed in the appropriateness of the category definitions, the key examples and the rules for coders. Sampling validity refers to the usual criteria for precise sampling and correlative validity refers to the correlation with some external criterion (e.g., the results of other methods like test, experiment or observation). Predictive validity can only be used as a quality criterion if predictions can reasonably be made from the material. Construct validity relates, for instance, to previous success with similar constructs, established models and theories, and representative interpretations. Stability refers to whether the same results are obtained in a renewed application of the analytical tool to the same text, and reproducibility is the extent to which the analysis achieves the same results under different circumstances, for instance, with different coders. It can be measured through inter-coder reliability for which a range of measures and indices have been developed. Finally, accuracy assumes stability and reproducibility and denotes the extent to which the analysis meets a particular functional standard" (Krippendorf, 2004, pp.214-216, 318-338; Mayring, 2003, pp.111-115; Tischer et al., 2000, pp.65-66). Mayring (2003) adds communicative validation as another quality criterion that has gained insignificance.

Finally, the last criterion is generalisability, which refers to "the degree to which the findings are applicable to other populations or samples" (Ryan & Bernard, 2000, p.786).

7.2.5 Applied research quality criteria

In the following, it will be outlined to what extension the quality criteria for this research step could be proved (table 7.2).

According to Mayring (2014), the results of the interview coding in MaxQdata will be demonstrated in building extreme sample groups with the minimum at the maximum in counted codes are compared. In total, 628 codes were counted over the whole sample of 11 interviewees. Interviewee 11 has serious a smaller number of codes, and also the interviewee achieved 100 codes which are outstanding from the rest as the next highest result in the ranking was 72 codes. Table 7.3 shows the results of the split-half reliability test to assess the consistency of the scores.

Table 7-2: Quality Criteria Overview

Quality Criteria	Quality Detail	Research Detail	Applied in Research
Objectivity	Conductive Objectivity	experts from 3 groups; interview guideline; Interview guideline with the timeframe	☑
	Evaluative Objectivity	Precise sampling via audio recorder and upload to MaxQdata,	☑
	Interpretative Objectivity	Coding Rules were defined and accordingly applied	☑
Reliability	Split-Half-Reliability	Random split into two halves; extreme deviations excluded	☑
	Internal Consistency	Cronbach Alpha Coefficient	☑

Validity	Correlation Validity	to be tested	☑
	Consistency Validity	Traditional transcribing delivers the same result - was tested for one full interview	☑
	Construct Validity	Each coloured section was counted. Assumption: The more often a topic (code) is mentioned, the more important it is	☑

Table 7-3: Split Half and Cleared Data

		Full Sample	Cleared Sample	Extreme Deviation	Half 1	Half 2
Warehouse Management	SUM	99	88	11	45	43
Applicability of Lean in WH	SUM	163	137	26	68	69
Internal	SUM	164	131	33	65	66
External	SUM	74	55	19	24	31
Lean Drivers/Show-stopper	Sum	64	41	23	27	14
	TOTAL	564	452	112	229	223

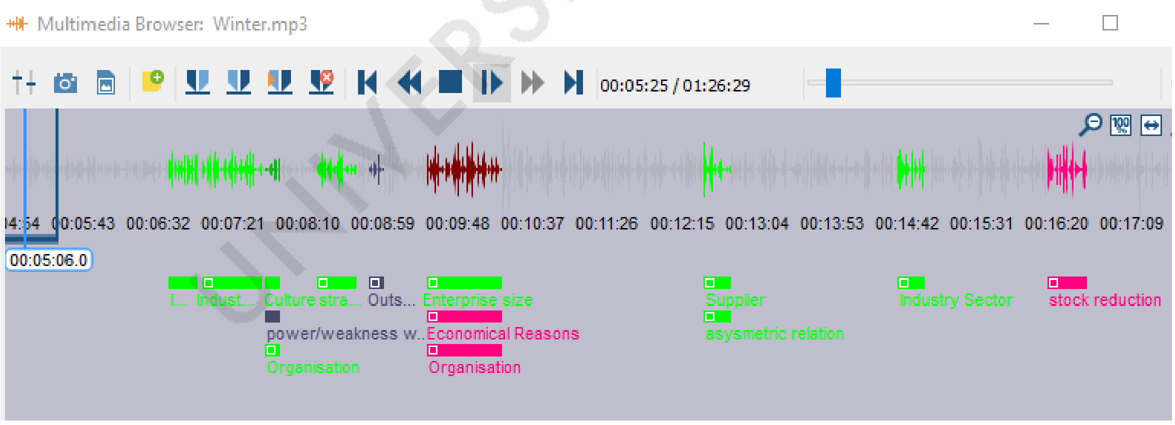
7.2.6 Execution of Documentation and Analysis

The digitally recorded interviews were uploaded to MaxQdata for analysis. Instead of a full transcription of all 12 interviews, each was transcribed through coloured markings on the audio spur. This new technique is called "Direct Audio Transcription" and has the advantage that later data analysis is supported by various statistical methods.

In comparison to the traditional transcription process itself, the transcription is still very intensive as the researcher listens to short sections of the audio records, again and again, to define the coding group and sub-codes to assign the heard section accordingly. Furthermore, the researcher adds the heard as a shortened comment to that code. This procedure is called "Coding" and means assigning codes to segments of text passages. A document or document segment can be coded with as many codes as needed. Coded segments can also overlap, intersect, or be wholly contained within other coded segments. For example, one answer could fit more than one code or sub-code.

The figure 7.3 below shows one example of a section marked in two different colours (code groups) and three markings in total. In this case, the marked section respectively the answer of the interviewee is pointing as well to the codes Enterprise Size, Economical reasons as well as to Organisation and therefore will be counted one time for each code group.

Figure 7-3: Coding Example



The identified factors from the literature review built the framework for the codes, and it turned out they could be clustered into five major codes and sub-codes. During the procedure of coding, the researcher found three new factors:

1) Asymmetric relationship

Several interviewees reported that the company's customers often hold so much power that internal processes cannot be improved because the customer is not interested and only considers its own processes so that no overlapping process improvements can be made. This can be observed predominantly in the automotive sector when large corporations exploit their market power against the smaller second-tier supplier.

2) Industry sector

During the interviews the factor industry sector was mentioned quite often and thereby confirmed the literature. Most of the interviewees were sure that the automotive industry is a leader in lean manufacturing and therefore also have advantages in lean warehousing. However, the literature gives hints that companies in the Fast Moving Consumer Goods (FMCG) industry have an increased need for optimized warehouse flow as compared to the automotive industry as they have in general a higher turnover of so called short shelf life products. FMCG have a rapid turnover on the shelf at the retailer and are purchased frequently due to rapid consumption at a low price (Matunga et al., 2018). Many of the goods a perishable too and, therefore, this industry sector could benefit enormously from LW implementation (Tanudiharjo et al., 2021) as it "…will ultimately be reflected in the logistics performance of downstream retailers and the whole distribution channel." (Abushakhai, et al., p.785, 2018)

3) Departmental Thinking

Often, companies do not know the relationship and the interaction between the departments, and usually, this is not sufficiently documented and therefore not taken into account in daily practice. Due to this lack of knowledge about the interaction between departments like purchasing and logistics or production and logistics and their impact on logistics indicators, companies fail to optimise the overall operational performance. Wöhrle (2016b) confirms this as a phenomenon, particularly in German SME's.

During the interviews and in the analysis, the role of external consultants was also mentioned several times.

<u>Exemplarily examples:</u>

Interviewee 8 (Int.8) reports about consultants, who could be the reason for failed lean introduction: *"Many Lean consultants just focusing on the tools and train the usage of the tools, but this is not enough!"*

"*Consultants are not only cost intensive, sometimes companies' don't want to share critical insider knowledge to externals"* (Int.5)

"Managers fear changes and don't listen to what consultants or specialist say" (Int.7)

"Employees are overburdened – they do not have the knowledge and competence for a lean implementation." (Int.4)

However, a precise classification cannot be made, as the consultants are perceived both as LW show-stoppers and, on the other hand, they are also required, as LW Philosophy and their methods are too complex. In the group of stakeholder factors, consultants were even mentioned as absolutely necessary for SMEs, as smaller companies cannot provide the human resources and the specialised knowledge.

This is a paradox as, at the same time, the experts confirm that the lean method, in general, is very complex and that employees do not have enough knowledge to practice Lean Warehousing. Thus, it would be necessary to get support and advice from expert advisors from outside, but there are various objections.

As reasons against were mentioned that fees for consultants are too high, and they do not have the specific knowledge for LW or only implement a specific lean method in a particular area. In literature, there are numerous examples for this approach to start with the easiest or most potential promising tools – also called "low hanging fruits" (Spee and Beuth, 2012, Baudin and Meyerson 2012, Mahfouz, Smith and Arisha, 2013). Ickerot (2013) outlined this approach as ERIP-Method, which starts with a change agent training for method mediation, Know-How transfer and building up responsibility. This is followed by a pilot project and best practice example and finally ends in an action plan and a company-wide roll-out.

These new factors will be considered and discussed in the following research steps. In the following, all codes and sub-codes from the transcription are listed.

1. Lean Show-stoppers
   - KPIs
   - No support by top management
   - Cost intensive
   - Departmental thinking
   - Outsourcing
   - Organisation
   - No influence on ongoing processes
   - High margins
   - Employee knowledge
   - Power/Weakness within the enterprise
2. Lean Drivers
   - Quality
   - Organisation
   - Flexibility
   - Standardised processes
   - Reduce throughput times
   - Reduce waste
   - Stock reduction
   - Economic reasons
   - Optimise production
   - Less warehouse space

- Warehouse turnover rate

3. Warehouse
    - Warehouse Management System
    - Automation
    - Warehouse techniques
    - Missing functions
4. Applicability of Lean in Warehouses
    - Training
    - Not or just partial applicable
    - Applied Lean Methods
    - Publicity
    - State of research
    - Complexity of the Lean Warehousing method
5. Stakeholder
    - Enterprise
        - Change Management
        - Industry sector
        - Enterprise size
        - Asymmetric relations
        - Organisation
        - Culture
        - Product
        - Strategy
        - Leadership
    - Supplier
    - Employee
    - Environment

- Society
- Competitor
- Customer

Figure 7.6 shows the original screenshot from the code matrix of MaxQdata, and in the following table 7.4, the codes a sub-codes are summed up for subsequent analysis.

Figure 7-4: Screenshot of original Data Output

Code System															
Lean Showstopper						1									1
KPIs					1										1
no support by top management				1	1	2	4	3		1	2		1		15
cost intensive			1				3		1	7			1		13
departmental thinking			1				2	1		1	1		1		7
Outsourcing		1	1	1	2		5		1	1	2		2		16
organization			1	1		1	3	3		6	5		4		24
no influence on ongoing processes/sup		2					1	3			2	1	4		13
high margins								1	2				2		5
employee knowledge		1	2	1	1	2	5		1	1	2		3		19
power/weakness within the enterprise		1	1				1	1	1	1	1		1		8
Lean Drivers															0
Quality		1	1							1					3
Transparency									1		1		1		3
Organisation		2			1	1	1	2	1	1			7		16
Flexibility			1								1	1	3		6
standardized processes		1			2				1	1			1		6
reduce throughput times		1					1						1		3
reduce waste		1											2		3
stock reduction		2											1		3
Economical Reasons		3		1	2	1	2	1		1			2		13
optimize production							1	1					1		3
less warehouse space		1								1			2		4
Turnover Rate Warehouse													1		1
Warehouse															0
Warehouse Management System		1	4	3	4	3	2	4	3	1					25
Automation		2	2	4	2	1	3	2	3	5	5	1	7		37
warehouse techniques				1							1				2
Missing Functions		3	1	4	3	1	7			5	7		3		34
Applicabillity of Lean in warehouses		2		2	2		2								8
training				1	2		1	1	1	1	1		1		9
not or just partial applicable				1		5	3	1	1			1	3		15
Applied Lean Methods		1	2	4	5	4	4	12	1	3	8		11		55
Publicity		1		3	2	2	1	2			1				12
State of Research				1		1					3				5
Complexity of the Lean Method		1	1	1	2	1	2	1	1	1	2	1			14
Stakeholder															0
Enterprise													1		1
Change Management		1		1		3				2	1				8
Industry Sector		4	5	6	3	1	2		1	2	10	1	8		43
Enterprise size		1	1	1	2		2	1	2	2	1				13
asysmetric relation		1	1		1										3
Organisation		3	4	2	1				1	2			2		15
Culture		2	2		4	1			1	1	5		4		20
product										3			2		5
strategy		2			1					1	2		3		9
Leadership		1		1	3	2		1			3		3		14
Supplier		1									1				2
Employee				2		1					1		4		8
Enviroment						1	1								2
Society													1		1
Competitor							1				2		2		5
Customer					1		2	3		1	1	1	4		13
SUM	0	44	32	43	48	35	62	44	24	53	72	7	100	0	564

Table 7-4: Interview Data per Code and Sub-Code

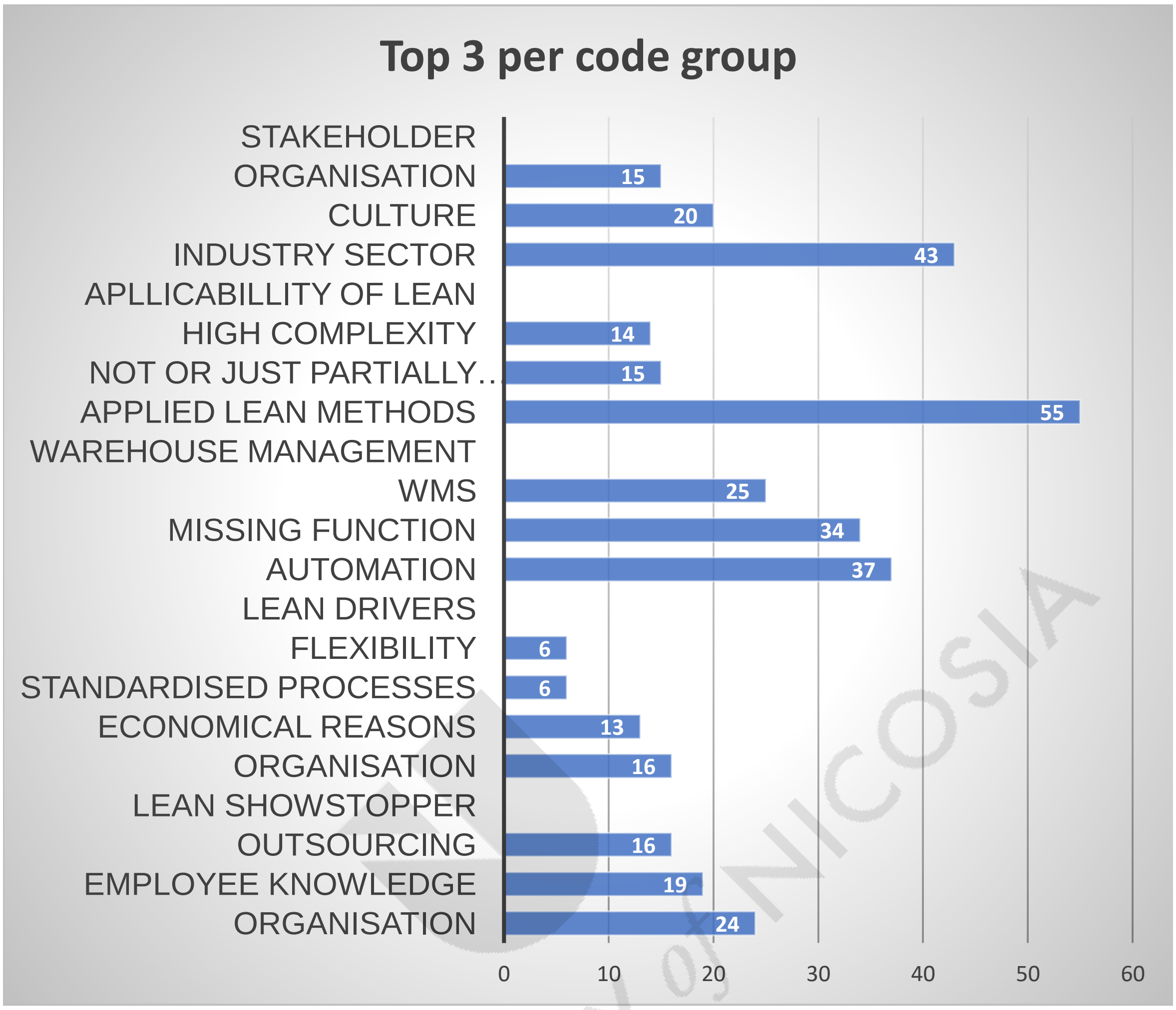
Interview Data		
Code	Sub-Code	No. in total
Warehouse Management	WMS	25
	Automation is hindering lean	37
	Warehouse Techniques	2
	Missing Functions	34
Sum		98
Applicability of Lean methods in warehouses	Training	9
	Not or just partial applicable	15
	Applied lean methods	55
	Publicity of Lean	12
	State of research	5
	Complexity of lean methods/philosophy	14
Sum		110
Stakeholder Internal	Enterprise – Change Management	8
	Enterprise – Industry sector	43
	Enterprise – Size	13
	Enterprise – Asymmetric relations	3
	Enterprise – Organisation	15
	Enterprise – Culture	20
	Enterprise – Product	5
	Enterprise – Strategy	9

	Enterprise – Leadership-Style	14
	Enterprise – Employee	8
Sum		138
Stakeholder External	Supplier	8
	Environment	2
	Society	1
	Competitor	5
	Customer	13
Sum		37
Lean Show-stopper	KPIs	1
	No support from top management	15
	Cost intensive	13
	Departmental thinking	7
	Outsourcing of logistics	16
	Organisation	24
	High margins	5
	Employee knowledge	19
	Weakness of logistics department within the organisation	8
Sum		108
Lean Drivers	Quality	3
	Transparency	3
	Organisation	16
	Flexibility	6
	Standardised processes	6
	Reduced throughput- times	3

	Reducesdwaste (according to Lean)	3
	Reduced stock	3
	Economical reasons	13
	Optimised production	3
	Turnover rate	1
	Optimised usage of warehouse space	4
Sum		64

The number of entries per code or sub-code reflects the importance or weighing of the factors. These results for each sub-code can be compared to create a ranking (see figure 7.7), but the sum of all codes can also be compared. However, the generation of an order is not acceptable, as the number of sub-codes is different, and therefore no reliable conclusion can be drawn. A rough indication, however, is possible.

Figure 7-5: Top 3 per Code Group



The highest single score is achieved by Applied lean Methods, which clearly shows that single lean methods like 5S, KANBAN, FIFO etc., are widespread and applied frequently. This is not necessarily a contraindication to High Complexity of the lean Philosophy as only some single methods were applied, but not LW as a holistic approach.

The second highest value in the ranking is the Industry sector. Only two interviewees did not mention this factor. All others are thinking that the industry sector is either positive or also negative.

Number 3 in the ranking is Automation, followed by Missing Functions and WMS, all in the primary group Warehouse Management. Therefore, it can be assumed that these factors are of great importance and influence the LWMI. Organisation in the code group Lean show-stopper has the sixth-highest value. It has the specific characteristic that it is also a sub-code for internal Stakeholder (enterprise) and the Lean Driver group.

In the next section, some exemplary statements from the interviewees per sub-code are cited, including the total number of entries (in brackets) according to the full analysis.

KPIs (1):

Interviewee 9 mentions, "If you don't have the right indicators lean initiatives going to fail or will be dropped after some time!"

High margins (5):

High margins are one of the new factors created during the interview analysis and were not expected. Nevertheless, there were at least three interviewees with a total of 5 responses concerning that factor. These responses show that enterprises and managers are still not planning for future process improvements with lean methods "as long they make good profits" (Int. 5). However, suppose it comes to an economic crisis. In that case, these enterprises and managers will find out that Lean and Lean Warehousing is a long-term methodology and that it needs time to gain profit from these efforts. And not all will have the luck to overcome the crisis and to reach "the highest turnover ever" (Int. 1). In the researchers' eyes, you should concentrate on continuous improvement in strong economic periods to be forearmed for an eventual crisis to come, because "if they do not have pressure like shrinking profit etc., they do not care about lean" (Int. 3). However, the pressure will double as soon you are stuck in a crisis.

Departmental thinking (7):

"Sales and procurement are the elementary departments and all other have just support functions" (Int.12)

"The organisation with very powerful site managers/profit center makes it difficult to enforce central lean structures" (Int.10)

“A top manager who is also responsible for IT, Logistics plus a staff department for process optimisation would be ideal” (Int. 12)

“Manager from the second level don't get support by the top management" (Int.10)

“Logistics is treated by the top management like a stepchild and also the managers do not have the knowledge about lean” (Int.7)

“Other departments have a big lobby and logistics department is not powerful enough to overrule” (Int.6)

Often, enterprises do not know the relation and the effective range across departments, and most often, it is not sufficiently documented. Due to this lack of knowledge about the interaction between departments like purchasing and logistics or production and logistics, the optimum enterprises fail to reach the logistic command variable and other corporate command variables (Wöhrle, 2016b3).

WMS:

“Standard systems are not flexible enough for all the different customers of a 3PL, and you are also constrained by externals“ (Int.10)

“Systems must be easy to configure and customisable by the customer itself” (Int. 9)

“There is a lot of potential for "lean modules" but the system developer/programmer does not have the needed lean know-how” (Int. 9)

“*WMS most often don't provide the right data or at least not in the way it is needed”* (Int. 8)

“Graphical workflows would be nice” (Int. 7)

“Workflow functionality is not supported and other systems like CRM systems etc. are ahead in this point” (Int. 7)

“CR's in software are cost intensive and there are no clear savings to oppose” (Int.4)

Missing functions:

“Standard systems are not flexible enough for all the different customers of a 3PL and you are also constrained by externals” (Int. 10)

“Systems must be easy to configure by the customer himself” (Int. 7)

“Most of systems are caring just about the stock management rather than the flow management” (Int. 9)

“Most often there are not the right indicators and soft indicators like suggestion rate is completely missing” (Int. 3)

"There is a lot of potential for "lean modules" but the system developer/programmer does not have the needed lean know-how to do it right or vendor just don't care about this topic." (Int. 9)

"Workflow functionality is not supported, and other systems like CRM are ahead in this point. (Int. 6)

Automation:

“It needs the right mix between technisation, automation and people involvement and leadership and not too stare system” (Int. 7)

“As a 3PL flexibility is needed to serve several different customers - contracts are closed for maximum 3 years and automation doesn't pay off as the time is too short." (Int.2)

“A highly automated system is not lean!" (Int. 3]

“Some think that a highly automated warehouse does not need any further optimisation and Lean Warehousing could not increase it even further.” (Int. 4)

“The topic resource planning has been implemented on a project basis but not as a standard feature. (Int. 4)

“The feature resource planning has been implemented as project specific feature and not as a standard feature” (Int. 7)

7.3 Adapted Model and derived hypothesis

The initial model was drafted according to the literature review and a neutral weighting of the components. After the qualitative analysis, the factors were weighted according to the number of entries per code and the affiliation to the main code group.

The model (see figure 7.8) has changed drastically, and Warehouse management theory is now the main factor, whereas Leadership and Change Management shrank to a minimal contribution to a viable Lean Warehouse.

Figure 7-6: Adapted Lean Warehousing model after the qualitative research phase

The findings from the qualitative phase also informed the next research step – the quantitative research. As a consequence of the new distribution of components, two hypotheses for Warehouse management (WMS and Automation Grade) and each one for Stakeholder, Leadership and were derived.

H1: The grade of satisfaction of WMS has a positive effect on the LWMI.

H01: The grade of satisfaction of WMS has not a positive effect on the LWMI.

H2: Warehouse Automation has a negative impact on the LWMI.

H02: Warehouse Automation has not a negative impact on the LWMI.

H3: Leadership is a significant factor for viable Lean Warehousing.

H03: Leadership is a not significant factor for viable Lean Warehousing.

H4: A successful Lean Warehousing is independent on the Industry sector a company is in.

H04: A successful Lean Warehousing is dependent on the Industry sector a company is in.

Chapter 8 Qquantitative Research

8.0 Quantitative Research

This chapter describes the method and procedure of how the quantitative data was sampled and finally analysed.

In order to determine the relationship between a dependent variable and the set of multiple independent variables, a multivariate linear regression analysis is conducted. This procedure determines the influence of independent variables on the dependent variable and to what extent or even which variable(s) may even have no relation to the dependent variable. In general, the model can be demonstrated as:

$$\boldsymbol{Y} = \boldsymbol{F}(\boldsymbol{x}1, \boldsymbol{x}2, \dots, \boldsymbol{xn}) + \boldsymbol{e}$$

8.1 Sample size

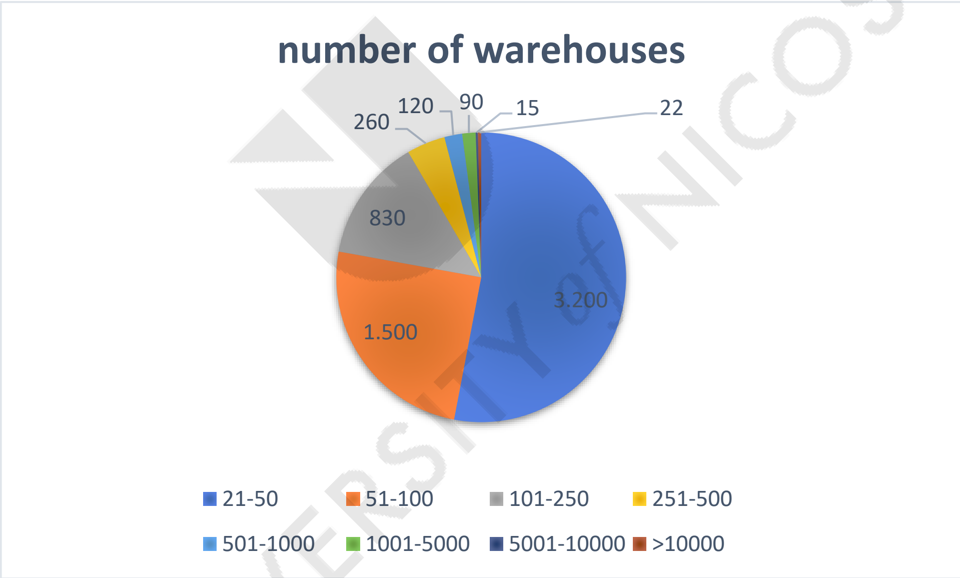
The sample size necessary to obtain a certain level of statistical power depends on the population value and effect size, which is, by definition, unknown. (Anderson et al., 2017.) Rocha Costa (2018) stresses the importance of the study design in relation to the sample size in quantitative studies. "In descriptive studies, sample size is mainly influenced by the variation of the phenomenon investigated in the population and the accuracy of the estimate that one wants to obtain. In this sense, the larger the population variation, the larger the sample size required. Similarly, the greater the accuracy required, the greater the number of participants in the sample." (Rocha Costa, 2018, p. 487)

Hence the effect size is the main finding of a quantitative study. The P-value measures whether an effect exists, but the P-value will not reveal the size of the effect. "In reporting and interpreting studies, both the substantive significance (effect size) and statistical significance (P-value) are essential results to be reported." (Sun, Pan and Wang, 2010, p. 989).

The total population relevant for this survey encompasses all enterprises in Germany that have warehouses according to the definition from chapter 4.1 (Richards, 2014 and Frazelle, 2001) and therefore is irrespective of the type of warehouse and the operational warehouse processes. This means the total population consists of pure logistics providers and all manufacturing industries and trading companies with warehouses.

The number of warehouses from logistic providers in Germany according to Hoppenstedt (2021), a statistical service provider, is at approximately 6.037. The following figure 8.1 shows the allocation after the number of employees.

Figure 8-1: Total population: Number of warehouses (Hoppenstedt 2021)



According to a survey from the Fraunhofer Center for Applied Research on Supply Chain Services SCS, 50% of all warehouses are provided by logistics providers and all others by the industry and trading companies themselves. (Kille and Schwemmer, 2019) This means the total population for this survey is assumed to be approximately 12.074.

"The two most commonly used measures of effect size are Cohen's d and Pearson's r." (Funder and Ozer, 2019, p. 157). Cohen's d is typically used to characterise the differences in means and is used in studies with experimental groups, whereas, the correlation coefficient (Pearson's r), is typically used to characterise the degree to which one variable can be predicted from another (Funder and Ozer, 2019) and therefore is suited for interpretations for the analysis of this study.

Pearson’s correlation measure ranges from -1 to +1. The effect size is interpreted in 3 categories Cohen, J. (1988b):

small effect = up to +0.2 or -0.2,

medium effect = up to +0,5 or -0.5

large effect = up to +0,8 or -0.8

Coefficient of determination: Range 0-1 (expressed in Percent); Effect size: small=0.04, Medium =0.25, large= 0.64

Braun and Clarke (2013) categories suggestions that were made by the type of data collection.

For small projects, they recommend six to ten participants for qualitative studies with interviews or two to four participants for focus groups. The recommendation for participant-generated text is at ten to fifty or for secondary sources ten to a hundred. "The upper range for large projects is '400+'. (Braun & Clarke, 2013, p. 50)

Four factors influence the sample size: power, effect size, significance level, and (drop-out) rate. Latter is not of interest as this factor is only needed longitudinal or repeated-measures research.

<u>Power:</u>

The power of statistical calculations is defined as a certain probability that the null hypothesis (H0) test reaches a statistical significance level when H0 is false. A so-called type 2 error is also avoided. A type 2 error is defined as the probability if and to what degree the researcher accepting a false H0. "The minimum power level of most quantitative research studies is set at 0.80, indicating that the researcher is willing to tolerate a 1-in-5 (20%) chance of detecting no difference between groups or relationship among variables even when such differences or relationships really exist." (Duffy et al., 2006, p. 9),

In studies where it is crucial not to miss a real effect, the minimum power level might be raised to 0.90 to detect the effect if it is really there. In addition, taking repeated measurements on the same study sample increases the power of a study. (Duffy et al., 2006)

Effect Size:

Effect size (ES) is the term that gives several indices that measure the magnitude of an effect or relationship that exists in the population. ES is an estimation of the researcher of what the expected difference might be in relation to the dependent variable and the independent variables within the sample, or the size of the anticipated association, or the explained variances of the variables. "Estimating the ES is the most difficult part of sample size planning. The smaller the anticipated critical ES, the larger the necessary sample size." (Duffy at al., 2006, p. 9)

Significance Level:

Significance level (P-value) is the probability that an observed difference between groups or relationship between variables is due to chance. The researcher usually sets this P-value beforehand at either the 0.05 or 0.01 level, indicating the margin of type 1 (") error that will be tolerated. In other words, the researcher is willing to be wrong only five times (0.05) or one time (0.01) out of a hundred that the observed difference or relationship would be found by chance. (Duffy et al., 2006)

Drop-out Rate:

The drop-out rate is defined as the rate of participants lost in longitudinal research before it is finished. However, this factor is irrelevant for this research.

This research follows the made previous scientific recommendation. However, on the other hand, the researcher is always in a dilemma to choose a sample size that is big enough to prove that the variable effects are significant. On the other hand, it should be as small as possible to not conduct the research with an appropriate effort of time and money.

It is common for sample-size planning to use the sample size from previous studies to estimate the population for prospective studies. This strategy is applied here. "Although this strategy is intuitively appealing, effect-size estimates, taken at face value, are typically not accurate estimates of the population effect size because of publication bias and uncertainty." (Anderson et al., 2017, p.7).

Jasti (2014) explored in his survey (literature review) the applied empirical research methodology in lean manufacturing. As this topic is close to lean warehousing, which has its origin in lean manufacturing, the findings should be best suited as an indicator for this research for the sample-size planning. Jasti (2014) reviewed a set of 178 empirical research articles in Lean manufacturing research. Only 24 journals of major management science publishers (e.g. Emeralds Online, Science Direct, Springer Link and Taylor & Francis) made an overview about the used sample size in each research and respective built-up categories as shown in the following table 8.1.

Table 8-1: Sample Size Planning

sample-size planning		
range of sample size (N)	frequency	percentage
0 < N ≤ 100	35	19,66%
1 < N ≤ 200	29	16,29%
2 < N ≤ 300	15	8,43%
3 < N ≤ 400	3	1,69%
4 < N ≤ 500	1	0,56%

5 < N ≤ 600	1	0,56%
6 < N ≤ 700	0	0,00%
7 < N ≤ 800	1	0,56%
8 < N ≤ 900	1	0,56%
9 < N ≤ 1000	0	0,00%
1000 > N	3	1,69%
na	89	50,00%
total	178	100,00%

According to this table, 50% of the analysed article did not mention the sample size, and about 36% have a sample size of 0 ≤ 200, which seems to be a reasonable number to collect within an acceptable effort according to effort in time and money but still deliver an acceptable and meaningful result.

The same study also reports that only 10.67% used triangulation from all analysed articles, which is applied in this research (Jasti, 2014). According to Lohdi (2016) is the combination of quantitative and qualitative methods "…a potent soured of strength for the hypothesis." (Lohdi, 2016, p. 73) and strengthen the credibility of the research. Moreover, data obtained from multiple sources like interviews, observations, questionnaires etc., afford the researcher validation of data through cross verification.

8.2 Questionnaire Design

The questionnaire was designed according to the identified variables from the literature review and the new variables identified after the qualitative analysis from the expert interviews.

8.2.1 Control Variables

This study also considered two control variables to verify the answers for plausibility. The control variables Experience in Lean Warehousing (yes or no) asked if the sample participants already took part in a Lean Warehousing project or introduction, even if they were not actively involved. The second control variable, Applied Lean Warehousing Methods, asked the intensity of used Lean Warehousing methods like milk run, KANBAN, 5S etc., as a Likert scale from 1 (no) to 5 (very intensive).

The results of control variables confirmed the plausibility as all participants who said they do not use Lean Methods also have the lowest LWI from 1. Furthermore, all who declared who have not participated actively or non-actively all have lower results compared to the median in the LWI (1.60 versus 2.63 median), the automation grade (3.09 versus 3.70 median) and in all sub-categories in the section Satisfaction in Warehouse Management. KPI´s: 2.40 vs. 3.53 median; Missing Functions: 2.07 vs. 2.95 median; Configuration possibilities: 2.40 vs. 2.76 median; Support of Vendor: 2.16 vs. 2.55 median.

This result approved that the questions were understood, and also the measurement instrument – the Likert scale – was appropriately used and was not mixed up. At the same time, this also approved the effectiveness of Lean Methods as all who do not use Lean Methods have also the lowest LWI.

8.2.2 Instrument for Measuring

Basically, the variables in the questionnaire are ordinally scaled according to Likert (Likert-Scale). "Likert-scale questionnaires are the most commonly used type of instrument for measuring affective variables such as motivation and self-efficacy, given that they allow researchers to gather large amounts of data with relative ease." (Nemoto and Beglar, 2014, p. 1). Likert-scales have the advantages to gather data very quickly and provide reliable estimates of persons. Furthermore, it can be easily compared with results from qualitative data-gathering methods (Nemoto and Beglar, 2014), like the expert interviews in this survey. This is supported by Nemoto and Beglar (2014) in writing that a complete understanding of the phenomena should be combined with data-gathering methods like participant observations and interviews. "By investigating a construct from multiple angles, there is a higher probability of accurately understanding that construct and arriving at more defensible interpretations and conclusions" (Nemoto and Beglar, 2014, p. 8). To design, a questionnaire Wilson (2015) suggest a five-step approach.

1) Understand the construct:

Here: Through an intensive literature review and expert knowledge from the author of this study, it is secured that the construct is fully understood. Moreover, after the expert interviews, more knowledge could be gathered firsthand.

2) Develop the items

Here: Generally, it is recommended to build six to eight items for a sufficient measuring of the construct items (source), but this survey intended to explore all barriers and enablers to develop a viable LW model. Therefore, the number of items was exceeded, mirroring all factors from the literature review and additional new factors from the expert interviews.

3) Determine the outcome

Here: The scale in the online questionnaire ranges from one to five as the dependent variable Len Warehousing Index LWI is also scaled from one to five. The questionnaire of this research consists of three main sections and four sub-sections for the last section: The first section, A, asking for respondent's demographic data (Company size, industry sector, type of warehouse, companies' strategy, warehouse-type and experience in lean transformation projects. The second section, B, measures the company's LWI (dependent variable). The third section, C, measures the independent variables clustered in four sub-sections: Warehouse management, Lean Warehousing methods and tools, internal and external stakeholders. The range of the five-point Likert Scale is basically from 1 (strongly disagree) to 5 (strongly agree) for each section and question but was slightly adapted for section B Warehouse Management and is interpreted here as 1 (very unsatisfied) to 5 (very satisfied).

4) Define the measurement

Here: The questions were designed as closed questions, and participants can choose on a Likert scale from 1 to 5 how much they agree or disagree and express their beliefs, attitudes and opinions to these questions. Likert Scale questions have the advantage of collecting massive data by using a universal method with easy-to-understand questions, and people have the option for a neutral answer if they are not clearly "agree" or "disagree". "The recommended measure of central tendency and dispersion for the ordinal data are the median (or the mode) & frequency (or range). An ordinal data set can further be statistically tested by non-parametric techniques such as Chi-square test, Kendall Tau B or C test." (Joshi et al., 2015, p. 396-403).

5) Pilot Questionnaire

Here: Before an online questionnaire is distributed, it is essential to inspect the questions derived from the literature review. It is constituting the survey instrument to gain its validity and reliability (Brace, 2018). Observer bias and error did not apply to this survey as the questionnaire was designed with questions for which interpretation was not possible and with fixed alternative answers. Thus, observer bias was irrelevant for this study (Binti et al., 2016). Reliability threats like subject or participant error, observer error, subject or participant bias and observed bias were addressed through a test pilot as recommended by Robson and McCartan 2016. The test pilot was launched and accessible and limited to the participants from the expert interviews. All interviewees took part and gave positive feedback. As not even one negative feedback or suggestion for improvement was given, the questionnaire was not adapted and launched on the internet platform unipark (https://ww2.unipark.de/uc/SDK_University_of_Nicosia/00eb/) for the new sample. The gathered test data from the pilot was not used for the analysis and was only used as feedback before launching the survey.

8.3 Data Sampling by Online Questionnaire

To distribute questionnaires, the researcher used business contacts he collected during his work as a Salesman and Consultant for Warehouse Management Systems. Therefore, the addressed contacts are all relevant for the sample. One thousand fifty-three emails were sent to all these contacts. All persons are responsible for logistics operations in their company or business unit and have job titles like Warehouse Manager, Logistics Manager, IT Manager, SCM Manager or similar. The E-Mail explained the research focus and contained a link to the online platform to register and fill in the online form. The response times to participate was initially set to four weeks. This timeframe was prolonged to three months as the return rate was only by rounded 3%. In addition, all who have not responded received one more email as a kind reminder to fill in the questionnaire form.

After this measurement, the return quote reached 9.3% or, in total numbers, ninety-eight participants. The researcher decided to conduct additional measures for data gathering to reach a significant sample number as described in chapter 8.1.

BVL Regional group meeting 2018:

At a regional group meeting of the BVL (Bundesverenigung Logistik), the researcher asked other participants to obtain more filled questionnaires for a broader sample. BVL is an independent German union with 11.300 members. The intended purpose of the BVL is to promote logistics activities in public, development of logistics topics, promotion of science and research in Germany and abroad. Basis are 38 regional groups throughout the whole of Germany but also abroad in the regions of Beijing, Singapore, Shanghai, Hefei, Luxembourg, Kattowitz, São Paulo, Moscow, Istanbul and the United States of America.

During a regional group meeting in Dingolfing, the researcher could hand out twenty-six printed questionnaires to participants and increase the number of respondents.

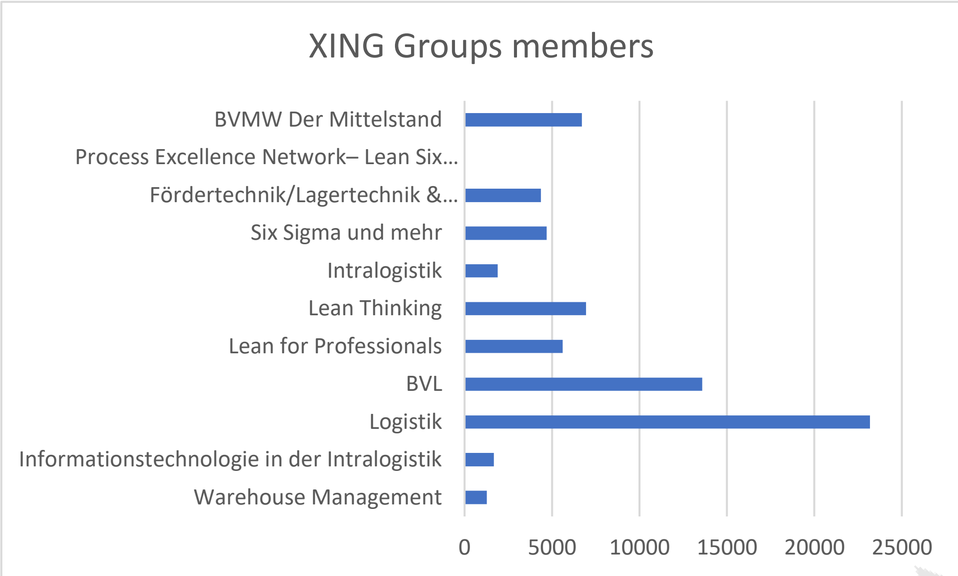
Exhibition LogiMAT 2018 in Stuttgart:

The researcher was asking visitors of the LogiMAT exhibition if they would like to participate. They could use either the paper-based version or scan the link as a QR-Code on their mobile devices to make it convenient.

Lean and logistics groups at XING platform:

Furthermore, the online questionnaire was posted on the social media platform XING, which is platform for business networking. Figure 8.2 shows relevant groups and the number of group members.

Table 8-2: XING Groups



In total, 127 usable responses were obtained. Based on similar studies (Bagais and Aljaaidi, 2020) the sample-size of 127 was considered acceptable to draw conclusions and link it to the qualitative data sampling in the pre-executed expert interviews.

8.4 Population statistics

In the questionnaire, the first questions were built to achieve data about the population itself and to link it to the data analysis to draw conclusions and cluster the data for conclusions.

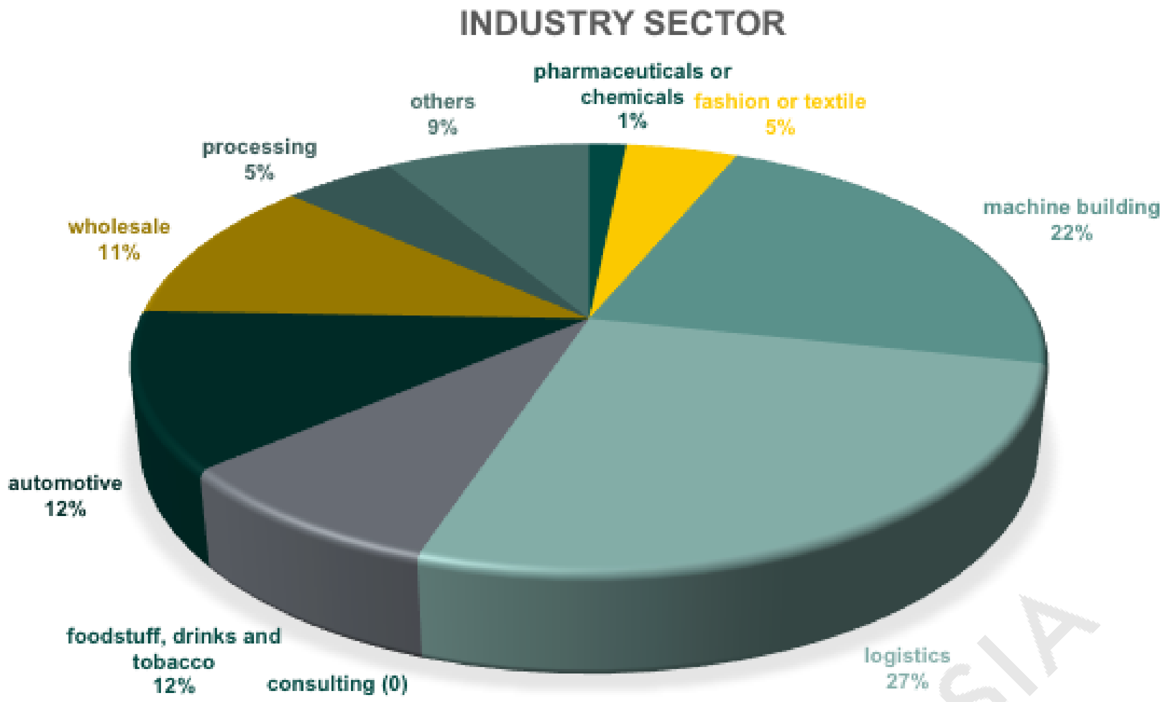
The figures below show the general statistics of the sample concerning company size, market strategy, industry sector, warehouse-type, automation grade, Lean Warehouse (LW) experience and the Lean Warehousing Maturity Index (LWMI). These general statistics are also used as independent variables. It is assumed that they influence the independent variable LWMI, and the first findings will be outlined in the next chapter.

8.4.1 Industry sector

The online questionnaire was open to any industry and consultants, but this group did not participate. Logistics companies are the most extensive sample group with 27 %, followed by machine building with 22%. Foodstuff, automotive, and wholesale are by 11 respectively 12 %. Processing industry is represented by 5% as well as fashion and textile. The chemical and pharmaceutical industry is by 1% and finally 9% others who are not specified. Figure 8.3 show the population divided by industry sectors.

Concerning the industry sector, companies within the food, drinks and tobacco sector have the highest LWMI with 2.72. However, the interviewees claimed the automotive industry should have the best preconditions due to the historical advantage that Toyota created lean philosophy. Obvisously, the need for process improvement and accelerating the flow in warehouses of the FMCG sector is that high that this industry sector in now the leading industry concerning LW. Also, electronics, textile, logistics, machine-building industry and distributors have a higher LWMI as the automotive sector. Just pharmaceutical and chemical and processing industries have a lower LWMI.

Figure 8-2: Represented Companies by Industry Sector



8.4.2 Company size

The following figure 8.4 shows the company size to distinguish between concerns and SMEs using the EU guideline 2003/361.

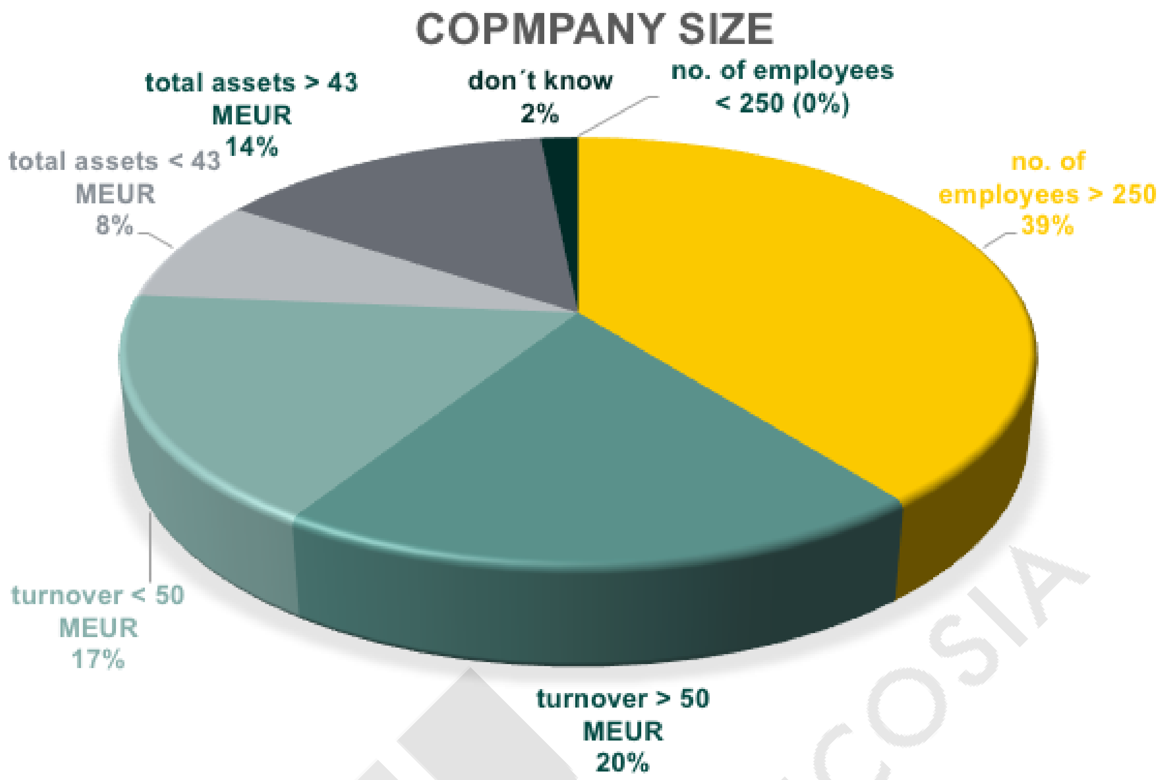
According to this EU guideline, the threshold values for SMEs are less than 250 employees, and up to 50 million Euros turnover or up 43 million Euros total assets.)

As this structure is not familiar or present for everybody and as not every employee knows the company's category, all these threshold values were given as a selection plus a "don't. know" choice for all who do not know the figures about staff headcount and financial data.

The spread in this population was 73% for concerns and 25% for SMEs, and 2% who do not know.

Concerns do have a higher LWMI than SME's. Also, companies with an international market strategy have the highest LWMI with a grade of 2.60 compared to companies doing business only in the national market.

Figure 8-3: Represented Companies by Company Size

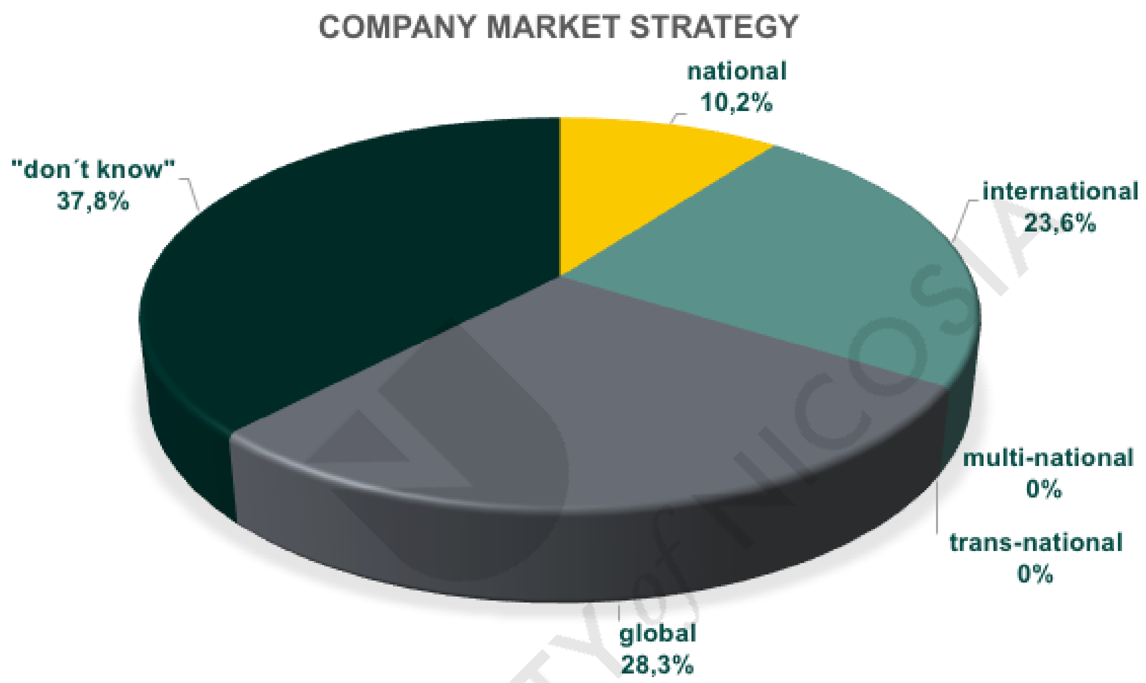


8.4.3 Company Market Strategy

The data here (figure 8.5) can be used as a rough tendency only as of the high value of the “don’t know” choice is exceptionally high with 37.8% and was too complex or detailed. A significant number of participants could not answer this question precisely. So not even one participant ticked multi- or trans-national as companies market strategy, which is very unlikely and a hint that the question was not understood completely or the difference between the strategies is not clear to most participants. This does not seem to be an issue during the pre-test and therefore was not adapted or eliminated.

Nevertheless, by analysing the data in relation to the media LWMI, at least a tendency could be hypothesised. The highest mean in LWMI is in the group international with 2,60 and second 2.30. A national market strategy is relatively seldom and possesses the lowest LWMI with 1.46. Interestingly, the entire sample has five companies with LWMI level 5, and three of them are in the group national and the other two companies follow a global market strategy or do not know. The factor alone, therefore does not seem to be a reliable indicator for the LWMI and is most probably related with industry sector and the competitive situation of the company.

Figure 8-4: Represented Companies by Market Strategy

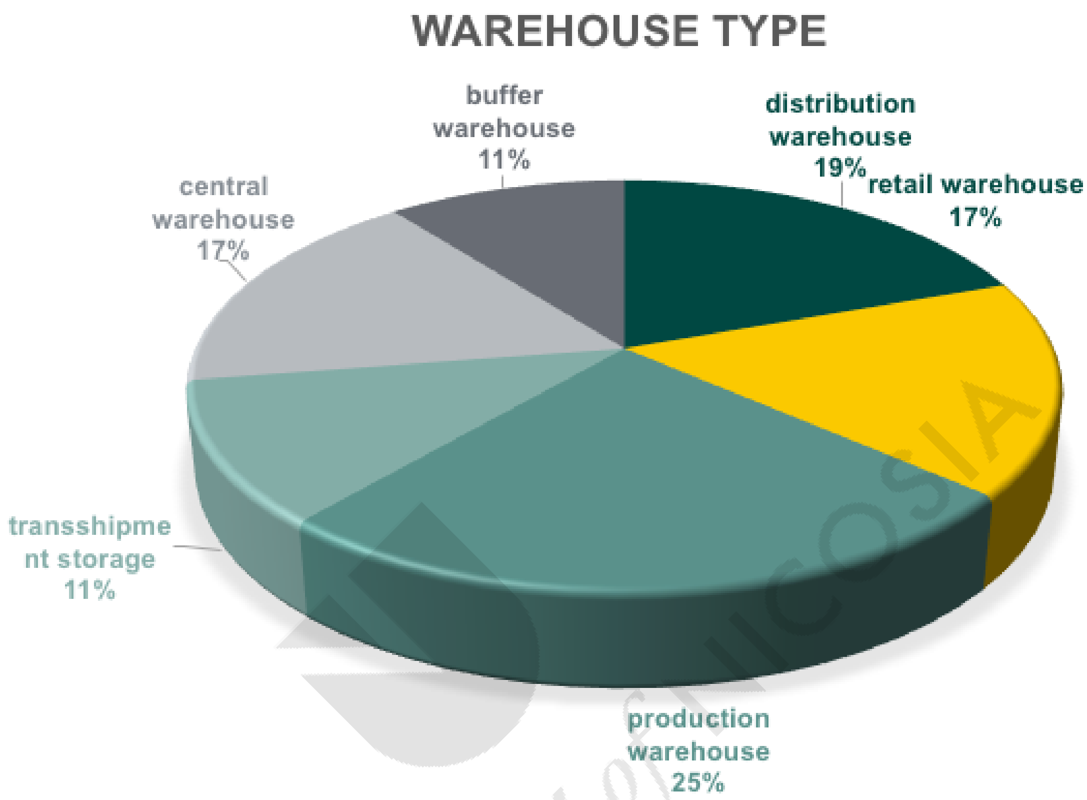


8.4.4 Warehouse type

The warehouse-type (figure 8.6) is used for general statistic data and as a variable, too. The warehouse-type already gives a rough conception about the kind of logistics processes and the grade of automation. Furthermore, the build-up of the staff is different. In distribution warehouses or retail warehouses, the warehouse staff are pure logisticians. In production warehouses or warehouses close to the production line, workers from the production line most often do the material transport themselves. This means a waste of skilled workforce resources according to lean philosophy as also the production throughput time with a high value-adding process is slowed down.

In the category of warehouse-type, the level of LWMI is more or less the same and fluctuates between 2.16 and 2.44. This means the warehouse-type seems not to be a crucial indicator for a high or low LWMI.

Figure 8-5: Represented companies by Warehouse Type



8.4.5 Lean Warehousing experience

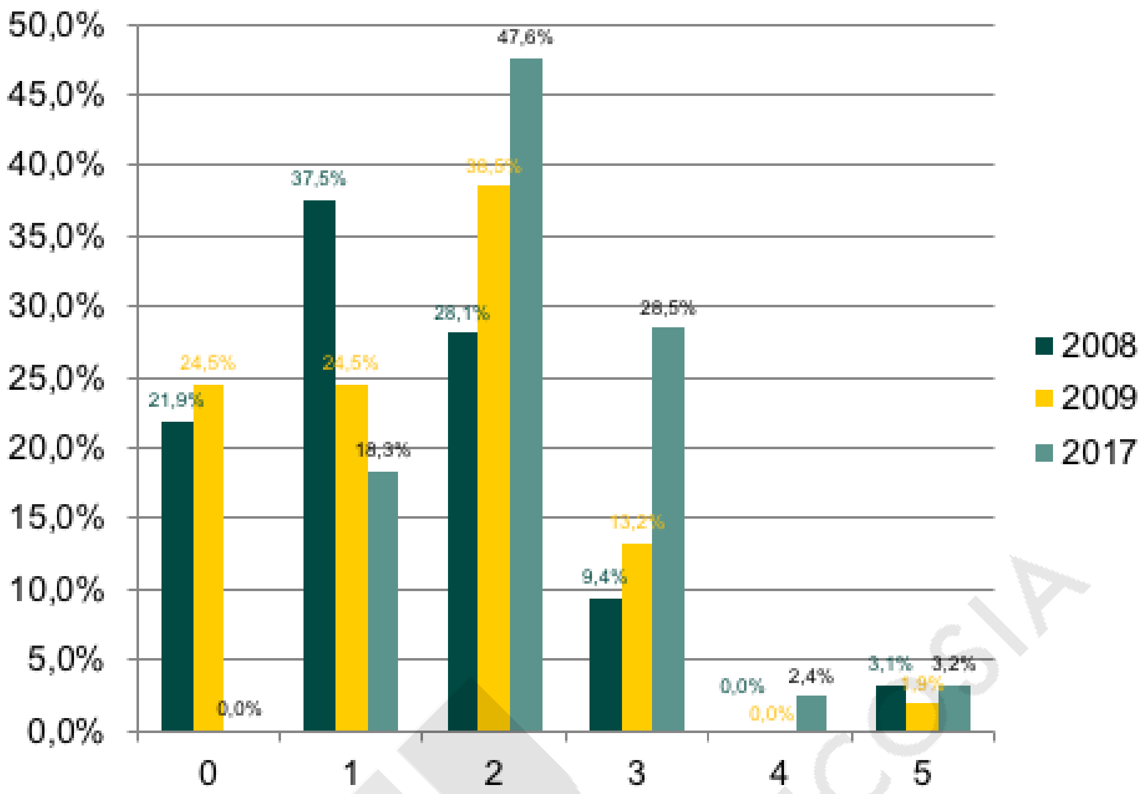
The data about the LW experience is a control variable or question like already outlined in the previous chapter 9.1.2 and is not considered an independent variable. The fact that around one-third of the population has no operational experience in LW is interesting as it allows the conclusion that a considerable number of companies have not started the attempt to introduce LW in the company. Alternatively, the company involved just a relatively small group of employees or only in specific areas and not a fully integrated and holistic approach (see figure 8.7)

Figure 8-6: Survey participants by LW Experience

8.4.6 Lean Warehousing Maturity Grade (LWMI)

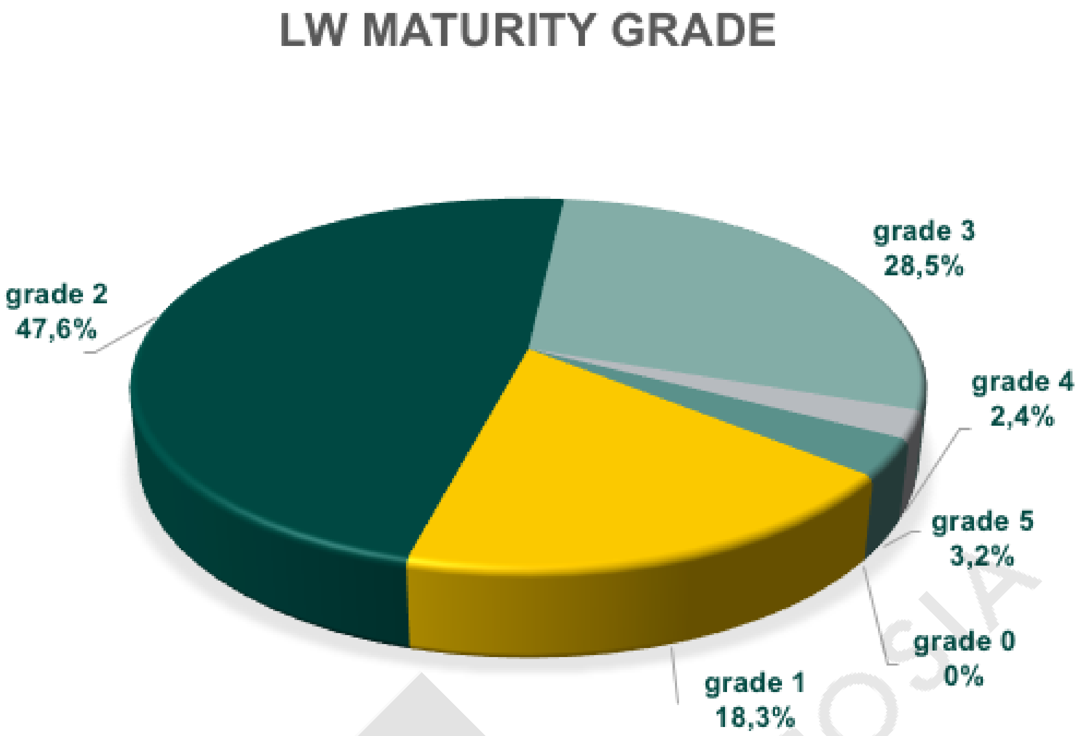
Figure 8.8 compares the samples of Augustin 2008 and 2009 with the results from this study in 2021. The rate of the highest LWMI of 5 is still at a low level with 3.2%, but on level 4, there is a slight absolute increase from 0% to 2.4%. However, level 3 has more than doubled, and level 2 evolved from 38.5% to 47.6%. In contrast, there is a decline on level 1 and level 0, which would mean there is absolutely no systematic and LW is not implemented is no longer represented.

Figure 8-7: LWMI Comparison 2008/2009/2021



The figure 8.9 below shows the values from the present study only.

Figure 8-8: Survey Participants by LWMI



8.5 Descriptive Statistics

For an overview and explanation, the data were clustered in median values for the group that reached the highest level (5) in LWI, the group with the lowest value (1), and a theoretical group with the overall median value. The table 8.2 shows all results, which will be discussed and explained in more detail in the following table 8.2.

Table 8-3: Table of Clusters for the Median, Best and Lowest Group

variables per group		highest (LVL 5)	median	lowest (LVL 1)
automation grade		4,4	3,5	2,7
WMS satisfaction		3,4	2,7	1,9
	KPI's	4,6	3,1	2,0

	missing functions	3,4	2,7	1,7
	configuration	2,8	2,6	1,8
	support	2,6	2,4	1,9
applicability of lean		2,0	2,2	2,2
	cost-intensive	1,8	2,6	3,0
	lean methods applied	5,0	3,5	1,9
	lean too complex?	1,6	1,7	2,3
	LWH not fully researched	1,2	2,2	1,9
	LWH does not affect overall SC	1,2	1,5	1,8
	low employee knowledge and cost-intensive training	1,2	1,8	2,1
	external trainer needed	2,0	2,1	2,6
internal factors		3,0	3,1	3,4
	support by top management	4,6	4,0	3,9
	outsourcing	1,4	2,9	2,0
	strength of logistics dep.	4,0	3,5	3,1
	company organisation	3,0	3,4	3,3
	change management	1,4	3,3	3,0
	employee motivation	4,4	3,7	3,1
	culture	4,0	3,7	3,1
	leadership style	3,4	4,1	3,5
	company size	2,2	2,7	2,8
	company strategy	4,0	3,6	3,6
	product	1,8	2,9	3,0

	departmental thinking	2,2	3,3	3,0
external factors		2,5	2,9	2,8
	high margin	2,0	2,8	2,7
	asymmetry	1,0	3,2	2,8
	competition	3,0	2,9	2,6
	society	2,4	2,5	2,4
	market/industry sector	3,6	3,1	3,1
	environmental idea	2,2	2,3	3,5
	customer	2,8	3,5	3,5

The analysis of the sample statistics was evaluated and resulted in some first findings by comparing the median value with the groups with the highest and lowest LWMI (see table 8.3)

8.6 Reliability and Validity

Reliability analysis (see table 8.5) was applied by examining the survey values of Cronbach's Alpha.

Table 8-4: Reliability Statistics

Reliability Statistic

Cronbach's Alpha	Cronbach's Alpha standardised items	no. of items
,804	,796	33

Values greater than 0.9 means that the survey achieved excellent consistency. Values above 0.7 are generally considered as acceptable. The Cronbach's Alpha here reached 0.804, which confirms good reliability. Setting the confidence interval at 95%, the results of the ANOVA test (see table 8.4) provides an F-test value for the null hypothesis. The result of F = 1.582 for the independent variables proves a relation to the Lean Warehousing Maturation Index (LWI). However, based on the analysis, the null hypothesis can be rejected. A further test like the T-Test is not necessary.

Table 8-5: ANOVA Test

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	82,816	31	2,671	10,539	,000b
Residual	24,082	95	0,253		
Total	106,898	126			

8.7 Regression Analysis

This research uses the Multiple Regression Model (see table 8.5). The ordinal values were allocated to measure the relation between the dependent and independent variables. In specific, the formula can be demonstrated as:

LWI (Y) = β0 +β1 X1 +β2 X1 +β3 X1 +e…

The dependent variable is:

LWI = Lean Warehousing Index with a significance level set at level 0.05.

The independent variables are:

Category A – Warehouse management: automation grade, KPIs, missing WMS functions, configuration possibilities, support software vendor

Category B – Applicability of LW: cost-intensive, applied lean methods, too complex, unexplored, useless referring to the overall supply chain.

Category C – internal factors: education level, consultant necessary, support by top management, outsourcing, the strength of logistics department, company organisation, change management, employee motivation, culture, leadership style, company size, company strategy, product, departmental thinking, high margin

Category D – asymmetry, competition, society, market/industry sector, “green label”, customer

Table 8-6: Model Summary

R	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Change Statistics**					**Durbin-Watson**
				R Square Change	F Change	df1	df2	Sig. F Change	
,880	0,775	0,701	0,503	0,775	10,539	31	95	0,000	2,063

<u>Inferences:</u>

The Model Summary (table 8.6) includes multiple correlation coefficient R and its square and the adjusted version of this coefficient as summary measures of the model fit. The linear regression coefficient R = 0.880 indicates a robust correlation between dependent and independent variables (a closer figure to 1.000 means a more robust correlation).

In terms of variability, the value of R^2 = 0.775 explains the variability within the population. So, 77.5% of the population in the sample agree on the correlation between the given variables. Further, the standard error of estimate value reflected in the table with 0.503 represents the mean absolute deviation and is moderate considering the LWMI ranges from 1 to 5.

8.8 Multi-Collinearity

In the matrix below in table 8.7, it is evident that there is no critical correlation. At the same time, the highest and statistically significant correlation is at 0.714 between applied lean methods and lean warehousing maturity index (LWMI). According to Field (2018) correlation values above 0.8 are an indicator for multi-collinearity. If more variables correlate with more than 0.8 or -0.8, the researcher should think about excluding one of them for further analysis. (Field and Field, 2018)

“But the VIF-value is even more reliable for testing multi-collinearity. VIF is the abbreviation for variance inflation factor and SPSS calculates this factor for each independent variable. A high value - above 10 – indicates a high correlation between one or more independent variables exits. If one of the variables has a value higher that 10 it is proven that there is multi-collinearity.” (Kutner et al. 2005, p. 410).

Interpretation of correlation coefficients can be interpreted after Cohen (1988a):

low / weak correlation	|r| = .10 or -.10
medium / moderate correlation	|r| = .30 or - .30
high / strong correlation	|r| = .50 or - .50

The following table 8.6 shows the finding of this study. Multi-collinearity can be rejected as there is no independent variable above 0.8 or below -0.8 and no VIF-value above 10.

Table 8-7: Coefficients of LWMI

Coefficients - LWMI

	Sig.	95,0% Confidence Interval for B		Correlations			Collinearity Statistics	
		Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
(Constant)	0,663	-1,126	0,719					

automation grade	0,001	0,094	0,359	0,411	0,329	0,166	0,318	3,141
KPIs	0,114	-0,035	0,322	0,440	0,162	0,078	0,130	7,704
missing functions	0,705	-0,163	0,240	0,397	0,039	0,018	0,122	8,185
configuration possibilities	0,403	-0,310	0,126	0,220	-0,086	-0,041	0,114	8,756
support software vendor	0,483	-0,248	0,118	0,329	-0,072	-0,034	0,138	7,241
cost-intensive	0,095	-0,355	0,029	-0,259	-0,170	-0,082	0,254	3,930
applied lean methods	0,000	0,349	0,615	0,714	0,595	0,351	0,270	3,701
too complex	0,265	-0,071	0,255	-0,291	0,114	0,055	0,275	3,632
unexplored	0,020	-0,288	-0,026	-0,108	-0,236	-0,115	0,337	2,965
useless referring to supply chain	0,747	-0,319	0,230	-0,190	-0,033	-0,016	0,185	5,397
education level	0,142	-0,324	0,047	-0,224	-0,150	-0,072	0,256	3,905
consultant necessary	0,360	-0,071	0,195	-0,219	0,094	0,045	0,312	3,209
support by top management	0,001	0,095	0,367	0,246	0,327	0,164	0,342	2,924
outsourcing	0,009	-0,279	-0,040	-0,028	-0,263	-0,129	0,448	2,231
strenght of logistics dep.	0,537	-0,159	0,083	0,070	-0,064	-0,030	0,425	2,352
company organisation	0,624	-0,198	0,120	0,078	-0,050	-0,024	0,297	3,367

change managment	0,419	-0,176	0,074	-0,020	-0,083	-0,040	0,335	2,982
employee motivation	0,185	-0,045	0,232	0,238	0,136	0,065	0,360	2,777
culture	0,046	0,004	0,382	0,342	0,203	0,099	0,272	3,673
leadeship style	0,063	-0,313	0,008	0,074	-0,190	-0,092	0,331	3,021
company size	0,033	0,020	0,464	-0,247	0,216	0,105	0,127	7,875
company strategy	0,008	-0,410	-0,063	0,037	-0,267	-0,132	0,274	3,654
product	0,711	-0,214	0,147	-0,172	-0,038	-0,018	0,152	6,590
departmental thinking	0,520	-0,080	0,158	0,053	0,066	0,031	0,344	2,907
high margin	0,145	-0,260	0,039	0,014	-0,149	-0,072	0,309	3,232
asymmetry	0,729	-0,126	0,180	-0,018	0,036	0,017	0,252	3,972
competition	0,006	0,053	0,314	0,053	0,275	0,136	0,416	2,406
society	0,676	-0,120	0,184	0,119	0,043	0,020	0,260	3,841
market/industry sector	0,143	-0,329	0,048	0,079	-0,150	-0,072	0,182	5,497
„green label“	0,025	0,019	0,286	-0,103	0,227	0,111	0,406	2,462
customer	0,995	-0,162	0,163	-0,127	0,001	0,000	0,282	3,546

8.9 Explanatory Analysis

The table 8.7 below shows the general statistics of the sample concerning company size, warehouse-type, industry sector, automation grade and the distribution of Lean Warehousing Maturity Index (LWI) per level.

Table 8-8: Explanatory Analysis

Company size	% in sample	Median LWMI
SME	25,20 %	2,16
concern	73,23 %	2,43
"don't know"	1,57 %	0,00
Market /Strategy		
national	10,24	1,46
internationl	23,26	2,60
multinational	0,00	0,00
transnational	0,00	0,00
global	28,35	2,31
“don’t´know”	37,80	2,25
Industry Sector		
Pharmaceutical and Pharma	1,57	1,57
Textile and Fashion	4,72	2,40
Machine Building	22,05	2,36
Logistics	26,77	2,26
Consulting	0,00	0,00
Food, Drinks and Tobacco	8,66	2,72
Automotive	11,81	1,93
Distributor	11,02	2,21
Processing	4,72	1,67
Electronics and other	8,66	2,64
Warehouse Type		

Distribution warehouse	19,42	2,25
Retail Warehouse	17,15	2,19
Production Warehouse	25,24	2,38
Transshipment Warehouse	11,33	2,20
Central Warehouse	16,50	2,16
Buffer Warehouse	10,36	2,44
Automation Grade		
Grade 1	8,66	1,73
Grade 2	8,66	1,45
Grade 3	23,62	2,07
Grade 4	38,58	2,59
Grade 5	18,90	2,58

The analysis of the sample statistics (see table 8.8) was evaluated and resulted in some first findings by comparing the median value for the LWMI.

Concerns do have a higher LWMI than SME's. Also, companies with an international market strategy have the highest LWMI with a grade of 2.60 compared to companies doing business only in the national market. Concerning the industry sector, surprisingly, companies within the food, drinks and tobacco sector have the highest LWMI with 2.72. However, the literature and the interviewees claimed the automotive industry should have the best preconditions due to the historical advantage that Toyota created lean philosophy.

Also, electronics, textile, logistics, machine-building industry and distributors have a higher LWMI. Just pharmaceutical and chemical and processing industries have a lower LWMI. In the category of warehouse-type, the level of LWMI is more or less the same and fluctuates between 2.16 and 2.44. This means the warehouse-type seems not to be a crucial indicator for a high or low LWMI. In contrast, the automation grade there has a clear relation to the LWMI. The higher the automation grade, the higher the LWMI.

Table 8-9: Analysis of Sample Statistics

section	**variable abridgement**	**highest LWI (LVL 5)**	**Overall median LWI**	**lowest LWI (LVL 1)**
automation grade		4,4	3,5	2,7
WMS satisfaction		3,4	2,7	1,9
	KPI's	4,6	3,1	2,0
	missing functions	3,4	2,7	1,7
	configuration	2,8	2,6	1,8
	support	2,6	2,4	1,9
applicability of lean		2,0	2,2	2,2
	cost-intensive	1,8	2,6	3,0
	lean methods applied	5,0	3,5	1,9
	lean too complex?	1,6	1,7	2,3
	LWH not fully researched	1,2	2,2	1,9
	LWH does not affect overall SC	1,2	1,5	1,8
	low employee knowledge and cost-intensive training	1,2	1,8	2,1

	external trainer needed	2,0	2,1	2,6
internal factors		3,0	3,1	3,4
	support by top management	4,6	4,0	3,9
	outsourcing	1,4	2,9	2,0
	strength of logistics dep.	4,0	3,5	3,1
	company organisation	3,0	3,4	3,3
	change management	1,4	3,3	3,0
	employee motivation	4,4	3,7	3,1
	culture	4,0	3,7	3,1
	leadership style	3,4	4,1	3,5
	company size	2,2	2,7	2,8
	company strategy	4,0	3,6	3,6
	product	1,8	2,9	3,0
	departmental thinking	2,2	3,3	3,0
external factors		2,5	2,9	2,8
	high margin	2,0	2,8	2,7
	asymmetry	1,0	3,2	2,8
	competition	3,0	2,9	2,6

society	2,4	2,5	2,4
market/industry sector	3,6	3,1	3,1
environmental idea	2,2	2,3	3,5
customer	2,8	3,5	3,5

8.9.1 Analysis and discussion per group

Automation grade:

The values show a higher grade for automation in the best group, which clearly predicate a correlation between this independent variable on LWMI. The median value is also higher than the lowest group, which means that the higher the automation grade, the higher the LWMI. Nevertheless, this effect has to be analysed in more detail in a further survey, as it did not consider when the automation was established. Usually, before such investment is made, the company conducts a detailed analysis of the internal logistics and the material flow either by internal or external consultants. This means that during the introduction of automation systems, the processes will be analysed and most often new designed. So eventually, the gained improvements only last over a short period and are not consequently questioned and improved by using continuous improvement (CIP) method according to the LW philosophy. Bucki (2019) investigated Lean Warehousing on a cost-based approach and concludes that manufacturing costs can be lowered by replacing human labour with robots which pay off in a defined period. However, another option would be reducing fixed and operating costs using lean tools without making costly investments.

WMS satisfaction grade:

The overall median value for this section and all single median values for each sub-category clearly indicates a higher grade of satisfaction of the WMS within the best group of LWMI compared to the lowest group. This could be reasoned by having a state-of-the-art WMS in use, which is suited to manage and monitor the warehouse processes. The sub-category KPI's featuring a big difference in the values 4.6 and 2.0 and also in the sub-category missing function (3.4 versus 1.7). This implies that companies with a higher LWMI do have more modern WMS in use or at least with updates and adaptions on a regular basis which supports the company to apply lean methods according to the LW philosophy. Further surveys should also confirm this conclusion.

Applicability of LW:

This section has sub-categories where a low or a high value could be interpreted differently. Therefore, the overall median in this section is not suited for a global relation to LWMI.

For the question, if the implementation of LW philosophy is cost-intensive, the best group negates this statement with a value of 1.8, whereas the lowest group tentative support it (3.0). In contrast, the sub-category lean methods applied show the highest value of 5 for the best group and a comparable extreme value of 1.9 for the lowest group. This example also confirms validity in the data. The group that claims to have reached LWMI level 5 also has the highest level of applied lean methods, and the group with the lowest LWMI, an inverse ratio, but both groups do not think that the LW philosophy is too complex to be not applied. This underpins the hypothesis that all companies could and should apply LW to improve the overall efficiency of their warehouses.

Further, both groups think LWH is more or less complete researched. Also, both groups confirm that it is worth striving for a holistic LW implementation as it has significant improvement effects in context with the entire supply chain. Studies from Hadrai (2019) and Vanichchinchai (2019) confirms this positive relationship between supply logistics and competitive performance (operational) and supply performance. Hadrai (2019) further determined that lean processes partially mediated this relationship and showed the importance of internal and external processes of companies' operations in an integrated manner in which supply chain management acts through crucial internal processes to impact competitive performance.

Internal Factors:

There is no general pattern for the external factor, but there are partially significant differences between the groups. Some factors rated very high in the group of highest LWMI are: Support by Top Management, the strength of logistics department, employee motivation and culture. In contrast, the other group rated these factors relatively low. In contrast, some factors in the group with the lowest LWMI rated some factors very high, e.g., product and change management which allows us to conclude that the companies with a lower LWMI do underestimate the influence of relevant factors like Support by Top Management and rates other factors to high.

External Factors:

In considerable contrast, the factors asymmetric commercial relationships were rated with 2.8 for the group with the lowest LWMI opposite to 1.0 for the group with the highest LWMI, and nearly all factors were rated higher in the group with the lowest LWMI. This pattern indicates that, in general, external factors do not have as much influence on the LWMI. Also, Ab Talib, Abdul Hamid and Thoo (2015) support this in a study about critical success factors in supply chains in stating that external factors are no significant critical factors in supply chains.

8.9.2 Boxplots

However, explanatory analysis was also conducted to search for outliers within the sample to check for validity and explain the reasons behind this. Outliers would influence the standard error and the t-test and could finally lead to a survey that is not significant.

The result of the explanatory analysis in SPSS detected 15 variables with outliers marked with an "*" in the box plots. However, for no variable, the standard error crossed the critical value of 0.7 or higher. The maximum number of outliers for a variable were 6 participants from a total population of 127, which means a maximum deviation of 4.57%. An analysis of the outliers did not show a specific pattern, and it was deducted that the answers are realistic and right even the statistic says they are extreme values. As they also do not affect the significance of the whole sample, it was decided to include these outliers to achieve the entire perspective and consider all data.

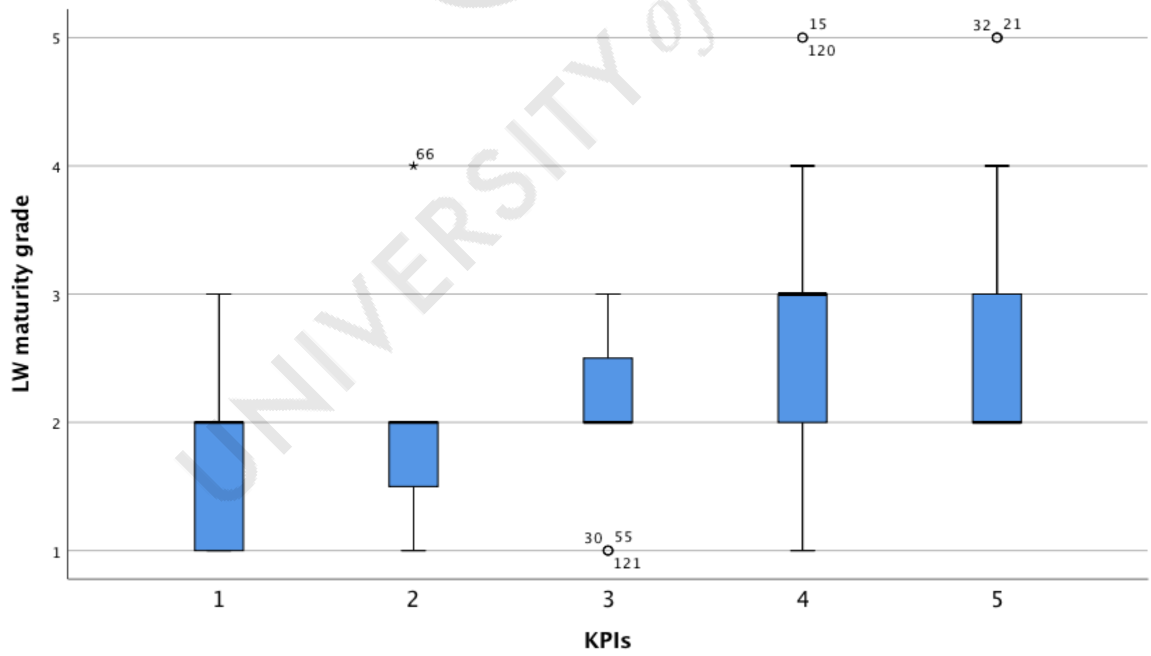
Moreover, these outliers could also help to understand the correlation to the independent variable Lean Warehousing Maturity Index (LWMI). The outliers were found in the sections automation grade, warehouse management system, internal and external stakeholders.

There were no outliers in the sections company size, industry sector, company strategy, and applicability of lean warehousing.

The following figure shows an example of the boxplot with the independent variable KPIs and the dependent variable (LWMI). In this case, there is one extreme outlier (66) which is more than three box lengths away from the 3rd quartile and several standard outliers (30, 55, 121, 15, 120, 32, 21), which have a maximum deviation between 1.5 and 3.0 of a box length.

The extreme outlier (66) is in the unsatisfied group (Likert value 2.0) with the existing set of KPIs in their WMS. This means the outlier data set digresses from the median of 2.0 for the grade of LWMI and shows a value of 4.0 in LWMI. Given that the higher the LWMI, the higher the satisfaction with the KPI set, this is an exceptional data set but realistic (see figure 8.10)

Figure 8-9: Example for Boxplot



8.9.3 Hypothesis Testing and significant variables

H1: The grade of satisfaction of WMS has a positive effect on the LWMI.

H01: The grade of satisfaction of WMS has not a positive effect on the LWMI.

Table 8-10: Significance Level of Variable Group related to "WMS"

	Unstandardised Coefficients	**Standardised Coefficients**	**t**	**Sig.**
Variables	B	Beta		
KPIs	0,143	0,216	1,597	0,114
missing functions	0,039	0,053	0,380	0,705
configuration possibilities	-0,092	-0,121	-0,841	0,403
support software vendor	-0,065	-0,092	-0,704	0,483

The result of the regression analysis (table 8.9) clearly indicates that there are no significant relations of any of the factors related to WMS to LWMI. All factors have a significance level above 0.05, and therefore the hypothesis H1 has to be rejected, and the Null-Hypothesis is accepted.

H1: WMS factors < 0.05 ➔ untrue

H01: WMS factors > 0.05 ➔ true

H01: The grade of satisfaction of WMS has not a positive effect on the LWMI.

H2: Warehouse Automation has a negative impact on the LWMI.

H02: Warehouse Automation has not a negative impact on the LWMI.

Table 8-11: Significance Level of Variable "Automation Grade"

	Unstandardised Coefficients	**Standardised Coefficients**	**t**	**Sig.**
Variable	B	Beta		
automation grade	0,226	0,294	3,401	0,001

The result of the regression analysis (Table 8.10) clearly indicates that there is a significant relation of the factor Automation Grade. The analysis shows a significance level of 0.001, which is considerably below 0.05 and highly significant. Therefore, hypothesis H1 has to be rejected and null-hypothesis H02 is confirmed.

H2: Automation Grade factors < 0.05 ➔ true

H02: Automation Grade factor > 0.05 ➔ untrue

H02: The automation grade has not a negative impact on the LWMI.

H3: Leadership is a significant factor for viable Lean Warehousing.

H03: Leadership is not a significant factor for viable Lean Warehousing.

Table 8-12: Significance Level of variable "Leadership Style"

	Unstandardised Coefficients	**Standardised Coefficients**	**t**	**Sig.**
	B	Beta		

leadership style	-0,152	-0,159	-1,882	0,063

The result of the regression analysis (table 8.11) clearly indicates that there is no significant relation of the factor Leadership Style to the LWMI. The analysis shows a significance level of 0.063, which is slightly above 0.05. Therefore, hypothesis H3 has to be rejected and null-hypothesis H03 has to be confirmed.

H3: Leadership Style < 0.05 ➔ untrue

H03: Leadership Style > 0.05 ➔ true

H03: Leadership is not a significant factor for viable Lean Warehousing.

However, there are 2 other variables, Support by Top Management and Culture (see table 8.14), pointing to leadership style – at least at the higher management level - which both significantly relate to LWMI too.

Table 8-13: Significance Level of Variable "Support by Top Management"

	Unstandardised Coefficients	**Standardised Coefficients**	**t**	**Sig.**
	B	Beta		
support by top management	0,231	0,281	3,370	0,001

The result of the regression analysis (table 8.12) clearly indicates that there is a significant relation of the factor Support by Top Management. The analysis shows a significance level of 0.001 and which is considerably below 0.05. This factor was not hypothesised but supported H3, as numerous studies identified this factor as crucial before (Punnakitikashem et al., 2013; Pokinska, Swartling and Drotz, 2013; Koenigsacker, 2013; Liker and Convis, 2013)

A lack of top management support can lead to failed lean implementation (Aljunaidi and Ankrak, 2014). Furthermore, top management has a central role in other factors, such as organisational culture.

In their study, Cichosz et al. (2020) identified leadership as the main success factor for a digital transformation: sharing a vision and creating an organisational culture, which also has a significant influence. (see table 8.15)

H4: A successful Lean Warehousing is independent on the Industry sector a company is in.

H04: A successful Lean Warehousing is dependent of the Industry sector a company is in.

Table 8-14: Significance Level of Variable "Industry Sector"

	Unstandardised Coefficients	**Standardised Coefficients**	**t**	**Sig.**
	B	Beta		
industry sector	-0,140	-0,169	-1,476	0,143

The regression analysis result clearly indicates no significant relation of the factor Industry sector to the LWMI. The analysis shows a significance level of 0.143, which is above 0.05. Therefore, hypothesis H4 must be rejected and the null-hypothesis H04 has to be confirmed.

H4: Industry sector < 0.05 → untrue

H04: Industry sector > 0.05 →true

H04: A successful Lean Warehosuing is dependent of the Industry sector a company is in.

The following table 8.15 shows all variables with a significance level below 0.05 and consequently have a significant relation to LWMI and are discussed after.

Table 8-15: Table of all found Significant Variables

	Unstandardised Coefficients	Standardised Coefficients	t	Sig.
	B	Beta		
applied lean methods	0,482	0,675	7,210	0,000
unexplored	-0,157	-0,199	-2,371	0,020
outsourcing	-0,160	-0,193	-2,655	0,009
culture	0,193	0,189	2,025	0,046
company size	0,242	0,295	2,160	0,033
company strategy	-0,236	-0,252	-2,706	0,008
competition	0,183	0,210	2,785	0,006
green logistics	0,153	0,174	2,274	0,025

<u>Applied Lean Methods:</u>

This variable has the highest coefficient factor overall and is a kind of control variable at the same time. This means that if you have not applied simple lean methods like 5S and KANBAN, you cannot reach a high LWMI. This has also been mirrored in the definition of the grades in the Lean Maturity Model by Augustin (2009). The definition says that for grade 2, some lean methods are applied sporadically, whereas grade 3 demands a systematic and periodic usage of lean methods.

<u>Unexplored LW:</u>

The table shows a negative relation on LWMI and confirms Spee and Beuth (2012), who started already in 2012, that Lean Warehousing is still in an early phase and that further research is needed. Apparently, this is still the case as the study participants still see this as a significant hurdle to implement LW sustainably.

Outsourcing:

The variable Outsourcing also shows a negative relation to LWMI and is reasoned by. the study of Hadrawi (2018) who could show the importance of both internal (production and logistics) and external (SCM and logistics) processes in an integrated manner to increase competitive performance.

Culture:

Also, culture shows a significant relation to LWMI with a coefficient value of 0.193. This result was expected as the Lean Philosophy is the solid foundation of Lean in general and thereby also for LW. Punnakitikashem at el. (2013) identified the organisational culture as the most critical factor for a successful implementation in their study about Thai logistics companies like other researchers did earlier (Bhasin and Burcher, 2004; Dahlgaard and Dahlgaard-Park, 2006). However, most recent studies also discovered that the Toyota Way culture has a significant and positive mediating effect on a Lean production system and helps achieve the desired Lean results (Loyd et al., 2020). Also, Fadnavis et al. (2020) found company culture to contribute to a successful Lean transformation significantly.

Company Size:

The company size has also significant relation on LWMI. Modrak and Semanco (2014) and identified five constraints for SMEs like little support from the top management, resistance to change by middle management, poor understanding of strategic vision and goals, poor or non-qualified implementation training activities and finally a lack of involvement of the supplier base".

Company Strategy / competition:

As international companies stand in a global competition in a global market, they usually have a stronger competition and need to adapt and overthink their processes to compete. Vadav et al. (2019) confirm that due to the intensive global competition the pressure on small- and medium-sized enterprises (SMEs) to implement lean has increased and led to more attempts.

Green Logistics:

The factor green logistics was mentiones as important only twice in total during the interviews, although there is evidence of a positive influence in the literature. “Leaness mitigates the negative impact of operations on the environment through the usage of environmentally friendly materials, waste and pollution reduction and time saving" (Giovanni and Cariola, 2020, p. 1). However, on the other hand, there are studies that report that a customer-focused system like Lean offers all the customer is demanding and willed to pay for which also could mean to induce more waste during production (Venkat and Wakeland, 2006) or upward the supply chain, e.g., like an express delivery service.

Chapter 9 Conclusions

9.0 Conclusions

The new factor WMS and all sub-categories do not have a significant significant negative influence on LWMI, which contradicts the qualitative research, where the WMS factor and missing functions were still ranked among the top 5 influencing factors. Additionally, a WMS delivers reliable KPI´s, which are indispensable to adopt CIP for Lean warehouse improvements.

The new factor asymmetric relationship which was identified during the interview phase does also not have significant influence in LWMI and should not be a plea for not implementing LW.

Warehouse automation is not an obstacle for a high LWMI. Quite the opposite is the case, as SPSS analysis shows a significant positive correlation to the LWMI. Generally, it could be concluded that the higher the automation grade, the higher the LWMI.

This result was unexpected since automation undisputably increases the performance, but not necessarily the level of LWMI, because even flawed processes can be automated and remain for a longer period of time, not exploiting the existing performance and productivity potential and, moreover the costs increase due to the investment of the automated solution and the reqiured maintenance in the years to come (Bick, 2014). (see also chapter 11 Outlook and further Research)

For the new factor industry sector affiliation, a dependency was found as a result of the hypothesis test. This reflects the result of the explanatory analysis, which identified participants in the FMCG industry as those with the highest LWMI levels. It can be concluded that this industry sector presently has a leadership in implementing LW successfully, but this does not imply that LW is not appropriate for other industries.

The Leadership hypothesis was not a significant on a confidence interval of 95%, hence it was rejected, but the factors support by top-management and culture were. Both are a leadership-related tasks or outcome. In addition, previous studies confirmed leadership as a significant factor though the factor leadership finally was accepted.

After the quantitative research, the model was adapted according to the findings and measured by the model's share. Leadership is now, together with Warehouse Management, the essential component of the model. (see figure 9.1)

Figure 9-1: LW Model after the quantitative research phase

The difference in the share of leadership compared to the model after the qualitative phase is an indicator that there is a big difference regarding the understanding of the lean warehousing philosophy between the top management level (interviewees from the qualitative research phase) and the middle management and operational level.

The top management sees the leadership style as less important and could not give a recommendation or experience regarding the appropriate leadership style. For this reason, it was not possible to ask for a specific leadership style in the questionnaire but only for a general estimation of the importance. This was estimated as very high and that the support from the top management was missed and also is one of the biggest show-stoppers.

For this reason, it is assumed as the biggest obstacle for LW and most likely the reason for a still low number of companies with an LWMI at level 5. Finally, this is a lack of leadership knowledge and a strong indicator that LW is not seen as a holistic philosophy and something that can be delegated to the middle management. Moreover, this study shows that WMS and Leadership do have more or less equal influence on LW. Stakeholders (internal and external) contribute by around 25% and Change management by around 10%, which is in contrast to the group with the highest LWMI who rated the influence shallow (1,4 median).

Chapter 10 Triangulation and Final Conclusion

10.0 Triangulation and Final Conclusion

10.1 Triangulation

The findings of this study confirm the literature, which describes that the general problems of Lean Warehouse implementations are based on soft skills like corporate vision, strategy, culture and leadership and, on the other hand, depict new factors (hard skills) like automation and warehouse software which have a significant influence on LWMI.

Triangulation is a popular way of seeking confirmation in qualitative research, which among other aspects, advocates the use of multiple methods. (Webb et al., 2015) and leads to a more consistent and objective picture of reality (Patton, 2014). According to Gaskell and Bauer (2010), triangulation is an institutionalisation method of theoretical perspectives and methods, aiming to reduce the inconsistencies and contradictions of research. The mixed-method research is appropriate, especially for investigating complex phenomena either because of the complexity of the field of study or the problem to be solved or because of the need for multiple levels of perception (Flick et al., 2012).

By triangulating research methods and research groups (top management and middle management), it was possible to show a serious imbalance between top and middle management as another gap in LW implementation. Middle management clearly misses the support of top management, while this group does not realise that their involvement is necessary and, according to their conviction, leadership style does not seem to have any influence on the successful implementation of LW either.

However, from the expert interviews (top management), some factors were identified that prevent companies from initially starting the Lean Warehousing transformation. These factors are:

Lean show-stoppers:

- LW is too cost-intensive
- There is no support by top management, which means if the leaders are not convinced to start or invest resources in the lean transformation, this company never starts. This factor explains why the rate of LWI has not risen

in the years from 2008 on. (But also, a significant factor for companies who started the Lean Transformation)

- Departmental thinking – a topic which is points to a lack in the companies' organisation and the weighing or importance of how the logistics is rated in the company. Finally, this is also pointing to a lack of leadership.
- Outsourcing – is maybe the result if companies are convinced that a Lean Warehouse Transformation is too cost-intensive (see the first point)
- There is no influence on the ongoing process in the upstream and downstream supply chain, so this means the effect of Lean Warehousing is doubted. This argument can be entirely disproved by numerous studies which approved the effect of Lean Warehousing.
- High margins – if companies could generate high margins with their products, do not focus on a Lean Transformation and instead invest in product development, marketing and sales.
- Employee knowledge – this argument can be easily solved by some training but would mean to invest upfront in knowledge setup and also point to the factor cost-intensive
- Weakness of logistics department – an organisational problem which finally also is caused by leaders

The study also depicts that there is also still a significant gap in knowledge about Lean or, in specific Lean Warehousing and uncertainty in how to practice. There is still a high rate of people (managers and operators) who say that LW is not or just partially helpful. However, on the other hand, there is a high rate of used lean methods like 5S, shadow boards etc., which are easy to establish - the so-called "low hanging fruits." This is reflected in the increase of companies with a LWMI level 2 and 3 from this study compared to the years 2008 and 2009 of the study by Augustin (2009). (see figure 8.8) In principle, the LWMI could be raised, but almost no company could reach the highest level 5. Here, there was only a marginal change of 0.1% compared with the figures for 2008, which rather corresponds to a stagnation. However, at least in level 4, a slight increase from 0.0% to 2.4% was observed. Overall, however, a more significant development would have been expected in view of the promising improvements in key figures from various studies since then and most recent ones. (Kaminska, 2021; Rossini et al., 2021; Tachy et al., 2021; Baptista et al., 2021; de Oliveira et al., 2022)

10.2 Final Conclusion

The research aim of this study was to investigate the application of Lean Philosophy to warehousing and create a new model in terms of already known factors and new factors. For this purpose, six research questions were set up at the beginning.

RQ1: What are the differentiating factors between the original Lean Manufacturing theory and the still-evolving Lean Warehousing theory?

Through the intensive literature research, some minor differences between Lean Warehousing and Lean Production could be identified in the methods (see chapter 4.4.1), but no major differences. So, some the methods would have to be reinterpreted in order to make them more understandable for managers and users in the warehouse. For example, the Chaku-Chaku method translated into English means "loading-loading" – in other words an uninterrupted loading of a machine. In warehouses that serve purely as distribution centres, there is no practical application for this. Also due to this flaws there is obviously still a certain skepticism in large parts of the sample about the applicability of LW. This is not at least because of the gaps in research in general, but also because of the numerous not self-explaining methods. The presented study aimed to help increase the understanding and acceptance of LW and has identified new important factors such as automation and industry sector in addition to those already known from previous studies.

RQ2: What leadership theory is best suited for a successful and comprehensive transformation to Lean Warehousing?

The study was not able to find a specific leadership style for LW because no concrete evidence was provided by the interviewees during the research process. However, leadership can be confirmed as one of the essential factors for a successful introduction of LW. Furthermore, through triangulation of the qualitative and quantitative results, a significant gap in understanding and influence of leadership on LW between middle and top management could be revealed. This finding is most probably the crucial cause for the still low number of companies who successful implemented LW. So, the leadership style remains a factor which needs to be researched in further studies (see also next chapter 11) and companies should

"…focusing on the softer aspects of organizational culture i.e. eomployee engagement…" (Cadden et al., p.28, 2020)

RQ3: Are there other factors for WMS besides the ones which were already identified in the literature review?

The identified functional lacks in the current WMS landscape like graphical controls and visualisation, KPI´s or vertical integration and lack of self-configuration options could be confirmed. These gaps were confirmed by the interviewees and gave some more details for the sub-category KPI´s. Most of the systems offer this functionality but not often flexible enough and not the indicators which were needed. In general, the KPI´s should not only display the performance of the system but also soft metrics like safety aspects (accidents, sick rate, etc.) or the morale of the employees (e.g. number of SI´s). Also, other costs for the logistics in general like consumption of gas and electricity, insurance, labour costs maintenance and support etc. should be managed here.

Other missing functionalities are an overall (graphical) flow management, Lean Modules (team corner, SI management, Andon Board, LW Tutorial). Furthermore, existing resource planning modules needs to be improved eventually through artificial intelligence (AI) to assist the warehouse manager in decision making process. Support from the WMS vendor was also critisised as the time for changes in the software takes too long and are cost intensive. The factor WMS was not significant regarding LWMI, but a (supply) chain is always just as strong as the weakest link and therefor these requirements should addressed to software vendors.

RQ4: Is the application of Lean Warehousing and the included set of factors flexible enough to adapt the process in terms of KAIZEN or due to new stakeholder requirements?

The lean approach is a result which was established to react utmost flexible due to requirements and exceeding, therefor, the company targets. But the new factor automation is critical in this point and companies should remember, that only standardized processes should be automated (Ohno and Bodek, 2019). Self-Configuration possibilities in WMS were also an identified lack in the functional toolset of WMS. Automation is not hindering LW and does not have negative effect on the LWMI, but massive changes in warehouse design and layout changes are of course not easy to convert.

The overall mean average for the category WMS and all sub-categories clearly indicates a higher grade of satisfaction with WMS within the best group of LWMI compared to the lowest group. This could be reasoned by having a state-of-the-art WMS in use, which is suited to manage and monitor the warehouse processes. The sub-category KPI's features a big difference in the values 4.6 and 2.0 and also in the sub-category missing function (3.4 versus 1.7). This implies that companies with a higher LWMI do have more modern WMS in use or at least with updates and adaptions on a regular basis which supports the company to apply lean methods according to the LWH philosophy.

RQ5: How do the grade of automation in warehouses and the lean warehousing maturity level correlate to one another?

The values show a higher grade for automation in the best group, which clearly predicates a correlation between this independent variable on LWMI. The median value is also higher than one in the lowest group, which means that the higher the automation grade, the higher the LWMI. This result was unexpected, as automation undisputably increases the performance, but not necessarily the level of LWMI, because even flawed processes can be automated and remain at the same level for a longer period of time. Existing full performance and productivity potential will not be tapped and further on the cost go up by the investment of the automated solution and needed maintenance in the coming years. (Bick, 2014) (see also chapter 11)

RQ6: What kind of relationship exists between the industry sector and the lean warehousing maturity level?

Concerning the industry sector, companies within the food, drinks and tobacco (FMCG) sector have the highest LWMI with 2.72 in mean. However, the literature and the interviewees claimed the automotive industry should have the best preconditions due to the historical advantage that Toyota created lean philosophy.

As a final conclusion it can be stated, that it is necessary to change the mindset by:

- ➔ **Understanding Lean as a comprehensive philosophy**
- ➔ **Change to/or establish a lean (warehouse) culture and nominate a Lean Champion**

➔ **Integrate Supply Chain Partners**

and to change the toolset

➔ **WMS development (simulation, KAIZEN, self-(re)configuration, workflow configuration, visualisation, "lean modules", etc.…)**

➔ **Automation is not a contraindication for LW but quite the opposite**

"Modern Jidoka Systems will enable a continuous improvement of SMEs manufacturing systems' flexibility, production quality and productivity and a continuous learning of the workforce since Jidoka Systems aim to develop and enhance human capabilities, rather than their immediately replacement for full automation solutions." (Romero, 2020, p. 902). However, on the other hand, automation systems require a considerable investment and a long depreciation period (Yamazaki et al., 2016). The future factory also requires flexibility and adaptability to satisfy market demands (Pantano et al., 2021), which could be reached using a lean automation concept. A proclaimed concept for the future could be cobots (collaborative robots) which allows a robot and a human to work in a shared work environment and using the strengths of both in parallel. (Malik and Bilberg, 2017)

Lean Warehousing affects all departments and the whole company and stakeholders as well as all Supply Chain Partners. It needs:

➔ **Supplier Integration**

➔ **Customer Integration**

➔ **Department Integration**

➔ **IT Integration**

➔ **Holistic Lean Method Integration**

➔ **Company Culture**

➔ **Strategy Integration**

<u>Integrated Lean Warehousing (ILW).</u>

The following table (table 10.1) leans on the Shingo Prize Model (see figure 4.4) and is a practical output of this study which can be used to check the ILW score.

The original model was expanded by the findings from this research and the understanding that Lean Warehousing needs to be fully integrated. The category "Results" was amended by Level of Suggestion Ideas (see pages 41-42) as an appropriate indicator for a high morale of the employees empowered by a true lean leadership.

The elements in the category "Behaviours" were fully replaced by new elements Customer, Lean Warehousing Department, Supplier, IT and Strategy Integration.

They weight of these factors were distributed equally as each integration element should be considered and fully integrated to reach the optimum ILW score 1000 points.

Table 10-1: ILW Scoring System

ILW Scoring System			
Category	**Element**	**Score (Points)**	**Percent of Total Score**
Behaviours (900 Points)	Customer Integration	150	15%
	Lean Warehousing Integration	150	15%
	Department Integration	150	15%
	Supplier Integration	150	15%
	IT-Integration (WMS)	150	15%
	Strategy Integration (Hoshin Kanri)	150	15%
Results (100 Points)	Level of Suggestion Ideas	20	2%
	Cost/Productivity	20	2%
	Delivery Acuracy	20	2%
	Customer Satisfaction	20	2%
	Safety/Environment	20	2%

This model is a first draft and needs to be evaluated and developed in future research. For each element there must be a set of questions to rate the grade of integration.

Chapter 11 Outlook and Further Research

11.0 Outlook and further research

The literature review shows that successful lean implementation can influence organisational performance, e.g., by reducing costs and increasing profits by enhancing customer satisfaction at the same time. Furthermore, employees' morale, could be increased if they feel inspired through a lean leadership. This study contributed to knowledge concerning some new aspects that companies should take into consideration and unveiled some further research questions as a meaningful continuation.

Although automation was shown to be a significant factor for lean warehousing in this study, it is not clear whether the LWMI was actually increased in the long term or if it is probably only a short to medium-term effect after the introduction of an automation system? An intensive analysis of the current processes is necessary to determine the appropriate automation solution and the required performance indicators in the long term. So, the question should be:

Do automated warehouses have a high LWMI just due to the recent automation project, or is it constantly high?

Most likely, at some point, the automation grade (in extreme characteristics a fully automated warehouse) the effect on LWMI is turning from positive to negative influence. This also raises the next question.

Finally, this study was able to prove that Support by top-management – a leadership-related factor - is significant factor for LW, jus as leadership in general is mentioned as an essential element of the lean philosophy. However, there is not a clear indication of which leadership style is best suited for LW. Transformational leadership seems to be a perfect fit, according to the literature. Poksinska et al. (2013) describe that a leader with a transformational leadership style strongly influences his or her followers to reach the defined goals. Tanudiharjo et al. (2021) also recommend a transformational leadership style for lean organisations. “Organizational Culture, Personnel Capability, Communications and Leadership are critical to the success of lean implementation and also provides the industry with information and measures that management can implement to achieve higher success in their lean implementation efforts.” (Tanudiharjo et al., 2021, p. 169)

Most recently, there are also some indicators in the literature that blue ocean leadership could be appropriate? Loh and Lau (2019) proclaim that Blue Ocean

Leadership can unleash the ocean of untapped talent and employee potential in organisations. Blue Ocean Leadership was developed by Kim and Mauborgne (2014). They were looking to the field of strategy to inform the practice of leadership in business to achieve fast results at low costs (Kim and Mauborgne, 2014). Sadiq et al. (2021) observed that Blue Ocean Leadership is a strong lever for Lean Manufacturing and improves the economic factors and improves environmental performance by reducing emissions to 50%.

Moreover, it would be interesting if the leadership style should vary due to the warehouse-type or automation grade or the company size and industry sector? Maybe there are also differences during the phases of an LW implementation, and the leadership style should be adapted the higher the LWMI is?

Chapter 12 References

12.0 References

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Chapter 13 Appendices

13.0 Appendices

13.1 Interview Guideline

Experten-Interview zum Thema Lean Warehousing

1. Zweck des Interviews:

Im Rahmen meiner Promotion am Lehrstuhl für Management & MIS, an der Universität Nicosia in Zypern führe ich eine Studie zum Thema Lean Warehousing durch.

Die empirische Forschung untereilt sich dabei in einen quantitativen mittels eines Online-Fragebogens und in einen qualitativen Teil in Form von Experten-Interviews, die zu Beginn durchgeführt werden.

Einführung zum Thema:

In einigen Studien (Overboom et al., 2010; Sobanski, 2011; Mahfouz 2012; Spee and Beuth 2012; Dehdari, 2013 etc.) wurde bereits die positive Wirkung auf Lagerkennzahlen nachgewiesen. Beispielsweise wurde in einer Studie eines Logistikdienstleister bereits nach 10 Monaten eine Produktivitätssteigerung von 32% gemessen und in einem weiteren Beispiel wurde nach Einführung von Lean Warehousing eine Reduktion des Lagerbestands von 45% erzielt.

Dennoch zeigt sich, dass nach wie vor viele Unternehmen an einer nachhaltigen Einführung scheitern (Agustin 2011, Kudernatsch 2014) und nur kurzfristige Erfolge verbuchen können und sich die Prozesse nach kurzer Zeit wieder verschlechtern und die Qualität als auch die Kennzahlen starken Schwankungen unterliegen.

Dies lässt den Schluss zu, dass viele Unternehmen die Werkzeuge und Methoden zum Schaffen von standardisierten und effizienten Prozessen im Rahmen eines Projektes einführen, jedoch keine nachhaltige „Lean-Kultur“ mit einer starken Lean-Führungs-Kultur innerhalb der Organisation etablieren. Es erfolgt demnach wohl auch keine Umsetzung auf strategischer Ebene und daher können auch keine nachhaltigen und fortlaufenden Verbesserungspotentiale gehoben werden und die Prozesse bleiben weiterhin instabil.

Im Rahmen meiner Forschung möchte ich die Ursachen des Scheiterns und Erfolgsfaktoren für eine nachhaltige Implementierung des Lean-Warehousing untersuchen.

Leitfrage: Welche Faktoren beeinflussen die nachhaltige Einführung von Lean Warehousing?

Ablauf:

Das Interview beansprucht ca. 60 Minuten und gliedert sich in folgende Themenblöcke bzw. Einflussfaktoren:

I. Statistische Angaben zum Interviewpartner (Position, Firma, Art und Dauer der Erfahrungen auf dem Wissensgebiet, etc.)

II. Unternehmen und Interessengruppen (Branche, Wettbewerb, Kunden, strategische Ausrichtung, Unternehmenskultur und Philosophie, Führungsstil, Einflüsse von Politik und Gewerkschaften (Gesetze und Vorschriften), etc.)

III. Besonderheiten der Lagerhaltung (Art des Lagers und der Ware, Automatisierungsgrad, IT-Systeme, Mitarbeiterqualifikation etc.)

IV. Lean-Methode (Übertragbarkeit auf Lagerlogistik, Komplexität, Forschungsstand, …)

Es gibt weder richtige noch falsche Antworten, da es um Meinungen, Motive und persönliche Einstellungen und Einschätzungen geht. Das Interview wird zum Zwecke der lückenlosen Dokumentation und späteren Auswertung digital aufgezeichnet.

Datenschutz:

Durch Ihre Teilnahme erklären Sie ihr Einverständnis, dass die Ergebnisse der Untersuchung für rein wissenschaftliche Zwecke genutzt werden können. Ihre Angaben werden streng vertraulich behandelt und anonym gespeichert, so dass kein Rückschluss auf Ihre Person oder Unternehmen möglich ist. Ihre Daten werden nur im Rahmen dieser Studie verwendet und nicht an Dritte weitergegeben.

Dem Interviewpartner steht es frei nach dem Interview seine Einverständniserklärung zur Nutzung der Daten für die Weiterverarbeitung rein wissenschaftlicher Zwecke zurückzuziehen oder nur in Teilen auszusprechen.

Bei Fragen oder Anregungen können Sie mich gerne jederzeit über simon.kallinger@gmail.com kontaktieren.

Auf Wunsch lasse ich Ihnen nach Fertigstellung auch gerne das Ergebnis dieser Studie per E-Mail zukommen.

Herzlichen Dank für Ihre Teilnahme und viele Grüße,

Simon Kallinger

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13.2 Exemplary traditional transcription of an Interview

12.2.1 Original German Version

R: Hallo Herr X, hier ist Simon Kallinger

I: Hallo Herr Kallinger, schön dass Sie anrufen

R: Schön, dass Sie sich Zeit nehmen am Interview teilzunehmen

I: Ja gerne, ist ja auch ein sehr spannendes Thema

R: Ich hatte ihnen vorab ein Informationsblatt zum Interview zukommen lassen. Hatten sie denn auch Gelegenheit es zu lesen?

I: Ja.

R: Gut. Bevor wir dann mit dem eigentlichen Interview starten, möchte ich sie nochmal über den Datenschutz aufklären, wobei das ja in dem Informationsblatt auch schon enthalten. Das folgende Interview möchte ich digital aufzeichnen, dazu hätte ich gerne ihr Einverständnis. Herr Winter.

I: Ja. Kein Problem

R: Vielen Dank. Denn nur so ist es möglich die Daten hinterher auch auswerten zu können. Die Daten werden selbstverständlich streng vertraulich behandelt und nur im Rahmen dieser Studie verwendet.

Ihre Daten werden außerdem anonym in die Studie einfließen, sodass keinerlei Rückschlüsse auf ihre Person oder Unternehmen möglich sind. Die Daten werden anonym gespeichert. Selbstverständlich auch nicht an dritte weitergegeben. Im Anschluss an das Interview können sie ihre Einverständniserklärung auch zurückziehen, wenn sie das möchten.

I: O.K. habe ich verstanden. Wichtig ist mir, dass es keine Rückschlüsse auf mein Unternehmen gibt! Ich persönlich hätte kein Problem damit namentlich genannt zu werden, bei Zitaten oder ähnlichem.

R: Gut Vielen Dank. Das Interview selbst ist nicht fest strukturiert, sondern als Experteninterview aufgebaut mit verschiedenen Themenblöcken, die nach und nach abgefragt werden.

Ich starte das Interview.

Man kann diverse Studien auch im Internet zum Thema Lean Warehousing finden, die die Wirksamkeit von Lean im Lagerumfeld nachweisen und von hohen Produktivitäts- und Qualitätssteigerungen sprechen. Lean hat sich ja bereits in der Produktion als Lean Production durchgesetzt und hält jetzt eben Einzug in den Bereich Warehousing. Allerdings gibt es auch Studien von Kudernatsch und Augustin die belegen, dass der Lean Reifegrad bei den meisten Firmen sich auf sehr niedrigem Niveau befindet. Der Lean Reifegrad beschreibt ja inwieweit die Lean Philosophie in der Firma verankert ist und nachhaltig gelebt wird. Es gibt in etwa nur 5% die den höchsten Lean Reifegrad erhalten. Dann gibt es noch etwa 10 % die den Level 4 erreichen. Die restlichen von 85 % erreichen entsprechend 3 oder weniger. Dieses Ergebnis ist natürlich erstaunlich im Vergleich zu den anderen Studien, die eben die hohe Wirksamkeit von Lean Warehousing bewiesen haben. Dieser Umstand bringt mich zu der Leitfrage: Warum ist das so? Bzw. welche Faktoren beeinflussen die nachhaltige Einführung von Lean Warehousing? Diese Faktoren egal ob positiv oder negativ möchte ich in meiner Studie herausfinden und damit zum ersten Themenblock das Unternehmen selbst und die Interessensgruppen rundherum die sogenannten Stakeholder. Abhängig davon in welcher Branche ich mich befinde, mit welchen Lieferanten und evtl. asymmetrischen Kundenbeziehungen ich zu tun habe. Außerdem die Firmenkultur. Philosophie und Führungsstil des Unternehmens und auch die Einflüsse durch Politik und Gewerkschaften sind hier gemeint.

Herr Winter wie schätzen sie denn das ein? Gibt es denn Ihrer Meinung nach, eine bestimmte Branche, die prädestiniert für Lean Warehousing ist? Oder aber sich besonders schwer tut Lean Warehousing einzuführen?

I: Ja. Meiner Meinung nach gibt es einige Branchen, die vorneweg marschieren, wie z. B die Automobilbranche und Branchen mit sehr standardisierten und professionalisierten Produktionsprozessen. Ich selber bin bereits seit 11 Jahren in der Textilbranche und die Textilbranche tut sich besonders schwer. Das liegt daran, dass die Branche Großteils nicht erkannt hat, dass der Bereich Logistik als Schlüsselkomponente gilt. Dazu kommt, dass die Textilbranche sehr geprägt ist durch die Unternehmensbereiche Verkauf und Einkauf und der Einkauf ist die mächtigste Abteilung im Unternehmen und die zweite kleinere Macht ist der Verkauf und alle anderen Unternehmensbereiche haben nur Supportcharakter. Bei uns beginnen die Inhaber langsam zu verstehen, dass die Supply Chain eine wichtige Rolle spielt da man im stationären Einzelhandel einen gesättigten Markt hat und in einem starken Verdrängungswettbewerb steht. Zusammengefasst kann ich sagen, dass die Textilbranche einen großen Nachholbedarf im Bereich Logistik hat. Zumindest diejenigen die Ihre Logistik noch nicht an einen Dienstleister outgesourced hat. Vielleicht liegt es auch daran, dass das Unternehmen erst in den letzten Jahren stark gewachsen ist. Von einem kleinen Mittelständler zu einem großen Mittelständler. Von 20 Filialen auf 150 Filialen. Die Internationalisierung kam dazu. Diesen Sprung haben andere Branchen wahrscheinlich schon früher vollzogen und sind deswegen besser im Bereich Logistik aufgestellt. Erst seit 2 Jahren gibt es ein eigenes Supply Chain Team.

R: Das ist ja interessant. Wenn ich nochmal zusammenfassen darf, dann sagen Sie, dass die Textilbranche im Vergleich zur Automobilbranche extremen Nachholbedarf hat weil diese Branchen als Vorreiter im Bereich Lean Production gelten und die Textilbranche dieses Knowhow noch nicht hat oder aufholen muss. Allerdings hätte ich erwartet, dass die Textilbranche in diesem Bereich schon weiter ist da es einen extremen Wettbewerb gibt und auch eher geringe Margen. Sodass man sich doch mit kontinuierlichen Prozessverbesserungen bzw. Lean auseinandersetzen hätte müssen.

I: Es gibt einen Vorreiter in der Textilbranche der logistisch geprägt ist. Dieser hat extrem kurze Durchlaufzeiten. Hat allerdings auch nur eine Eigenmarke. Bei uns ist das anders. Wir haben 50 % Eigenmarken und 50 % Fremdmarken. Hier hat man es z. B. mit Lieferanten wie Armani zu tun und ist auch auf deren Supply Chain und Logistik angewiesen. Mit solchen mächtigen Lieferanten gibt es auch nicht die Möglichkeit über Prozessharmonisierung zu sprechen. Diese nutzen ihre Marktmacht voll aus und geben ihre Prozesse vor. Das sind eben die Schwierigkeiten, wenn man mit Fremdprodukten zu tun hat. Solche wie Armani gibt es viele und somit multiplizieren sich die Probleme. Ein wesentlicher Aspekt in der Textilbranche ist die Kurzlebigkeit der Produkte und das Erkennen von Trends was jetzt im Vergleich mit der Automobilbranche nicht so gravierend ist. Ein großes Thema in der Branche sind zu große Warenbestände, die daher rühren, dass die

Verkäufe eben schlecht planbar sind durch z. B. milde Winter sodass sie den geplanten Absatz von Winterjacken nicht erreichen. In der Automobilbrache ist das alles sehr viel planbarer da der Produktionsausstoß für das nächste halbe Jahr gesichert ist und man eine ganz klare Taktzeit von z. B. 4 Minuten hat und daraufhin die Bestände planen kann. In der Modebranche gibt es keinen Kunden, der ihnen ein halbes Jahr vorhersagen wird dass er dann einen Boss Anzug kaufen wird. Wobei es aber sicherlich Möglichkeiten gibt hier relativ verlässliche Prognosen zu schaffen, da man ja Abverkaufszahlen über mehrere Jahre hinweg kennt sowohl für Eigen- als auch Fremdmarken. Aber dieses Potential wird noch nicht geschöpft.

R: Ja sie sprechen damit Big Data an.

I: Ja ich möchte noch anführen, dass das Marktumfeld auch ganz wesentlich ist. Wir sind ja in den letzten Jahren extrem schnell gewachsen und haben uns auch international ausgerichtet und hatten eben einen Markt, der durchaus noch gewachsen ist und erst in den letzten 3 bis 4 Jahren ist dieses Marktwachstum extrem gebremst. Man hat jetzt einen stark gesättigten Markt. Es gibt nur ganz wenige Anbieter, die es geschafft haben, sich in einer Nische oder Preissegment zu etablieren. Durch diese Marktsättigung hatten wir dann auch die Kosten ganz anders im Blick und auch die Prozesse ganz anders im Blick.

R: Hat der Schritt zur Internationalisierung auch schon dahin geführt, dass der Blick auf die Prozesse gelenkt wird?

I: Ja. Das war am Anfang noch gar nicht der Fall. Allerdings ist durch die steigende Zahl der Filialen auch die Komplexität in den Prozessen gestiegen. Z. B. spezielle Vorgaben von Behörden im Ausland und vor allem aber auch durch das gestiegene Volumen das durch die gleichbleibend großen Logistikflächen bewirtschaftet wird. Somit ist der Druck auf die Prozesse erst nach und nach gestiegen.

R: Aha. verstehe.

I: Die Verkaufsflächen sind auch sehr produktivitätsgetrieben. Ich war 7 Jahre lang im gleichen Unternehmen für die Instore-Logistik tätig und dort hatte man eben einen sehr hohen Anspruch an Geschwindigkeit und Prozesseffizienz.

R: O.K., der Begriff Instore-Logistik sagt mir jetzt konkret nichts. Ich kann mir etwas darunter vorstellen. Aber was verbirgt sich denn hinter dem Begriff?

I: In Deutschland gibt es hierfür eine extra ausgegliederte Logistikgesellschaft mit 30 Mitarbeitern. Die übernehmen die komplette Intralogistik. Angefangen vom Wareneingang bis hin zur Verräumung an die Verkaufstische und –Ständer. Eine Spezialität meines Unternehmens ist, dass wir kein Zentrallager betreiben, sondern jede Filiale ihr eigenes Regionallager hat. In großen Häusern entspricht das etwa 150.000 bis 200.000 Teilen. Hinzu kommen noch weitere logistikfremde Dienstleistungen. Das ist in der Branche aber nicht einmalig und kann auch z. B. in der Lebensmittelbranche beobachtet werden. Dass z. B. externe Dienstleister die Regale einräumen. Das Lohnniveau dieser Mitarbeiter ist sehr niedrig, da man dazu keine Facharbeiter braucht.

R: An dieser Stelle möchte ich nochmals auf die Logistikzentren zurückkommen, über die wir ja auch kurz gesprochen hatten. Diese sind ja heutzutage sehr häufig schon geprägt durch einen sehr hohen Automatisierungsgrad wie z. B automatische Kleinteilelager, der Einsatz von fahrerlosen Transportsystemen oder aber auch die Anwendung aktueller Kommissionier-Technologien wie Datenbrillen etc. Wie schätzen sie es ein wie die Automatisierung und der Lean Gedanke sich gegenseitig positiv oder negativ beeinflussen? Kennen sie vielleicht auch Mitbewerber, die automatisierte Warenlager nutzen?

I: Ja. Das gibt es in der Branche. In der Textilbranche gibt es eine besondere Herausforderung und das ist die hängende Ware. Dementsprechend gibt es auch große Unterschiede in den Prozessen zwischen hängender und liegender Ware. Auch die Automatisierung muss unterschiedlich ausgeprägt sein. Bei uns selbst spielt die Automatisierung noch keine Rolle da wir ja dezentrale Lagerstrukturen haben und nicht die kritische Masse erreichen, um eine Investition in Automatisierung rechtfertigen zu müssen. Da die Instore-Prozesse, wie bereits angesprochen, schon sehr schlank sind würde sich die Investition nicht lohnen. Aber dennoch denken wir darüber nach ob wir die richtige Logistikstruktur haben und nicht doch in ein Zentrallager und Automatisierung investieren sollen. Da z. B heute bei der manuellen Kommissionierung sehr häufig Fehler auftreten. Also zusammenfassend möchte ich noch sagen, dass die Logistikprozesse insgesamt noch unterentwickelt sind und mit Automatisierung noch wesentlich effizienter sein könnten. Zu beachten ist dabei jedoch, dass es wenig standardisierte Prozesse gibt und es sehr viele Ausnahmen und Spezialprozesse, die wahrscheinlich nur schwer zu automatisieren sind. Evtl. ist dies aber auch ein kulturelles oder

Führungsproblem, dass man zu viele Ausnahmen zulässt und nicht auf eine standardisierte Lösung der Prozesse setzt. Gegenwärtig wird auch ein Logistikberater beschäftigt, der die Prozesse im Unternehmen analysiert und der auch die Meinung vertritt, dass die Prozesse standardisiert werden sollten um die Komplexität zu reduzieren. Automatisierung sollte jedoch nicht in allen Bereichen vorgenommen werden. Gegenwärtig sind wir noch weit von der Automatisierung entfernt. Die Kommissionierung erfolgt noch belegorientiert. Ein erster Schritt wäre sicherlich die Verwendung von mobilen Funkterminals.

R: Ja. Das kann ich in meiner Tätigkeit auch noch sehr häufig beobachten, dass viele große nicht nur mittelständische Unternehmen noch mit Kommissionier Belegen arbeiten. Wie sie auch schon sagten kann man auch einige Prozessschritte automatisieren. Allerdings lässt sich ja auch mit einigen Lean-Methoden wie Pokayoke versuchen die Prozesse so zu gestalten, dass sie Narrensicher werden. Das ist es ja was Pokayoke eigentlich bedeutet. Man muss die Fehler ergründen und Maßnahmen ergreifen, dass diese nicht mehr passieren. Damit wären die Prozesse auch sicher gestaltet, ohne zu automatisieren. Damit bleiben die Prozesse auch flexibel.

I: Ja genau. Ich glaube das ist auch ein Trugschluss alles zu automatisieren, zumal ja auch die Kunden immer flexiblere Prozesse fordern.

R: Richtig. Elemente wie Fördertechnik, Regalbediengeräte und automatische Hochregallager sind ja starre Gebilde und unflexibel.

I: Ja dem stimme ich zu. Automatisierung macht eben nicht überall Sinn. Wir haben z.B. in unseren Crosdocking-Lagern festgestellt, dass die von die Durchlaufzeit zu 70-80% reine Standzeiten der Waren auf irgendwelchen Pufferflächen ist. Hier analysieren wir gerade wie wir die Durchflaufzeit und auch die Produktivität der Fläche insgesamt erhöht werden kann. Ein aktueller Lösungsansatz, den wir uns gerade genauer betrachten, ist eine Fördertechnik zu installieren, die die Ware an die Arbeitsplätze fördert um dort noch entsprechend etikettiert zu werden. Eine automatische Etikettierung wäre wünschenswert, aber aufgrund der heterogenen Ware vom Socken bis hin zum Hochzeitskleid. Das macht es natürlich unheimlich schwierig den Prozess vollständig zu automatisieren, aber das muss es an der Stelle eben auch gar nicht.

R.: Wie sieht den aktuell die IT-Unterstützung bei Ihnen aus. Hier gibt es am Markt ja eine Vielzahl an Systemen, die den User ja auch sehr stark unterstützen und bereits sehr viel Standard-Funktionalitäten mitbringen. Nutzen Sie bspw. bereits ein WMS oder ein ERP mit einem entsprechenden Lagerverwaltungsmodul. Allerdings gibt es hierzu auch immer wieder Kritikpunkte zu hören, die Systeme wären nicht flexible genug und werden einmal initial eingerichtet und dann sind die Prozesse für die nächsten Jahre „in Stein gemeißelt". Wie ist Ihre Erfahrung hierzu oder wie schätzen Sie diese Systeme ein?

I.: Ich bin vor 11 Jahren als Consultant im Unternehmen gestartet bevor ich in die Geschäftsführung gewechselt bin und während dieser Zeit hat mein ein WMS eingeführt. Damals hat man sich für eine Eigenprogrammierung entschieden, was Fluch und Segen zugleich war. Die Software ist genau auf unsere Prozesse abgestimmt, allerdings müssen wir funktionale Änderungswünsche immer neu programmieren. Dies ist zeitaufwändig und damit teuer und Standard Software dagegen, bieten diese und weitere Funktionen mittlerweile als Standardfunktionalität. Hier reicht ein Upgrade.

R.: Absolut richtig, hier muss man natürlich ins Detail gehen, um die Anforderungen abzugleichen, aber im Grundsatz kann ich das nur bestätigen.

Damit wäre ich dann auch mit meinen Fragen am Ende und möchte mich für Ihre Zeit und das interessante Gespräch bedanken. Auf Wiederhören.

I.: Gern geschehen. Auf Wiederhören.

12.2.2 Translated Version

R: Hello Mr X, this is Simon Kallinger.

I: Hello Mr. Kallinger, nice of you to call.

R: Thank you for taking the time to participate in the interview.

I: Yes, of course, it's a very exciting topic.

R: I had sent you an information sheet about the interview in advance. Did you have the opportunity to read it?

I: Yes.

R: Good. Before we start with the actual interview, I would like to explain to you about data protection, which is already included in the information sheet. I would like to record the following interview digitally, I would like to have your consent. Mr Winter.

I: Yes. No problem

R: Thank you very much. This is the only way to be able to analyse the data afterwards. The data will of course be treated as strictly confidential and will only be used in the context of this study.

Your data will also be used anonymously in the study, so that no conclusions can be drawn about your person or company. The data will be stored anonymously. Of course, it will not be passed on to third parties. After the interview, you can withdraw your declaration of consent if you wish.

I: OK, I understand. It is important to me that no conclusions are drawn about my company! Personally, I would have no problem with being mentioned by name in quotations or the like.

R: Good, thank you very much. The interview itself is not structured in a fixed way but is set up as an expert interview with different topic blocks that are asked one after the other.

I start the interview.

You can find various studies on the Internet on the topic of lean warehousing that prove the effectiveness of lean in the warehouse environment and speak of high increases in productivity and quality. Lean has already established itself in production as Lean Production and is now finding its way into warehousing. However, there are also studies by Kudernatsch and Augustin that show that the level of lean maturity in most companies is at a very low level. The level of lean maturity describes the extent to which the lean philosophy is anchored in the company and is lived sustainably. There are only about 5% that get the highest Lean maturity level. Then there are about 10 % who reach level 4. The remaining 85% achieve 3 or less. This result is of course astonishing compared to the other studies that have just proven the high effectiveness of lean warehousing. This fact brings me to the main question: Why is this so? What factors influence the viable introduction of lean warehousing? These factors, whether positive or negative, are what I want to find out in my study, and thus to the first thematic block, the company itself and the interest groups around it, the so-called stakeholders. Depending on which industry I am in, which suppliers and possibly asymmetrical customer relationships I have to deal with. Also, the company culture. The philosophy and management style of the company and also the influences of politics and trade unions are meant here.

Mr. Winter, how do you assess this? In your opinion, is there a particular industry that is predestined for lean warehousing? Or is it particularly difficult to introduce lean warehousing?

I: Yes. In my opinion, there are some industries that are leading the way, such as the automotive industry and industries with very standardised and professionalised production processes. I myself have been in the textile industry for 11 years and the textile industry has been particularly difficult. This is because most of the industry has not recognised that logistics is a key component. In addition, the textile industry is very much characterised by the sales and purchasing departments and purchasing is the most powerful department in the company and the second smaller power is sales and all other departments only have a support character. In our company, the owners are slowly beginning to understand that the supply chain plays an important role because in the stationary retail sector, the market is saturated and there is strong predatory competition. In summary, I can say that the textile industry has a lot of catching up to do in the area of logistics. At least those that have not yet outsourced their logistics to a service provider. Perhaps it is also due to the fact that the company has only grown strongly in recent years. From a small medium-sized company to a large medium-sized company. From 20 branches to 150 branches. Internationalisation came on top of that. Other sectors have probably made this leap earlier and are therefore better positioned in the area of logistics. We have only had our own supply chain team for two years.

R: That's interesting. If I may summarise again, you say that the textile industry has a lot of catching up to do compared to the automotive industry because these industries are considered pioneers in the area of lean production and the textile industry does not yet have this know-how or has to catch up. However, I would have expected the textile industry to be further ahead in this area because there is extreme competition and also rather low margins. So that one would have had to deal with continuous process improvements or lean.

I: There is a pioneer in the textile industry that is logistically characterised. It has extremely short lead times. However, it only has one own brand. It's different with us. We have 50 % own brands and 50 % external brands. Here you have to deal with suppliers like Armani, for example, and are also dependent on their supply chain and logistics. With such powerful suppliers there is no possibility to talk about process harmonisation. They make full use of their market power and dictate their processes. These are the difficulties when dealing with third-party products. There are many like Armani and thus the problems multiply. An important aspect in the textile industry is the short life of the products and the recognition of trends, which is not so serious compared to the automotive industry. A big issue in the sector is too much stock, which is due to the fact that sales are difficult to plan because of mild winters, for example, so that they do not achieve the planned sales of winter jackets. In the automotive industry, everything is much more plannable because the production output for the next half year is secured and you have a very clear cycle time of e.g., 4 minutes and can plan the stocks on that basis. In the fashion industry, there is no customer who will tell you six months in advance that he will buy a Boss suit. However, there are certainly possibilities to create relatively reliable forecasts here, since one knows sales figures over several years for both own and third-party brands. But this potential has not yet been tapped.

R: Yes, you are referring to Big Data.

I: Yes, I would like to add that the market environment is also very important. We have grown extremely fast in the last few years and have also aligned ourselves internationally and had a market that was still growing and only in the last 3 to 4 years has this market growth slowed down extremely. We now have a highly saturated market. There are only a few suppliers who have managed to establish themselves in a niche or price segment. Due to this market saturation, we had a completely different view of costs and processes.

R: Has the step towards internationalisation also led to a focus on processes?

I: Yes. That was not the case at the beginning. However, the increasing number of branches has also increased the complexity of the processes. For example, special requirements from authorities abroad and, above all, the increased volume that is managed by the consistently large logistics areas. So, the pressure on the processes has only increased gradually.

R: I see. I see.

I: The sales areas are also very productivity driven. I worked for the same company for 7 years in instore logistics and there they had a very high demand for speed and process efficiency.

R: OK, the term "in-store logistics" doesn't mean anything to me. I can imagine something about it. But what is behind the term?

I: In Germany, there is a separate logistics company with 30 employees. They take care of the entire intralogistics. Starting with the receipt of goods and ending with the storage of the goods on the sales tables and stands. One of my company's specialities is that we don't operate a central warehouse, but each branch has its own regional warehouse. In large stores, this corresponds to about 150,000 to 200,000 parts. In addition, there are other logistics-related services. However, this is not unique in the industry and can also be observed in the food sector, for example. For example, external service providers stock the shelves. The wage level of these employees is very low because you don't need skilled workers for that.

R: At this point I would like to come back to the logistics centres, which we also talked about briefly. These days, they are very often characterised by a very high degree of automation, such as automated small parts warehouses, the use of driverless transport systems or the application of current order picking technologies such as data glasses, etc. How do you assess how automation and lean thinking influence each other positively or negatively? Do you know of any competitors who use automated warehouses?

I: Yes. That exists in the industry. In the textile industry there is a particular challenge and that is hanging goods. Accordingly, there are also big differences in the processes between hanging and lying goods. Automation also has to be developed differently. For us, automation does not yet play a role because we have decentralised warehouse structures and do not reach the critical mass to justify an investment in automation. Since the in-store processes, as already mentioned, are already very lean, the investment would not be worthwhile. But we are still thinking about whether we have the right logistics structure and should not invest in a central warehouse and automation. Because, for example, errors occur very often in manual order picking today. In summary, I would like to say that the logistics processes are still underdeveloped and could be much more efficient with automation. However, it should be noted that there are few standardised processes and there are many exceptions and special processes that are probably difficult to automate. However, this may also be a cultural or leadership problem that too many exceptions are allowed and that a standardised solution for the processes is not being implemented. At present, a logistics consultant is also employed to analyse the processes in the company and who is also of the opinion that the processes should be standardised in order to reduce complexity. However, automation should not be applied in all areas. At the moment, we are still far away from automation. Picking is still document oriented. A first step would certainly be the use of mobile radio terminals.

R: Yes. In my work, I can often observe that many large and not only medium-sized companies still work with picking documents. As you said, some process steps can be automated. However, with some lean methods like Pokayoke, you can also try to design the processes in such a way that they become foolproof. That is what Pokayoke actually means. You have to find out the mistakes and take measures so that they don't happen anymore. This would also make the processes safe without automating them. This would also keep the processes flexible.

I: Yes, exactly. I think it's also a fallacy to automate everything, especially since customers are demanding more and more flexible processes.

R: Correct. Elements like conveyor systems, storage and retrieval machines and automatic high-bay warehouses are rigid and inflexible.

I: Yes, I agree with that. Automation does not make sense everywhere. In our crosdocking warehouses, for example, we have found that 70-80% of the throughput time is pure standing time of the goods on some buffer areas. We are currently analysing how we can increase the throughput time and also the productivity of the area as a whole. A current solution that we are looking at more closely is to install a conveyor system that transports the goods to the workstations where they can be labelled accordingly. Automatic labelling would be desirable, but due to the heterogeneous nature of the goods, from socks to wedding dresses. Of course, this makes it incredibly difficult to fully automate the process, but it doesn't have to at this point.

R.: What does IT support currently look like for you? There are a lot of systems on the market that support the user very strongly and already have a lot of standard functionalities. For example, do you already use a WMS or an ERP with a corresponding warehouse management module? However, there is always criticism that the systems are not flexible enough and are set up initially and then the processes are "set in stone" for the next few years. What is your experience with this or how do you assess these systems?

I.: I started 11 years ago as a consultant in the company before I moved to the management and during this time my company introduced a WMS. At that time, we decided to develop it ourselves, which was both a blessing and a curse. The software is exactly tailored to our processes, but we always have to reprogramme functional change requests. This is time-consuming and therefore expensive. Standard software, on the other hand, now offers these and other functions as standard features. An upgrade is enough here.

R.: Absolutely right, of course you have to go into detail here to match the requirements, but in principle I can only confirm that.

That concludes my questions, and I would like to thank you for your time and the interesting discussion. Goodbye.

I.: You're welcome. Goodbye.

13.3 Interview Details – Overview of all codes

Lean Warehousing Show-stopper

1.

many lean consultants just focussing on the tools and train the usage of the tools and that is not enough

[Interviewee8; Position: 00:15:36.9-00:15:48.6; Autor: Simon; 21.03.2016 11:41; Gewicht: 0]

KPIs

1.

in don´thaving the right indicators leab initiavie going to fail or will be dropped after some time

[Interviewee9; Position: 00:13:58.8-00:14:11.6; Autor: Simon; 01.04.2016 15:13; Gewicht: 0]

No support by top management

1.

manger from the scond level don´t get support bythe top management

[Interviewee10; Position: 00:04:22.8-00:04:55.0; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

2.

lean implemenation is a longterm approach and it needs a long breath by the menagement and self discipline

[Interviewee9; Position: 00:10:26.3-00:10:48.8; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

3.

support by management is crucial and the change team must have the full backing

[Interviewee8; Position: 00:15:07.4-00:15:23.3; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

4.

top management is the crucial factor

[Interviewee8; Position: 00:44:14.9-00:44:43.8; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

5.

[Interviewee7; Position: 00:15:37.7-00:15:45.2; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

6.

logistics is treated by the top management like a stepchild and also the managers do not have the knowledge about lean

[Interviewee7; Position: 00:22:07.1-00:22:45.6; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

7.

logistics is still not seen as an important segment and this is what people feel and therefore no suggesstion ideas

[Interviewee7; Position: 00:35:12.8-00:35:59.7; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

8.

mangers are not willed to invest in logistics and if they have done and it needs more invest the refuse further budget

[Interviewee7; Position: 00:41:19.2-00:41:34.8; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

9.

[Interviewee6; Position: 00:10:20.2-00:10:25.1; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

10.

education of the top management in SMEs is also a key element

[Interviewee6; Position: 00:21:22.4-00:21:42.8; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

11.

80% of the managers think lean is just hoax

[Interviewee6; Position: 00:21:46.1-00:22:14.6; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

12.

no understanding for long time consuming process redisgning projects

[Interviewee4; Position: 00:33:55.8-00:34:22.5; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

13.

background from the top managemot (production, marketing etc.)

[Interviewee3; Position: 00:18:11.8-00:18:24.3; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

14.

[Interviewee3; Position: 00:19:18.9-00:19:30.5; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

15.

[Interviewee 1; Position: 01:16:06.6-01:16:19.7; Autor: Simon; 22.03.2016 09:36; Gewicht: 0]

Cost intensive

1.

lean warehousing implementation will cost extra money and the logistics cost anyway so let us at least save the extra money

[Interviewee11; Position: 00:27:32.2-00:27:51.4; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

2.

no investments in procss optimisation although it will bring a lot of benefits but the managers can´t see the potential

[Interviewee7; Position: 00:39:31.6-00:39:52.3; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

3.

[Interviewee7; Position: 00:41:19.2-00:41:34.8; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

4.

training and regular meetings are cost intensive and the output is not measurable

[Interviewee7; Position: 00:46:53.1-00:47:21.7; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

5.

extrenal consultants are not only cost intensive sometimes companies don´t want to share critical insider knowledge to stranger

[Interviewee5; Position: 00:06:54.6-00:07:24.3; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

6.

CIP is an effort to implement and you don´t know the effect when you start it

[Interviewee4; Position: 00:34:39.0-00:34:45.6; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

7.

no extra ressources

[Interviewee4; Position: 00:37:05.2-00:39:02.4; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

8.

customizing of It system is very expensive

[Interviewee4; Position: 01:03:01.4-01:03:07.7; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

9.

[Interviewee4; Position: 01:05:36.1-01:06:24.6; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

10.

CR in software is cost and time intensive

[Interviewee4; Position: 01:18:49.4-01:19:20.9; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

11.

costs for CR is a big hurdle

[Interviewee4; Position: 01:19:42.0-01:19:55.5; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

12.

CR´s in software are costointensive and no clear savings to oppose

[Interviewee4; Position: 01:23:10.2-01:24:45.0; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

13.

not willed to spend a lot of money in a IT system which suggests the optimmum behavior

[Interviewee 1; Position: 01:04:24.9-01:04:41.5; Autor: Simon; 22.03.2016 09:14; Gewicht: 0]

Departmental thinking

1.

just a few really know the processes beyond their department borders

[Interviewee11; Position: 00:13:52.1-00:14:16.6; Autor: Simon; 21.03.2016 16:39; Gewicht: 0]

2.

[Interviewee7; Position: 00:35:12.8-00:35:59.7; Autor: Simon; 21.03.2016 16:39; Gewicht: 0]

3.

logisticians saay very often sales and purchase department are our biggest enemies - they don´t discuss with each other

[Interviewee7; Position: 01:02:53.8-01:03:14.4; Autor: Simon; 21.03.2016 16:39; Gewicht: 0]

4.

other depratments have a big lobby and logistics can´t overrule

[Interviewee6; Position: 00:10:20.2-00:10:25.1; Autor: Simon; 21.03.2016 16:39; Gewicht: 0]

5.

correlation to other departments like production, purchase etc. which also have to support the lean idea

[Interviewee4; Position: 00:40:17.4-00:41:22.6; Autor: Simon; 21.03.2016 16:39; Gewicht: 0]

6.

It system has to meet the requirements ad settings from other departments

[Interviewee3; Position: 00:50:55.6-00:51:16.6; Autor: Simon; 21.03.2016 16:39; Gewicht: 0]

7.

[Interviewee 1; Position: 00:37:56.4-00:38:22.9; Autor: Simon; 21.03.2016 16:39; Gewicht: 0]

Outsourcing

1.

in textile sector many companies do outsource or have already outsourced logistics

[Interviewee12; Position: 00:08:50.0-00:08:59.2; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

2.

outsourcing is still very common

[Interviewee11; Position: 00:31:52.0-00:32:24.1; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

3.

outsourcing is also a driver for lean for 3PL because customer dictate exactly which tools and saving rates they expect

[Interviewee10; Position: 00:11:16.1-00:11:26.3; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

4.

outsourcing is not t he solution, you just have tp pay the logistics costs zo someone else maybe from an other cost center

[Interviewee9; Position: 00:15:47.3-00:15:58.6; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

5.

some enterprises enforce 3PL to srictly keep the preseetings so that they are not able to improve processes according lean

[Interviewee9; Position: 00:34:34.6-00:35:11.2; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

6.

comapnies tend tp outsource, so they don´t have established lean principles but the 3 PL have of course

[Interviewee7; Position: 00:16:13.0-00:16:30.2; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

7.

[Interviewee7; Position: 00:20:50.1-00:21:04.1; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

8.

[Interviewee7; Position: 00:21:12.6-00:21:35.7; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

9.

there are no positions for a stregic prozess management - the logistics manager is responsible for the operative processes

[Interviewee7; Position: 00:25:59.7-00:26:15.0; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

10.

this is also pressurae for the internal logistics to cope with 3PL

[Interviewee7; Position: 01:10:33.7-01:10:41.0; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

11.

logistics processes getting too complex and companies start to outsource this task to specialists/3PL

[Interviewee5; Position: 00:12:42.0-00:12:51.2; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

12.

outsourcing of process design to consult. often brings not the desired output and you also need ressources internally before/af

[Interviewee4; Position: 01:08:56.7-01:09:23.5; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

13.

leased labor

[Interviewee3; Position: 00:52:23.9-00:52:49.1; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

14.

leased employees are one factor to be considered

[Interviewee3; Position: 00:54:37.7-00:55:08.5; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

15.

[Interviewee 1; Position: 00:30:53.2-00:30:59.3; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

16.

[Interviewee 1; Position: 00:46:19.7-00:46:38.4; Autor: Simon; 21.03.2016 16:14; Gewicht: 0]

Organisation

1.

[Interviewee11; Position: 00:33:11.7-00:33:34.6; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

2.

the organisation with very powerful site mangers/profit center makes it difficult to enforce central lean structures

[Interviewee10; Position: 00:17:31.2-00:18:39.3; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

3.

companies don´t know there status quo and have not definde a clear goal what and why the want to optimise processes

[Interviewee8; Position: 00:17:57.4-00:18:36.5; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

4.

they are not able to worl as efficient as necessary and then they tend to outsource this area

[Interviewee7; Position: 00:21:12.6-00:21:35.7; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

5.

many times a company even do not have a logistics manager and less than ever no staff position for the overall approach

[Interviewee7; Position: 00:25:08.6-00:25:22.1; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

6.

logistics is assigned to the purchase manager, who does have the thinking of good purchase and not of lean logistic processes

[Interviewee7; Position: 00:25:22.8-00:25:42.2; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

7.

KANBAN only in the warehouse not in the working cells itself which would be better reason behind this is the booking of partlis

[Interviewee6; Position: 00:09:29.7-00:09:40.4; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

8.

emergent structures slowing down of preventing lean implementation

[Interviewee6; Position: 00:09:56.3-00:10:07.0; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

9.

it is also a qustion of changing generations - this is often a signal for innovation and restructuring and redesign of processe

[Interviewee6; Position: 00:20:23.8-00:20:31.3; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

10.

not very general manager has a sense for logistics, process design and IT and then lean warehousing is not on the agenda

[Interviewee4; Position: 00:22:18.6-00:22:29.4; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

11.

generally lean is acknowleldged, but there are no additional ressources. This must happen beside the daily business.

[Interviewee4; Position: 00:37:05.2-00:39:02.4; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

12.

a cntral department with corresponding comtence makes things easier

[Interviewee4; Position: 00:40:17.4-00:41:22.6; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

13.

cooperaton between the departments is very important

[Interviewee4; Position: 00:42:19.5-00:42:30.1; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

14.

common golas - they may not exclude but be in line (Hoshin Kanri!)

[Interviewee4; Position: 00:42:38.5-00:42:41.3; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

15.

[Interviewee4; Position: 01:05:36.1-01:06:24.6; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

16.

organistion has no competency in the whole SC in the top management

[Interviewee3; Position: 00:19:18.9-00:19:30.5; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

17.

SCM must be a division and also represented at the board

[Interviewee3; Position: 00:19:31.8-00:19:38.5; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

18.

logistic is seen as part of the production

[Interviewee3; Position: 00:20:41.2-00:20:46.0; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

19.

[Interviewee3; Position: 00:52:23.9-00:52:49.1; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

20.

team leader etc. must be replaceable to keep the flexibility during illnes or job transfer etc.

[Interviewee3; Position: 00:56:40.2-00:56:48.7; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

21.

organisation does not allow lean, because the responsible peoble arenot responsible for the money

[Interviewee 1; Position: 00:27:35.0-00:28:11.1; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

22.

one head who is responisble for the operative as well as the stratecic planning and maybe procurment would be ideal

[Interviewee 1; Position: 00:43:49.5-00:44:12.8; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

23.

managers who are just thinking short term and comparing costs and decisions are driven purely economically

[Interviewee 1; Position: 00:46:19.7-00:46:38.4; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

24.

process is planned (lean), but other departments or processes outside the logistics are the constraint

[Interviewee 1; Position: 01:06:47.3-01:06:53.8; Autor: Simon; 21.03.2016 16:06; Gewicht: 0]

No influence on ongoing processes/supply chains

1.

it would be also important to track the upstream processes like delivery performance, punctuality etc.

[Interviewee12; Position: 00:59:49.8-01:01:26.3; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

2.

you have to monitor and manage the whole supply chain it is not enough to take care just about the internal processes

[Interviewee12; Position: 01:03:55.6-01:04:40.6; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

3.

people don´t look in the upstream processes to improve the intralogistic processes

[Interviewee7; Position: 00:51:54.1-00:52:31.0; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

4.

[Interviewee6; Position: 00:23:34.5-00:23:39.1; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

5.

planning tools give the takt for the logistic

[Interviewee6; Position: 00:36:32.4-00:36:58.9; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

6.

production often fall back in a push system instead a pull system

[Interviewee6; Position: 00:37:05.7-00:37:19.1; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

7.

the issue isthe whole sc

[Interviewee3; Position: 01:12:08.1-01:12:17.6; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

8.

big blocks instaed of low hanging fruits

[Interviewee3; Position: 01:12:55.3-01:13:04.7; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

9.

3Pl serve several different customer with different needs therefore a common lean approach is not possible

[Interviewee2; Position: 17-17; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

10.

if you have no control on the processes you can´t be lean

[Interviewee 1; Position: 00:26:24.1-00:26:46.7; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

11.

[Interviewee 1; Position: 00:39:12.4-00:39:22.1; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

12.

no influence or no knowledge about the next supply chain

[Interviewee 1; Position: 00:41:16.7-00:41:34.6; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

13.

[Interviewee 1; Position: 01:07:12.3-01:07:15.4; Autor: Simon; 21.03.2016 16:02; Gewicht: 0]

High margins

1.

after the crisis the company could reach the highest turnover ever - from then on lean was of no more interst again

[Interviewee6; Position: 00:23:13.0-00:23:22.5; Autor: Simon; 21.03.2016 15:31; Gewicht: 0]

2.

as long the companies make good profits they don´t touch lean

[Interviewee5; Position: 00:06:12.7-00:06:18.4; Autor: Simon; 21.03.2016 15:31; Gewicht: 0]

3.

if they don´t have pressure like shrinking profit etc. they don´t care about lean

[Interviewee5; Position: 00:08:25.0-00:08:35.2; Autor: Simon; 21.03.2016 15:31; Gewicht: 0]

4.

[Interviewee 1; Position: 00:19:05.0-00:19:27.8; Autor: Simon; 21.03.2016 15:31; Gewicht: 0]

5.

[Interviewee 1; Position: 00:45:06.9-00:45:17.2; Autor: Simon; 21.03.2016 15:31; Gewicht: 0]

Employee knowledge

1.

no external consultants were allowed and no input and knowledge from outside was available for process optimization

[Interviewee12; Position: 00:54:50.8-00:55:10.8; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

2.

employees are not able to see waste or process improvements

[Interviewee11; Position: 00:24:59.1-00:25:10.5; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

3.

employees are seen as less educated and this is a reason to let the ptrocesses as they are

[Interviewee11; Position: 00:29:39.2-00:30:02.1; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

4.

mangers don´t have the deep knowledge in operational procedures and also don´t know the lean approach

[Interviewee10; Position: 00:14:35.4-00:14:43.9; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

5.

you cant expect to get high qualified people to absorb seasonal peaks - logistics are more the simple people with low education

[Interviewee9; Position: 00:39:27.9-00:39:58.4; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

6.

level of lean maturity is still very low

[Interviewee8; Position: 00:07:20.0-00:07:23.8; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

7.

the leader is respnsible to implement the lean thought into the heads of the employees

[Interviewee8; Position: 00:23:29.5-00:24:09.7; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

8.

bad or no education

[Interviewee7; Position: 00:13:58.9-00:14:08.3; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

9.

knowledege increases biut is still on a poor level and most of the workers are not educated enough

[Interviewee7; Position: 00:14:10.5-00:14:33.6; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

10.

fear for change and don´t listen to what consultants or specialist say

[Interviewee7; Position: 00:15:12.0-00:15:26.1; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

11.

[Interviewee7; Position: 00:21:12.6-00:21:35.7; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

12.

good people who overthinking and monitor the prcesses are the exception

[Interviewee7; Position: 00:41:03.7-00:41:13.7; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

13.

lack of competence and knowledge in the companies

[Interviewee5; Position: 00:09:46.2-00:09:54.1; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

14.

employee are overburdend - not the knowledge and comtence for a lean implementation

[Interviewee4; Position: 01:06:31.4-01:06:34.4; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

15.

[Interviewee3; Position: 00:22:05.9-00:22:09.3; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

16.

leased labor don´t have the knowledege about the products and processes and don´t see the full context

[Interviewee3; Position: 00:52:23.9-00:52:49.1; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

17.

logistics department is like a collecting pond in enterprises wheer all the less performant people will be forced to transfer

[Interviewee 1; Position: 00:14:40.2-00:14:49.0; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

18.

[Interviewee 1; Position: 00:14:58.3-00:15:04.5; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

19.

less educated people

[Interviewee 1; Position: 00:29:39.5-00:30:02.4; Autor: Simon; 21.03.2016 11:51; Gewicht: 0]

Power/weakness within the enterprise

1.

[Interviewee12; Position: 00:07:42.2-00:07:51.1; Autor: Simon; 21.03.2016 11:43; Gewicht: 0]

2.

logistics department is a very weak link in the company and the mangement have rather an eye on marleting, sales and production

[Interviewee11; Position: 00:27:59.5-00:28:53.9; Autor: Simon; 21.03.2016 11:43; Gewicht: 0]

3.

[Interviewee7; Position: 00:35:12.8-00:35:59.7; Autor: Simon; 21.03.2016 11:43; Gewicht: 0]

4.

after introducin lean factory it is not used any more, but you still can see some relicts in the productuin from that time

[Interviewee6; Position: 00:05:28.9-00:05:37.5; Autor: Simon; 21.03.2016 11:43; Gewicht: 0]

5.

high stocks in fear to loose customers and to be able to deliver in any case - logistic department can´t overrule the sales

[Interviewee5; Position: 00:16:56.6-00:17:14.8; Autor: Simon; 21.03.2016 11:43; Gewicht: 0]

6.

logistic manager with knowledge in lean is blocked by the top management

[Interviewee4; Position: 00:22:34.1-00:22:45.9; Autor: Simon; 21.03.2016 11:43; Gewicht: 0]

7.

less eductaed people in the logistics department

[Interviewee3; Position: 00:22:05.9-00:22:09.3; Autor: Simon; 21.03.2016 11:43; Gewicht: 0]

8.

Logisticdepartment is traditinally one of the weakest in the enterprise!

[Interviewee 1; Position: 00:14:07.5-00:14:16.4; Autor: Simon; 21.03.2016 11:43; Gewicht: 0]

Lean Warehousing Drivers

Quality

1.

automation to reduce failure rate - management has accepted that investments are neccesarry here

[Interviewee12; Position: 00:29:08.5-00:29:54.8; Autor: Simon; 23.03.2016 09:42; Gewicht: 0]

2.

reduce error rate is one driver

[Interviewee11; Position: 00:14:33.0-00:14:41.7; Autor: Simon; 23.03.2016 09:42; Gewicht: 0]

3.

[Interviewee4; Position: 00:25:17.5-00:25:22.4; Autor: Simon; 23.03.2016 09:42; Gewicht: 0]

Transparency

1.

no overview about order structures and process costs to assign them accordingly

[Interviewee5; Position: 00:17:55.4-00:18:52.0; Autor: Simon; 22.03.2016 09:13; Gewicht: 0]

2.

[Interviewee3; Position: 01:00:10.8-01:00:19.1; Autor: Simon; 22.03.2016 09:13; Gewicht: 0]

3.

It system is important to piledata for analyses

[Interviewee 1; Position: 01:04:24.9-01:04:41.5; Autor: Simon; 22.03.2016 09:13; Gewicht: 0]

Organisation

1.

siince 2 years there is a new department for SCM and Logistics

[Interviewee12; Position: 00:09:28.7-00:10:16.5; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

2.

new member of the booard who is responsible for logistics

[Interviewee12; Position: 00:31:00.7-00:31:25.0; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

3.

it needs the right mix between technisation, automation and people involvement and leadership and not too stare system

[Interviewee9; Position: 00:11:46.5-00:11:57.8; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

4.

[Interviewee8; Position: 00:48:06.4-00:48:32.9; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

5.

concerns most often have a logistic management position at the board of directors and this is different to SME´s

[Interviewee7; Position: 00:26:27.4-00:27:20.6; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

6.

logistics manager was the driver for lean in the warehouse

[Interviewee6; Position: 00:06:13.1-00:06:20.9; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

7.

SMEs are typically managed by the owner familiy-this could be a blocker or a driver if this person is intersted in logistics

[Interviewee6; Position: 00:18:44.6-00:19:07.7; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

8.

include logistics in sales decision (buy 10 instead of 8 and you´ll get an additinal 2% discount)

[Interviewee5; Position: 00:19:35.7-00:19:41.8; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

9.

Generall Manager was interested in logistics, process design, IT and this was a big advantage

[Interviewee4; Position: 00:16:17.7-00:16:27.9; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

10.

new division manager with new ideas aiming on optimized logistics processes

[Interviewee 1; Position: 00:43:15.7-00:43:46.8; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

11.

[Interviewee 1; Position: 00:43:49.5-00:44:12.8; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

12.

pressure from the top management

[Interviewee 1; Position: 00:48:28.3-00:48:40.0; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

13.

[Interviewee 1; Position: 00:49:42.9-00:49:50.8; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

14.

system break

[Interviewee 1; Position: 01:07:12.3-01:07:15.4; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

15.

outsourcing is contra productive because the departmental interface are gone but important for the whole process understanding

[Interviewee 1; Position: 01:07:31.5-01:07:37.1; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

16.

lean prevents outsourcing

[Interviewee 1; Position: 01:15:05.9-01:15:16.1; Autor: Simon; 21.03.2016 16:47; Gewicht: 0]

Flexibility

1.

ecspecially 3PL need to flexible in order to serve all the different customer requirements

[Interviewee11; Position: 00:14:41.5-00:14:50.9; Autor: Simon; 21.03.2016 15:48; Gewicht: 0]

2.

[Interviewee3; Position: 00:07:05.7-00:07:07.3; Autor: Simon; 21.03.2016 15:48; Gewicht: 0]

3.

Flexibility needed to serve several different customer - contracts as 3Pl max. 3 years; automation doesn´t pay off if time is too short

[Interviewee2; Position: 20-20; Autor: Simon; 21.03.2016 15:48; Gewicht: 0]

4.

next day delivery service; flexibility

[Interviewee 1; Position: 00:22:58.3-00:23:03.1; Autor: Simon; 21.03.2016 15:48; Gewicht: 0]

5.

[Interviewee 1; Position: 00:23:22.5-00:23:28.8; Autor: Simon; 21.03.2016 15:48; Gewicht: 0]

6.

outsourcing will block flexibility

[Interviewee 1; Position: 01:07:46.3-01:07:57.3; Autor: Simon; 21.03.2016 15:48; Gewicht: 0]

Standardised processes

1.

[Interviewee12; Position: 00:31:30.6-00:31:54.0; Autor: Simon; 21.03.2016 15:28; Gewicht: 0]

2.

failure reduction also lead to cost reduction and satisfied customers

[Interviewee9; Position: 00:04:13.2-00:04:36.2; Autor: Simon; 21.03.2016 15:28; Gewicht: 0]

3.

this is the best way to start the lean journey and is argumented by safe processes and stability short introduction times etc.

[Interviewee9; Position: 00:04:36.8-00:05:07.2; Autor: Simon; 21.03.2016 15:28; Gewicht: 0]

4.

[Interviewee5; Position: 00:32:24.0-00:32:58.1; Autor: Simon; 21.03.2016 15:28; Gewicht: 0]

5.

standardisation

[Interviewee4; Position: 00:17:29.5-00:17:52.0; Autor: Simon; 21.03.2016 15:28; Gewicht: 0]

6.

[Interviewee 1; Position: 00:17:24.7-00:17:42.0; Autor: Simon; 21.03.2016 15:28; Gewicht: 0]

Reduce throughput times

1.

[Interviewee12; Position: 00:36:39.2-00:36:50.7; Autor: Simon; 21.03.2016 12:05; Gewicht: 0]

2.

the business is getting faster 24 delivery service etc.

[Interviewee7; Position: 00:31:22.9-00:31:34.4; Autor: Simon; 21.03.2016 12:05; Gewicht: 0]

3.

[Interviewee 1; Position: 00:16:45.0-00:16:58.0; Autor: Simon; 21.03.2016 12:05; Gewicht: 0]

Reduce waste

1.

one underdevelopped process was picked and optimnized and the result was a 40% waste reduction

[Interviewee12; Position: 01:15:22.3-01:16:08.4; Autor: Simon; 21.03.2016 12:03; Gewicht: 0]

2.

[Interviewee 1; Position: 00:15:54.2-00:16:01.4; Autor: Simon; 21.03.2016 12:03; Gewicht: 0]

3.

to avoid longer pathes as necessary

[Interviewee 1; Position: 01:04:51.2-01:04:54.3; Autor: Simon; 21.03.2016 12:03; Gewicht: 0]

Stock reduction

1.

stock reduction is the top issue for the textile sector

[Interviewee12; Position: 00:16:14.1-00:16:39.4; Autor: Simon; 21.03.2016 12:01; Gewicht: 0]

2.

[Interviewee12; Position: 00:36:39.2-00:36:50.7; Autor: Simon; 21.03.2016 12:01; Gewicht: 0]

3.

[Interviewee 1; Position: 00:15:17.0-00:15:22.9; Autor: Simon; 21.03.2016 12:01; Gewicht: 0]

Economical Reasons

1.

along with internationalism also comes the pressure of costs

[Interviewee12; Position: 00:09:28.7-00:10:16.5; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

2.

saturated markets in germany for fashion

[Interviewee12; Position: 00:18:44.8-00:19:09.9; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

3.

Management expects to use the existing warehouses and is not willed to invest in new distribution centers

[Interviewee12; Position: 00:23:04.4-00:23:12.7; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

4.

contract dictates a specific cost saving rate e.g. 2% each year and also how to reach it with which lean tools

[Interviewee10; Position: 00:11:16.1-00:11:26.3; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

5.

[Interviewee9; Position: 00:03:14.9-00:03:31.1; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

6.

cost reduction as driver is very dangerous because people starts to fear about their jobs and lean lives by involving all

[Interviewee9; Position: 00:03:33.4-00:04:08.9; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

7.

costs problems or savings are most often the drivers for lean

[Interviewee8; Position: 00:51:08.6-00:51:49.2; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

8.

tthere is a lot of pressure regadung cost, speed and quality

[Interviewee7; Position: 00:19:06.6-00:19:12.9; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

9.

is not crucial and not the decisive factor for a lean initiative

[Interviewee7; Position: 00:29:51.2-00:30:11.8; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

10.

common project with purchase department to reduce the efforts and costs for C-parts

[Interviewee6; Position: 00:12:08.9-00:12:58.9; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

11.

extreme cost pressure

[Interviewee4; Position: 00:28:38.8-00:28:44.4; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

12.

Lean saves money in not investing into conveyor system

[Interviewee 1; Position: 00:12:00.5-00:12:09.5; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

13.

only economical pressure have lead to lean thinking!

[Interviewee 1; Position: 00:13:31.5-00:13:41.2; Autor: Simon; 21.03.2016 11:27; Gewicht: 0]

Optimize production

1.

[Interviewee7; Position: 01:10:33.7-01:10:41.0; Autor: Simon; 21.03.2016 11:22; Gewicht: 0]

2.

the starting momentum was the production

[Interviewee6; Position: 00:07:41.1-00:07:50.1; Autor: Simon; 21.03.2016 11:22; Gewicht: 0]

3.

[Interviewee 1; Position: 00:10:40.0-00:10:49.6; Autor: Simon; 21.03.2016 11:22; Gewicht: 0]

Less warehouse space

1.

[Interviewee12; Position: 00:23:04.4-00:23:12.7; Autor: Simon; 21.03.2016 11:19; Gewicht: 0]

2.

issue with warehouse space

[Interviewee4; Position: 00:19:34.6-00:19:39.4; Autor: Simon; 21.03.2016 11:19; Gewicht: 0]

3.

[Interviewee 1; Position: 00:09:34.9-00:09:37.3; Autor: Simon; 21.03.2016 11:19; Gewicht: 0]

4.

[Interviewee 1; Position: 00:15:12.0-00:15:16.5; Autor: Simon; 21.03.2016 11:19; Gewicht: 0]

Turnover Rate Warehouse

1.

[Interviewee 1; Position: 00:09:20.9-00:09:30.2; Autor: Simon; 21.03.2016 11:16; Gewicht: 0]

Warehouse Management System

1.

decision for a self-programmed system which was both a blessing and a curse - short period for changes but not standards

[Interviewee12; Position: 00:42:49.6-00:44:29.5; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

2.

WMS have a wide range of reporting and KPI measuerement and visualisation, but the interest in that is low

[Interviewee11; Position: 00:18:05.7-00:19:12.0; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

3.

WMS would offer a wide range of functinality and optional modules but just a few take the chance

[Interviewee11; Position: 00:24:59.1-00:25:10.5; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

4.

wms offers a lot of sophisticated startegies an algorhytms but they were not used

[Interviewee11; Position: 00:26:49.7-00:27:02.8; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

5.

up to now not even one customer asked explicitly for lean functionalities in WMS

[Interviewee11; Position: 01:04:43.1-01:04:52.5; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

6.

self prgrammed system which is permanently improoved by new prgrammed functions etc.

[Interviewee10; Position: 00:26:25.0-00:26:52.3; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

7.

3PL often forced to use the customer software systems either WMS or ERP

[Interviewee10; Position: 00:31:02.0-00:31:22.4; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

8.

short training for new employees, but the knowledege for the material how to pack etc. is more complex

[Interviewee10; Position: 00:41:31.6-00:42:10.4; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

9.

a good criteria if to invest in automation is if this process could be done by machines or not if yes keep it manual

[Interviewee9; Position: 00:43:34.9-00:44:31.5; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

10.

most often the smaller software vendors respecvtively systems are best of breed but the IT manger decides to go for the big nam

[Interviewee9; Position: 00:50:05.6-00:50:24.9; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

11.

a WMS implementation is ideal for process design and lean warehouse introduction as each process will/should be analyzed

[Interviewee9; Position: 00:54:57.2-00:55:18.2; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

12.

could also be negative because the implentation phase is that energy-sapping that you don´t wnat to overthink processes again

[Interviewee9; Position: 00:56:15.7-00:56:39.7; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

13.

running systems are seldom adapted but it is possible and it needs a good project manager and a clear comittment from mangement

[Interviewee8; Position: 00:36:13.3-00:38:07.3; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

14.

sometimes wms are extreme customized and not standard anymore and this makes it difficult to change settings regarding kaizen

[Interviewee8; Position: 00:42:29.0-00:42:41.6; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

15.

sometimes the new wms adapts the old processes and no real improvement takes place

[Interviewee8; Position: 00:43:53.4-00:44:04.8; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

16.

pprocess optimisation takes place during a WMS implementation and after that just little changes are done for about 10 years

[Interviewee7; Position: 00:39:13.8-00:39:25.5; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

17.

WMS software is providing all functions it needs for a lean warehouse and could be adapted from time to time but they don´t

[Interviewee7; Position: 00:40:35.5-00:40:57.3; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

18.

is dominated by the ERP and the planning tools for production

[Interviewee6; Position: 00:36:32.4-00:36:58.9; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

19.

implemnetation of WMS was also kind of Lean implementation , because all process werde discussed and redesigned if useful

[Interviewee6; Position: 00:39:37.7-00:39:47.9; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

20.

many WMS are working like a production software and this is not very good

[Interviewee6; Position: 00:41:08.8-00:41:21.6; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

21.

[Interviewee6; Position: 00:41:21.8-00:41:28.0; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

22.

ERP systems are good enough to manage a warehouse so a invest in additional sytems means aditional interface and unforseen cost

[Interviewee5; Position: 00:25:18.8-00:25:58.6; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

23.

once a system is implemented just few really do changes themed "never touch a running system"

[Interviewee5; Position: 00:27:52.7-00:28:23.0; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

24.

system specification is best suited to implement lean methods as you look in every process in detail

[Interviewee5; Position: 00:33:23.0-00:34:10.0; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

25.

several companies starts in the ealy 80s and there were no WMS available it has to be selfprogrammed - a later change is unlikl

[Interviewee4; Position: 01:12:12.4-01:12:47.1; Autor: Simon; 20.03.2016 13:42; Gewicht: 0]

Missing Functions

1.

SAP Retail is very slow concerning updates and fixed release dates this is not comparable with the self-programmed WMS

[Interviewee12; Position: 00:48:50.8-00:49:38.7; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

2.

WMS software has all needed functions already included just littele exceptions like industry sector specific ones

[Interviewee12; Position: 00:57:58.1-00:58:15.8; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

3.

yard-management and management of suppliers

[Interviewee12; Position: 00:59:49.8-01:01:26.3; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

4.

WMS are already very felxible interfaces are done in 12 hours but they are not easy to confugure by the customer himself

[Interviewee11; Position: 00:45:11.7-00:45:31.8; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

5.

interfaces are complex and seldom changed but often they should or have to be changed but IT avoid touchinh running interfaces

[Interviewee10; Position: 00:26:56.2-00:27:10.7; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

6.

standard systems are not felxible enough for all the differned customers of a 3PL and you are also constarined by externals

[Interviewee10; Position: 00:33:27.1-00:34:10.3; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

7.

3Pl need very flexible systems and also ues this system felxibility to convince customer and win tenders

[Interviewee10; Position: 00:35:35.7-00:35:56.0; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

8.

slef prgrammed system is able to monitorand simulate indicators if processes were changed or also for suggestion ideas

[Interviewee10; Position: 00:37:20.8-00:37:52.4; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

9.

systems mut be easy to configure and customizable by the customer itself

[Interviewee9; Position: 00:48:15.4-00:49:03.6; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

10.

most of systems are caring about the stock management rather the flow management

[Interviewee9; Position: 00:51:40.3-00:52:19.7; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

11.

there is a lot of potential for "lean modules" but the system developer/programmer does not have the needed lean know-how

[Interviewee9; Position: 00:52:25.5-00:52:33.1; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

12.

wms most often don´t provide the right data or in the way it is needed

[Interviewee8; Position: 00:40:29.3-00:41:29.8; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

13.

grphical workflows

[Interviewee7; Position: 00:53:52.8-00:54:01.9; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

14.

logistic assistant system funtionality to give advice to the logistics manager what to do to keep the indicators or get back

[Interviewee7; Position: 00:54:47.4-00:55:41.5; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

15.

workflow functionality is not supported and others ystems like CRM are ahead in this point

[Interviewee7; Position: 00:55:48.6-00:56:22.5; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

16.

the topic ressoucing planning is been implemented on projectbasis but nor as a standard feature

[Interviewee7; Position: 00:57:25.2-00:58:08.5; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

17.

a common feature for ressource planning is very and probably too difficult

[Interviewee7; Position: 00:58:28.3-00:58:40.5; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

18.

standard KPI´s are not right for the customer

[Interviewee7; Position: 00:59:35.5-00:59:50.3; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

19.

BI/business intelligence - data transferred to asisstances systems fro analysing

[Interviewee7; Position: 01:00:52.0-01:01:06.5; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

20.

It follows the process design and not the other way round

[Interviewee4; Position: 00:58:22.3-00:59:55.0; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

21.

modern best of breed solutions offer a wide range of functionality and there shoulkdn´t be any case the system couldn´t support

[Interviewee4; Position: 01:01:02.4-01:01:23.8; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

22.

you need to customize a system to get a highly productive system and this could be very comlex and also cost intensive

[Interviewee4; Position: 01:01:28.5-01:01:50.5; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

23.

[Interviewee4; Position: 01:18:49.4-01:19:20.9; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

24.

difficulty to calculate - this blocks process adaptions/CR´s

[Interviewee4; Position: 01:23:10.2-01:24:45.0; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

25.

most often there are not the right indicators and soft indicators like suggestions rate are compltely missing

[Interviewee3; Position: 00:58:48.8-00:59:34.4; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

26.

break down from cost in the logistics (gas, electricity, insurances etc.) to logistics indicators most often not possible

[Interviewee3; Position: 01:01:45.0-01:01:56.5; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

27.

ERP systems interprets data in another way like a WMS

[Interviewee3; Position: 01:02:31.5-01:02:38.2; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

28.

KPIs can be misinterpreted if they are not detailed enough e.g. customer complaint - who where what how when?

[Interviewee3; Position: 01:03:33.9-01:03:58.2; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

29.

inetgration to erp is difficult - companies tend to have only one system e.g. SAP

[Interviewee3; Position: 01:06:26.8-01:07:10.3; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

30.

lean reporting - but not necessarily in wms

[Interviewee3; Position: 01:07:50.4-01:08:07.0; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

31.

integration with systems from supplier, customer etc.

[Interviewee3; Position: 01:11:09.8-01:11:15.7; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

32.

SAP - Advanced planning an precalculating does not realy work and gives different results and takes too long

[Interviewee 1; Position: 00:56:54.6-00:57:48.1; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

33.

Human is at least equal or even better as an IT planning tool

[Interviewee 1; Position: 00:59:11.7-00:59:15.4; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

34.

SAP standard modul just support basic path optimizing functions

[Interviewee 1; Position: 01:05:14.6-01:05:19.4; Autor: Simon; 20.03.2016 13:46; Gewicht: 0]

Warehouse techniques

1.

mobile terminals, pick by light, pick by voice,pick by vision

[Interviewee10; Position: 00:43:25.8-00:44:09.5; Autor: Simon; 19.03.2016 21:30; Gewicht: 0]

2.

It system must be able to realize the new processes

[Interviewee3; Position: 00:50:51.4-00:50:54.8; Autor: Simon; 19.03.2016 21:30; Gewicht: 0]

Automation

1.

automatin is a strong trend in the textile sector

[Interviewee12; Position: 00:28:00.3-00:28:46.1; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

2.

automationis best suited if you have standfardized processeswith nearly no exceptions

[Interviewee12; Position: 00:31:00.7-00:31:25.0; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

3.

automation can block lean

[Interviewee11; Position: 00:40:00.7-00:40:09.0; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

4.

all technology is just as good as the processes. A good mix between automation and manual processes under lean aspects

[Interviewee11; Position: 00:41:32.2-00:41:45.2; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

5.

automation level in logistics service sector is very low because contracts durations are short and it doesn´t pay off

[Interviewee10; Position: 00:22:43.3-00:23:41.9; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

6.

in the field of production automation has good chances to pay off

[Interviewee10; Position: 00:23:42.6-00:23:53.6; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

7.

for a holistic lean approach it has to be a mix betwen automation and manual warehouses

[Interviewee10; Position: 00:24:14.9-00:24:35.6; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

8.

up- and downstream processes in automated areas have to fit in order to have a high efgficiency rate of the automation

[Interviewee10; Position: 00:28:11.0-00:28:33.5; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

9.

it is a big invest and also a lot of money for the running costs so the econimical tiime scale is relively long

[Interviewee9; Position: 00:43:34.9-00:44:31.5; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

10.

it makes much more sense to keep the process manual because it is much more flexible and agile

[Interviewee9; Position: 00:45:24.7-00:45:42.8; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

11.

lean and automation does not exclude one another

[Interviewee8; Position: 00:33:00.5-00:33:56.7; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

12.

the drivers are also drivers for automation

[Interviewee7; Position: 00:31:35.1-00:31:41.9; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

13.

automation is or could be one part of lean warehousing

[Interviewee7; Position: 00:43:44.7-00:43:56.6; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

14.

automations helps to improve efficiency

[Interviewee7; Position: 00:44:02.5-00:44:22.4; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

15.

order by supllier via RFID

[Interviewee6; Position: 00:14:26.3-00:14:37.5; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

16.

since 2006 lean shuttle system (vertical tablar system)

[Interviewee6; Position: 00:37:45.6-00:38:00.3; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

17.

many times completely senseless and without ratio

[Interviewee5; Position: 00:12:53.9-00:13:03.0; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

18.

depends in which industry sector you are in and what the planning/strategy demands

[Interviewee5; Position: 00:22:38.8-00:23:04.7; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

19.

automation does not automatically mean you are lean

[Interviewee5; Position: 00:24:31.0-00:24:52.0; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

20.

mixed warehouse technique - on some sites AS/RS and other just manuel operation

[Interviewee4; Position: 00:20:11.3-00:20:15.8; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

21.

invest in autmation is much easier to grab than the idea to implement CIP, because you don´t have figures

[Interviewee4; Position: 00:32:57.3-00:33:29.6; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

22.

you can find the thinking that an highly automated warehouse does not need any further optimisation thrugh lean implementation

[Interviewee4; Position: 00:51:47.8-00:52:09.6; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

23.

crucial are also the up and downstream processes in order to have a fully integrated system

[Interviewee4; Position: 00:52:32.6-00:53:06.7; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

24.

technology and processes must fit together

[Interviewee4; Position: 00:53:47.0-00:53:52.1; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

25.

highly automated system is not lean

[Interviewee3; Position: 00:43:33.0-00:43:50.1; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

26.

example: company regrets the autommatisation and wants to turn back to a manual warehouse

[Interviewee3; Position: 00:44:38.7-00:44:52.8; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

27.

automatisation could be exatly the opposite to lean

[Interviewee3; Position: 00:44:55.5-00:45:05.2; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

28.

automated systems give the pace/tact and stick to specific processes and are not lean

[Interviewee3; Position: 00:46:42.9-00:46:54.1; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

29.

new way of automatic systems like modular conveyors, swarm technology etc.

[Interviewee3; Position: 00:48:36.3-00:48:48.1; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

30.

industry sector doesn´t allow to invest too much in automation

[Interviewee2; Position: 20-20; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

31.

Lean vs. Automation

[Interviewee 1; Position: 00:11:05.8-00:11:37.4; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

32.

manual warehouse means flexibility - in conflict with automation

[Interviewee 1; Position: 00:23:22.5-00:23:28.8; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

33.

flexible assignment of employees for goods entry, picking etc.

[Interviewee 1; Position: 00:33:12.2-00:33:40.5; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

34.

either you have an auto system with 50% load which is very expensive or a system close to techn. system limit with no flexibili

[Interviewee 1; Position: 00:34:10.9-00:34:37.1; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

35.

strictly limited to the maximum system load

[Interviewee 1; Position: 00:35:26.7-00:35:30.3; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

36.

availability an strong dependency to a running system

[Interviewee 1; Position: 00:35:39.0-00:35:47.0; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

37.

flexibility is needed an automated system hasn´t

[Interviewee 1; Position: 00:36:15.7-00:36:23.7; Autor: Simon; 19.03.2016 21:22; Gewicht: 0]

Enterprise

1.

international orientation - worldwide deliveries

[Interviewee 1; Position: 00:20:55.4-00:21:10.4; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

Asysmetric relation

1.

big international fashion brands are extreme powerful and dictate processes

[Interviewee12; Position: 00:12:29.7-00:12:46.0; Autor: Simon; 23.03.2016 12:13; Gewicht: 0]

2.

asymmetric relations drives lean initiatives for 2nd or 3rd tier supüplier of the automotive sector

[Interviewee11; Position: 00:15:19.5-00:15:37.5; Autor: Simon; 23.03.2016 12:13; Gewicht: 0]

3.

it does not make sense to destroy a good supplier - this is also a cultural thing

[Interviewee9; Position: 00:33:28.0-00:33:43.9; Autor: Simon; 23.03.2016 12:13; Gewicht: 0]

Organisation

1.

sales and procurment arethe elementary departrments and all other have just support functions

[Interviewee12; Position: 00:07:42.2-00:07:51.1; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

2.

a staff department with project managers and process managers was established

[Interviewee12; Position: 01:08:12.1-01:09:15.7; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

3.

top manager who is also responsible for IT, Logistics and a staff department for process optmisation would be ideal

[Interviewee12; Position: 01:12:36.0-01:13:02.3; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

4.

in most companies there is a lack of people who know the processes from the beginning to the end and with all corelations

[Interviewee11; Position: 00:12:59.1-00:13:33.1; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

5.

logistics department must get a better standing uin the company

[Interviewee11; Position: 00:29:39.2-00:30:02.1; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

6.

3PL have many sites but not naturally rather by aquisition and each site has to be integrated in a central management philosoph

[Interviewee11; Position: 00:33:11.7-00:33:34.6; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

7.

the organisation needs process responsibles this is absolut crucial nad what have changed compared to the 80ies and early 90ies

[Interviewee11; Position: 01:03:10.9-01:03:38.6; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

8.

lean not as a general philosophy across all sites but for each cost center but always in a different way and just partial

[Interviewee10; Position: 00:05:10.5-00:05:29.1; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

9.

each cost center has its own approach and characteristic and sometimes strange interpretation which leads to negative publicit

[Interviewee10; Position: 00:06:17.1-00:06:31.7; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

10.

controlling need to use the right KPIs cicle times or process costs, but this is not very easy - controller avoid this endeavou

[Interviewee9; Position: 00:13:15.8-00:13:52.2; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

11.

lack of reliable indicators and lack of interpreting them and to overthink processes - no logistics controlling

[Interviewee5; Position: 00:15:26.1-00:16:18.5; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

12.

educated people wit lean knowledge

[Interviewee4; Position: 00:31:59.8-00:32:56.2; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

13.

assignment of intern people who cares about the project as " lean agents"

[Interviewee4; Position: 01:10:13.8-01:10:21.3; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

14.

[Interviewee 1; Position: 00:27:35.0-00:28:11.1; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

15.

[Interviewee 1; Position: 00:37:56.4-00:38:22.9; Autor: Simon; 21.03.2016 16:08; Gewicht: 0]

Culture

1.

[Interviewee12; Position: 00:07:42.2-00:07:51.1; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

2.

the cultural change esspecially for the employees with long affilitation to the comppany is difficult

[Interviewee12; Position: 01:21:56.6-01:22:18.5; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

3.

change of mindset about logistics as a crucial element in business processes must take place

[Interviewee11; Position: 00:29:39.2-00:30:02.1; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

4.

you need to change your culture towards a uclture with continous improvement

[Interviewee11; Position: 01:09:34.6-01:10:00.6; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

5.

lean is a management philosophy and to motivate the people and not to manage the machines

[Interviewee9; Position: 00:09:20.0-00:09:47.3; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

6.

people are not used to transfer lean methods on their daily jobs and this is the challenge to empower them

[Interviewee9; Position: 00:23:43.8-00:23:54.0; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

7.

it is not a question of general culture in germany rather the company culture

[Interviewee9; Position: 00:26:57.6-00:27:22.3; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

8.

to be fair against customer and supplier

[Interviewee9; Position: 00:33:28.0-00:33:43.9; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

9.

by reaching small improvements - low hanging fruits - top management ca be convinced about lean ant that it is worth to do

[Interviewee8; Position: 00:48:06.4-00:48:32.9; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

10.

many times no clear visions egl. empty phrases like the best quality without knowing what the customer exactly demands!

[Interviewee5; Position: 00:13:31.4-00:14:15.2; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

11.

lean warehousing stays alive in automotive supplier sector because this is well established over the years an people stick to i

[Interviewee4; Position: 00:31:59.8-00:32:56.2; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

12.

change of mindset - logistics need well trained peoople with high responsibility

[Interviewee3; Position: 00:22:41.8-00:23:03.1; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

13.

culture with empowered people wh oget positive feedback for suggestions ideas and not a bad treatment

[Interviewee3; Position: 00:25:38.0-00:25:46.4; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

14.

culture is more important than the leadership model

[Interviewee3; Position: 00:38:10.8-00:38:23.9; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

15.

[Interviewee3; Position: 00:40:00.9-00:40:22.8; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

16.

culture is key to lean

[Interviewee3; Position: 00:40:56.1-00:40:59.3; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

17.

cultural change

[Interviewee 1; Position: 00:24:43.6-00:24:50.6; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

18.

social responsibility against there employees; compny wnats no negative puplicity like others like union strikes etc.

[Interviewee 1; Position: 00:31:40.9-00:32:01.9; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

19.

[Interviewee 1; Position: 00:47:10.8-00:47:27.1; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

20.

cultural change to overtake responsibility for the own suggestion idea

[Interviewee 1; Position: 00:52:33.4-00:52:39.4; Autor: Simon; 21.03.2016 15:54; Gewicht: 0]

Product

1.

differnet products needs different treatment/processes and stands against standardisation

[Interviewee4; Position: 00:19:26.5-00:19:30.3; Autor: Simon; 21.03.2016 15:43; Gewicht: 0]

2.

snsitive products (interior for cars)

[Interviewee4; Position: 00:19:55.8-00:20:01.0; Autor: Simon; 21.03.2016 15:43; Gewicht: 0]

3.

a car exists out of 15.000 single components, thsi is a complex process and demands stable processes and reliability

[Interviewee4; Position: 00:25:17.5-00:25:22.4; Autor: Simon; 21.03.2016 15:43; Gewicht: 0]

4.

spare parts have an high share in slow or "zero" movers

[Interviewee 1; Position: 00:21:50.0-00:21:57.4; Autor: Simon; 21.03.2016 15:43; Gewicht: 0]

5.

[Interviewee 1; Position: 00:22:05.2-00:22:15.7; Autor: Simon; 21.03.2016 15:43; Gewicht: 0]

Strategy

1.

top management is starting to recognnize that logistics becomes more and more the crucial function in highly competitive market

[Interviewee12; Position: 00:08:16.5-00:08:41.9; Autor: Simon; 21.03.2016 15:41; Gewicht: 0]

2.

[Interviewee12; Position: 00:54:50.8-00:55:10.8; Autor: Simon; 21.03.2016 15:41; Gewicht: 0]

3.

lean is measurable, but it needs years

[Interviewee9; Position: 00:12:13.5-00:12:35.1; Autor: Simon; 21.03.2016 15:41; Gewicht: 0]

4.

also many process optimistaions are started without the customer pressure to stay attractive and convince (new) customers

[Interviewee4; Position: 00:28:15.6-00:28:36.5; Autor: Simon; 21.03.2016 15:41; Gewicht: 0]

5.

but lean is also subordinated to the companies profit goals

[Interviewee3; Position: 00:02:59.9-00:03:10.6; Autor: Simon; 21.03.2016 15:41; Gewicht: 0]

6.

[Interviewee3; Position: 01:12:55.3-01:13:04.7; Autor: Simon; 21.03.2016 15:41; Gewicht: 0]

7.

[Interviewee 1; Position: 00:22:58.3-00:23:03.1; Autor: Simon; 21.03.2016 15:41; Gewicht: 0]

8.

logistics is no ta core comtence

[Interviewee 1; Position: 00:30:53.2-00:30:59.3; Autor: Simon; 21.03.2016 15:41; Gewicht: 0]

9.

global strategy causes pressure on process optimization

[Interviewee 1; Position: 00:47:31.8-00:47:37.9; Autor: Simon; 21.03.2016 15:41; Gewicht: 0]

Change Management

1.

before you can start with concrete lean process optimisation you have to "implemnet Lean philosophy into the DNA of the company

[Interviewee12; Position: 01:10:13.9-01:11:06.5; Autor: Simon; 20.03.2016 13:45; Gewicht: 0]

2.

the organisational structure must be changed but this takes years

[Interviewee10; Position: 00:18:46.9-00:19:20.0; Autor: Simon; 20.03.2016 13:45; Gewicht: 0]

3.

it ii crucial to involve the people

[Interviewee8; Position: 00:23:29.5-00:24:09.7; Autor: Simon; 20.03.2016 13:45; Gewicht: 0]

4.

[Interviewee8; Position: 00:25:40.3-00:25:56.7; Autor: Simon; 20.03.2016 13:45; Gewicht: 0]

5.

just a few easy to grasp goals to change the culture slowly and create trust in lean

[Interviewee8; Position: 00:48:06.4-00:48:32.9; Autor: Simon; 20.03.2016 13:45; Gewicht: 0]

6.

basis is a change in culture and other departments must be convinced

[Interviewee4; Position: 00:44:18.5-00:44:32.4; Autor: Simon; 20.03.2016 13:45; Gewicht: 0]

7.

it has to be in mind of every employee and manager - this a change process and also consumes a lot of ressources

[Interviewee4; Position: 00:49:02.5-00:49:14.0; Autor: Simon; 20.03.2016 13:45; Gewicht: 0]

8.

avoiding changes according the thinking if I do nothing or nothing different I can´t do any failure

[Interviewee3; Position: 00:39:10.5-00:39:18.8; Autor: Simon; 20.03.2016 13:45; Gewicht: 0]

Leadership

1.

it needs also a strong leader who believes in the change and the power of lean

[Interviewee12; Position: 01:12:36.0-01:13:02.3; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

2.

at the profit centers/sites very often there are old an experienced managers which have a patriarchic leadership style

[Interviewee10; Position: 00:19:41.5-00:20:13.2; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

3.

the failure rate is not unexpected beacsue it depneds on the leader and management and if it changes also strategy changes e.g.

[Interviewee9; Position: 00:01:11.5-00:01:50.6; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

4.

empowerment of the people is crucial

[Interviewee9; Position: 00:11:27.4-00:11:31.8; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

5.

also leadership must be tained and not verybody is a born leader

[Interviewee9; Position: 00:24:36.4-00:24:59.1; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

6.

leadership is crucial and if it failed once it is nearly impossible to win them back for the sake

[Interviewee8; Position: 00:23:29.5-00:24:09.7; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

7.

leader should act as a consultant and should give them the feeling to understand their needs and values

[Interviewee8; Position: 00:26:21.9-00:26:49.8; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

8.

not authorian but more cooperative leadership style and the employees have the right to say there matter

[Interviewee6; Position: 00:32:15.1-00:32:35.9; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

9.

leadership model ist not that important furthermore the content is essential and if the people accept and trust the leader

[Interviewee3; Position: 00:33:56.9-00:34:15.4; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

10.

leadership means transfer, acceptance, bottom up ideas, but the leadership model itself ist not deciceively

[Interviewee3; Position: 00:35:09.6-00:35:45.4; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

11.

to bereactive and flexible eventhough the high stndardisation is crucial

[Interviewee3; Position: 00:36:11.3-00:36:24.9; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

12.

[Interviewee 1; Position: 00:24:54.5-00:24:59.8; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

13.

paticiptive leadership

[Interviewee 1; Position: 00:29:17.8-00:29:43.8; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

14.

leadership team is that big that you even not know each name - who is the decision maker?

[Interviewee 1; Position: 00:49:42.9-00:49:50.8; Autor: Simon; 19.03.2016 21:32; Gewicht: 0]

Applicabillity of Lean in warehouses

1.

lean warehousing is maybe to short thinking because you also have to care about the up-and dowwnstream processes

[Interviewee12; Position: 00:59:49.8-01:01:26.3; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

2.

lean warehousing is essential to stay competitive and you should not ignore it

[Interviewee12; Position: 01:18:35.0-01:18:46.6; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

3.

customer justdo cherry-pick some tools and force the 3PL to transpose it

[Interviewee10; Position: 00:04:02.2-00:04:14.7; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

4.

yes, lean is absolutely useful and aplicable to warehouse operations

[Interviewee10; Position: 00:45:16.3-00:45:20.5; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

5.

logistic processes are similiar too productional processes and lean is absolutely suitable

[Interviewee9; Position: 00:16:19.1-00:16:57.8; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

6.

lean is acknowledged and will stay as a rellay useful management philosohy

[Interviewee9; Position: 00:57:45.5-00:58:46.4; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

7.

TPS/lean production is best suited for logistics because production processes and logistics processes are basically very simili

[Interviewee7; Position: 00:17:52.2-00:18:15.6; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

8.

lean wave is not stppable and will be applied more and more because the pressure is too big and also educated people will come

[Interviewee7; Position: 01:09:18.3-01:10:16.5; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

Training

1.

just very simple tools like 5S are known - it need more training

[Interviewee10; Position: 00:15:14.4-00:16:05.8; Autor: Simon; 22.03.2016 08:54; Gewicht: 0]

2.

training just on demand not all methods in one training session

[Interviewee9; Position: 00:21:39.0-00:23:23.5; Autor: Simon; 22.03.2016 08:54; Gewicht: 0]

3.

training must be tailored to the differnet groups and tasks not verybody must be trained in process design etc.

[Interviewee9; Position: 00:41:28.6-00:41:51.7; Autor: Simon; 22.03.2016 08:54; Gewicht: 0]

4.

it is absolutely worth to train the people

[Interviewee7; Position: 00:48:55.7-00:49:21.8; Autor: Simon; 22.03.2016 08:54; Gewicht: 0]

5.

some people get the training "lean manager"

[Interviewee6; Position: 00:05:05.7-00:05:14.4; Autor: Simon; 22.03.2016 08:54; Gewicht: 0]

6.

training sessions on a frequent basis are crucial otherwise the knowledege gets lost

[Interviewee5; Position: 00:29:21.3-00:30:07.7; Autor: Simon; 22.03.2016 08:54; Gewicht: 0]

7.

before you start lean implementation it needs training in lean basics and specilist knowhow in some fields

[Interviewee4; Position: 01:06:31.4-01:06:34.4; Autor: Simon; 22.03.2016 08:54; Gewicht: 0]

8.

people have no training

[Interviewee3; Position: 00:22:41.8-00:23:03.1; Autor: Simon; 22.03.2016 08:54; Gewicht: 0]

9.

engaged employees get tarinings about lean

[Interviewee 1; Position: 00:53:36.9-00:53:42.4; Autor: Simon; 22.03.2016 08:54; Gewicht: 0]

Not or just partial applicable

1.

the mindset of the top manager is still that lean is for production and not for logistic services

[Interviewee10; Position: 00:04:22.8-00:04:55.0; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

2.

lean is not suited for Warehousing

[Interviewee8; Position: 00:09:34.6-00:10:26.6; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

3.

producer are product and 3PL are process orientated and therefore not compareable and lean not applicable on logistics

[Interviewee8; Position: 00:10:56.7-00:11:41.8; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

4.

some methods and tools are applicable but some not

[Interviewee8; Position: 00:14:06.8-00:14:47.8; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

5.

lean is more suited for production and not for logistic processes

[Interviewee8; Position: 00:55:35.4-00:56:17.4; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

6.

eg. FMEA is not applicable in logistics

[Interviewee8; Position: 00:56:50.6-00:56:53.4; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

7.

this could be one of the problems but not most important

[Interviewee7; Position: 00:17:38.1-00:17:50.5; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

8.

process optimisation is not easy to measure e.g. customer satisfaction

[Interviewee7; Position: 00:46:18.2-00:46:38.4; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

9.

[Interviewee7; Position: 01:07:26.5-01:07:40.5; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

10.

JIT yes, but just towards the customer and not internally

[Interviewee6; Position: 00:27:46.2-00:27:54.9; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

11.

just partial implementation of some lean elements/methods

[Interviewee5; Position: 00:06:20.0-00:06:31.8; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

12.

They don´t see the universal applicability - research and puplicity is needed for a specific usage in logistics/warehousing

[Interviewee2; Position: 23-23; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

13.

distribution network means to consider the whole Supply Chain and not only the warehouse.

[Interviewee 1; Position: 00:25:13.2-00:25:31.2; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

14.

distribution means to have processes not under control like freightforwarders, customs etc.

[Interviewee 1; Position: 00:26:24.1-00:26:46.7; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

15.

no control about the further supply chain

[Interviewee 1; Position: 00:39:12.4-00:39:22.1; Autor: Simon; 21.03.2016 15:57; Gewicht: 0]

Applied lean methods

1.

Poka Yoke through customized GUI for handheld terminals quick inputs and reduced to minimum information

[Interviewee12; Position: 00:50:35.1-00:51:05.8; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

2.

Kanban

[Interviewee11; Position: 00:57:59.7-00:58:29.4; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

3.

supermarket

[Interviewee11; Position: 00:58:32.5-00:58:53.6; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

4.

value chain analysis which is also forced by customers and even content of the contract

[Interviewee10; Position: 00:08:44.2-00:09:15.2; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

5.

CIP, KAizen also forced by customer and internally e.g. 5S and standardisation

[Interviewee10; Position: 00:10:01.2-00:10:26.5; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

6.

CIP (suggesstion ideas)

[Interviewee10; Position: 00:15:14.4-00:16:05.8; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

7.

Andon board (visualisation) over WMS

[Interviewee10; Position: 00:38:12.1-00:38:48.1; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

8.

poka yoke

[Interviewee9; Position: 00:04:36.8-00:05:07.2; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

9.

KANBAN

[Interviewee9; Position: 00:17:09.6-00:17:22.3; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

10.

leveled sheduling

[Interviewee9; Position: 00:18:49.8-00:18:53.9; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

11.

Total Productive Maintanance

[Interviewee9; Position: 00:20:06.2-00:20:23.3; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

12.

5S

[Interviewee9; Position: 00:21:05.1-00:21:07.9; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

13.

[Interviewee8; Position: 00:14:06.8-00:14:47.8; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

14.

DMAIC

[Interviewee8; Position: 00:27:01.6-00:27:17.0; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

15.

5S

[Interviewee8; Position: 00:28:10.6-00:28:14.7; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

16.

team board

[Interviewee8; Position: 00:39:59.2-00:40:25.0; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

17.

Kanban

[Interviewee7; Position: 01:04:59.0-01:05:14.5; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

18.

milkruns

[Interviewee7; Position: 01:05:46.1-01:05:59.3; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

19.

Fifi is very common and sometimes it is executed but not useful or needed and slows down processes

[Interviewee7; Position: 01:07:26.5-01:07:40.5; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

20.

supermarket

[Interviewee7; Position: 01:08:04.5-01:08:25.0; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

21.

Kaizen

[Interviewee6; Position: 00:04:54.2-00:05:01.5; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

22.

[Interviewee6; Position: 00:05:42.7-00:05:55.2; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

23.

fifo

[Interviewee6; Position: 00:07:00.2-00:07:04.0; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

24.

pull system production has a allocation area which is automatically deliverd it is empty

[Interviewee6; Position: 00:07:31.0-00:07:38.5; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

25.

KANBAN

[Interviewee6; Position: 00:08:02.5-00:08:06.4; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

26.

Kanban

[Interviewee6; Position: 00:25:25.6-00:25:49.4; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

27.

JIT

[Interviewee6; Position: 00:26:51.8-00:27:06.2; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

28.

JIT

[Interviewee6; Position: 00:27:46.2-00:27:54.9; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

29.

suggestion ideas

[Interviewee6; Position: 00:32:51.8-00:33:25.0; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

30.

KVP

[Interviewee6; Position: 00:34:13.0-00:34:24.0; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

31.

standardisation

[Interviewee6; Position: 00:39:37.7-00:39:47.9; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

32.

pull system in WMS

[Interviewee6; Position: 00:40:35.3-00:40:42.5; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

33.

CIP

[Interviewee5; Position: 00:10:13.6-00:10:29.7; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

34.

KVP

[Interviewee4; Position: 00:14:53.4-00:14:58.1; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

35.

JIS/JIT

[Interviewee4; Position: 00:16:00.3-00:16:04.4; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

36.

[Interviewee4; Position: 00:17:29.5-00:17:52.0; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

37.

standards

[Interviewee3; Position: 00:04:00.2-00:04:06.1; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

38.

flow principle

[Interviewee3; Position: 00:04:16.1-00:04:19.2; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

39.

visualisation

[Interviewee3; Position: 00:04:27.0-00:04:29.1; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

40.

KVP

[Interviewee3; Position: 00:04:30.0-00:04:32.2; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

41.

KPIs

[Interviewee3; Position: 00:04:32.3-00:04:35.8; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

42.

striving for excellence - KVP

[Interviewee3; Position: 00:06:54.8-00:06:57.3; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

43.

suggestion ideas

[Interviewee3; Position: 00:27:24.7-00:27:29.7; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

44.

path optimized

[Interviewee3; Position: 00:45:54.3-00:45:56.7; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

45.

Kanban

[Interviewee 1; Position: 00:11:52.7-00:11:55.2; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

46.

Overall Process Reflection

[Interviewee 1; Position: 00:12:32.9-00:12:45.5; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

47.

Integration of SC Partners (Supplier)

[Interviewee 1; Position: 00:13:12.5-00:13:15.6; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

48.

you have to incorporate the complete Lean SCM!

[Interviewee 1; Position: 00:13:50.0-00:14:05.6; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

49.

KVP

[Interviewee 1; Position: 00:23:53.6-00:24:11.8; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

50.

Kaizen board; team meetings; Kaizen newspaper

[Interviewee 1; Position: 00:50:32.5-00:50:46.9; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

51.

one piece flow

[Interviewee 1; Position: 01:00:27.0-01:00:29.9; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

52.

controling by KPI´s

[Interviewee 1; Position: 01:00:37.5-01:00:47.5; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

53.

Kanban

[Interviewee 1; Position: 01:02:21.0-01:02:50.5; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

54.

reliable system is better than the theoretical optimum and gives flexibility

[Interviewee 1; Position: 01:03:20.1-01:03:30.3; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

55.

path optimizing - reduced waste

[Interviewee 1; Position: 01:04:51.2-01:04:54.3; Autor: Simon; 21.03.2016 11:25; Gewicht: 0]

Publicity

1.

the term lean warehousing has to be searched in internet browser because it wasn´t known before

[Interviewee12; Position: 00:58:55.8-00:58:59.0; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

2.

Lean Warehousing is still not very spreadedand acknoledged to be a management philosophy for logistics

[Interviewee10; Position: 00:04:22.8-00:04:55.0; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

3.

lean is not really useful rather eyewash for customer, management and audits

[Interviewee10; Position: 00:06:17.1-00:06:31.7; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

4.

it is up to science to give lean as a warehosuing philosophy a better standing still too many people shut down by hearing TPS

[Interviewee10; Position: 00:46:05.8-00:47:12.5; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

5.

in many heads there is still the thinking that lean is about rationalism and cutting of costs but you should change the input

[Interviewee9; Position: 00:06:40.2-00:08:21.8; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

6.

many people connect lean with cutting costs and dismiss employees

[Interviewee9; Position: 00:32:36.7-00:32:52.0; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

7.

[Interviewee8; Position: 00:09:34.6-00:10:26.6; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

8.

[Interviewee8; Position: 00:46:04.8-00:46:25.4; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

9.

people could not imagine whar improvemnts lean philosophy can bring

[Interviewee7; Position: 00:15:30.0-00:15:33.7; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

10.

lean still has a bad standing

[Interviewee6; Position: 00:21:46.1-00:22:14.6; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

11.

lean is not crucial it is the market which gives us the way and this what we can influence, we just can follow

[Interviewee6; Position: 00:23:34.5-00:23:39.1; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

12.

[Interviewee3; Position: 01:12:55.3-01:13:04.7; Autor: Simon; 19.03.2016 21:31; Gewicht: 0]

State of Research

1.

lean warehousing is limited onto warehouses but in the upstream supply chain are also a lot of untapped potential

[Interviewee10; Position: 00:29:04.8-00:29:59.6; Autor: Simon; 19.03.2016 21:29; Gewicht: 0]

2.

if cost improvments are necessary management don´t trust in Lean rather in optimisation in other departments eg. procurement

[Interviewee8; Position: 00:46:04.8-00:46:25.4; Autor: Simon; 19.03.2016 21:29; Gewicht: 0]

3.

lean warehousing must go beyond the operative stage and should also be used for planning

[Interviewee3; Position: 00:09:13.9-00:09:26.0; Autor: Simon; 19.03.2016 21:29; Gewicht: 0]

4.

b

ehaviour research is not

fully investigated in terms of lean

[Interviewee3; Position: 00:39:39.0-00:39:46.9; Autor: Simon; 19.03.2016 21:29; Gewicht: 0]

5.

lean warehousing is too short - the whole sc has to be considered

[Interviewee3; Position: 01:09:36.2-01:09:40.9; Autor: Simon; 19.03.2016 21:29; Gewicht: 0]

Complexity of the Lean Method

1.

lean philosphy is very complex and maybe also to theoretical it would be good to have practice examples for each method/tool

[Interviewee12; Position: 01:06:14.5-01:07:42.5; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

2.

lean is not really complex it is more the terms which needs to described more easier and practice examples on hand

[Interviewee11; Position: 01:00:36.2-01:01:33.1; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

3.

internal consulting has problems to introduce and argument lean - it be kept it as simple as possible

[Interviewee10; Position: 00:13:04.2-00:14:13.4; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

4.

management philosophy and not just quick wins by implementing some tools like 5S

[Interviewee9; Position: 00:10:26.3-00:10:48.8; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

5.

it is complex, but just the coaches have to know them and just to haveto present/teach it if it is needed

[Interviewee9; Position: 00:21:39.0-00:23:23.5; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

6.

nearly everybody speak about CIP but nobody really knows what is behind

[Interviewee8; Position: 00:44:48.8-00:44:58.2; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

7.

[Interviewee7; Position: 00:17:38.1-00:17:50.5; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

8.

but this agian has to do with the staus of education in the logistics sector

[Interviewee7; Position: 00:18:18.0-00:19:01.8; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

9.

lean in the warehouse is not easy to apply

[Interviewee6; Position: 00:06:39.0-00:06:50.0; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

10.

..and also complexity of upstream or downstream processes...e.g. defined stock minimum for specific cust. but it exist no more

[Interviewee5; Position: 00:10:45.0-00:11:37.6; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

11.

lean introduction is most often too complex that a company could master ist by itself - it needs ext. consultants and ressoures

[Interviewee4; Position: 01:05:36.1-01:06:24.6; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

12.

top manager do not understand the SC and the need for lean processes

[Interviewee3; Position: 00:19:54.0-00:19:57.6; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

13.

the main thing is to understand the lean philosophy and not the tools (see Iceberg model) german industry has its problems with

[Interviewee3; Position: 00:40:00.9-00:40:22.8; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

14.

Lean approach does not fit for warehousing

[Interviewee2; Position: 23-23; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

Stakeholder

Supplier

1.

big fashion brands are very powerful and force distributors to overtake their processes and fulllfil their requirements

[Interviewee12; Position: 00:12:29.7-00:12:46.0; Autor: Simon; 21.03.2016 11:35; Gewicht: 0]

2.

lean succes is only possible in agreemnet with the supplier

[Interviewee3; Position: 01:16:00.2-01:16:05.3; Autor: Simon; 21.03.2016 11:35; Gewicht: 0]

Employee

1.

we don´t unse leased employees because the processes are complex and would influence the quality

[Interviewee10; Position: 00:40:02.0-00:41:10.8; Autor: Simon; 21.03.2016 11:57; Gewicht: 0]

2.

just long term employees bring the needed quality

[Interviewee10; Position: 00:41:31.6-00:42:10.4; Autor: Simon; 21.03.2016 11:57; Gewicht: 0]

3.

employees are also in fear about their job as once you speak about optimisation therefore it is crucila ti involve them early

[Interviewee8; Position: 00:25:40.3-00:25:56.7; Autor: Simon; 21.03.2016 11:57; Gewicht: 0]

4.

leased labor needs training

[Interviewee3; Position: 00:53:25.4-00:53:30.8; Autor: Simon; 21.03.2016 11:57; Gewicht: 0]

5.

[Interviewee 1; Position: 00:14:40.2-00:14:49.0; Autor: Simon; 21.03.2016 11:57; Gewicht: 0]

6.

Logistic needs top educated people with high awareness for responsibility

[Interviewee 1; Position: 00:14:58.3-00:15:04.5; Autor: Simon; 21.03.2016 11:57; Gewicht: 0]

7.

[Interviewee 1; Position: 00:29:39.5-00:30:02.4; Autor: Simon; 21.03.2016 11:57; Gewicht: 0]

8.

flexible assignment needs good education

[Interviewee 1; Position: 00:33:41.9-00:33:52.2; Autor: Simon; 21.03.2016 11:57; Gewicht: 0]

Enviroment

1.

this more a additional benefit but to weak as to be single driver for lean

[Interviewee8; Position: 00:52:57.5-00:53:27.0; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

2.

energy recovery in automatic warehouse s is just a topic at the edge and nice to have but not crucial

[Interviewee7; Position: 00:32:00.0-00:32:26.3; Autor: Simon; 19.03.2016 21:26; Gewicht: 0]

Society

1.

[Interviewee 1; Position: 00:31:40.9-00:32:01.9; Autor: Simon; 19.03.2016 21:24; Gewicht: 0]

Enterprise size

1.

textile companies in Germany have changed from small SME´to big SMEs due to internationalism

[Interviewee12; Position: 00:09:28.7-00:10:16.5; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

2.

in SME´s very often they don´t have the ressources to start a lean initiave

[Interviewee11; Position: 01:05:35.2-01:05:40.9; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

3.

big companies from the eletrical sector setting a high value on lean

[Interviewee10; Position: 00:21:03.6-00:21:10.3; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

4.

food sector is also very lean due to short best before dates

[Interviewee9; Position: 00:29:13.2-00:29:23.0; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

5.

reataurants and hotels are also very often lean with high quality and standardized efficient processes - very close to customer

[Interviewee9; Position: 00:29:29.5-00:30:04.2; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

6.

[Interviewee7; Position: 00:26:27.4-00:27:20.6; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

7.

the bigger the company they have more money/budgets for process optimisations on a regular basis

[Interviewee7; Position: 00:41:51.9-00:42:20.0; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

8.

in concerns it is easier to implement lw because it is said from the top managemnet and done this does not haben in SMEs

[Interviewee6; Position: 00:10:10.0-00:10:16.6; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

9.

SME have a huge potential

[Interviewee5; Position: 00:06:00.4-00:06:19.1; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

10.

in SMEs it is difficult to bring all responsible departments on the table to discuss about lean - it needs external consultants

[Interviewee5; Position: 00:06:54.6-00:07:24.3; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

11.

it is always a fight in big companies to keep the processes equal because there are always tendencies for slef designed process

[Interviewee4; Position: 00:18:11.2-00:18:33.1; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

12.

monitoring if all sites are working within the process guidelines is very complex and nearly not possible

[Interviewee4; Position: 00:18:45.7-00:18:52.5; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

13.

SME or concern doesnt play a role if a company is congenial for lean warehousing

[Interviewee3; Position: 00:28:01.4-00:28:25.0; Autor: Simon; 19.03.2016 21:20; Gewicht: 0]

Industry Sector

1.

[Interviewee12; Position: 00:06:39.9-00:06:57.6; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

2.

textile sector is underdeveloped concerning lean and logistics in general - sales and procurement are most powerful

[Interviewee12; Position: 00:07:01.5-00:07:39.6; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

3.

fashion is very special due to permanently changing articles per season and changing trends with high stocks at the season star

[Interviewee12; Position: 00:14:36.4-00:14:53.4; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

4.

FAshion logistics has a staurated market in Germany

[Interviewee12; Position: 00:18:44.8-00:19:09.9; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

5.

3Pl want to be flexible in order to attract new cusomers and to satisfy all different needs of the still existent ones

[Interviewee11; Position: 00:14:41.5-00:14:50.9; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

6.

automotive sector is the best developed sector concerning lean and they even force their supplier in being extreme powerful

[Interviewee11; Position: 00:15:19.5-00:15:37.5; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

7.

regular audits are also driver for lean and this is also very common in the automotive sector

[Interviewee11; Position: 00:16:03.5-00:16:15.9; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

8.

3PL are driven to improve their processes due to a hard competion and low margin

[Interviewee11; Position: 00:31:52.0-00:32:24.1; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

9.

due to several sites it is difficult to implement a overal strategy or lean approach

[Interviewee11; Position: 00:33:11.7-00:33:34.6; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

10.

customer of 3PL demand lean processes already in the tender

[Interviewee10; Position: 00:03:44.0-00:03:59.1; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

11.

[Interviewee10; Position: 00:05:10.5-00:05:29.1; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

12.

from the food sector there are nearly no lean requirements to 3PL

[Interviewee10; Position: 00:20:37.8-00:20:51.7; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

13.

metal an d elecrical industry have a lot of lean requirements towards 3PL

[Interviewee10; Position: 00:20:52.5-00:21:01.5; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

14.

3PL have predominately manual warehouses and just partial automated warehouses or areas but easy to modify for other customers

[Interviewee10; Position: 00:22:43.3-00:23:41.9; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

15.

just for production

[Interviewee10; Position: 00:23:42.6-00:23:53.6; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

16.

pharam sector is not a benchmarl for lean even they have a lot of standards but not necessaryily in a lean sense

[Interviewee9; Position: 00:28:02.8-00:28:12.5; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

17.

automotive sector are a lot of lean enterprises

[Interviewee9; Position: 00:28:49.8-00:28:58.6; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

18.

2nd tier supplier automotive sector are enforced to be lean due to very small margins- this could be negative for lean standin

[Interviewee9; Position: 00:32:36.7-00:32:52.0; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

19.

logistics oriented industry sectors are not that developed, because lean is not value adding

[Interviewee8; Position: 00:09:34.6-00:10:26.6; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

20.

pharma sector has also a lot of pressure and this why many of them do outsource the logistics, because they trus specialists

[Interviewee7; Position: 00:20:50.1-00:21:04.1; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

21.

even if the production department works according lean and has the knowledege but this is not transferred or adapted to logisti

[Interviewee7; Position: 00:23:48.2-00:24:38.2; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

22.

pharma and automotive sector lean is already wide spreaded

[Interviewee5; Position: 00:05:46.5-00:06:00.3; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

23.

automotive sector lean was always one of the top topics - batch size 1 etc.

[Interviewee4; Position: 00:16:04.2-00:16:11.6; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

24.

automotive sector of course does matter and is leading in lean progress

[Interviewee4; Position: 00:24:27.5-00:24:35.7; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

25.

with a background of lean practice in the companies production, it is easier to implement lean also in the warehouse

[Interviewee3; Position: 00:03:40.0-00:03:57.3; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

26.

position in the value chain - 1tier 2tier etc.

[Interviewee3; Position: 00:10:18.3-00:10:24.9; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

27.

mass production has typically more competition

[Interviewee3; Position: 00:11:32.7-00:11:36.3; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

28.

pharma sector is also congenial for lean because they are used to follow strict processes and legal norms (standards)

[Interviewee3; Position: 00:12:57.2-00:13:22.6; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

29.

lean in pharma means more safety and quality and not to reduce waste in the first place

[Interviewee3; Position: 00:15:24.1-00:15:46.9; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

30.

logistics cost are not really relevant compared to purchase prizes for ressources - rather more stock and probably scrap it

[Interviewee3; Position: 00:16:09.8-00:16:17.9; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

31.

[Interviewee3; Position: 00:29:29.3-00:29:42.4; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

32.

some of the leading 3PL are very keen in lean and started very early

[Interviewee3; Position: 00:30:02.9-00:30:21.1; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

33.

3PL who are working for atomotive companies are also very competent in lean

[Interviewee3; Position: 00:30:23.0-00:30:52.5; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

34.

flexible usage of the warehouse for different customer needs (3PL)

[Interviewee3; Position: 00:50:08.5-00:50:15.7; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

35.

each industry secto has different requirements mostly electic ot automotive companies less in food sector!

[Interviewee2; Position: 18-18; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

36.

in production environment it isn easy to implent lean, because logistic department don´t have the power to initiate such change

[Interviewee 1; Position: 00:14:17.0-00:14:25.4; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

37.

logistic is underepresented in production environment

[Interviewee 1; Position: 00:14:27.4-00:14:40.2; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

38.

pharmaceutical sectorhas high margins and extrem expensive stock in comparrison to the logistics costs

[Interviewee 1; Position: 00:19:05.0-00:19:27.8; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

39.

[Interviewee 1; Position: 00:21:50.0-00:21:57.4; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

40.

high rate of returns

[Interviewee 1; Position: 00:22:05.2-00:22:15.7; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

41.

short lead times

[Interviewee 1; Position: 00:22:58.3-00:23:03.1; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

42.

high margins

[Interviewee 1; Position: 00:45:06.9-00:45:17.2; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

43.

quality driven processes - more than others like 3PL etc.

[Interviewee 1; Position: 00:48:04.2-00:48:08.9; Autor: Simon; 19.03.2016 21:19; Gewicht: 0]

Competitor

1.

companies often feel pressutre by market competitors but are not able to respond with lean principles because the don´t know ho

[Interviewee7; Position: 00:15:47.3-00:16:08.6; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

2.

also cometitor orientated in the meaning of what can we do better

[Interviewee3; Position: 00:03:16.4-00:03:18.8; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

3.

competition is a lean driver

[Interviewee3; Position: 00:03:27.0-00:03:34.3; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

4.

Pharma industry has less competition like other industry sectors

[Interviewee 1; Position: 00:20:03.0-00:20:07.9; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

5.

not according benchmark or far away

[Interviewee 1; Position: 00:45:43.5-00:45:57.5; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

Customer

1.

"i f you want to be lean you must be very close to the customer"

[Interviewee9; Position: 00:30:28.5-00:30:34.9; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

2.

customer requirements are crucial and also online markets/e-commerce is one of the biggest driver for lean

[Interviewee7; Position: 00:30:16.5-00:30:31.4; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

3.

customer are not very loyal and change to another trustworthy supplier

[Interviewee7; Position: 00:30:43.3-00:31:06.8; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

4.

customer demands Kanban

[Interviewee6; Position: 00:25:25.6-00:25:49.4; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

5.

customer demnad sJIT, which is not a problem because it just 40 km away - for customers outside this range it won´t work

[Interviewee6; Position: 00:26:51.8-00:27:06.2; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

6.

we have just a few customers (80% concerns) and the have great power to force us to do the things they say

[Interviewee6; Position: 00:31:04.6-00:31:14.6; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

7.

car manufacturer are extreme powerful an can push their interests through

[Interviewee4; Position: 00:26:58.6-00:27:10.8; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

8.

lean is absolutely customer orientated

[Interviewee3; Position: 00:02:31.2-00:02:52.9; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

9.

"each customer has specific demands. A gneralised Lean Warehousing approach is not possible"

[Interviewee2; Position: 17-17; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

10.

[Interviewee 1; Position: 00:22:58.3-00:23:03.1; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

11.

[Interviewee 1; Position: 00:39:12.4-00:39:22.1; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

12.

customer needs are not known!

[Interviewee 1; Position: 00:39:39.2-00:40:05.3; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

13.

customer needs unknown

[Interviewee 1; Position: 00:41:16.7-00:41:34.6; Autor: Simon; 19.03.2016 21:17; Gewicht: 0]

13.4 (Online) Questionnaire

The questionnaire was puplished online at unipark and was used also as a hardcopy for several events to increase the number of participants. Following you find the original version in german and afterwards a translated English version.

12.4.1 Original German Version

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Studie zum Thema Lean Warehousing

Im Rahmen meiner Promotion am Lehrstuhl für Management & MIS, an der Universität Nicosia in Zypern führe ich eine Umfrage zum Thema Lean Warehousing durch.

In einigen Studien (Overboom 2010, Sobanski 2011, Mahfouz 2012, Spee and Beuth 2012, Dehdari 2013 etc.) wurde bereits die positive Wirkung auf Lagerkennzahlen nachgewiesen. Beispielsweise wurde in einer Studie eines Logistikdienstleister eine Produktivitätssteigerung von 32% bereits 10 Monate nach Einführung der Lean Warehousing Methode gemessen.

Dennoch zeigt sich, dass nach wie vor viele Unternehmen an einer nachhaltigen Einführung scheitern und nur kurzfristige Erfolge verbuchen können und sich die Prozesse nach kurzer Zeit wieder verschlechtern und die Qualität als auch die Kennzahlen starken Schwankungen unterliegen.

Dies lässt den Schluss zu, dass viele Unternehmen die Werkzeuge und Methoden zum Schaffen von standardisierten und effizienten Prozessen im Rahmen eines Projektes einführen, jedoch keine nachhaltige „Lean-Kultur" mit einer starken Lean-Führungs-Kultur innerhalb der Organisation einführen. Es erfolgt keine Umsetzung auf strategischer Ebene und daher können auch keine nachhaltigen und fortlaufenden Verbesserungspotentiale gehoben werden und die Prozesse bleiben instabil.

Im Rahmen meiner Forschung möchte ich die Ursachen und Erfolgsfaktoren für eine nachhaltige Implementierung des Lean-Warehousing untersuchen.

Das Ausfüllen dieser Umfrage beansprucht ca. 10 Minuten. Es gibt weder richtige noch falsche Antworten, da es um Meinungen, Motive, Einstellungen und persönlicher Einschätzungen geht.

Ihre Angaben werden streng vertraulich behandelt und anonym gespeichert, so dass kein Rückschluss auf Ihre Person oder Unternehmen möglich ist. Ihre Daten werden nur im Rahmen dieser Studie verwendet und nicht an Dritte weitergegeben.

Durch Ihre Teilnahme erklären Sie ihr Einverständnis, dass die Ergebnisse der Untersuchung für rein wissenschaftliche Zwecke genutzt werden können.

Bei Fragen oder Anregungen können Sie mich gerne jederzeit über lean-warehousing@gmail.com kontaktieren. Auf Wunsch lasse ich Ihnen auch gerne das Ergebnis dieser Umfrage per E-Mail zukommen. Bitte geben sie dazu auf der letzten Seite Ihre E-Mail-Adresse an.

Herzlichen Dank für Ihre Teilnahme!

Simon Kallinger

Unternehmensgröße

Bitte ordnen Sie Ihr Unternehmen hinsichtlich der Unternehmensgröße und Umsatzzahlen ein. Bitte kreuzen Sie im ersten Fragenblock alle für Ihr Unternehmen zutreffenden Antworten an.

Mitarbeiteranzahl < 250 ☐

Mitarbeiteranzahl > 250 ☐

Jahresmsatz > 50 Mio € ☐

Jahresumsatz < 50 Mio € ☐

Bilanzsumme < 43 Mio € ☐

Bilanzsumme >43 Mio € ☐

Weiß nicht ☐

Branchenzugehörigkeit

Welcher Branche ist ihr bzw. das Unternehmen für das Sie arbeiten zuzuordnen?

Bitte markieren Sie die zutreffende Branche.

Pharma, Chemie ☐

Textil, Mode ☐

Maschinenbau ☐

Logistik ☐

Beratung ☐

Nahrungs- u. Genussmittel ☐

Automobilindustrie ☐

Großhandel ☐

Verarbeitende Industrie ☐

Sonstige ☐

Unternehmensstrategie

Wie ist die strategische Ausrichtung Ihres Unternehmens? Nur eine Antwortmöglichkeit.

National ☐

International ☐

Multinational ☐

Transnational ☐

Global ☐

Weiß nicht ☐

Lagerart

Nach welcher Art bzw. Zweck lässt sich Ihr Lager einordnen? Mehrfachauswahl möglich.

Distributionslager ☐

Handelslager ☐

Produktionslager ☐

Umschlaglager ☐

Zentrallager ☐

Pufferlager ☐

Lean Warehousing Erfahrung

Haben Sie bereits bei einer Lean (Warehousing) Einführung teilgenommen oder ist Lean Warehousing - zumindest teilweise - bereits in Ihrem Unternehmen eingeführt worden?

Unter Teilnahme ist hierbei nicht unbedingt eine aktive Beteiligung als Projektmitglied zu verstehen.

Ja ☐

Nein ☐

Wie beurteilen Sie den Lean-Reifegrad Ihrer Firma bzw. in Ihrem Lager?

Die Antworten entsprechen dem Reifegradmodell in 5 Levels. Es ist nur eine Antwortmöglichkeit auswählbar.

☐ Lean (Warehousing) wird nicht systematisch angewendet

☐ Vereinzelt werden Lean-Methoden angewendet (Kanban, 5S, etc.)

☐ Alle angewendeten Methoden sind definiert und werden regelmässig angewendet

☐ Lean (Warehousing) wird als ganzheitliche Methode eingesetzt und ist standardisiert und dokumentiert

☐ Lean (Warehousing) ist vollständig implementiert und Prozesse werden kontinuierlich überdacht und verbessert und präventiv optimiert

Automatisierungsgrad

Bitte ordnen Sie den Automatisierungsgrad in Ihrem Lager auf der Skala von 1 - 5 ein.

0 (niedrigster Grad) bis 5 (höchster Grad)

☐ Level 1 (papierbasierte Lagerprozesse)

☐ Level 2 (LVS/ERP wird zur Lagerverwaltung genutzt)

☐ Level 3 (Einsatz von mobilen Terminals (papierlose Prozesse))

☐ Level 4 (Einsatz von Kommissoniertechniken wie Pick by Vision, PbL oder PbV)

☐ Level 5 (Nutzung automatisierter Lagertechnik (AKL, HRL, FTS etc.))

Warehouse Management

Inwieweit unterstützt Sie ihr Warehouse Management System(-haus) bei der Einführung bzw. Umsetzung von Lean Methoden im Lager?

Bitte stellen Sie ihren Grad der Zufriedenheit ein beginnend mit 1 (= sehr unzufrieden) bis hin zu 5 (= vollumfänglich zufrieden). Falls Sie kein WMS im Einsatz haben, gehen Sie bitte zur nächsten Frage.

Kennzahlen/Key Performance Indicators

1	2	3	4	5

Fehlende Funktionen (Daten Analyse, Visualisierungen wie z.B. Andon Board etc.)

1	2	3	4	5

Anpassung/Konfiguration/Änderung bestehender Prozesse

1	2	3	4	5

Unterstützung durch Systemhaus (Support, Change Request, Management, Beratung)

1	2	3	4	5

Lean Warehousing

Wie gut oder schlecht lässt sich Ihrer Meinung nach die Lean Philosophie und Methodiken im Lagerumfeld einsetzen? Bitte kreuzen Sie den Wert entsprechend Ihrem Grad der Zustimmung zu den einzelnen Aussagen an. (1 = stimme nicht zu; 5 = stimme voll zu)

Die Umsetzung von Lean im Lager ist sehr kostenintensiv.

1	2	3	4	5

Wir wenden bereits einige Lean Methoden an (KANBAN, 5S, Supermarkt, Milkrun, etc.).

1	2	3	4	5

Die Lean Philosophie und deren Methodik ist zu komplex und nicht im Lager anwendbar.

1	2	3	4	5

Lean Warehousing ist noch nicht ausreichend erforscht und bekannt.

1 2 3 4 5

Lean Warehousing ist uninteressant, da die vor- und nachgelagerten Prozesse der Supply Chain ohnehin nicht beeinflusst werden können.

1 2 3 4 5

Der Ausbildungsstand der Mitarbeiter in der Logistik ist zu gering und ein Training wäre zu aufwändig und auch zu kostenintensiv.

1 2 3 4 5

Die Umsetzung von Lean kann nur durch externe Hilfe (Berater) bewerkstelligt werden.

1 2 3 4 5

Interne Stakeholder und Faktoren

Wie stark schätzen sie den Einfluss interner Faktoren und Interessengruppen auf die (nachhaltige) Einführung von Lean Warehousing ein?

Bitte kreuzen Sie entsprechend Ihrer Einschätzung die Stärke des Einflusses ein von 1 = kein Einfluss bis zu 5 = starker Einfluss an.

Unterstützung durch Top Management und Geschäftsführung

1 2 3 4 5

Trend zum Outsourcing

1	2	3	4	5

Position und Stärke der Logistik-Abteilung innerhalb des Unternehmens

1	2	3	4	5

Organisation des Unternehmens

1	2	3	4	5

Begleitendes professionelles Change Management

1	2	3	4	5

Mitarbeiter (Motivation, Ausbildungsstand, Fluktuation etc.)

1	2	3	4	5

Firmenkultur

1	2	3	4	5

Führungsmannschaft und Führungsstil

1	2	3	4	5

Unternehmensgröße

1	2	3	4	5

Unternehmensstrategie

1	2	3	4	5

Produkt/Dienstleistung des Unternehmens

1	2	3	4	5

"Abteilungsdenken"

1	2	3	4	5

Externe Stakeholder und Faktoren

Wie stark schätzen Sie den Einfluss externer Interessengruppen und Faktoren auf die (nachhaltige) Einführung von Lean Warehousing ein?

Bitte stellen sie die Schieberegler entsprechend Ihrer Einschätzung über die Stärke des Einflusses ein. (1 = kein Einfluss; 5 = starker Einfluss)

Hohe Margen innerhalb der Branche oder Marktes

1	2	3	4	5

Asymetrische Beziehung(en) zu Zulieferer und Liefernaten (Macht, Einflussnahme, Vorgaben kommen von extern! etc.)

1 2 3 4 5

Wettbewerber

1 2 3 4 5

Gesellschaft (inkl. Gewerkschaften, Gesetzgebung etc.)

1 2 3 4 5

Branche/Markt

1 2 3 4 5

Umweltgedanke

1 2 3 4 5

Kunden

1 2 3 4 5

Wenn Sie Interesse an den Forschungsergebnissen haben tragen Sie bitte hier Ihre E-Mail-Adresse ein:

……………………………………………………………….@....................................
....

Sobald die Analyse und Auswertung abgeschlossen ist, erhalten Sie dann eine Zusammenfassung der Forschungsergebnisse.

Herzlichen Dank für Ihre Teilnahme!!!

Simon Kallinger

12.4.2 Translated Version

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Survey on Lean Warehousing

As part of my PhD at the Department of Management & MIS, at the University of Nicosia in Cyprus, I am conducting a survey on lean warehousing.

In some studies (Overboom 2010, Sobanski 2011, Mahfouz 2012, Spee and Beuth 2012, Dehdari 2013 etc.) the positive effect on warehouse metrics has already been demonstrated. For example, a study of a logistics service provider measured a productivity increase of 32% already 10 months after the introduction of the lean warehousing method.

Nevertheless, it is evident that many companies still fail to implement lean warehousing in a persistent manner and can only achieve short-term successes, with processes deteriorating again after a short period of time and quality and key performance indicators being subject to strong fluctuations.

This leads to the conclusion that many companies introduce the tools and methods for creating standardized and efficient processes as part of a project, but do not introduce a continuing "lean culture" with a strong lean leadership culture within the organization. There is no implementation on a strategic level and therefore no continuous improvement potentials can be lifted and the processes remain unstable.

As part of my research, I would like to investigate the causes and success factors for a viable implementation of lean warehousing.

Completing this survey takes about 10 minutes. There are neither right nor wrong answers, as it is about opinions, motives, attitudes and personal assessments.

The information you provide will be treated as strictly confidential and stored anonymously, so that it is not possible to draw any conclusions about you or your company. Your data will only be used in the context of this study and will not be passed on to third parties.

By participating, you agree that the results of the study may be used for purely scientific purposes.

If you have any questions or suggestions, please feel free to contact me at any time via lean-warehousing@gmail.com. If you wish, I will also be happy to send you the results of this survey by e-mail. Please enter your e-mail address on the last page.

Thank you very much for your participation!

Simon Kallinger

Company size

Please rank your company in terms of company size and sales figures. Please tick all the answers that apply to your company in the first block of questions.

Number of employees < 250 ☐

Number of employees > 250 ☐

Annual turnover > 50 Mio € ☐

Annual turnover < 50 Mio € ☐

Total assets < 43 Mio € ☐

Total assets >43 Mio € ☐

Don´t know ☐

Industry sector

To which industry do you or the company you work for belong? Please mark the relevant industry.

Pharmaceutical, Chemicals ☐

Textile, Fashion ☐

Mechanical engineering ☐

Logistics ☐

Consulting ☐

Food, beverages and tobacco ☐

Automotive ☐

Wholesale ☐

Processing industry ☐

Others ☐

Corporate strategy

What is the strategic direction of your company? Only one answer option.

National ☐

International ☐

Multinational ☐

Transnational ☐

Global ☐

Don´t know ☐

Warehouse type

According to which type or purpose can your warehouse be classified? Multiple selection possible.

Distribution centre ☐

Retail warehouse ☐

Production warehouse ☐

Transshipment storage ☐

Central Warehouse ☐

Buffer warehouse ☐

Lean Warehousing Experience

Have you already participated in a lean (warehousing) implementation or has lean warehousing - at least partially - already been implemented in your company?

Participation does not necessarily mean active involvement as a project member.

Yes ☐

No ☐

How would you rate the Lean maturity level of your company or your warehouse?

The answers correspond to the maturity model in 5 levels. Only one answer option can be selected.

☐ No systematic. Lean Warehousing is not implemented

☐ Lean methods are partially used (Kanban, 5S, etc.)

☐ Some relevant methods are defined and used and regular used

☐ Implemented as a holistic approach, standardised and documented

☐ Lean Warehousing is fully implemented and processes are continuously reconsidered and improved and preventively optimized

Grade of automation

Please rank the degree of automation in your warehouse on the scale of 1 - 5.

0 (lowest level) to 5 (highest level)

☐ Level 1 (paperbased processes)

☐ Level 2 (WMS/ERP is used for warehouse management)

☐ Level 3 (Deployment of mobile terminals (paerless processes)

☐ Level 4 (Deployment of picking technologies like Pick by Vision, Pick by Light or Pick by Vision)

☐ Level 5 (Deployment of automated warehouse techniques (miniload, AS/RS, AGV etc.)

Warehouse Management

To what extent does your warehouse management system (house) support you in the introduction or implementation of lean methods in the warehouse?

Please set your level of satisfaction starting with 1 (= very dissatisfied) up to 5 (= completely satisfied). If you do not use a WMS, please go to the next question.

Kennzahlen/Key Performance Indicators

1	2	3	4	5

Missing functions (Data analysis, visualisation like Andon Board etc.)

1	2	3	4	5

Adaption/Configuration/Modification of existing processes

1	2	3	4	5

Support by system house (support, change request, management, consulting)

1 2 3 4 5

Lean Warehousing

n your opinion, how well or poorly can the lean philosophy and methodologies be applied in the warehouse environment? Please tick the value according to your level of agreement with each statement. (1 = strongly disagree; 5 = strongly agree)

The implementation of Lean in the warehouse is very cost-intensive.

1	2	3	4	5

We alteady use some lean methods (KANBAN, 5S, Supermarktet, Milkrun, etc.).

1	2	3	4	5

The Lean philosophy and its methodology is too complex and not applicable in the warehouse.

1	2	3	4	5

Lean warehousing is not yet sufficiently researched and recognized.

1	2	3	4	5

Lean warehousing is not interesting, because the upstream and downstream processes of the supply chain cannot be influenced anyway.

1	2	3	4	5

The level of qualification of employees in logistics is too low and training would be too time-consuming and also too cost-intensive.

1	2	3	4	5

The implementation of Lean can only be accomplished with external help (consultants).

1	2	3	4	5

Internal Stakeholder and factors

How strong do you estimate the influence of internal factors and stakeholders on the (viable) introduction of lean warehousing?

Please tick the strength of the influence according to your assessment from 1 = no influence to 5 = strong influence.

Suppport by Top Management und Management Board

1	2	3	4	5

Outsourcing trend

1	2	3	4	5

Position and strength of the logistics department within the company

1	2	3	4	5

Company organisation

1 2 3 4 5

Supportive professional change management

1 2 3 4 5

Employee (motivation, education status, fluctuation etc.)

1 2 3 4 5

Company culture

1 2 3 4 5

Management team and leadership style

1 2 3 4 5

Company size

1 2 3 4 5

Company strategy

1 2 3 4 5

Company products/services

1 2 3 4 5

"Departmental thinking"

1 2 3 4 5

External stakeholder and factors

How strong do you estimate the influence of external stakeholders and factors on the (viable) implementation of lean warehousing?

Please adjust the sliders according to your assessment of the strength of the influence. (1 = no influence; 5 = strong influence)

High margins within the industry sector or market

1 2 3 4 5

Asymmetrical relationship(s) with suppliers and vendors (power, influence, specifications come from outside! etc.)

1 2 3 4 5

Competitors

1 2 3 4 5

Society (incl. unions, legislation etc.)

1 2 3 4 5

Industry sector/market

1	2	3	4	5

Environmental thinking

1	2	3	4	5

Customers

1	2	3	4	5

If you are interested in the research results please enter your email address here:

....@...

Once the analysis and evaluation is completed, you will then receive a summary of the research results.

Thank you very much for your participation!!!

Simon Kallinger

13.5 Publications

12.4.3 NOFOMA Kopenhagen 2014

Potential Analysis of Lean Warehousing

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Purpose of this paper

Today´s supply chains have to cope with volatile markets and extremely high customer demands in a highly competitive global market, which allows comparing prices within seconds by the internet. Therefore, companies have to face this challenge and are looking for methods to speed up processes and to do their logistics operation as efficient as possible. Hence lean thinking will be applied in nearly all business operation: Lean Production, Lean Management, Lean Supply Chain and others. The most recent is Lean Warehousing, which tries to adopt lean techniques from the lean toolbox like 5S, KANBAN, MUDA, KAIZEN and Jidoka just to name a few. There is some academic literature about Lean Warehousing, which explain these methods and describe how to implement and also give a view what to expect and what to avoid in order not to fail. But you can´t find the information about the interaction between Lean Warehousing and Warehouse Management Systems (WMS). Indeed Augustin states that it will be from a great help, but don´t speak about the areas in which there is an overlap. WMS are created and designed to support the management to create their warehouse processes as efficient as possible and to provide them with defined key performance indicators to monitor them on a regular basis, which is necessary to establish a Continuous Improvement Process (CIP). For example, a WMS is ready for avoiding waste of resources by offering a forklift guidance system, which, in addition works, according the pull, strategy. Lean Warehousing aims at the same goal with the MUDA philosophy, which helps to detect and eliminate any kind of waste. KANBAN is also a method which is well established in WMS, which can be triggered by falling below a defined minimum stock or by pushing a button for request of material in the production line. Dickmann writes that it makes absolutely sense to link a KANBAN Management with a WMS.

This WIP paper will give an overview of the first conclusions and initial model, which is considering Lean Warehousing and WMS at the same time to combine these two techniques to get the most potential out of them.

Design/methodology/approach

The full research is structured as shown in the following figure, whereas this WIP paper just mirroring the content and findings within the red frame and interim results from objectives within the dashed red frame.

Figure 1: Roadmap of doctoral thesis

Findings

Literature review/Initial Model

The literature reviews show that the current status of science is still in the state to define which lean methods are suitable for usage in the field of warehousing and which not and to describe how to analyze and how to implement, but without considering WMS. But in fact almost every company with logistics operations uses WMS or an ERP with a logistic module for execution and managing.

It was found that approximately 90% of the proclaimed lean tools for lean warehousing could be managed and improved by using corresponding WMS modules like, for example, a forklift guidance system (MUDA, MURI, MURA), KANBAN, sensors on conveyors (Jidoka) and JIT etc. Further, it seems that the only thing which is not covered with Standard WMS´s, are methods which deal with personnel management and teamwork, like regular team meetings (KAIZEN, CIP).

Research limitations/implications

The present job as a warehouse management consultant of the author could bias the conclusions in matters of lean functions which the author was/is convinced up to now they are already provided by WMS´s. This is also limiting the research results in matters of getting the latest and proper information about the functional scope of lean tools in WMS´s, which are in competition with the author's employer. So the research is in this point limited to secondary research where maybe primary research methods would develop more detailed and proper results.

Practical implications

The outcome of this research could be of great help for software vendors of warehouse management systems to extend their software according the identified gaps between Lean Warehousing and their WMS and to adapt their modules accordingly or to engineer new modules for lean tools which are located in the middle pillar (figure2) e.g. for a CIP process.

For warehouse manager and Supply Chain Managers it could be also of great benefit to review their warehouse operations and WMS functions to identify on which lean level they currently are. Further, they can use the identified methods to plan their lean warehouse project.

Originality/value

The author will cover this gap by assessing the different lean methods in line with the typical warehouse operations and measure the savings. Finally, it will end up in a potential analysis, which will be very helpful for managers to preparing their decision to implement lean warehousing or just the most suitable ones. In addition, as stated already in the section above, it could be used as a development plan for warehouse vendors.

Keywords: Lean Management, Lean Production, Lean Supply Chain Management, Lean Warehousing, TPS, Warehouse Management, Warehouse Excellence, WMS.

12.4.4 EuroMed Kristiansand 2014

IMPLEMENTING LEAN WAREHOUSING BY USING A WAREHOUSE MANAGEMENT SYSTEM AT THE SAME TIME. A POTENTIAL ANALYSIS

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Abstract

This WIP paper will give an overview about the current scientific status of Lean Warehousing and up-to-date Warehouse Management Systems (WMS). Lean Warehousing bases on the methods of Lean Production with aiming on increasing of efficiency and effectiveness of warehouse operations. A simple definition for al lean warehouse quoted by Chua and Katayama (2009, p. 3) "…would be a warehouse, that is capable to operate in such manner that the throughput is optimized for warehousing activities". But it will be shown, that the Lean Warehousing approach doesn´t consider standard functions of up-to-date WMS, which already have lean functions inside and already do increase efficiency in warehouses. Beside the core functions: inventory control, storage location management, order picking, replenishment, receiving and shipping, a WMS offers a wide range of additional features like batch picking and many others which lead to waste reduction according one the leading thoughts of Lean Thinking, which are avoiding waste and continuous improvement (Myerson 2012). So, both Systems WMS and Lean Warehousing aiming at the same goals and this gap will be closed by comparing these set of functions with the proposed lean methods and tools from the literature review to achieve lean operation in the warehouse. Companies who are planning to implement Lean Warehouse should combine it with their WMS in use to get the most potential out of them.

Keywords: Lean Management, Lean Supply Chain, Lean Warehousing, Warehouse Management System

Track No: 1

Introduction

Today's supply chains have to cope with volatile markets and extremely high customer demands in a highly competitive global market, which allows comparing prices within seconds by the internet. Therefore, companies have to face this challenge and are looking for methods to speed up processes and to do their logistics operation as efficient as possible. Hence lean thinking will be applied in nearly all business operation: Lean Production, Lean Management, Lean Supply Chain and others. The most recent one isis Lean Warehousing, which tries to adopt lean methods and lean tools for warehouse operations like 5S, KANBAN, MUDA, KAIZEN and JIDOKA just to name a few. There is some academic literature about Lean Warehousing (Spee and Beuth 2012; Sobanski (2009), which explain these tools and describe how to implement and also give a view what to expect and what to avoid in order not to fail. But you can´t find the information about the interaction between Lean Warehousing and Warehouse Management Systems (WMS). Indeed Augustin (2010) states that it will be from a great help, but don´t speak about the areas in which there is an overlap and also Dickmann (2008) writes that it makes absolutely sense to link a KANBAN Management with a WMS. Already 1997 in volume number 27 3/4 of the International Journal of Physical Distribution & Logistics an article was published about lean logistics by D. T. Jones et al. (1997), which indicated a gap concerning the right operating systems for lean logistics in asking the question “What are the right warehouse types, locations and operating systems for lean logistics?” (D.T. Jones et al 1997, p. 171). This research question already implicate, that the usage of the operating system – a warehouse management system – should be used to achieve lean logistics. Until now the academic literature still don´t provides an answer, whether in context with lean logistics, nor with lean warehousing — which is a specified form of lean logistics applied in warehouse operations only.

Design/Methodology/Approach

Systematic literature review about Warehouse Management Systems and Lean Management in general and Lean Warehousing in particular was used to attain the latest state of these approaches and methods. Now the research goes ahead with primary research starting with an initial model derived from the findings from the literature review. Further research tactics like interviews, questionnaires, focus groups will be used to gather new information on this topic. These results will then be discussed, compared to the initial model and interpreted to present a new model of lean warehouse implementation by considering WMS accordingly.

First Findings

The literature reviews show that the current status of science is still in the state to define which lean methods are suitable for usage in the field of warehousing and which not and to explain how to analyse and how to implement, but without considering WMS. But in fact, almost every company with logistics operations uses WMS or an ERP with a logistic module for execution and managing. It was found that approximately 2/3, etc. of the proclaimed lean tools for lean warehousing could be managed and improved by using corresponding WMS modules like, for example, a forklift guidance system (MUDA), KANBAN, sensors on conveyors (JIDOKA) and JIT, etc. Further, it seems that the only thing which is not covered with Standard WMS´s, are methods and tools which deal with personnel management and teamwork, like regular team meetings and tools for process analysis like 5WHYS, VALUE STREAM MAP, etc.

Research Limitations

This survey doesn´t consider ERP-Systems, which also provide various warehouse management functions and are absolutely sufficient for many companies and many ERP software companies have incorporated lean functionalities, including one-piece-flow KANBAN signals and sequencing, etc. So, this could be an idea for future research.

Practical Implications

The outcome of this research could be of great help for software vendors of warehouse management systems to extend their software according the identified gaps between Lean Warehousing and their WMS and to adapt their modules accordingly or to engineer new modules for lean tools for a CIP process. For warehouse manager and Supply Chain Managers it could be also of great benefit to review their warehouse operations and WMS functions to identify on which lean level they currently are. Further, they can use the identified model to plan their lean warehouse project/introduction.

In general, the findings would support a permanent economic development. Bozer states (2012, p. 3) “Although warehouses and distribution centres are vital facilities in a supply chain, applications of Lean in warehousing has been lagging compared to manufacturing and SCM. This created a gap of knowledge for Lean warehousing.”

Originality/Value

The author will cover the introduced gap by assessing the different lean methods in line with the typical warehouse operations. As result it will end up in a potential analysis, which will be very helpful for managers preparing their decision to implement lean warehousing or even WMS vendors to use it as developing guideline, as well.

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Efficient Warehouse Management by implementing Lean Warehousing

- A Potential Analysis

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Abstract

Today's supply chains have to cope with volatile markets and extremely high customer demands in a highly competitive global market. The consumer behavior has also changed regarding smaller but more often purchase offers, and this all leads to an extreme increase in data information and goods movement in warehouses. Against this backdrop, traditional warehousing is no longer capable of tackling these challenges. Therefore, companies need to have a high-performance IT infrastructure and specialised software (Warehouse Management Systems) in place to be connected with supply chain partners and to execute complex warehouse operations. WMSs can manage, monitor and optimise these complex warehouse and distribution systems and to track the whole internal material flow. Further, they are interacting with other software systems like SCE systems, by which they are contributing to transparency and efficiency in the overall supply chain. However, the potential of warehousing is still underexploited, and in order to be compatible and profitable companies are looking for strategies and methods tapping the full potential. Also, customer's expectations regarding delivery speed and accuracy demand even more accelerated and error-free logistics processes.

Therefore, the latest approach called “Lean Warehousing” adopts Lean Production theory onto warehousing. Through the introduction of lean techniques like 5S, KANBAN, MUDA and KAIZEN, the efficiency in warehouse logistics processes should be further improved.

The results of the literature review show that current WMSs are already supporting many of the lean methods on a tactical level, but the elements of analysing and implementing at a strategic level are missing. At the same time, numerous failed

attempts at implementing Lean Warehousing point to systemic flaws such as the lack of philosophy and transformational leadership and/or change management. This leads to the following research questions and gaps to arise:

1. Why is traditional warehousing still being applied even though it does not suffice current system demands?

2. Which factors explain why Lean Warehousing theory is still hardly applied and fraught with problems during implementation?

Keywords - Lean Warehousing, Warehouse Management, WMS.

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LEAN WAREHOUSE CULTURE AS A CRITICAL SUCCESS FACTOR FOR A LEAN WAREHOUSE MANAGEMENT SYSTEM IMPLEMENTATION IN WMS CONTROLLED WAREHOUSES

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Abstract

This WIP paper examines the success factors for a sustainable implementation of the lean warehouse culture in WMS (Warehouse Management System) controlled warehouses.

Lean is often understood as a toolbox (WMS) rather than a strategic alignment and a philosophy. Therefore, the implementation of Lean warehousing has systemic

flaws relating to the lack of understanding and integrating the corporate philosophy, transformational leadership, and change management but also in missing modules in warehouse management software.

The literature showed that the general problems of lean warehousing implementations are based on the still existing ignorance and ability to implement the philosophy, which, in the first instance, means to change the mindset and to establish a new corporate strategy and culture of engaged employees.

Furthermore, for the implementation of Lean Warehousing, the toolset (WMS) has been proven to be not sufficient and needs further development for a comprehensive lean warehousing transformation.

Keywords: Lean Warehousing, Lean Culture, Lean Warehouse Management System, WMS, Lean Champion

Track No: 7

LEAN WAREHOUSE CULTURE AS A CRITICAL SUCCESS FACTOR FOR A LEAN WAREHOUSE MANAGEMENT SYSTEM IMPLEMENTATION IN WMS CONTROLLED WAREHOUSES

Introduction

Several studies (Overboom 2010, Sobanski 2011, Mahfouz 2012, Spee and Beuth 2012, Dehdari 2013, etc.) have been verified the positive effect of a Lean Warehousing implementation on warehouse key performance indicators (KPI). Latest since then, this approach was and is still from great interests for companies who are looking for strategies to cope within a global competition in global distribution systems. Bradley reports that the warehouse productivity in a distribution center of Menlo Worldwide has improved by 32% within 10 months after they implemented Lean Warehousing successfully. Phogat (2013) states that a lean warehousing transformation is amazingly effective and perform like a production line delivering predictable and reproducible results with significantly less labour.

On the other hand, in a survey based on a small sample by Augustin (2009) a chart about the maturity of Lean Warehousing implementations confirm that from 53 surveyed companies 98% already implemented Lean Warehousing tools and methods. But not as a holistic approach with a sustainable Lean Warehousing culture and an established continuous improvement process.

These findings from the literature clearly imply that the transfer from lean management into warehouses is still not standardized and afflicted with mistrust, prejudices and lack of knowledge about the real lean philosophy (Kuther and Schaaf, 2013; Dombrowski Hellmich and Evers, 2012). This is supported by Liker (2011) pointing out that Lean Management is a holistic approach which penetrates the whole organization and its culture and also by Womack and Jones (2003) as they are writing about "… managers who had drowned in techniques as they tried to implement isolated bits of a lean system without understanding the whole".

The Lean Warehousing theory is still in its fledgling phase and, up to now, there is no generalisable approach and it needs further scientific examination. Especially the transformation process to a lean warehousing culture and the engagement of employees is not sufficiently investigated. "Lean warehousing is a leadership concept. This concept aims at a permanent, systematic, analytic, sustainable, and measurable improvement of processes in the warehouse environment. This happens with the contribution of all employees and with the goal of gaining awareness of perfection in each corporate action." (Dehdari, P. 2014, p. 21)

Design/Methodology/Approach

From the perspective of a critical realist, this paper is based on a narrative literature review and an initial model, which reflects and synthesises the currently existing implementation gaps of Lean Warehousing. Next, applying the survey method, structured questionnaires will be sent to a sample of WMS vendors, warehouse managers and consultants in the fields of warehousing and lean management to validate the initial model. Finally, after continuously redesigning the model, a qualitative case study approach is chosen to conduct in-depth interviews with warehouse managers and consultants for Lean, Management. The results from the quantitative and the qualitative research stages will be analysed to design the final model.

First Findings

This survey starts on Pearce (2014), Cano et al. (2014), Modrak and Semanco (2014) depict success factors for a lean implementation in general. The results are very useful as a basis in this research however it is not considering the specific conditions and demands or cultural aspects in the area of warehousing. The identified success factors and constraints need to be approved for application in the field of warehousing.

Summarising, the literature showed that the general problems of Lean Warehouse implementations are based on the ignorance of understanding and implementing the philosophy in full, which in the first instance means to change the mindset and to establish a new corporate strategy and culture of engaged employees. Employees must be integrated with the top management to master the transformation into a lean company. Therefore, this study will analyse existing leadership models in order to check them for compatibility with the lean methods to reach better success rates for lean warehousing implementations, which will finally result in new lean warehousing culture theory.

Research Limitations

This survey starts on the results on existing qualitative research based on case studies in the German-speaking area and therefore does not provide evidence for a general global approach.

Practical Implications

The findings can be used as a guideline for the logistics management, for a sustainable implementation of Lean Warehousing and increasing its effectiveness by using the untapped potential of engaged employees who are motivated to bring in their knowledge and ideas for a continuous improvement.

Originality/Value

The method of Lean Warehousing is still not fully explained and requires further research. In addition, there is also a gap as to the relationship between WMSs, Lean Warehousing, Transformational Leadership and Change Management and in terms of anchoring Lean as a philosophy in the corporate culture.

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LEAN WAREHOUSING IN TIMES OF SMART FACTORIES – A MIXED METHOD STUDY

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Abstract

In contrast to Lean Warehousing (LW) (Kallinger and Kaufmann, 2014, the Lean Manufacturing approach is a commonly acknowledged and numerous successful implementations testify its effectiveness (Achieng, 2018; Kotcharat, 2020; Srisuk and Tippayawong, 2020; Bukhari, Asim and Manzoor, 2020; Sobanski, 2009). Representing a crucial research gap, LW has systemic flaws due to a lack of understanding and integration of corporate philosophy and culture, leadership and change management as well as, so far, not considered factors in Warehouse Management. This paper explores the relation of these factors to the level of Lean Maturity Index (LMI) and depict the lean drivers and lean show-stoppers.

The study starts with a narrative literature review to identify the scientific gaps and factors, which affect the sustainability of Lean warehousing approach. The results will be synthesised by an initial model followed by research hypotheses and finally validated by further empirical research. The data collection process starts with conducting semi-structured expert interviews. The qualitative findings inform the following quantitative research stage. This research approach pursues the quantitative survey and qualitative case study methods to triangulate the research results, which leads to higher levels of reliability and validity (Weyers et al., 2011).

The synthesis of both research results — the quantitative and qualitative research sequence — will then lead to a final model of Lean Warehousing. This methodology considers conducive to the development of new knowledge in the field as former studies either used case studies or quantitative surveys and not both.

Keywords: Lean Thinking, Lean Warehousing, Lean Logistics, Lean Leadership, Warehouse Management System, Logistics 4,0, Smart Factory, Warehouse Excellence.

LEAN WAREHOUSING IN TIMES OF SMART FACTORIES – A MIXED METHOD STUDY

Introduction

Today's supply chains have to cope with volatile markets and extremely high customer demands in a highly competitive global market. Furthermore, global incidents like the latest outbreak of coronavirus disrupt supply chains and companies starting to mount over their stock as they are afraid not to meet contractual obligations. On the same time supply chain partners have shortages on products whereas e-commerce companies have shortages in personnel (Hasanat et. al, 2020; Fernandes 2020). In general, there is trend in consumer and purchase behavior to place smaller orders but more often, but during the corona pandemic quite the opposite has happened, and consumers started to buy much more than they need for their daily life to pile up a safety stock for staple food and cosmetics etc. This all leads to an extreme increase in data information and goods movement in warehouses. Against this backdrop, traditional warehousing is no longer capable of tackling these challenges, but it is vital to include warehouses in the definition of a supply chain as managing inventories is a key component of effective supply chain management. (Patil, Halegowda and Patil, 2016) Production is faced with the same challenges as complexity in production systems which is increasing more and more (Hofmann, 2014). Reasons are increasing demand in quality, shorter lead times, shortened product life cycles and finally the high increase in variances and lot size one. (Hofmann 2014). Therefore, organisations are striving for low inventory in warehouses to reduce costs and increases profitability at the same time. (Holweng,

2013) Hofmann (2014) proclaims a four-step process mature model. Following this model production systems started in the early nineties with Computer Integrated Manufacturing (CIM) followed by the Lean Management or Lean Production integration to the segmented and fractal factory. The last step is the so-called industry 4.0 or smart factory. This last step could also be solved with the Lean philosophy and automation (Lean Automation). An analysis of digitalization effects on the usability of lean tools by Pekarčíková, M. et. al. (2019) allows to note the great influence and compatibility of lean tools with Industry 4.0 tools and is also confirmed by Stefanic, A., et. al. (2019). So not only logisticians in distribution centers but also manufacturing warehouses have to deal with this complexity to serve their customers (internal or external) best.

“The experience shows that a high performant logistics and fast material flow systems make the difference between success and failure especially in this sector (logistics). But it is also shown that the traditional distribution system is no more capable to meet the requirements and if then just with poor satisfaction” (ten Hompel and Schmidt, 2010, p. 18).

This means logistics are the backbone of global supply chains (Pejic´et al., 2016; Alsaad, Yousif and AlJedaiah 2018, Ab Talib et al., 2015) and companies need to have a high-performance IT infrastructure and specialised software (Warehouse Management Systems) in place to be connected with supply chain partners and to execute complex warehouse operations. WMSs can manage, monitor and optimise these complex warehouse and distribution systems and do track the whole internal material flow. Further, they are interacting with other software systems like SCE (Supply Chain Execution) systems, by which they are contributing to transparency and efficiency in the overall supply chain. However, the potential of warehousing is still underexploited, and in order to be compatible and profitable companies are looking for strategies and methods tapping the full potential. Also, customer's expectations regarding delivery speed and accuracy demand even more accelerated and error-free logistics processes. “One efficient strategy for coordinating within and between firms with a focus on eliminating waste, achieving efficiency, or overburden and creating value in products is the concept of lean management.” (Patil, Halegowda and Patil, 2016, p.354)

Therefore, the latest approach called “Lean Warehousing” adopts Lean Production theory onto warehousing. Through the introduction of lean techniques like 5S, KANBAN, MUDA and KAIZEN, the efficiency in warehouse logistics processes should be further improved.

The results of the literature review show that current WMSs are already supporting many of the lean methods on a tactical level, but the elements of analysing and implementing at a strategic level are missing. At the same time, numerous failed attempts in integrating Lean Warehousing point to systemic flaws such as the lack of philosophy and a corresponding leadership style. Only 5 to 7 percent of the companies that attempt to implement lean do so successfully. (Byrne, 2013 p. xxi) Garza-Reyes et al. (2018) investigated the adoption status of Lean Manufacturing in the Transport and Logistics sector. They come to the conclusion that the application of Lean in this specific sector is still relatively unknown especially compared to the manufacturing sector. They also found out that the barriers for implementing Lean are the "...organizational structure, misalignment between the goals of individuals and their companies as well as a lack of sustainment of a lean culture..." (Garza-Reyes, et al., 2018). Further reasons for failed attempts or not to implement are the lack of understanding the Lean Philosophy and a lack of knowledge and experience. Most of the companies therefore trust in technology-based tools to improve logistic operations. Following research questions arises.

1. What are the gaps for Lean Warehousing theory to be implemented?

2. What are the success factors for the creation of a Lean Warehousing Culture?

3. Do current WMSs enable its users to sustainably change over to Lean Warehousing?

The research objectives (RO) of this study based on the research questions are:

RO1: To investigates the applicability of the Lean Manufacturing theory in order to develop an innovative Lean Warehousing theory (common and differentiated factors).

RO2: To examine the factors which comprise the definition of the Lean Warehousing theory.

RO3: To develop a conceptual framework for Lean Warehousing by investigating the role of corporate philosophy, corporate culture, change management and (transformational) leadership, asymmetric supplier or customer relationships and warehouse management for a new Lean Warehousing theory.

Methodology

This study will be conducted by the view of a critical realist, which combines positivism and phenomenology to gain a comprehensive picture of the Lean Warehousing theory as earlier studies used mainly structured questionnaires. However, "…the critical realist's position is that the social world is constantly changing is much more in line with the purpose of business and management research which is too often to understand the reason for phenomena as a precursor to recommending change" (Saunders et. al, 2009, p.115). The critical realist, also recognises the importance of multi-level study (e.g., at the level of the individual, the group and the organisation) and of a greater variety of structures, procedures and processes (Saunders et. al., 2009).

The study started with a narrative literature review gathering data about Lean Warehousing methods and the standard scope of functions of WMS, corporate philosophy and culture (Mann 2015; Hermalin, 2013), change management (Kotter and Seidenschwarz, 2013; Doppler and Lauterburg, 2014) and transformational leadership (Vitalo et al., 2009; Liker, 2011; Givens, 2008) to identify the scientific gaps. The search was using several internet search engines like Metager, WorldCat as well as databases like EBSCO, ProQuest and Emerald and conducted secondary research in the libraries of the University of Nicosia and at the University of Applied Sciences Landshut.

The results were then synthesized by an initial conceptualization and research hypotheses to be validated by further empirical research. The data collection process starts with conducting a pre-determined sample size of 15 semi-structured expert interviews with in 3 groups. Logistics managers, WMS vendors and consultants specialised in lean transformation. By mixing the groups within the same sample and the same sample method the researcher obtains a triangulation within the research method.

In each group five interviews are conducted as the qualitative research focus on the views of less people in greater depth (Curry et al., 2009). The sample size is in line with Baker and Edwards (2012), Denzin (2012) and Back (2012) who are following the data saturation pattern that the majority of information comes from initial interviews and less and less new information by later interviews. The transcription of the voice records will be analysed with the software programme MaxQdata in form of a content analysis.

The qualitative findings will then inform the following quantitative research stage and the results will be analysed with SPSS (regression analysis) and will disclose the specific demands and reasons of failed lean implementations.

This research approach pursues the quantitative survey and qualitative case study methods to triangulate the research results. This combines the respective advantages of both methodologies and will lead to higher levels of reliability and validity (Weyers et al, 2011). The synthesis of both research results will then lead to a final model of Lean Warehousing.

This methodology is considered conducive to the development of new knowledge in the field as the aforementioned studies only used observed case studies or surveys respectively.

Findings and Discussion

Qualitative research – Expert Interviews

The digital recorded interviews were uploaded to MaxQdata for analysis. Instead of a full transcription of all 12 interviews each interview was transcribed through colored markings on the audio spur. This technique is called “Direct Audio Transcription” and has the advantage that latter analysis of the data is supported by various statistical methods. Similar to the method of selective transcription it is suited for researches with huge amount of data (Laforest, 2009; Kurzrock, 2014). As the interviews with 12 interview partners resulted into nearly 14 hours of voice data the method of summarising transcription is best suited even more as the categories respectively research objectives were already built. The transcription in comparison to the traditional transcription process itself is still very intensive as the researcher listens to short sections of the audio records again and again to define the codes and sub-codes and to assign the heard section accordingly. One answer could fit to more than one code or sub-code and if appropriate it will be counted once for each code group.

The identified factors from the literature review build the framework for the codes and it turned out that they could be clustered into 6 major codes and several sub-codes.

Codes	Sub-Codes (No)
Warehouse Management	WMS (1), Automation (2); Warehouse Techniques (3), Missing Functions (4)
Applicability of Lean methods in warehouses	Training (1), Not or just partially applicable (2), Applied Lean Methods (3), Publicity of Lean (4), State of Research (5), Complexity of Lean Methods/Philosophy (6)
Internal Factors (Enterprise)	Change Management (1), Industry sector (2), Size (3), Asymmetric relations (4), Organisation (5), Culture (6), Product (7), Strategy (8), Leadership Style (9), Employee (10)
External Factors (Stakeholder)	Supplier (1), Environment (2), Society (3), Competitor (4), Customer (5)
Lean Showstopper	KPIs, (1) No support from Top Management (2), Cost intensive (3), Departmental thinking (4), Outsourcing of logistics (5), organization (6), High margins (7), Employee knowledge (8), Weakness of logistics department within the organization (9)
Lean Drivers	Quality (1), Transparency (2), Organisation (3), Flexibility (4), Standardised processes (5), Reduced throughput-times (6), Reduced waste (according lean philosophy) (7), Reduced stock (8), Economical reasons (9), Optimised production (10), Turnover rate (11), Optimised usage of warehouse spaces (12)

Table 1. List of Codes and Sub-Codes

The table below shows the result of the interviews per code and sub-code. Thereby these figures being an indicator about the power of influence each factor or independent variable has on the dependent variable Lean Warehousing Maturation (LWM).

Code	Sub-Code												Total No. in Code-Group
	1	2	3	4	5	6	7	8	9	10	11	12	
Warehouse Management	25	37	2	34	-	-	-	-	-	-	-	-	98
Applicability of Lean methods in warehouses	9	15	55	12	5	14	-	-	-	-	-	-	110
Internal Factors (Enterprise)	8	43	13	3	15	20	5	9	14	8	-	-	128
External Factors (Stakeholder	8	2	1	5	13	-	-	-	-	-	-	-	29
Lean Showstoppers	1	15	13	7	16	24	5	19	8	-	-	-	108
Lean Drivers	3	3	16	6	6	3	3	3	13	3	1	4	64

Table 2. Total Number of Codes and Sub-Codes

The ten strongest sub-codes which seems to have a strong influence on LWH are:

- Applied Lean Methods (55 codes)
- Industry sector (43 codes)
- Warehouse Automation (37 codes)
- Missing Functions in WMS (34 codes)
- WMS (25 codes)
- Organisation as a show-stopper (24 codes)
- Culture (20 codes)
- Employee knowledge (19 codes)
- Organisation as lean-driver (16 codes)
- Outsourcing of logistics (16)

Quantitative research – Online and paper-based Survey

Before an online questionnaire is distributed, it is essential to inspect the questions derived from the literature review and it is constituting the survey instrument in order to gain its validity and reliability (Brace, 2018). Reliability threats like subject or participant error, observer error, subject or participant bias and observed bias were addressed through a test pilot as recommended by Robson and McCartan (2016).

In total 127 usable responses were obtained. Based on similar studies the sample size of 127 was considered acceptable to draw conclusions and link them to the findings from qualitative data sampling in the pre-executed expert interviews. Observer bias and error were not applicable to this survey as the questionnaire was designed with questions for which interpretation was not possible with fixed alternative answers. Thus, observer bias was irrelevant for this study (Binti et al., 2016). The table below shows the general statistics of the sample concerning company size, warehouse type, industry sector and the median Lean Maturity Index (LMI) for the respective groups.

Company size	% in sample	Median LMI
SME	25,20 %	2,16
concern	73,23 %	2,43
"don´t know"	1,57 %	0,00
Market /Strategy		
national	10,24	1,46
internationl	23,26	2,60
multinational	0,00	0,00
transnational	0,00	0,00
global	28,35	2,31
"don't´know"	37,80	2,25
Industry Sector		
Pharmaceutical and Pharma	1,57	1,57
Textile and Fashion	4,72	2,40
Machine Building	22,05	2,36
Logistics	26,77	2,26
Consulting	0,00	0,00
Food, Drinks and Tobacco	8,66	2,72
Automotive	11,81	1,93
Distributor	11,02	2,21
Processing	4,72	1,67
Electronics and other	8,66	2,64
Warehouse Type		
Distribution warehouse	19,42	2,25
Retail Warehouse	17,15	2,19
Production Warehouse	25,24	2,38
Transshipment Warehouse	11,33	2,20
Central Warehouse	16,50	2,16
Buffer Warehouse	10,36	2,44
Automation Grade		
Grade 1	8,66	1,73
Grade 2	8,66	1,45
Grade 3	23,62	2,07
Grade 4	38,58	2,59
Grade 5	18,90	2,58

Table 3. Sample Statistics in comparison to LMI

The analysis of the sample statistics was evaluated and resulted into some first findings by comparing the median value for the LMI.

Concerns do have a higher LMI than SME´s and also companies with an international market strategy do have the highest LMI with a grade of 2.60 in comparison with companies doing business only in the national market. Concerning the industry sector surprisingly companies within the food, drinks and tobacco sector have the highest LMI with 2.72, although literature and the interviewees claimed the automotive industry should have the best preconditions due to the historical advantage that Lean philosophy was created by Toyota. Also, electronics, textile, logistics, machine building industry and distributor have a higher LMI. Just pharmaceutical and chemical and processing industry have a lower LMI. In the category of warehouse type the level of LMI is more or less the same and fluctuates between 2.16 and 2.44. This means the warehouse type seems not to be a crucial indicator for a high or low LMI. In contrast, the automation grade there has a clear relation to the LMI. The higher the automation grade the higher the LMI.

Reliability and Validity

Reliability analysis was applied by examining the survey values of Cronbach´s Alpha.

Reliability Statistics		
Cronbachs Alpha	Cronbachs Alpha standardised items	no. of items
,804	,796	33

Table 4. Sample Statistics in comparison to LMI

Values greater than 0.9 means that the survey achieved an excellent consistency. Values above 0.7 are generally considered as acceptable. The Cronbach´s Alpha here reached 0.804 which confirms a good reliability. Setting the confidence interval at 95%, the results of ANOVA test (table below) provides an F-test value for the null hypothesis. The result of F = 1.582 for the independent variables proves a relation to Lean warehousing Maturation Index (LWI). However, based on the analysis, null hypothesis can be rejected. A further test like T-Test is not necessary.

ANOVA						
	sum of squares	df	median squares	F	Sig.	
between persons	692,252	126	5,494			
within persons	between items	2078,037	32	64,939	60,172	0,000
	not standardiesd residual	4351,417	4032	1,079		
	total	6429,455	4064	1,582		
total	7121,707	4190	1,700			
total median	2,87					

Table 5. ANOVA table

However also explanatory analysis was conducted to search for outliers within the sample to check for validity and to explain the reasons behind this. Outliers would influence the standard error and also the t-test and could finally lead to a survey which is not significant.

The result of the explanatory analysis in SPSS detected in total 15 variables with outliers which are marked with an "*" in the box plots but for no variable the standard error crossed the critical value of 0.7 or higher. The maximum number of outliers for a variable were 6 participants from a total population of 127, which means a maximum deviation of 4.57%. An analysis of the outliers did not show a specific pattern and it was deducted that the answers are realistic and right even the statistic says they are extreme values. As they also do not affect the significance of the whole sample it was decided to include these outliers to achieve the full perspective and consider all data. Moreover, these outliers could also help to understand the correlation to the independent variable Lean Warehousing Maturity Index (LWI). The outliers were found in the sections automation grade, warehouse management system, internal stakeholder and external stakeholder. In the sections company size, industry sector, company strategy and applicability of lean warehousing there were no outliers.

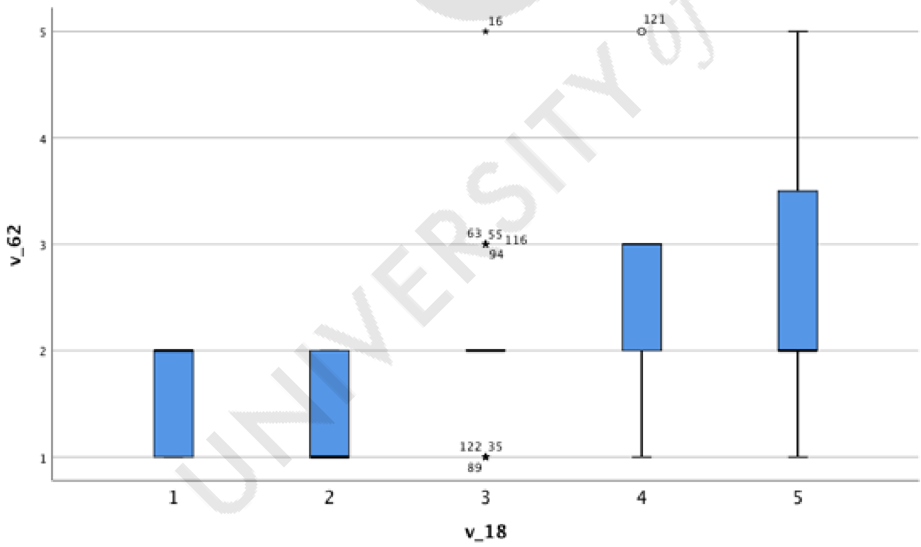

Figure 1. Example for a box-plot with variable 18 (automation grade) in relation to dependent variable 62 LMI

For an overview and explanation, the data were clustered in median values for the group which reached the highest level (5) in LWI, the group with the lowest value

(1) and a theoretical group with the overall median value. The table below shows all results which will be discussed and explained in more detail in the following.

Table 2: Exploratory analysis of median values comparing highest and lowest group in LWI

section	variable abridgement	highest LWI (lvl 5)	Overall median LWI	lowest LWI (lvl 1)
automation grade		4,4	3,5	2,7
wms satisfaction		3,4	2,7	1,9
	KPI´s	4,6	3,1	
	missing functions	3,4	2,7	
	configuration	2,8	2,6	1,8
	support	2,6	2,4	1,9
applicability of lean		2,0	2,2	2,2
	cost intensive	1,8	2,6	3,0
	lean methotds applied	5,0	3,5	
	lean too complex?	1,6	1,7	2,3
	LWH not fully researched	1,2	2,2	1,9
	LWH has no effect on overall SC	1,2	1,5	1,8
	low employee knowledege and cost intensive traning	1,2	1,8	2,1
	external trainer needed	2,0	2,1	2,6
internal factors		3,0	3,1	3,4
	support by top management	4,6	4,0	3,9
	outsourcing	1,4	2,9	2,0
	strenght of logistics dep.	4,0	3,5	3,1
	company organisation	3,0	3,4	3,3
	change management	1,4	3,3	3,0
	employee motivation	4,4	3,7	3,1
	culture	4,0	3,7	3,1
	leadership style	3,4	4,1	3,5
	company size	2,2	2,7	2,8
	company strategy	4,0	3,6	3,6
	product	1,8	2,9	3,0
	departmental thinking	2,2	3,3	3,0
external factors		2,5	2,9	2,8
	high margin	2,0	2,8	2,7
	asymmetry	1,0	3,2	2,8
	competition	3,0	2,9	2,6
	society	2,4	2,5	2,4
	market/industry sector	3,6	3,1	3,1
	environmental idea	2,2	2,3	3,5
	customer	2,8	3,5	3,5

Table 6. Explanatory analysis of median values comparing highest and lowest group in LWI

Analysis and discussion per section:

1. Automation grade

The values show a higher grade for automation in the best group which clearly predicate a correlation between this independent variable on LWI. The median value is also higher than the lowest group which means that the higher the automation grade the higher the LWI. But this effect has to be analysed in more detail in a further survey, as it did not consider when the automation was established. Usually before such invest is done the company conducts a detailed analysis of the internal logistics and the material flow either by internal or external consultants. This means during the introduction of automation system also the processes will be analysed an most often new designed. So eventually the gained improvements are only last over a short period of time and are not consequently questioned and improved by using continuous improvement (CIP) method according the LWH philosophy. Bucki (2019) investigated Lean Warehousing on a cost-based approach and concludes that manufacturing cost can be lowered by replacing human labour by robots which pays off in a defined period of time, but another option would be reducing fixed and operating costs by means of lean tools without doing costly investments.

2. WMS satisfaction grade

The overall median value for this section and all single median values for each subcategory clearly indicates a higher grade of satisfaction of the WMS within the best group of LWI compared to the lowest group. This could be reasoned by having a state-of-the-art WMS in use, which is suited to manage and monitor the warehouse processes. The sub-category KPI´s featuring a big difference in the values 4.6 and 2.0 and also in the sub-category missing function (3.4 versus 1.7). This implies that companies with a higher LWI do have more modern WMS in use or at least with updates and adaptions on a regular basis which supports the company to apply lean methods according the LWH philosophy. This should also be confirmed by further surveys.

3. Applicability of LWH

This section has sub-categories where a low or a high value could be interpreted differently. Therefore, the overall median in this section is not suited for a global relation to LWI. For the question if the implementation of LWH philosophy is cost intensive the best group negates this statement with a value of 1.8 whereas the lowest group tentative support it (value 3.0). In contrast to that the sub-category lean methods applied shows the highest value of 5 for the best group and comparable extreme value of 1.9 for the lowest group. This example confirms also validity in the data as the group who claims to have reached LWI level 5 also have the highest level of applied lean methods and inverse ratio for the group with the lowest LWI. An interesting result is that both groups don´t think that the LWH philosophy is too complex to be not applied. This underpins the hypothesis that all companies could and should apply LWH to improve the overall efficiency for their warehouses. Further both groups think LWH is more or less full researched. Also, both groups confirm that it is worth to strive for a holistic LWH implementation as it has significant improvement effects also in context with the full supply chain. Studies from Hadrai (2019) and Vanichchinchai (2019) confirms this positive relationship between supply logistics, and competitive performance (operational) and supply performance. Hadrai (2019) further determined that lean processes are partially mediating this relationship and showed the importance of internal and external processes of companies' operations in an integrated manner in which supply chain management acts through key internal processes to impact competitive performance.

4. Internal Factors

For the external factor there is no general pattern, but between the groups there are partially big differences. Some factors which are rated very high in the group of highest LMI are: Support by Top Management, strength of logistics department, employee motivation and culture. Whereas the other group rated these factors relatively low. In contrast some factors in the group with the lowest LMI rated some factors very high e.g., product and change management which allows to draw the conclusion, that the companies with a lower LMI do underestimate the influence of the relevant factors and rates other factors to high.

5. External Factors

In big contrast the factors asymmetric commercial relationships were rated with 2.8 for the group with the lowest LMI opposite to 1.0 for the group with the highest LMI and nearly all factors were rated higher in the group with the lowest LMI. This pattern indicates that in general external factors do not have as much influence on the LMI. Also, Ab Talib et al. (2015) support this in a study about critical success factors

(CSF) in supply chains in stating that external factors are no significant critical factors in supply chains.

Multivariate Analysis

In order to determine the relationship between dependent variable and the set of multiple independent variables a multivariate linear regression analysis is conducted. This procedure is used to determine the influence of independent variables on dependent variable and to what extent or even which variable(s) may even have no relation to the dependent variable. The general formula for the regression analysis is:

$$\boldsymbol{Y} = \boldsymbol{F}(\boldsymbol{x}1, \boldsymbol{x}2, \dots, \boldsymbol{xn}) + \boldsymbol{e}$$

Model Summary						
Model	R	R-Square	Corrected R-Square	Standard Error of Estimate	adjusted in R-Square	adjusted in F
1	,880	,775	,701	,503	,775	10,539

Table 7. Summary of of multivaraite refression analysis

Inferences

The Model Summary includes multiple correlation coefficient R and its square and also the adjusted version of this coefficient as summary measures of the model fit. The linear regression coefficient R = 0.880 indicates that there is very strong correlation between dependent and independent variables (a closer figure to 1.000 means a stronger correlation). In terms of variability, the value of $R^2 = 0.775$ explains the variability within the population. So, 77,5% of the population in the sample agree on the correlation between the given variables. Further the standard error of estimate value reflected in the table with 0.503 represents the mean absolute deviation and is moderate considering the LMI ranges from 1 to 5.

Conclusions and Limitations

The study shows a very strong correlation between the LMI and the automation grade which indicates that automation and Lean Philosophy does not exclude each other although it needs a further study to figure out in detail what kind of automation has the greatest impact and if the LWH was introduced and applied in a holistic and sustainable way. Furthermore, by triangulation of the survey groups with managers in the qualitative survey and with operators at the quantitative survey it could be shown a lack of understanding between the importance of single factors. According to that the group of managers tend to underestimate the role of leadership and culture whereas operators ascribe a high influence on that factors like the literature does (Byrne, 2013; Garza-Reyes et al., 2018; Ghimire, 2017; Hadrawi, 2019). So, on the one hand the findings of this study confirm the literature which describes that the general problems of Lean Warehouse implementations are based on soft skills like corporate vision, strategy, culture and leadership (Kallinger and Kaufmann, 2015) and on the other hand depict new factors (hard skills) like automation and warehouse software which have significant influence in LWI.

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“We are what we repeatedly do. Excellence then, is not an act, but a habit.”

Aristoteles